

2008 BRAKES

Vehicle Dynamic Systems - Mustang

SPECIFICATIONS

Material

Item	Specification	Fill Capacity
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1	714 ml (1.5 pt)

TORQUE SPECIFICATIONS

Description	Nm	lb-ft	lb-in
ABS module screws	3	-	27
Brake tube-to-Hydraulic Control Unit (HCU) fittings	17	-	150
HCU bracket-to-frame bolts	25	18	-
HCU bracket-to-HCU bolt	11	-	97
Wheel speed sensor bolt	15	-	133

DESCRIPTION AND OPERATION

ANTI-LOCK CONTROL

Anti-Lock Brake System (ABS) with Traction Control

The ABS consists of the following components:

- Hydraulic Control Unit (HCU)
- ABS module
- Front wheel speed sensors
- Front wheel speed sensor rings
- Rear wheel speed sensors
- Rear wheel speed sensor rings
- Traction control switch

The ABS prevents wheel lock up by monitoring the wheel speed sensors and actuating the HCU modulating the brake pressure to prevent wheel lockup. By preventing the wheels from locking up, the driver is able to maintain steering control and stop in the shortest possible distance under most conditions. The traction control system utilizes the same components as the ABS to prevent wheel spin and help maintain vehicle control during acceleration.

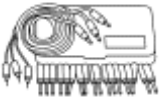
DIAGNOSTIC TESTS

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ANTI-LOCK CONTROL

Special Tools

Illustration	Tool Name	Tool Number
 ST1137-A	73III Digital Multi-meter	105-R0057 or equivalent
 ST1138-A	Flex Probe Kit	418-F090 (105-R025B) or equivalent
 ST3030-A	Rotunda Active Wheel Speed Sensor Tester	105-R0110
 ST2834-A	Vehicle Communication Module (VCM) and Integrated Diagnostic System (IDS) software with appropriate hardware, or equivalent scan tool	

Principles of Operation

Anti-Lock Braking

The standard ABS module manages anti-lock braking to maintain vehicle control during deceleration.

The ABS module monitors and compares the rotational speed of each wheel. Wheel speeds are measured by the wheel speed sensor, which electrically senses each tooth of the sensor ring as it passes through the magnetic field of the sensor. When the ABS module detects an impending wheel lock, the ABS module commands the hydraulic pump motor on and commands the Hydraulic Control Unit (HCU) to open and close the appropriate solenoid valves to modulate the brake pressure to the individual brake caliper(s). Once the affected wheel(s) return to the desired speed, the ABS module commands the HCU to return the solenoid valves to their normal position and normal base brake operation is restored.

The ABS module is self-monitoring. When the ignition switch is in the RUN position, the ABS module does a preliminary electrical check and, at approximately 12 km/h (8 mph), the hydraulic pump motor is turned on for approximately one-half second. During this time a buzzing or humming noise may be heard and a vibration maybe felt in the brake pedal. This is a normal condition. If a malfunction is detected in the system, the module disables the ABS system and illuminates the yellow ABS warning indicator. However, the base power-assist

braking system functions normally.

Traction Control

Traction control utilizes ABS components to detect and control excessive rear wheel spin on low-traction surfaces.

When the drive wheels lose traction on a low-traction surface, with vehicle speed under 100 km/h (62 mph), the ABS module commands the hydraulic pump motor on and commands the HCU to open and close the appropriate solenoid valves to modulate the brake pressure to the rear brake caliper(s) while simultaneously sending a request to the PCM over the High Speed Controller Area Network (HS-CAN) bus to reduce engine torque to maintain vehicle traction. The PCM accomplishes this by minor incremental timing changes and fewer fuel injector pulses until the ABS module ends the request. The request ends when the driven wheel speed returns to the desired speed. After the vehicle speed exceeds 100 km/h (62 mph), the traction control is accomplished only through the PCM torque control. During a traction control event, the traction control indicator in the instrument cluster will flash.

The intention of traction control is to detect and control excessive rear wheel spin on low-traction surfaces. On high-traction surfaces, a controlled amount of rear wheel spin will be allowed in the interest of quick acceleration. In order to avoid unnecessary traction control activation, the traction control strategy uses several inputs to determine when traction control activation is beneficial to the driver. The PCM relays throttle position information to the ABS module over the HS-CAN bus. The throttle position is utilized to determine if the driver intends to accelerate quickly. If this is the case, traction control will allow a controlled amount of rear wheel spin. If rear wheel spin is permitted, input from the front wheel speed sensors will be used to calculate vehicle acceleration. If the vehicle is accelerating while wheel spin is occurring, the ABS module will check for a difference between the left front and right front wheel speeds to determine if the vehicle is accelerating in a straight line. If the vehicle is not accelerating (rear wheels spinning on a slippery surface) or if the vehicle is turning, traction control will activate to help make better use of the available traction.

