

2012 Ford Pickup F150

2012 ENGINE Starting System - F-150

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SPECIFICATIONS

GENERAL SPECIFICATIONS

Item	Specification
Normal engine cranking speed	140-220 RPM
Starter motor maximum load	800 amps ⁽¹⁾
Starter motor maximum voltage drop (engine at normal operating temperature)	0.5 volt
Starter motor minimum stall torque (at 5 volts)	14.7 Nm (10.8 lb-ft)
Starter motor no load current draw	60-84 amps
Starter motor normal load current draw	130-220 amps ⁽²⁾
(1) Initial "in-rush" current draw.	
(2) Continuously running current draw.	

TORQUE SPECIFICATIONS

Description	Nm	lb-ft	lb-in
Starter motor mounting bolts - 3.5L Gasoline Turbocharged Direct Injection (GTDI) and 3.7L	48	35	-
Starter motor mounting bolts - 5.0L (4V) and 6.2L (2V)	25	18	-
Starter motor mounting stud bolts - 5.0L (4V) and 6.2L (2V)	25	18	-
Starter motor ground cable nut - 5.0L (4V) and 6.2L (2V)	25	18	-
Starter solenoid B+ terminal nut	12	-	106
Starter solenoid S-terminal nut	5	-	44

DESCRIPTION AND OPERATION

STARTING SYSTEM

The starting system consists of the following:


- Fuse(s)
- Battery
- Battery cables
- Ignition switch
- Starter motor
- Starter relay (located in the Battery Junction Box (BJB))
- PCM (located on the RH side of cowl)

- Body Control Module (BCM)
- Transmission Range (TR) sensor (located inside the transmission)
- Integrated Keyhead Transmitter (IKT)
- Tire Pressure Monitor Module (TPM) (TPM is standard equipment, also used for optional remote start feature)
- External antenna (if equipped with remote start)
- Hood switch (hood switch is standard equipment, also used for optional remote start feature)

DIAGNOSIS AND TESTING

STARTING SYSTEM

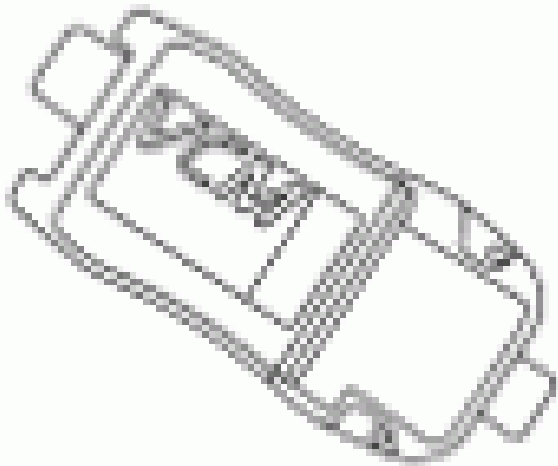
SPECIAL TOOLS

 <p>ST2574-A</p>	<p>Flex Probe Kit NUD105-R025D or equivalent</p>



ST3093-A

Fluke 77-IV Digital Multimeter
FLU77-4 or equivalent



ST2834-A

Vehicle Communication Module (VCM) and
Integrated Diagnostic System (IDS) software
with appropriate hardware, or equivalent scan
tool

Principles of Operation

NOTE: This vehicle is equipped with **Passive Anti-Theft System (PATS)** that disables the engine from cranking and starting if an unprogrammed PATS key is used or an invalid PCM ID is received. PATS is controlled by the **Body Control Module (BCM)**. If there is a PATS concern that causes the engine to be disabled, the **Instrument Panel Cluster (IPC)** displays **"STARTING SYSTEM FAULT"** in the message center. REFER to **ANTI-THEFT - PASSIVE ANTI-THEFT SYSTEM (PATS)** to diagnose a PATS concern.

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

- PATS enable status from the BCM
- Correct transmission PARK or NEUTRAL input from the Transmission Range (TR) sensor
- Request to start the engine, ignition switch in the START position

Under normal operation when the ignition is turned to the START position, the BCM generates a key verification message. It sends this message to the PATS transceiver. The transceiver reads the key and sends a key verification message back to the BCM. If the message received does not match the key verified in the BCM memory, the engine is disabled and does not crank and start. Once the BCM determines the correct programmed key is in the ignition, the BCM sends the PCM a valid PATS message. When the PCM receives the message, it generates a response and sends it back to the BCM. If the response from the PCM does not match the response in the BCM memory, PATS is not enabled and the engine does not crank. If both the key verification and PCM ID pass, PATS is enabled. The PCM recognizes the correct electronically coded passive key and provides voltage and ground to the starter relay coil. The starter relay coil is energized causing the relay contacts to close providing voltage to the starter solenoid, allowing the starter motor to crank and start the engine. The PCM disengages the starter once an engine RPM threshold is reached, a set crank time is exceeded or the ignition is turned OFF.

The TR sensor prevents operation of the starter motor unless the transmission is in NEUTRAL or PARK.

Remote Start

The factory remote start system (if equipped) does not operate if the ignition is in the RUN/START position or the hood is not closed.

The remote start system can be enabled or disabled by the customer. When enabled, the customer can set the engine run time for 5, 10 or 15 minutes. For information on setting the engine run time, refer to the Owner's Literature or **INSTRUMENTATION, MESSAGE CENTER, AND WARNING CHIMES** .

The remote start system enables the engine to be started from up to 100 m (328 ft) away, by pressing a sequence of buttons on the Integrated Keyhead Transmitter (IKT). The remote start system is activated by pressing the lock button on the IKT, to make sure the doors are locked, followed by 2 presses of the remote start button. The 3 button presses must occur within 3 seconds. The system acknowledges the start request by flashing the exterior lights twice.

Once started, the engine runs for 10 minutes (default run time is 10 minutes; the time can be programmed by the customer to 5, 10 or 15 minutes) and the parking lights remain illuminated until the cycle is complete. The remote start duration can also be extended by initiating remote start while the first timer is still running or by

initiating a completely independent start cycle when the first has completed. No more than 2 remote start sequences can occur within a one hour period, unless the ignition is set to the RUN/START position between the remote start requests. During the remote start cycle the power windows are inhibited and the radio will not turn on automatically but may be switched on manually from inside the vehicle. If the remote start system fails to start the horn chirps twice.

To transition from remote start mode to drive mode, use a programmed IKT to switch the ignition to the RUN position. If a programmed IKT is not used, the engine shuts off.

To deactivate the remote start system, press the remote start button once. When deactivating the remote start system the parking lights turn off to give a visual indication that the engine and climate control features have turned off. It may be necessary to be closer to the vehicle to deactivate the remote start feature than it was to initiate it due to ground deflections and added noise from the engine running.

The remote start system conditions the cabin temperature during remote start based on the outside temperature. For information on cabin temperature conditioning during remote start, REFER to **CLIMATE CONTROL SYSTEM - GENERAL INFORMATION AND DIAGNOSTICS** .

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: Make sure the anti-theft system is functioning correctly before carrying out a logical starting system diagnosis. Address anti-theft system concerns before continuing. REFER to **ANTI-THEFT - PASSIVE ANTI-THEFT SYSTEM (PATS)** .

1. Verify the customer concern.
2. Remove the accessory drive belt. REFER to **ACCESSORY DRIVE** . Verify the crankshaft and each of the components driven by the accessory drive belt rotate and are not seized or damaged.
3. Inspect to determine if any of the following mechanical or electrical concerns apply.

VISUAL INSPECTION CHART

Mechanical	Electrical
<ul style="list-style-type: none"> • Starter motor • Starter motor bolts 	<ul style="list-style-type: none"> • Battery • Battery cables • Battery Junction Box (BJB) fuse 13 (30A) • Body Control Module (BCM) fuse 28 (15A) • Loose or corroded connections • Starter relay

4. If an obvious cause for an observed or reported concern is found, correct the cause before proceeding to the next step.

NOTE: Make sure to use the latest scan tool software release.

5. If the cause is not visually evident, connect the scan tool to the Data Link Connector (DLC).

NOTE: The LED prove out confirms power and ground from the DLC are provided to the VCM.

6. 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 **MODULE COMMUNICATIONS NETWORK** , 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 **MODULE COMMUNICATIONS NETWORK** to diagnose no communication with the scan tool.

8. Carry out the network test.

- If the scan tool responds with no communication for one or more modules, REFER to **MODULE COMMUNICATIONS NETWORK** .
- If the network test passes, proceed with module self-test diagnostics.

9. Carry out the self-test diagnostics for the BCM, PCM and Tire Pressure Monitor Module (TPM) (TPM is standard equipment, also used for optional remote start feature).

10. If the DTCs retrieved are related to the concern, go to **DTC Charts**.

11. If no DTCs related to the concern are retrieved, GO to **Symptom Chart**.

DTC Charts

PCM DTC CHART

DTC	Description	Action
P0512	Starter Request Circuit - Circuit has Power With the Ignition in the OFF Position	CARRY OUT the Ignition Switch Component Test. Refer to OEM WIRING DIAGRAMS for component testing. If necessary, INSTALL a new ignition switch. If the ignition switch passed the component test, REPAIR circuit CDC35 (BU/WH) for a short to voltage.
P0705	Transmission Range Sensor A Circuit (PRNDL Input): No Sub Type Information	REFER to <u>AUTOMATIC TRANSAXLE/TRANSMISSION - 6R80</u> to diagnose the Transmission Range (TR) sensor concern.
	Transmission Range Sensor "A" Circuit	REFER to <u>AUTOMATIC TRANSAXLE/TRANSMISSION -</u>

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P0706	Range/Performance: No Sub Type Information	6R80 to diagnose the TR sensor concern.
P0707	Transmission Range Sensor "A" Circuit Low: No Sub Type Information	REFER to <u>AUTOMATIC TRANSAXLE/TRANSMISSION - 6R80</u> to diagnose the TR sensor concern.
P0708	Transmission Range Sensor "A" Circuit High: No Sub Type Information	REFER to <u>AUTOMATIC TRANSAXLE/TRANSMISSION - 6R80</u> to diagnose the TR sensor concern.
P0709	Transmission Range Sensor "A" Circuit Intermittent: No Sub Type Information	REFER to <u>AUTOMATIC TRANSAXLE/TRANSMISSION - 6R80</u> to diagnose the TR sensor concern.
P161A	Incorrect Response From Immobilizer Control Module	REFER to <u>ANTI-THEFT - PASSIVE ANTI-THEFT SYSTEM (PATS)</u> .
P1702	Transmission Range Sensor Circuit Intermittent: No Sub Type Information	REFER to <u>AUTOMATIC TRANSAXLE/TRANSMISSION - 6R80</u> to diagnose the TR sensor concern.
P1705	Transmission Range Circuit Not Indicating Park/Neutral During Self Test: No Sub Type Information	REFER to <u>AUTOMATIC TRANSAXLE/TRANSMISSION - 6R80</u> to diagnose the TR sensor concern.
P1921	Transmission Range Signal: No Sub Type Information	REFER to <u>AUTOMATIC TRANSAXLE/TRANSMISSION - 6R80</u> to diagnose the TR sensor concern.
P2532	Ignition Switch Run Position Circuit High	GO to <u>Pinpoint Test G.</u>
P2535	Ignition Switch Run/Start Position Circuit High	GO to <u>Pinpoint Test G.</u>
All other PCM DTCs	-	REFER to <u>ELECTRONIC ENGINE CONTROLS</u> .

BODY CONTROL MODULE (BCM) DTC CHART

DTC	Description	Action
B1305:01	Hood Switch: General Electrical Failure	REFER to <u>ANTI-THEFT - PERIMETER</u> .
C113A:11	Wake up Control: Circuit Short to Ground	GO to <u>Pinpoint Test C.</u>
C113A:15	Wake up Control: Circuit Short to Battery or Open	GO to <u>Pinpoint Test C.</u>
U1000:00	Solid State Driver Protection Activated - Driver Disabled: No Sub Type Information	The Body Control Module (BCM) has temporarily disabled an output because an excessive current draw exists (such as a short to ground). The BCM cannot enable the output until the cause of the short is corrected. ADDRESS all other DTCs first. After the cause of the

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		concern is corrected, CLEAR the DTCs. REPEAT the self-test.
All other DTCs	-	REFER to <u>MULTIFUNCTION ELECTRONIC MODULES</u> .

TIRE PRESSURE MONITOR (TPM) MODULE DTC CHART

DTC	Description	Action
B1D55:01	Antenna #2: General Electrical Failure	GO to <u>Pinpoint Test D.</u>
All other DTCs	-	REFER to <u>WHEELS AND TIRES</u> .

Symptom Chart

SYMPTOM CHART

Condition	Possible Sources	Action
<ul style="list-style-type: none"> The engine does not crank 	<ul style="list-style-type: none"> Battery Battery cables Fuse Starter motor Wiring, terminals or connectors PCM Starter relay Ignition switch Transmission Range (TR) sensor Passive Anti-Theft System (PATS) Body Control Module (BCM) 	<ul style="list-style-type: none"> GO to <u>Pinpoint Test A.</u>
<ul style="list-style-type: none"> Unusual starter noise 	<ul style="list-style-type: none"> Starter motor Starter motor mounting Starter motor engagement Flexplate ring gear 	<ul style="list-style-type: none"> GO to <u>Pinpoint Test B.</u>
<ul style="list-style-type: none"> The engine cranks slowly 	<ul style="list-style-type: none"> Battery Battery cables Starter motor Wiring, terminals or connectors 	<ul style="list-style-type: none"> CARRY OUT the Starter Motor - Feed Circuit and Starter Motor - Ground Circuit Tests. REFER to <u>Component Tests</u> .
<ul style="list-style-type: none"> The starter spins but 	<ul style="list-style-type: none"> Damaged flexplate 	<ul style="list-style-type: none"> REFER to <u>Starter Motor Drive Gear and</u>

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the engine does not crank	<ul style="list-style-type: none"> • Starter motor 	<p><u>Flywheel Ring Gear Inspection</u> to continue diagnosis.</p>
<ul style="list-style-type: none"> • The starter does not disengage from the flexplate 	<ul style="list-style-type: none"> • Starter motor • Wiring, terminal or connectors • Starter relay 	<ul style="list-style-type: none"> • REFER to <u>Starter Motor Drive Gear and Flywheel Ring Gear Inspection</u> to continue diagnosis. • REMOVE the starter relay, if the engine stops cranking INSTALL a new relay. If the engine continues to crank, REPAIR circuit CDC25 (BN/GN) for a short to voltage.
<ul style="list-style-type: none"> • The remote start system operates with reduced range 	<ul style="list-style-type: none"> • Wiring, terminals or connectors • External antenna • Tire Pressure Monitor Module (TPM) 	<ul style="list-style-type: none"> • GO to <u>Pinpoint Test D.</u>
<ul style="list-style-type: none"> • The remote start is inoperative 	<ul style="list-style-type: none"> • Wiring, terminals or connectors • Remote start feature not enabled • Integrated Keyhead Transmitter (IKT) • Hood switch • PCM 	<ul style="list-style-type: none"> • GO to <u>Pinpoint Test E.</u>
<ul style="list-style-type: none"> • One-Touch Integrated Start (OTIS) is inoperative 	<ul style="list-style-type: none"> • OTIS not enabled 	<ul style="list-style-type: none"> • Using a scan tool, ENABLE OTIS.

Pinpoint Tests

Pinpoint Test A: The Engine Does Not Crank

Refer to OEM WIRING DIAGRAMS Starting System for schematic and connector information.

Normal Operation

When the ignition switch is turned to the START position, the Body Control Module (BCM) and PCM receive a request to start the engine. When the PCM receives the correct coded key ID messages from the BCM and the correct input from the Transmission Range (TR) sensor that the gear selector is in PARK or NEUTRAL, voltage and ground is supplied to the starter relay coil. When the starter relay is energized the relay contacts close. Voltage is then supplied from Battery Junction Box (BJB) fuse 13 (30A) to the starter relay contacts which supplies voltage to the starter solenoid. The starter solenoid is grounded at the starter motor. Energizing

the starter solenoid engages the starter drive into the ring gear and closes the starter solenoid contacts allowing voltage directly from the battery to the starter motor to crank the engine. The PCM disengages the starter once an RPM threshold is reached, a set crank time is exceeded or the ignition is turned OFF.

This pinpoint test is intended to diagnose the following:

- Battery
- Battery cables
- Wiring, terminals or connectors
- Fuse
- Ignition switch
- PCM
- Starter motor
- Starter relay
- TR sensor
- Passive Anti-Theft System (PATS)
- BCM

PINPOINT TEST A: THE ENGINE DOES NOT CRANK

A1 CHECK THE BATTERY

- Check the battery condition and charge. REFER to **BATTERY, MOUNTING AND CABLES** .
- **Is the battery OK?**

YES : GO to A2.

No : CHARGE or INSTALL a new battery as necessary. REFER to **BATTERY, MOUNTING AND CABLES** . TEST the system for normal operation.

A2 CHECK FOR ANY MESSAGES IN THE MESSAGE CENTER

- Ignition ON.
- Check the message center with the ignition key in the RUN position.
- **Is STARTING SYSTEM FAULT displayed in the message center?**

YES : REFER to **ANTI-THEFT - PASSIVE ANTI-THEFT SYSTEM (PATS)** .

No : GO to A3.

A3 RETRIEVE PCM DTCs

- Ignition ON.
- Enter the following diagnostic mode on the scan tool: PCM - Self-Test.
- **Were DTCs retrieved during the self-test?**

YES : REFER to the **PCM chart** .

No : GO to A4.

A4 CHECK THE PCM TRANSMISSION RANGE TR SENSOR PID

- Enter the following diagnostic mode on the scan tool: DataLogger - PCM.

- While observing the TR PID, place the gear selector in PARK and then NEUTRAL.
- **Does the PID match the selector lever position?**

YES : GO to A5.

No : REFER to AUTOMATIC TRANSAXLE/TRANSMISSION - 6R80 , to diagnose the TR sensor concern.

A5 CHECK THE STARTER MOTOR RELAY ENABLE (STRT_RLY) PID

- While holding the key in the START position, monitor the STRT_RLY PID.
- **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 RELAY

- Ignition OFF.
- Disconnect: Starter Relay.
- Measure the voltage between starter relay socket 3, circuit SBB13 (GY/RD) and ground.

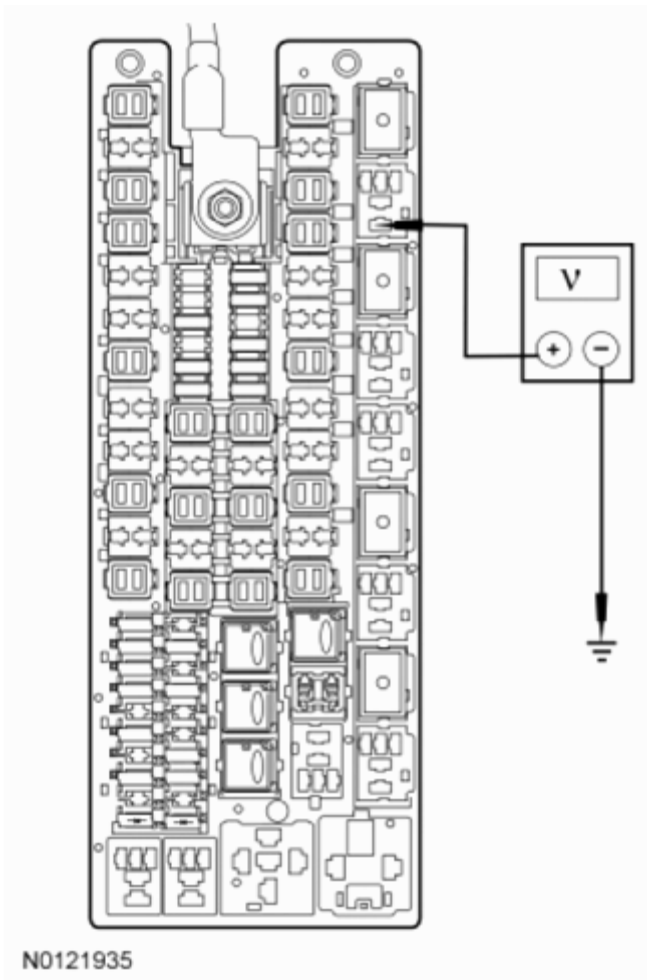


Fig. 1: Measuring Voltage Between Starter Relay Socket 3, Circuit SBB13 (GY/RD) And Ground
 Courtesy of FORD MOTOR CO.

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

YES : GO to A8.

No : VERIFY BJB fuse 13 (30A) is OK. If OK, REPAIR circuit SBB13 (GY/RD) for an open. If not OK, REFER to the Wiring Diagrams information to identify the possible causes of the circuit short. TEST the system for normal operation.

A8 CHECK THE STARTER MOTOR

- With the transmission in PARK, connect one end of a fused jumper wire to starter relay socket 3, circuit SBB13 (GY/RD) and momentarily connect the other end of the fused jumper wire to starter relay socket 5, circuit CDC25 (BN/GN).