Traction Control Switch

The traction control switch allows the driver to control use of the traction control system. This is independent of the standard ABS function, which cannot be switched off by the driver. The traction control system status is indicated by a light in the traction control switch and an indicator in the instrument cluster. When the traction control system is switched off, the indicator in the switch will illuminate. When the traction control system is turned off, the standard ABS functions continue to operate as designed unless the yellow ABS warning indicator is also illuminated. Normal braking function always occurs, unless the red brake warning indicator is illuminated.

Inspection and Verification

1. Verify the customer concern.
2. Verify the stoplamp operate correctly by applying and releasing the brake pedal with the ignition switch in the OFF position. If the stoplamp do not operate correctly, refer to **EXTERIOR LIGHTING** article. If the stoplamp operate correctly, proceed to the next step.
3. Visually inspect for obvious signs of mechanical or electrical damage:

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VISUAL INSPECTION CHART

Mechanical	Electrical
• Base brake system • Hydraulic Control Unit (HCU) • Suspension components • Tire pressure • Tire size or mismatched tires • Wheel speed sensor ring	• ABS module • Brake Pedal Position (BPP) switch • Bussed Electrical Center (BEC) fuse(s): ○ 8 (40A) ○ 44 (15A) ○ 65 (30A) • Smart Junction Box (SJB) fuse 18 (10A) • Traction control switch • Wheel speed sensors • Wiring, terminals or connectors

4. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) 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 Vehicle Communication Module (VCM) 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** article, 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** article 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 **MODULE COMMUNICATIONS NETWORK** article.
 - If the network test passes, retrieve and record continuous memory DTCs.

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9. Clear the continuous DTCs and carry out the self-test diagnostics for the ABS module and the instrument cluster.
10. If the DTCs retrieved are related to the concern, go to the ABS Module DTC Chart and/or the Instrument Cluster DTC Chart. For all other DTCs, refer to the Master DTC Chart in **MULTIFUNCTION ELECTRONIC MODULES** article.
11. If no DTCs related to the concern are retrieved, go to **Symptom Chart**.

DTC Charts

ABS MODULE DTC CHART

DTC	Description	Source	Action
B1317	Battery Voltage High	ABS Module	Go to <u>Pinpoint Test A</u> .
B1318	Battery Voltage Low	ABS Module	Go to <u>Pinpoint Test A</u> .
B1342	ECU is Faulted	ABS Module	NOTE: If other DTCs are present, repair them before installing a new module. CLEAR the DTCs. RETRIEVE the DTCs. If DTC B1342 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module</u> . REPEAT the self-test.
C1095	ABS Hydraulic Pump Motor Circuit Failure	ABS Module	Go to <u>Pinpoint Test B</u> .
C1096	ABS Hydraulic Pump Motor Circuit Open	ABS Module	Go to <u>Pinpoint Test B</u> .
C1115	ABS Power Relay Output Short Circuit to Battery	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1115 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module</u> . CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1145	Wheel Speed Sensor RF Input Circuit Failure	ABS Module	Go to <u>Pinpoint Test C</u> .
C1155	Wheel Speed Sensor LF Input Circuit Failure	ABS Module	Go to <u>Pinpoint Test C</u> .
C1165	Wheel Speed Sensor RR Input Circuit Failure	ABS Module	Go to <u>Pinpoint Test C</u> .
C1175	Wheel Speed Sensor LR Input Circuit Failure	ABS Module	Go to <u>Pinpoint Test C</u> .
C1185	ABS Power Relay Output Circuit	ABS	CLEAR all DTCs. If DTC C1185 is retrieved

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	Failure	Module	again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module</u> . CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1194	ABS Outlet Valve Coil LF Circuit Failure	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1194 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module</u> . CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1198	ABS Inlet Valve Coil LF Circuit Failure	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1198 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module</u> . CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1210	ABS Outlet Valve Coil RF Circuit Failure	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1210 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module</u> . CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1214	ABS Inlet Valve Coil RF Circuit Failure	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1214 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module</u> . CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1222	Wheel Speed Mismatch	ABS Module	Go to <u>Pinpoint Test D.</u>
C1233	Wheel Speed LF Input Signal Missing	ABS Module	Go to <u>Pinpoint Test D.</u>
C1234	Wheel Speed RF Input Signal Missing	ABS Module	Go to <u>Pinpoint Test D.</u>
C1235	Wheel Speed RR Input Signal Missing	ABS Module	Go to <u>Pinpoint Test D.</u>
C1236	Wheel Speed LR Input Signal Missing	ABS Module	Go to <u>Pinpoint Test D.</u>
C1242	ABS Outlet Valve Coil LR Circuit Failure	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1242 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake</u>