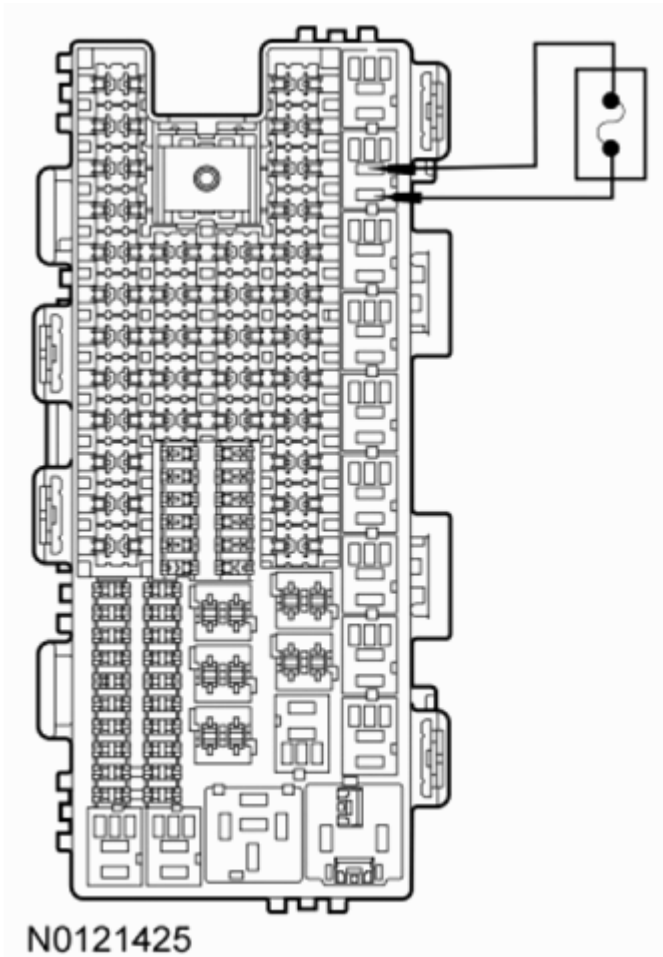


Fig. 2: Connecting Fused Jumper Wire To Starter Relay Socket 3, Circuit SBB13 (GY/RD) And Starter Relay Socket 5, Circuit CDC25 (BN/GN)
Courtesy of FORD MOTOR CO.

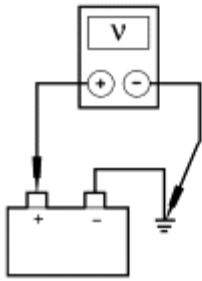
- **Did the starter motor engage and the engine crank?**

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.



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Fig. 3: Measuring Voltage Between Positive Battery Post And Battery Ground Cable Connection
Courtesy of FORD MOTOR CO.

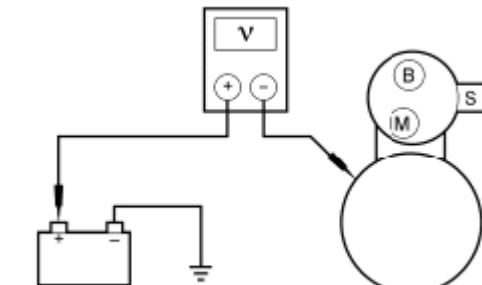
- Is the voltage greater than 10 volts?

YES : GO to A10.

No : INSTALL new battery cables. REFER to **BATTERY, MOUNTING AND CABLES** .
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.



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Fig. 4: Measuring Voltage Between Positive Battery Post And Starter Motor Case
Courtesy of FORD MOTOR CO.

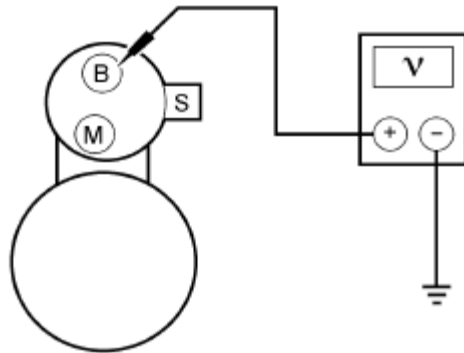
- Is the voltage greater than 10 volts?

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 the starter solenoid C197A-1, circuit SDC02 (RD) and ground.



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Fig. 5: Measuring Voltage Between Starter Solenoid C197A-1, Circuit SDC02 (RD) And Ground

Courtesy of FORD MOTOR CO.

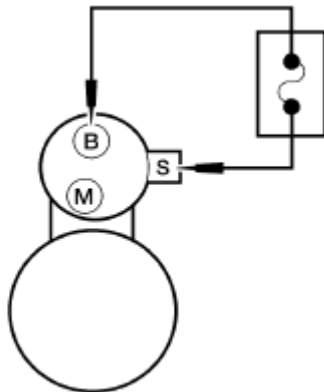
- Is the voltage greater than 10 volts?

YES : GO to A12.

No : INSTALL new battery cables. REFER to **BATTERY, MOUNTING AND CABLES** . TEST the system for normal operation.

A12 CHECK THE STARTER MOTOR

- Connect one end of a fused jumper wire to starter solenoid C197A-1, circuit SDC02 (RD) and momentarily connect the other end of the fused jumper wire to starter solenoid C197B-1, circuit CDC25 (BN/GN).



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Fig. 6: Connecting Fused Jumper Wire To Starter Solenoid C197A-1, Circuit SDC02 (RD) And Starter Solenoid C197B-1, Circuit CDC25 (BN/GN)

Courtesy of FORD MOTOR CO.

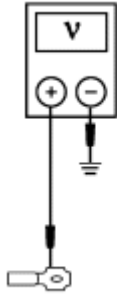
- Did the starter engage and the engine crank?

YES : GO to A13.

No : INSTALL a new starter motor. REFER to **Starter Motor - 3.5L GTDI, 3.7L** or **Starter Motor - 5.0L (4V), 6.2L (2V)** . TEST the system for normal operation.

A13 CHECK FOR START INPUT AT THE STARTER

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



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Fig. 7: Measuring Voltage Between Starter Solenoid C197B-1, Circuit CDC25 (BN/GN) And Ground
 Courtesy of FORD MOTOR CO.

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

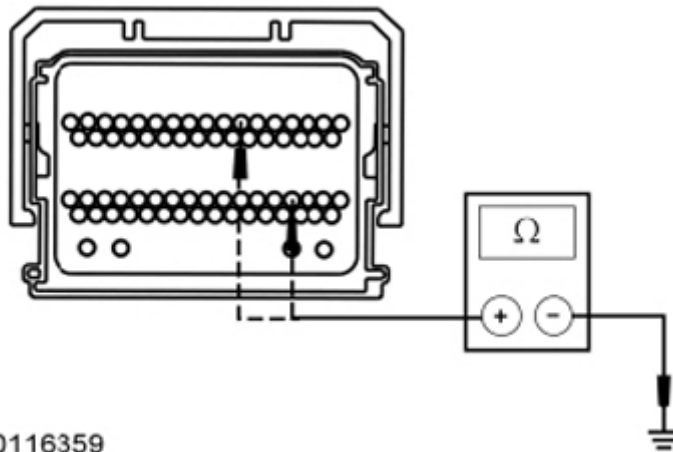
YES : CLEAN the starter solenoid "S" terminal and C197B. CHECK the wiring and the starter motor for a loose or intermittent connection. TEST the system for normal operation.

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: PCM C175B (5.0L and 6.2L), C1381B (3.7L) or C1551B (3.5L).
- Measure the resistance between the PCM C175B (5.0L and 6.2L) or C1381B (3.7L), harness side and ground, using the following chart:

PCM Connector-Pin	Circuit
C175B-7 (5.0L and 6.2L) or C1381B-7 (3.7L)	CDC12 (YE)
C175B-37 (5.0L and 6.2L) or C1381B-37 (3.7L)	CDC54 (WH/GN)

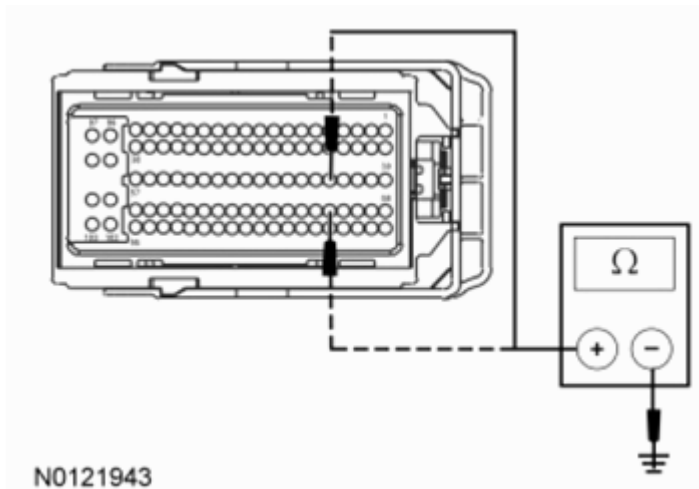


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Fig. 8: Measuring Resistance Between PCM C175B (5.0L And 6.2L) Or C1381B (3.7L), Harness Side And Ground
 Courtesy of FORD MOTOR CO.

- Measure the resistance between the PCM C1551B (3.5L), harness side and ground, using the following chart:

PCM Connector-Pin	Circuit
C1551B-43 (3.5L)	CDC12 (YE)
C1551B-62 (3.5L)	CDC54 (WH/GN)



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Fig. 9: Measuring Resistance Between PCM C1551B (3.5L), Harness Side And Ground
 Courtesy of FORD MOTOR CO.

- Are the resistances greater than 10, 000 ohms?

YES : GO to A15.

No : REPAIR the affected circuit. TEST the system for normal operation.

A15 CHECK THE PCM START CIRCUITS FOR AN OPEN

- Measure the resistance between the PCM C175B (5.0L and 6.2L) or C1381B (3.7L), harness side and the starter relay using the following chart:

PCM Connector-Pin	Circuit	Starter Relay Socket
C175B-7 (5.0L and 6.2L) or C1381B-7 (3.7L)	CDC12 (YE)	2
C175B-37 (5.0L and 6.2L) or C1381B-37 (3.7L)	CDC54 (WH/GN)	1

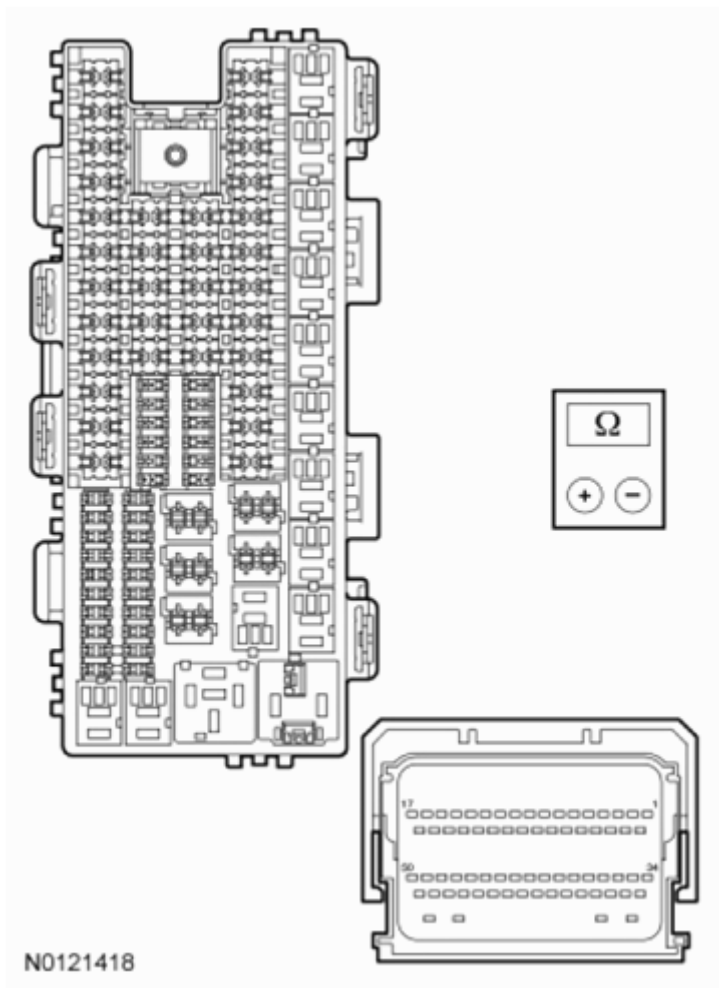


Fig. 10: Measuring Resistance Between PCM C175B (5.0L And 6.2L) Or C1381B (3.7L), Harness Side And Starter Relay
 Courtesy of FORD MOTOR CO.

- Measure the resistance between the PCM C1551B (3.5L), harness side and the starter relay using the following chart:

PCM Connector-Pin	Circuit	Starter Relay Socket
C1551B-43 (3.5L)	CDC12 (YE)	2
C1551B-62 (3.5L)	CDC54 (WH/GN)	1

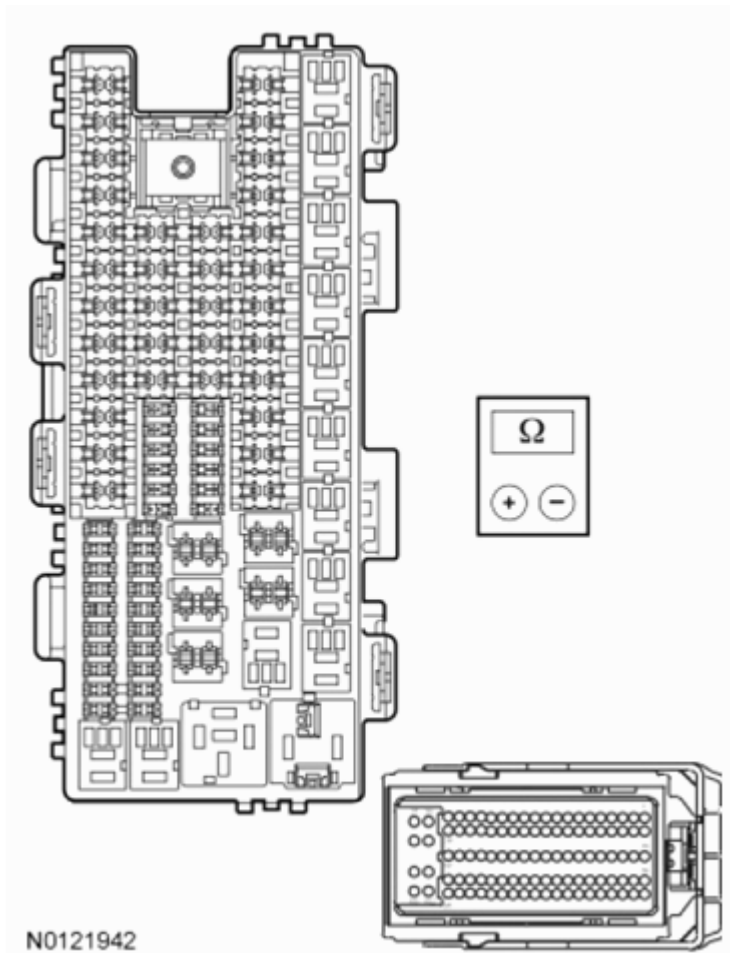


Fig. 11: Measuring Resistance Between PCM C1551B (3.5L), Harness Side And Starter Relay
Courtesy of FORD MOTOR CO.

- Are the resistances less than 5 ohms?

YES : INSTALL a new PCM. REFER to **ELECTRONIC ENGINE CONTROLS** . TEST the system for normal operation.

No : REPAIR the affected circuit. TEST the system for normal operation.

A16 CHECK THE START CIRCUIT FOR VOLTAGE AT THE PCM

- Ignition OFF.
- Disconnect: PCM C175B (5.0L and 6.2L), C1381B (3.7L) or C1551B (3.5L).
- While holding the key in the START position, measure the voltage between the PCM C1551B-47 (3.5L), circuit CDC35 (BU/WH), harness side and ground.

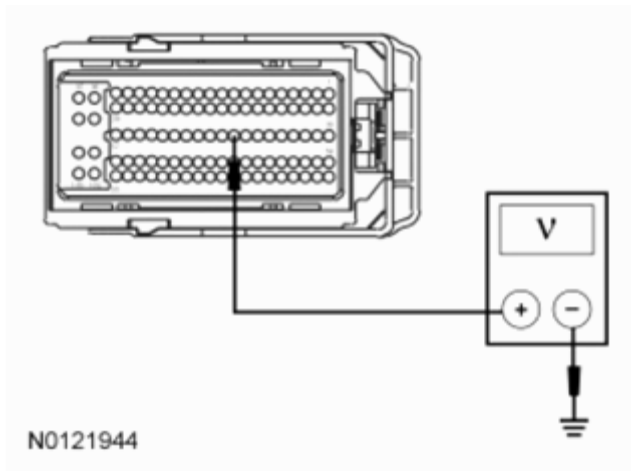


Fig. 12: Measuring Voltage Between PCM C1551B-47 (3.5L), Circuit CDC35 (BU/WH), Harness Side And Ground
 Courtesy of FORD MOTOR CO.

- While holding the key in the START position, measure the voltage between the PCM C175B-16 (5.0L and 6.2L) or C1381B-16 (3.7L), circuit CDC35 (BU/WH), harness side and ground.

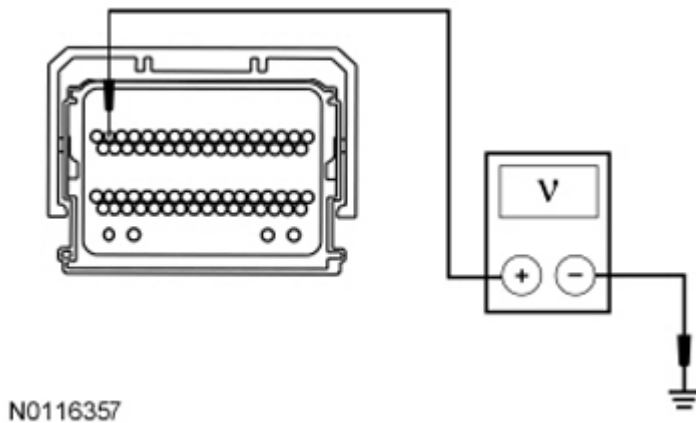


Fig. 13: Measuring Voltage Between PCM C175B-16 (5.0L And 6.2L) Or C1381B-16 (3.7L), Circuit CDC35 (BU/WH), Harness Side And Ground
 Courtesy of FORD MOTOR CO.

- **Is the voltage greater than 10 volts?**
YES : INSTALL a new PCM. REFER to **ELECTRONIC ENGINE CONTROLS** . TEST the system for normal operation.
No : GO to A17.

A17 CHECK THE IGNITION SWITCH

- Carry out the ignition switch component test. Refer to OEM WIRING DIAGRAMS 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 **STEERING COLUMN SWITCHES** . TEST the system for normal operation.

Pinpoint Test B: Unusual Starter Noise

Normal Operation

Correct starter operation relies on correct mounting of the starter to the engine, alignment of the starter ring gear to the 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
- Flexplate ring gear

PINPOINT TEST B: UNUSUAL STARTER NOISE

B1 CHECK THE STARTER 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 - 3.5L GTDI, 3.7L** or **Starter Motor - 5.0L (4V), 6.2L (2V)** . TEST the system for normal operation.

B2 CHECK FOR STARTER NOISE

- Ignition OFF.
- Connect a remote starter switch between the starter solenoid C197A-1 and C197B-1.

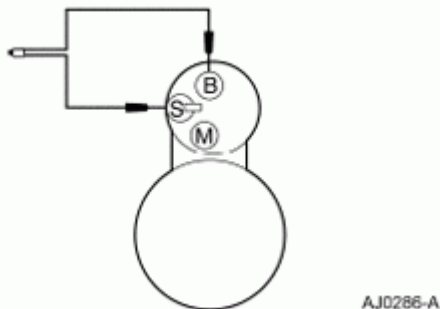


Fig. 14: Connecting Remote Starter Switch Between Starter Solenoid C197A-1 And C197B-1
Courtesy of FORD MOTOR CO.

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

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

YES : REFER to Starter Motor Drive Gear and Flywheel Ring Gear Inspection to continue diagnosis.

No : REFER to ENGINE SYSTEM - GENERAL INFORMATION , Symptom Chart - Engine NVH to continue diagnosis.

Pinpoint Test C: DTC C113A:11 or C113A:15

Refer to OEM WIRING DIAGRAMS Passive Anti-Theft System for schematic and connector information.

Normal Operation

The wake up control circuit is used to wake up the PCM prior to engine cranking. The PCM needs to wake up prior to a crank request so that it has time to go through its own initialization. The wake up control circuit also powers the Passive Anti-Theft System (PATS) transceiver. The wake up control circuit is controlled by the Body Control Module (BCM) and receives voltage from fuse 18 (10A). The BCM uses a Field-Effect Transistor (FET) to control the wake up control circuit. A DTC sets and the wake up control circuit is disabled via the FET if a fault is detected. Once the condition that caused the DTC to set is repaired, the BCM must pass a self-test in order for the DTC to clear and the system to resume normal operation.

The BCM activates the wake up control circuit when:

- the driver door is opened.
- a remote start request is received (if equipped with factory remote start).
- the brake pedal is pressed.
- a key is inserted into the ignition.
- the ignition is in the RUN or START position.
- DTC C113A:11 (Wake up Control: Circuit Short To Ground) - sets when the BCM detects a short to ground on the wake up control circuit.
- DTC C113A:15 (Wake up Control: Circuit Short To Battery or Open) - sets when the BCM detects a short to voltage or an open on the wake up control circuit.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- PATS transceiver
- PCM
- BCM

PINPOINT TEST C: DTC C113A:11 OR C113A:15

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

C1 RETRIEVE THE BCM DTCs

- Ignition ON.
- Enter the following diagnostic mode on the scan tool: BCM - Self-Test.
- **Is DTC C113A:15 on demand during the self-test?**

YES : GO to C2.

No : GO to C5.

C2 CHECK THE WAKE UP CONTROL CIRCUIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: BCM C2280F.
- Disconnect: PATS Transceiver C252.
- Disconnect: PCM C175B (5.0L and 6.2L), C1381B (3.7L) or C1551B (3.5L).
- Ignition ON.
- Measure the voltage between the PCM C1551B-28 (3.5L), circuit CE436 (VT/OG), harness side and ground.