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			System (ABS) Module. CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1246	ABS Outlet Valve Coil RR Circuit Failure	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1246 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module.</u> CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1250	ABS Inlet Valve Coil LR Circuit Failure	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1250 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module.</u> CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1254	ABS Inlet Valve Coil RR Circuit Failure	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1254 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module.</u> CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1329	ABS Outlet Valve Coil RF Circuit Excessive Temperature	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1329 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module.</u> CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1330	ABS Outlet Valve Coil LR Circuit Excessive Temperature	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1330 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module.</u> CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1331	ABS Outlet Valve Coil RR Circuit Excessive Temperature	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1331 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module.</u> CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.

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C1332	ABS Outlet Valve Coil LF Circuit Excessive Temperature	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1332 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module</u> . CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1333	ABS Inlet Valve Coil LR Circuit Excessive Temperature	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1333 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module</u> . CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1334	ABS Inlet Valve Coil LF Circuit Excessive Temperature	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1334 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module</u> . CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1335	ABS Inlet Valve Coil RF Circuit Excessive Temperature	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1335 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module</u> . CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1336	ABS Inlet Valve Coil RR Circuit Excessive Temperature	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1336 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module</u> . CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1404	Traction Control Valve Rear Circuit Failure	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1404 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module</u> . CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1446	Brake Switch Circuit Failure	ABS Module	Go to <u>Pinpoint Test E</u> .
C1527	Traction Control Rear Valve Circuit Excessive Temperature	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1527 is retrieved again, INSTALL a new

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			ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module</u> . CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1531	Dynamic Stability Control LF Valve Circuit Excessive Temperature	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1531 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module</u> . CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1730	Reference Voltage Out of Range (+5 V)	ABS Module	If any other DTCs are present, DIAGNOSE those DTCs first. CLEAR all DTCs. DRIVE the vehicle. If the DTC is still present, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module</u> . CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
C1958	Dynamic Stability Control Valve LF circuit Failure	ABS Module	CLEAR all DTCs. DRIVE the vehicle. If DTC C1958 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module</u> . CARRY OUT the self-test with the <u>Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator</u> not applied.
U0073	Control Module Communication Bus Off	ABS Module	REFER to <u>MODULE COMMUNICATIONS NETWORK</u> article to diagnose the Hydraulic Control Unit (HCU) bus.
U1900	CAN Communication Bus Fault - Receive Error	ABS Module	REFER to <u>MODULE COMMUNICATIONS NETWORK</u> article to diagnose the HCU bus.
U2011	Module Transmitted Invalid Data (Non-SCP)	ABS Module	VERIFY PCM configuration, REFER to Programmable Module Installation (PMI) in <u>MODULE CONFIGURATION</u> article. If the PCM is not correctly configured, CONFIGURE the PCM. If the PCM is correctly configured, REFER to <u>MODULE COMMUNICATIONS NETWORK</u> article to diagnose the HCU bus.
U2050	No Application Present	ABS Module	CONFIGURE the ABS module. REFER to Programmable Module Installation (PMI) in <u>MODULE CONFIGURATION</u> article. CLEAR the DTCs. RETRIEVE the DTCs and VERIFY successful module configuration. If DTC U2050 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock</u>

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			<u>Brake System (ABS) Module.</u> CLEAR the DTC. REPEAT the self-test.
U2051	One or More Calibration Files Missing/Corrupt	ABS Module	CALIBRATE the ABS module, follow the directions on the scan tool. CLEAR the DTCs. CARRY OUT the ABS module self-test. RETRIEVE and RECORD any DTCs. If DTC U2051 is retrieved again, INSTALL a new ABS module. REFER to <u>Anti-Lock Brake System (ABS) Module.</u> CLEAR the DTC. REPEAT the self-test.

INSTRUMENT CLUSTER DTC CHART

DTC	Description	Source	Action
C1093	Traction Control Disable Switch Circuit Failure	Instrument Cluster	Go to <u>Pinpoint Test H.</u>
-	All Other Instrument Cluster DTCs	Instrument Cluster	REFER to the Master DTC Chart in <u>MULTIFUNCTION ELECTRONIC MODULES</u> article.