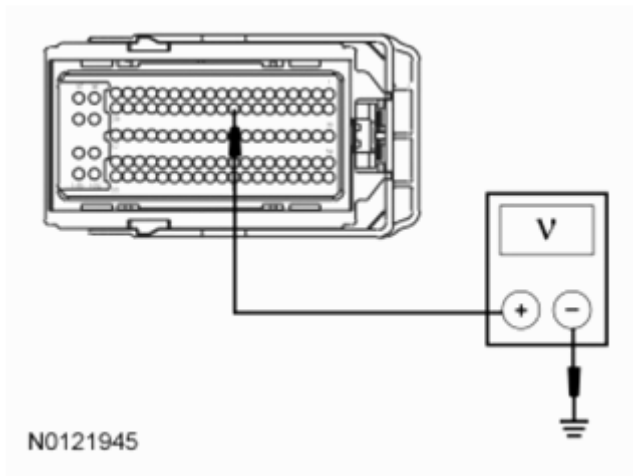


Fig. 15: Measuring Voltage Between PCM C1551B-28 (3.5L), Circuit CE436 (VT/OG), Harness Side And Ground

Courtesy of FORD MOTOR CO.

- Measure the voltage between the PCM C175B-35 (5.0L and 6.2L) or C1381B-35 (3.7L), circuit CE436 (VT/OG), harness side and ground.

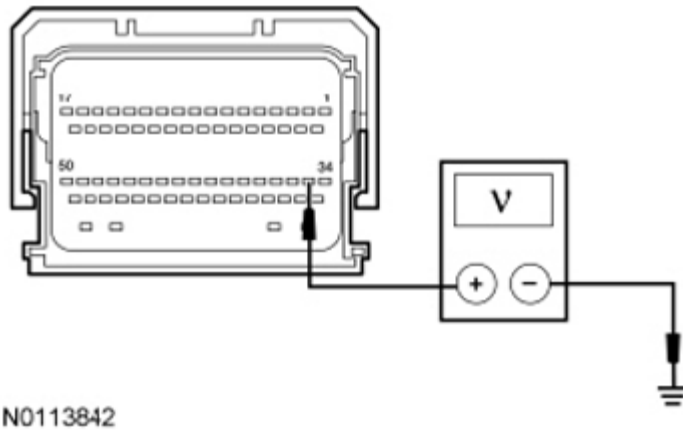


Fig. 16: Measuring Voltage Between PCM C175B-35 (5.0L And 6.2L) Or C1381B-35 (3.7L), Circuit CE436 (VT/OG), Harness Side And Ground
 Courtesy of FORD MOTOR CO.

- Is any voltage present?

YES : REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

No : GO to C3.

C3 CHECK THE WAKE UP CONTROL CIRCUIT FOR AN OPEN

- Ignition OFF.
- Measure the resistance between the PCM C1551B-28 (3.5L), circuit CE436 (VT/OG), harness side and BCM C2280F-5, circuit CE436 (VT/OG), harness side.

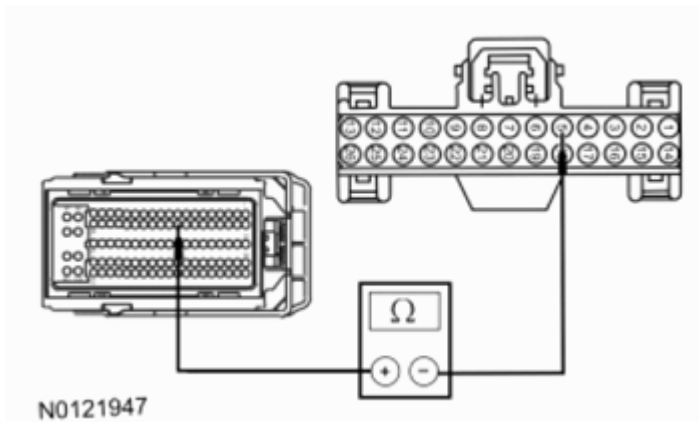


Fig. 17: Measuring Resistance Between PCM C1551B-28 (3.5L), Circuit CE436 (VT/OG) And BCM C2280F-5, Circuit CE436 (VT/OG), Harness Side
 Courtesy of FORD MOTOR CO.

- Measure the resistance between the PCM C175B-35 (5.0L and 6.2L) or C1381B-35 (3.7L), circuit CE436 (VT/OG), harness side and BCM C2280F-5, circuit CE436 (VT/OG), harness side.

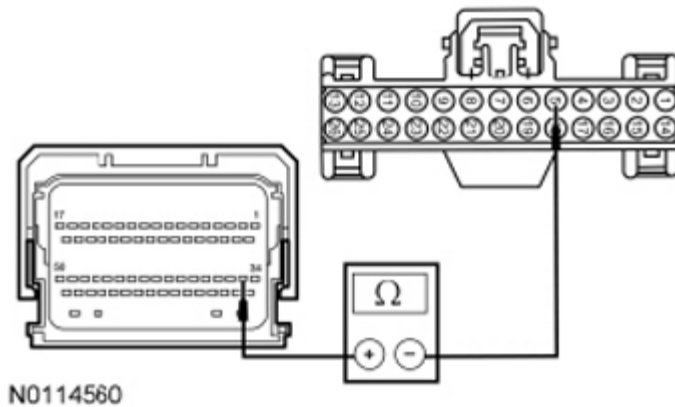


Fig. 18: Measuring Resistance Between PCM C175B-35 (5.0L And 6.2L) Or C1381B-35 (3.7L), Circuit CE436 (VT/OG) And BCM C2280F-5, Circuit CE436 (VT/OG), Harness Side
Courtesy of FORD MOTOR CO.

- Is the resistance less than 5 ohms?

YES : GO to C4.

No : REPAIR circuit CE436 (VT/OG) for an open. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

C4 CHECK THE BCM AND PCM FOR CORRECT OPERATION

- Connect: BCM C2280F.
- Ignition ON.
- Measure the voltage between PCM C1551B-28 (3.5L), circuit CE436 (VT/OG), harness side and ground.

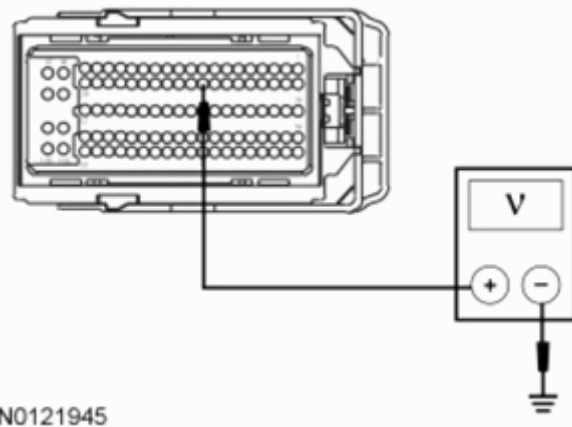


Fig. 19: Measuring Voltage Between PCM C1551B-28 (3.5L), Circuit CE436 (VT/OG), Harness Side And Ground
Courtesy of FORD MOTOR CO.

- Measure the voltage between the PCM C175B-35 (5.0L and 6.2L) or C1381B-35 (3.7L), circuit

CE436 (VT/OG), harness side and ground.

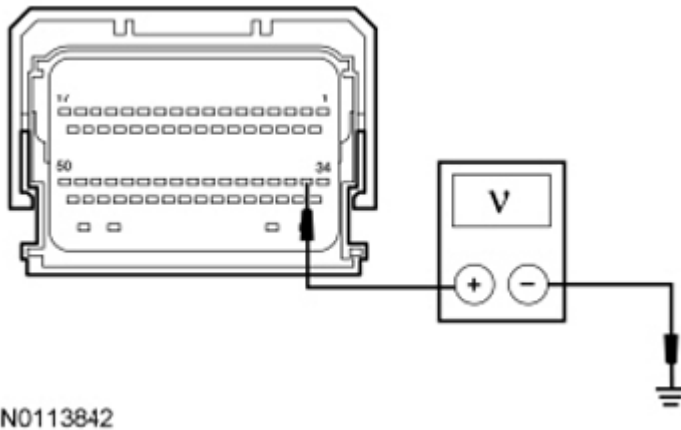


Fig. 20: Measuring Voltage Between PCM C175B-35 (5.0L And 6.2L) Or C1381B-35 (3.7L), Circuit CE436 (VT/OG), Harness Side And Ground
Courtesy of FORD MOTOR CO.

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

YES : INSTALL a new PCM. REFER to **ELECTRONIC ENGINE CONTROLS** .
CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

No : VERIFY BCM fuse 18 (10A) is OK. If OK, INSTALL a new BCM. REFER to **MULTIFUNCTION ELECTRONIC MODULES** . If not OK, REFER to the Wiring Diagrams information to identify the possible causes of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

C5 CHECK THE WAKE UP CONTROL CIRCUIT DTC FOR A FAULT STATUS CHANGE (SHORT TO GROUND INDICATED)

- Enter the following diagnostic mode on the scan tool: Clear BCM Continuous DTCs.
- Ignition OFF.
- Disconnect: PATS Transceiver C252.
- Connect: PCM C175B (5.0L and 6.2L), C1381B (3.7L) or C1551B (3.5L).
- Ignition ON.
- Enter the following diagnostic mode on the scan tool: BCM - Self-Test.
- **Was DTC C113A:11 retrieved on demand during self-test?**

YES : GO to C6.

No : GO to C7.

C6 CHECK THE WAKE UP CONTROL CIRCUIT FOR A SHORT TO GROUND

- Ignition OFF.
- Disconnect: BCM C2280F.
- Measure the resistance between the PCM C1551B-28 (3.5L), circuit CE436 (VT/OG), harness side and ground.

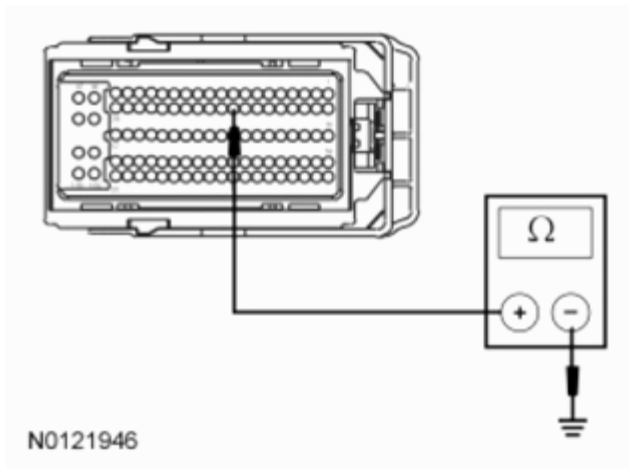


Fig. 21: Measuring Resistance Between PCM C1551B-28 (3.5L), Circuit CE436 (VT/OG), Harness Side And Ground
Courtesy of FORD MOTOR CO.

- Measure the resistance between the PCM C175B-35 (5.0L and 6.2L) or C1381B-35 (3.7L), circuit CE436 (VT/OG), harness side and ground.

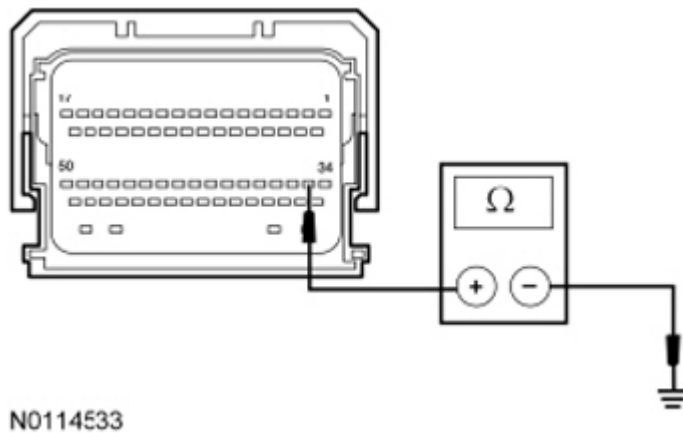


Fig. 22: Measuring Resistance Between PCM C175B-35 (5.0L And 6.2L) Or C1381B-35 (3.7L), Circuit CE436 (VT/OG), Harness Side And Ground
Courtesy of FORD MOTOR CO.

- **Is the resistance greater than 10, 000 ohms?**
YES : INSTALL a new BCM. REFER to **MULTIFUNCTION ELECTRONIC MODULES** . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
No : REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

C7 CHECK THE PCM FOR CORRECT OPERATION

- Enter the following diagnostic mode on the scan tool: Clear BCM Continuous DTCs.

- Ignition OFF.
- Connect: PCM C175B (5.0L and 6.2L), C1381B (3.7L) or C1551B (3.5L).
- Ignition ON.
- Enter the following diagnostic mode on the scan tool: BCM - Self-Test.
- **Was DTC C113A:11 retrieved on-demand during self-test?**

YES : INSTALL a new PCM. REFER to **ELECTRONIC ENGINE CONTROLS** .
CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

No : INSTALL a new PATS transceiver. REFER to **ANTI-THEFT - PASSIVE ANTI-THEFT SYSTEM (PATS)** . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint Test D: DTC B1D55:01

Normal Operation

An external antenna connected to the Tire Pressure Monitor Module (TPM) receives a signal from the Integrated Keyhead Transmitter (IKT) to enable activation of the remote start function from a distance of up to 100 meters (328 feet). If the external antenna fails, the remote start operates with a reduction in the range of operation.

- DTC B1D55:01 (Antenna #2: General Electrical Failure) - this DTC is set if the vehicle is equipped with remote start but the system feedback circuit does not detect an external antenna.

This pinpoint test is intended to diagnose the following:

- External antenna
- External antenna lead
- TPM

PINPOINT TEST D: DTC B1D55:01

D1 CHECK THE EXTERNAL ANTENNA CONNECTION

- Check the connections at the external antenna and TPM.
- **Are the connections loose or disconnected?**

YES : REPAIR as necessary. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

No : GO to D2.

D2 CHECK THE EXTERNAL ANTENNA

- INSTALL a new external antenna.
- ATTEMPT to start the vehicle using the IKT from a distance of 100 meters (328 feet) from the vehicle.
- **Does the vehicle start from this distance?**

YES : System is operating correctly at this time. CLEAR the DTCs. REPEAT the self-test.

TEST the system for normal operation.

No : GO to D3.

D3 CHECK THE EXTERNAL ANTENNA CABLE

- INSTALL a new external antenna cable. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.
- ATTEMPT to start the vehicle using the IKT from a distance of 100 meters (328 feet) from the vehicle
- **Does the vehicle start from this distance?**

YES : System is operating correctly at this time. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

No : INSTALL a new TPM. REFER to **WHEELS AND TIRES** . CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

Pinpoint test E: The Remote Start Is Inoperative

Normal Operation

The factory equipped remote start system enables the engine to be started from up to 100 meters (328 feet) away by pressing the Integrated Keyhead Transmitter (IKT) lock button followed by 2 presses of the remote start button. The 3 button presses must occur within 3 seconds. The IKT signal is received through an external antenna attached to the Tire Pressure Monitor Module (TPM) module and communicated over the Medium Speed Controller Area Network (MS-CAN) to initiate the vehicle start.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Remote start feature disabled
- IKT
- Hood switch
- PCM

PINPOINT TEST E: THE REMOTE START IS INOPERATIVE

E1 CHECK THE OPERATION OF THE IKT

- Press all buttons on the IKT and check for the correct operation.
- **Is the remote start the only function that is inoperative?**

YES : GO to E2.

No : REFER to **HANDLES, LOCKS, LATCHES AND ENTRY SYSTEMS** to DIAGNOSE and REPAIR the Remote Keyless Entry (RKE) system.

E2 CHECK THE VEHICLE STARTING

- Attempt to start the vehicle.
- **Did the vehicle start?**

YES : GO to E3.

No : This is not a remote start issue. GO to **Symptom Chart** to diagnose the no crank condition.

E3 CHECK FOR ILLUMINATED ENGINE WARNING LAMPS

- With the engine running check the instrument cluster for illuminated warning lamps.
- **Are any engine warning lamps illuminated?**

YES : CARRY OUT a self test of the PCM. DIAGNOSE and REPAIR any present DTCs. REFER to **ELECTRONIC ENGINE CONTROLS** or **INTRODUCTION - GASOLINE MODELS** .

No : GO to E4.

E4 RETRIEVE BCM AND TPM DTCs

- Enter the following diagnostic mode on the scan tool: BCM - Self-Test.
- Enter the following diagnostic mode on the scan tool: TPM - Self-Test.
- **Are any DTCs present?**

Yes : For BCM DTCs C113A:11 or C113A:15, GO to **Pinpoint Test C** .

For BCM DTC B1305:01, REFER to **ANTI-THEFT - PERIMETER** .

For TPM DTCs U0140:87 or U0422:68, REFER to **WHEELS AND TIRES** .

For all other DTCs, REFER to **MULTIFUNCTION ELECTRONIC MODULES** .

No : GO to E5.

E5 CONFIRM THE REMOTE START FUNCTION IS ENABLED

- Ignition ON.
- Check the message center and confirm the remote start function is enabled. Refer to the Owner's Literature or **INSTRUMENTATION, MESSAGE CENTER, AND WARNING CHIMES** .
- **Is the remote start function enabled?**

YES : GO to E6.

No : ENABLE the remote start function. TEST the system for normal operation.

E6 CHECK THE BCM LAST RECEIVED RKE TRANSMITTER BUTTON PRESS (LST_RKE_xMTR) TRANSMITTER PID

- Enter the following diagnostic mode on the scan tool: DataLogger - BCM.
- Press the remote start button on the IKT and note the PID status.
- **Does the selected PID indicate the remote start button was the last button pressed?**

YES : GO to E7.

No : INSTALL and PROGRAM a new IKT. REFER to **ANTI-THEFT - PASSIVE ANTI-THEFT SYSTEM (PATS)** . TEST the system for normal operation.

E7 CHECK THE PCM WAKE UP CIRCUIT

- Ignition OFF.
- Disconnect: PCM C175B (5.0L and 6.2L), C1381B (3.7L) or C1551B (3.5L).

- Ignition ON.
- Measure the voltage between the PCM C1551B-28 (3.5L), circuit CE436 (VT/OG), harness side and ground.

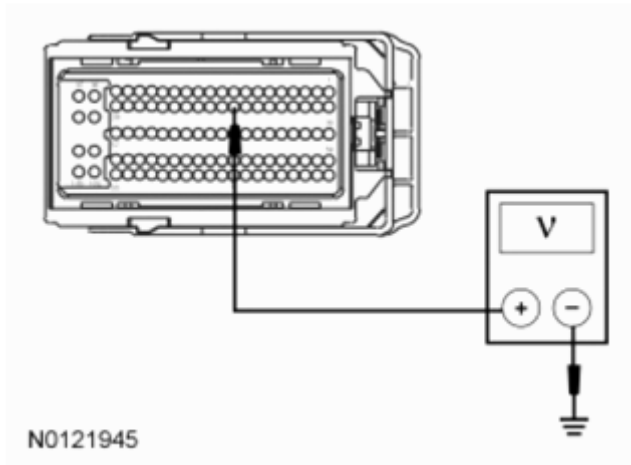


Fig. 23: Measuring Voltage Between PCM C1551B-28 (3.5L), Circuit CE436 (VT/OG), Harness Side And Ground
 Courtesy of FORD MOTOR CO.

- Measure the voltage between the PCM C175B-35 (5.0L and 6.2L) or C1381B-35 (3.5L), circuit CE436 (VT/OG), harness side and ground.

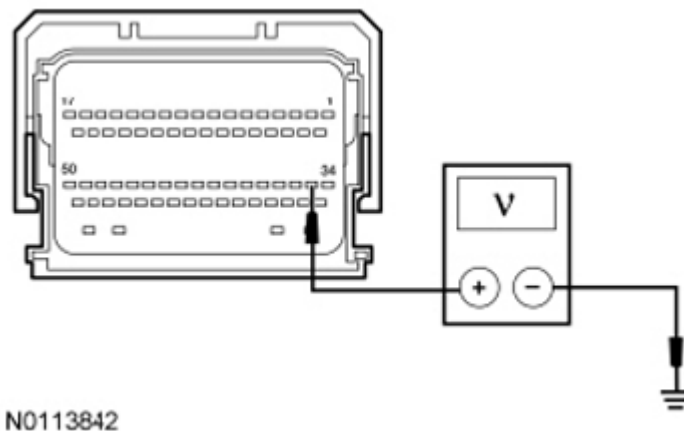


Fig. 24: Measuring Voltage Between PCM C175B-35 (5.0L And 6.2L) Or C1381B-35 (3.5L), Circuit CE436 (VT/OG), Harness Side And Ground
 Courtesy of FORD MOTOR CO.

- **Is the voltage greater than 10 volts?**
 YES : GO to E8.
 No : VERIFY BCM fuse 18 (10A) is OK. If OK, REPAIR circuit CE436 (VT/OG) for an open. If not OK, REFER to the Wiring Diagrams information to identify the possible causes

of the circuit short. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

E8 CHECK THE REMOTE START PRECONDITIONS FOR CORRECT OPERATION

NOTE: **The Body Control Module (BCM) acknowledges the remote start request and that all preconditions have been met by providing 2 short flashes of the turn indicators and a system complete chirp.**

- Make sure that the following preconditions for remote start have been met:
 - Hood is closed with no DTC present.
 - Ignition must be off
 - Vehicle must be in PARK.
 - Remote start feature is configured ON.
 - Number of remote start events does not exceed allowed time (2 events in a 1 hour duration).
 - Attempt to carry out a remote start.
- **Is the remote start system still inoperative?**
 - YES :** INSTALL a new PCM. REFER to **ELECTRONIC ENGINE CONTROLS** . TEST the system for normal operation.
 - No :** CARRY OUT the required precondition as necessary. TEST the system for normal operation.

Pinpoint Test G: DTC P2532 And P2535

Refer to OEM WIRING DIAGRAMS Starting System for schematic and connector information.

Normal Operation

When the ignition key is turned to the RUN or START position, the ignition switch supplies voltage to the PCM logic through the ignition circuit inputs to the BCM. The PCM then provides a ground to the START/RUN relay control circuit to activate the RUN/START relay. When the relay contacts close voltage is supplied to the PCM through Battery Junction Box (BJB) fuse 52 (10A) on the RUN/START bus and circuit.

- DTC P2532 (Ignition Switch Run Position Circuit High) -- sets when the PCM detects a voltage from the ACC/RUN bus when the ignition key is not in the START or RUN position.
- DTC P2535 (Ignition Switch Run/Start Position Circuit High) -- sets when the PCM detects a voltage from the RUN/START bus when the ignition key is not in the START or RUN position.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Starter relay
- BJB
- BCM
- PCM

PINPOINT TEST G: DTC P2532 AND P2535

G1 CHECK THE PCM FOR DTCS

- Ignition ON.
- Check the PCM for DTCs.
- **Are any DTCs present?**
Yes : For DTC P2532, GO to G2.

For DTC P2535, GO to G3.

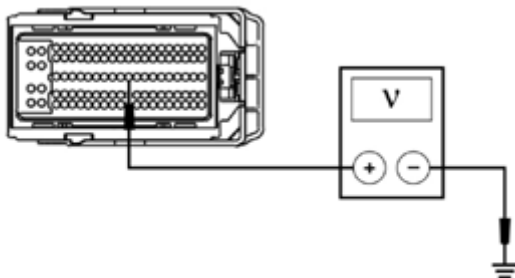
For all other PCM DTCs, REFER to **ELECTRONIC ENGINE CONTROLS** .

No : The system is operating correctly at this time. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

G2 CHECK THE RUN START CIRCUIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Disconnect: PCM.
- Ignition ON.

NOTE: Voltage is present **ONLY** when the ignition switch is in the **START** or **RUN** position.



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Fig. 25: Measuring Voltage Between PCM C1551B-48, Circuit CBB53 (GY/BN), Harness Side And Ground

Courtesy of FORD MOTOR CO.

- For 3.5L equipped vehicles, measure the voltage between the PCM C1551B-48, circuit CBB53 (GY/BN), harness side and ground.
- Ignition ON.

NOTE: Voltage is present **ONLY** when the ignition switch is in the **START** or **RUN** position.

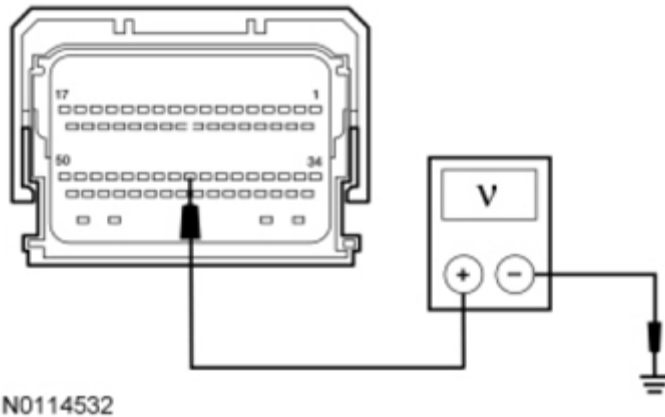


Fig. 26: Measuring Voltage Between PCM C175B-42, Circuit CBB53 (GY/BN), Harness Side And Ground
 Courtesy of FORD MOTOR CO.

- For 3.7L equipped vehicles, measure the voltage between PCM C175B-42, circuit CBB53 (GY/BN), harness side and ground
- Ignition ON.
 - **NOTE:** Voltage is present ONLY when the ignition switch is in the START or RUN position.
- For 5.0L and 6.2L equipped vehicles, measure the voltage between PCM C1381B-42, circuit CBB53 (GY/BN), harness side and ground

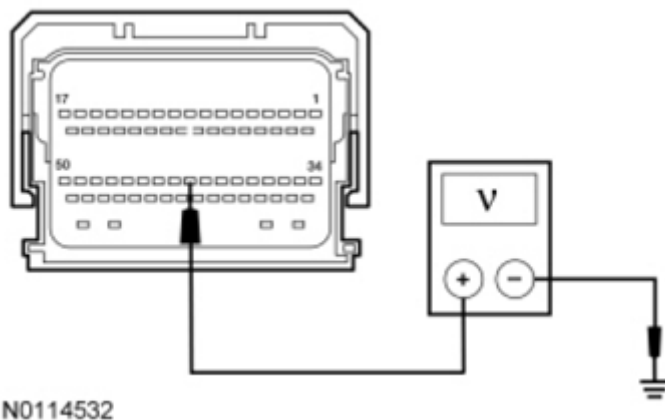


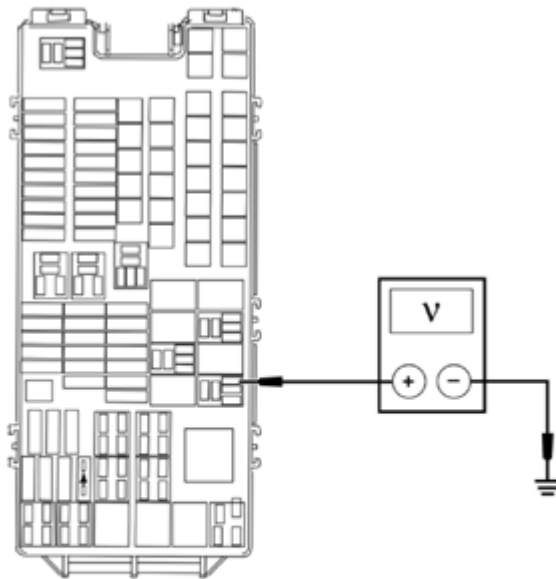
Fig. 27: Measuring Voltage Between PCM C1381B-42, Circuit CBB53 (GY/BN), Harness Side And Ground
 Courtesy of FORD MOTOR CO.

- Is any voltage present?
 - YES : REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

No : CHECK for causes of the intermittent fault. ATTEMPT to recreate the hard fault by flexing the wire harness and cycling the ignition key frequently. ACTIVATE other systems in the same wire harness. REPAIR any concern found. REPEAT the self-test. TEST the system for normal operation. If DTC returns. INSTALL a new PCM. REFER to **ELECTRONIC ENGINE CONTROLS** .

G3 CHECK THE START MOTOR REQUEST CIRCUIT

- Start the engine.
- Disconnect: Starter Motor Relay.
- Measure the voltage between BJB starter relay socket pin 2, circuit CDC26 (GY/OG) and ground.



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Fig. 28: Measuring Voltage Between BJB Starter Relay Socket Pin 2, Circuit CDC26 (GY/OG) And Ground

Courtesy of FORD MOTOR CO.

- **Is any voltage present?**

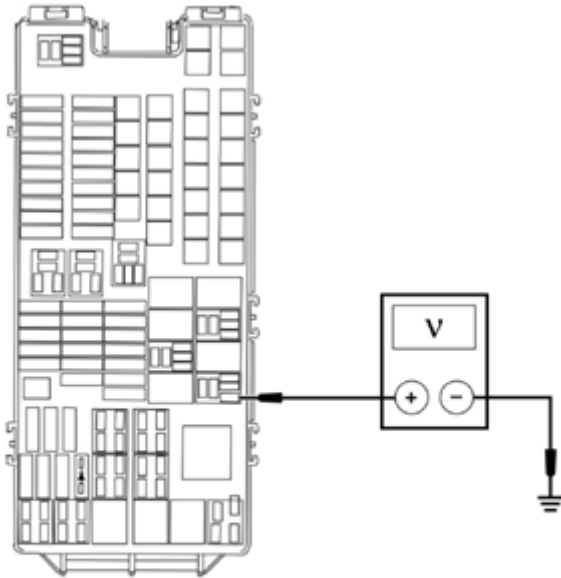
YES : GO to G4.

No : INSTALL a new PCM. REFER to **ELECTRONIC ENGINE CONTROLS** . TEST the system for normal operation.

G4 CHECK THE START MOTOR REQUEST CIRCUIT FOR A SHORT VOLTAGE

- Ignition OFF.
- Disconnect: PCM C175B.
- Ignition ON.

- Measure the voltage between BJB starter relay socket pin 1, circuit CDC12 (YE) and ground.



N0146536

Fig. 29: Measuring Voltage Between BJB Starter Relay Socket Pin 1, Circuit CDC12 (YE) And Ground

Courtesy of FORD MOTOR CO.

- **Is any voltage present?**

YES : REPAIR the circuit. CLEAR the DTCs. REPEAT the self-test. TEST the system for normal operation.

No : INSTALL a new PCM. REFER to **ELECTRONIC ENGINE CONTROLS** . 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 Digital Multimeter connections at the component terminal rather than at the wiring end of the connector. Making a connection at the wiring end of the connector could result in false readings because the meter will not pick up high resistance between the wiring connector and component.

Starter Motor - Feed Circuit Test

1. Make sure the battery is fully charged; carry out a battery Drain test. REFER to **BATTERY, MOUNTING AND CABLES** .
2. Connect a remote starter switch between the starter solenoid C197B and the battery positive terminal.
3. Connect the Digital Multimeter positive lead to the battery positive post. Connect the negative lead to the starter solenoid "M" terminal.

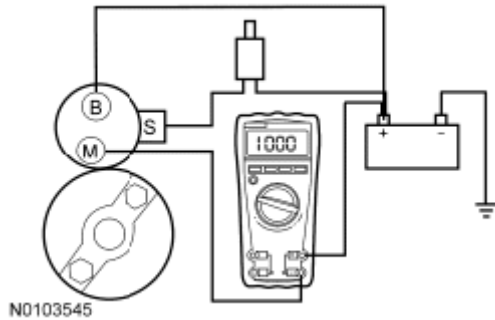


Fig. 30: Checking Starter Motor - Motor Feed Circuit
Courtesy of FORD MOTOR CO.

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 Digital Multimeter negative lead to the starter solenoid C197A and repeat the test. If the voltage reading at starter solenoid C197A is lower than 0.5 volt, the concern is either in the connections at the starter solenoid or in the solenoid contacts.
7. Remove the cables from starter solenoid C197A, C197B 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 C197A, the concern is in the solenoid contacts. Install a new starter motor. Refer to **Starter Motor - 3.5L GTDI, 3.7L** or **Starter Motor - 5.0L (4V), 6.2L (2V)** .
8. If the voltage reading taken at starter solenoid C197A is still greater than 0.5 volt after cleaning the cables and connections at the solenoid, the concern is either in the 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 battery cables. REFER to **BATTERY, MOUNTING AND CABLES** .

Starter Motor - Ground Circuit Test

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 a remote starter switch between the starter solenoid C197B and the battery positive terminal.
2. Connect the 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.

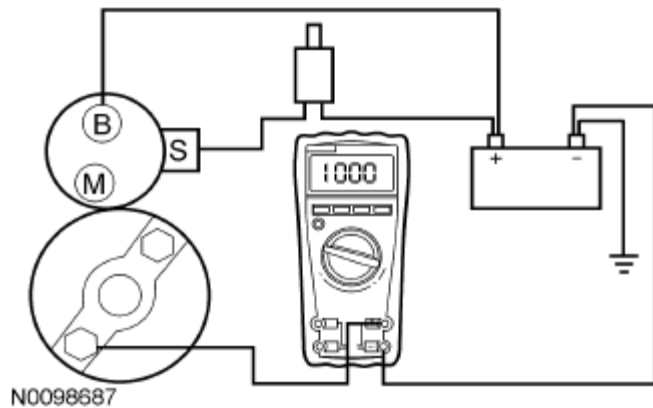


Fig. 31: Checking Starter Motor - Ground Circuit
Courtesy of FORD MOTOR CO.

- Engage the remote starter switch and crank the engine. Read and record the voltage reading. The reading should be 0.5 volt or less.
- If the voltage drop is greater than 0.5 volt, clean the negative cable connections at the battery, the body ground connections and the starter ground connection. Retest.
- If the voltage drop is greater than 0.5 volt, install new cables. REFER to **BATTERY, BATTERY MOUNTING & BATTERY CABLES -- F250-F550 SUPER DUTY** . If the voltage reading is less than 0.5 volt and the engine still cranks slowly, install a new starter motor. Refer to **Starter Motor - 3.5L GTDI, 3.7L** or **Starter Motor - 5.0L (4V), 6.2L (2V)** .

GENERAL PROCEDURES

STARTER MOTOR DRIVE GEAR AND FLYWHEEL RING GEAR INSPECTION

- Check the wear patterns on the starter drive and the flexplate ring gear. If the wear pattern is not normal, install a new starter motor. For additional information, refer to **Starter Motor - 3.5L GTDI, 3.7L** or **Starter Motor - 5.0L (4V), 6.2L (2V)** .

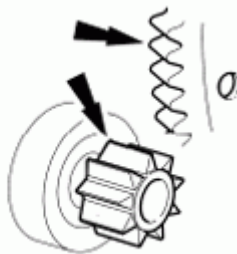
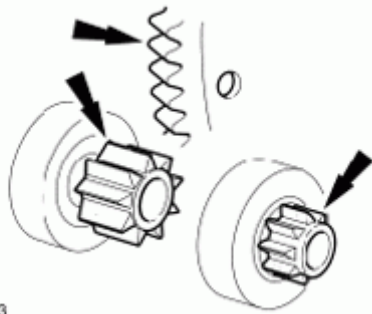


Fig. 32: Locating Starter Drive And Flywheel Ring Gear Wear Patterns
Courtesy of FORD MOTOR CO.

- If the starter drive gear and the flywheel ring gear are not fully meshing or the gears are milled or damaged, install a new starter motor. For additional information, refer to **Starter Motor - 3.5L GTDI,**

3.7L or **Starter Motor - 5.0L (4V), 6.2L (2V)** . Install a new flexplate. For additional information, REFER to **ENGINE - 3.5L GTDI** , **ENGINE - 3.7L** , **ENGINE - 5.0L (4V)** or **ENGINE - 6.2L (2V)** .

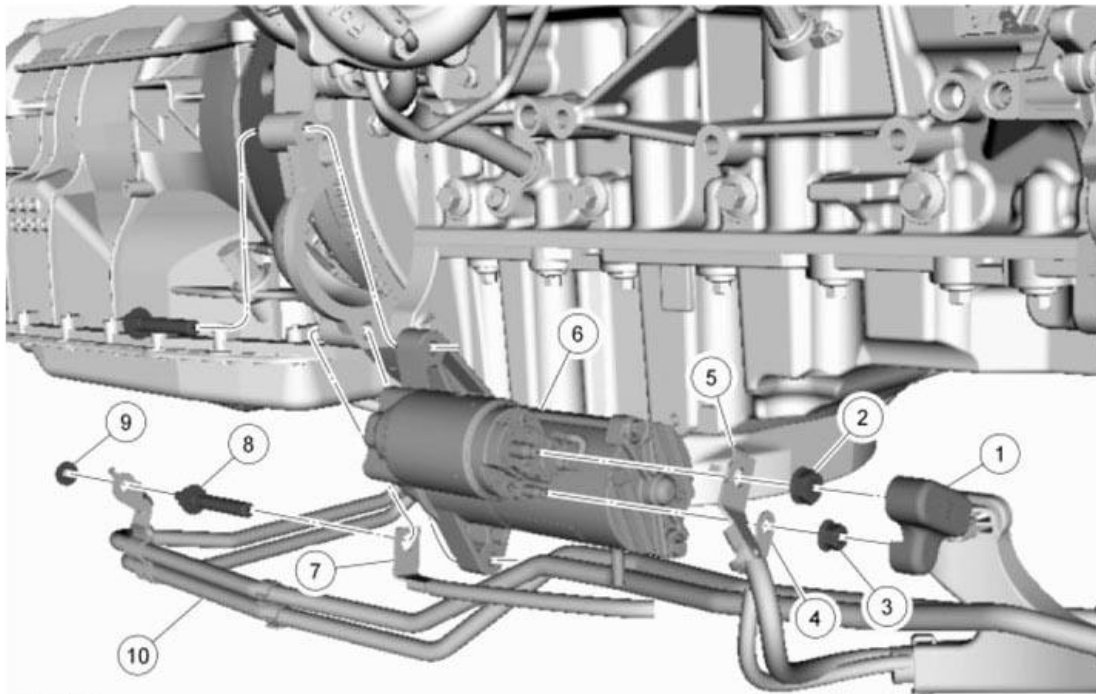


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Fig. 33: Locating Damage Starter Drive Gear And Flexplate Ring Gear
Courtesy of FORD MOTOR CO.

REMOVAL AND INSTALLATION

STARTER MOTOR - 3.5L GTDI, 3.7L



N0129368

Fig. 34: Identifying Starter Motor Related Components - 3.5L GTDI, 3.7L
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	11N087	Starter solenoid terminal cover
2	W706414	Starter solenoid B+ terminal nut - 12 Nm (106 lb-in)

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3	W705790	Starter solenoid S-terminal nut - 5 Nm (44 lb-in)
4	14463	Starter solenoid S-terminal eyelet
5	14463	Starter solenoid B+ terminal eyelet
6	11002	Starter motor
7	14463	Starter motor ground cable eyelet
8	W714290	Starter motor mounting stud bolts (2 required) - 48Nm (35 lb-ft)
9	W709450	Transmission fluid cooler tube bracket nut - 12 Nm (106 lb-in)
10	7R081	Transmission fluid cooler inlet and outlet tubes

Removal and Installation

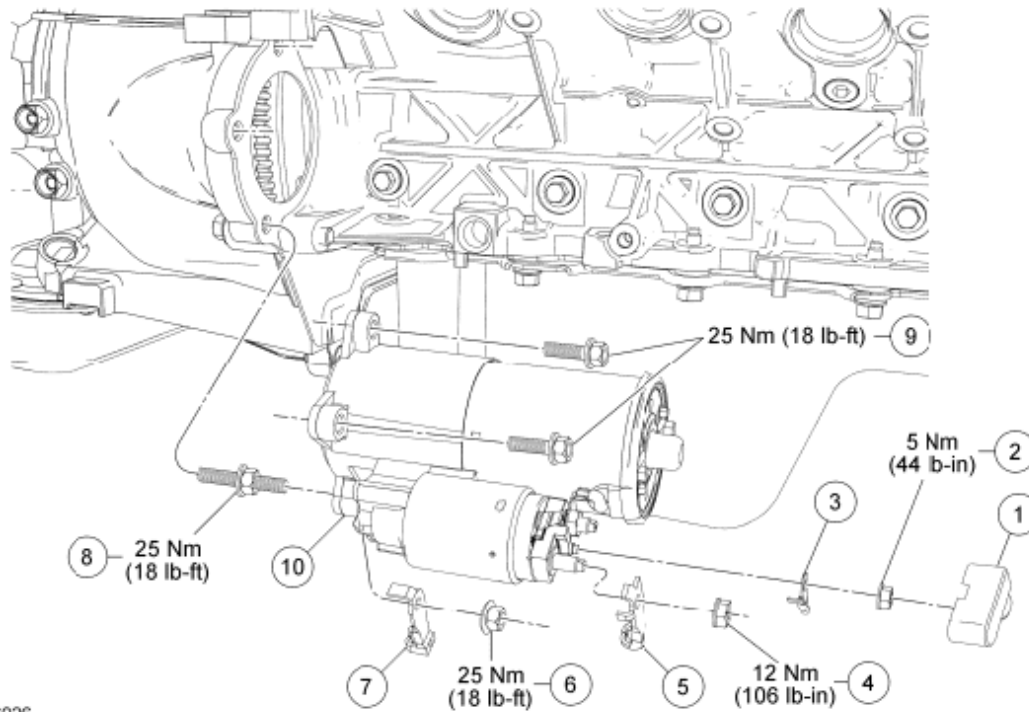
WARNING: Always disconnect the battery ground cable at the battery before disconnecting the starter motor battery terminal lead. If a tool is shorted at the starter motor battery terminal, the tool can quickly heat enough to cause a skin burn. Failure to follow this instruction may result in serious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

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, REFER to **JACKING & LIFTING**.
2. Disconnect the battery ground cable. For additional information, REFER to **BATTERY, MOUNTING AND CABLES**.
3. Remove the terminal cover.
4. Remove the nut and disconnect the starter solenoid B+ terminal eyelet.
 - To install, tighten to 12 Nm (106 lb-in).
5. Remove the nut and disconnect the starter solenoid S-terminal eyelet.
 - To install, tighten to 5 Nm (44 lb-in).
6. Remove the transmission fluid cooler tube bracket nut and position the transmission cooler inlet and outlet tubes aside.
 - To install, tighten to 12 Nm (106 lb-in).
7. Remove the lower stud bolt and position starter motor ground cable eyelet aside.
 - To install, tighten to 48Nm (35 lb-ft).

NOTE: Tighten the upper bolt before tightening the lower fasteners.

8. Remove the upper stud bolt and the starter motor.
 - To install, tighten to 48Nm (35 lb-ft).
9. To install, reverse the removal procedure.

STARTER MOTOR - 5.0L (4V), 6.2L (2V)



N0096026

Fig. 35: Identifying Starter Motor Related Components With Torque Specifications - 5.0L (4V), 6.2L (2V)
 Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	11N087	Terminal cover
2	W705790	Starter solenoid S-terminal nut
3	14463	Starter solenoid S-terminal eyelet
4	W706414	Starter solenoid B+ terminal nut
5	14463	Starter solenoid B+ terminal eyelet
6	N805024	Starter motor ground cable nut
7	14463	Starter motor ground cable eyelet
8	W704941	Starter motor mounting stud bolt
9	W704942	Starter motor mounting bolts (2 required)
10	11002	Starter motor

Removal and Installation

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.

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, REFER to **JACKING & LIFTING** .
2. Disconnect the battery ground cable. For additional information, REFER to **BATTERY, MOUNTING AND CABLES** .
3. Remove the terminal cover.
4. Remove the nut and disconnect the starter solenoid S-terminal eyelet.
 - To install, tighten to 5 Nm (44 lb-in).
5. Remove the nut and disconnect the starter solenoid B+ terminal eyelet.
 - To install, tighten to 12 Nm (106 lb-in).
6. Remove the nut and disconnect the starter motor ground cable eyelet.
 - To install, tighten to 25 Nm (18 lb-ft).

NOTE: Tighten the upper bolt before tightening the lower fasteners.

7. Remove the stud bolt, the 2 bolts and the starter motor.
 - To install, tighten to 25 Nm (18 lb-ft).
8. To install, reverse the removal procedure.