Symptom Chart

Symptom Chart

Condition	Possible Sources	Action
No communication with the ABS module	- Wiring, terminals or connectors - ABS module	REFER to <u>MODULE COMMUNICATIONS NETWORK</u> article to diagnose the no communications concern.
No communication with the instrument cluster	- Wiring, terminals or connectors - Instrument cluster	REFER to <u>MODULE COMMUNICATIONS NETWORK</u> article to diagnose the no communication concern.
The yellow ABS warning indicator is illuminated	DTCs in the ABS module	RETRIEVE and RECORD any ABS module DTCs. Go to the ABS Module DTC Chart.
The yellow ABS warning indicator is never on	- Wiring, terminals or connectors - Instrument cluster	REFER to <u>INSTRUMENT CLUSTER (IC), MESSAGE CENTER, AND WARNING CHIMES</u> article to continue diagnosis of the yellow brake warning indicator.
Spongy/soft/low brake pedal with no warning indicator	- Air in brake hydraulic system - Base brake system - Hydraulic Control	Go to <u>Pinpoint Test F.</u>

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	Unit (HCU)	
Poor vehicle tracking during anti-lock function	- Air in the brake system - Base brake system - HCU	Go to <u>Pinpoint Test G.</u>
The traction control system is inoperative	- Wiring, terminals or connectors - Traction control switch - Instrument cluster - ABS module	Go to <u>Pinpoint Test I.</u>
The traction control system cannot be disabled	- Wiring, terminals or connectors - Traction control switch - Instrument cluster - ABS module	Go to <u>Pinpoint Test H.</u>
The traction control switch indicator is never/always on	- Circuitry - Traction control switch - Instrument cluster	REFER to Diagnosis and Testing in <u>INSTRUMENT CLUSTER (IC), MESSAGE CENTER, AND WARNING CHIMES</u> article to diagnose the traction control indicator.

Pinpoint Tests

Pinpoint Test A: DTCs B1317 and B1318 - Battery Voltage High/Low

Refer to appropriate SYSTEM WIRING DIAGRAM ARTICLE, Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The operating voltage required to operate the ABS module, hydraulic pump and isolation valves is in a range between 10 and 16 volts.

Fused ignition voltage is supplied to the ABS module from Smart Junction Box (SJB) fuse 18 (10A) along circuit 1844 (LG/RD). Fused battery voltage is supplied to the ABS module from Bussed Electrical Center (BEC) fuse 65 (30A) along circuit 601 (LB/BK) and BEC fuse 8 (40A) along circuit 534 (YE/LG). Ground is provided to the ABS module along circuit 1205 (BK). There are 2 ground circuits (one for the ABS module and one for the hydraulic pump motor) both share the same circuit number and wire color.

- DTC B1317 Battery Voltage High - If during an ABS module self-test or normal operation, the battery or charging system voltage exceeds 16 volts, DTC B1317 will be set.

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- DTC B1318 Battery Voltage Low - If during an ABS module self-test or normal operation, the battery or charging system voltage drops below 10 volts, DTC B1318 will be set.

This pinpoint test is intended to diagnose the following:

- Fuse(s)
- Wiring, terminals or connectors
- Charging system
- Vehicle battery
- ABS module

PINPOINT TEST A: DTCs B1317 AND B1318 - BATTERY VOLTAGE HIGH/LOW

NOTE: Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.

A1 CHECK THE BATTERY VOLTAGE

- Measure the battery voltage between the positive and negative battery posts with the Key ON Engine OFF (KOEO), and with the engine running.
- **Is the battery voltage between 10 and 13 volts with KOEO, and between 13 and 17 volts with the engine running?**

YES : Go to A2.

NO : REFER to **CHARGING SYSTEM - GENERAL INFORMATION** article to continue diagnosis of the charging system and vehicle battery.

A2 CHECK THE VOLTAGE TO THE ABS MODULE

- Key in OFF position.
- Disconnect: ABS Module C135
- Key in ON position.

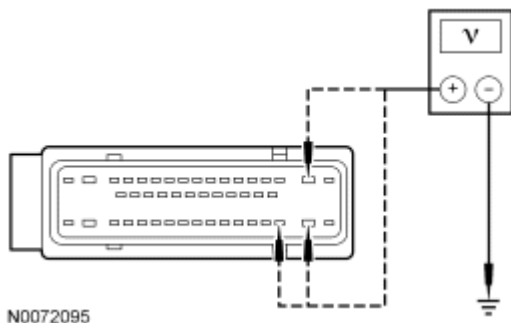


Fig. 1: Checking Voltage To ABS Module
Courtesy of FORD MOTOR CO.

- Measure the voltage between ground and:

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- ABS module C135-2, circuit 601 (LB/PK), harness side.
- ABS module C135-31, circuit 534 (YE/LG), harness side.
- ABS module C135-32, circuit 1844 (LG/RD), harness side.
- **Are the voltages greater than 10 volts?**
YES : Go to A3.
NO : VERIFY SJB fuse 18 (10A) is OK. If OK, REPAIR circuit 1844 (LG/RD).

VERIFY BEC fuse 8 (40A) is OK. If OK, REPAIR circuit 534 (YE/LG).

VERIFY BEC fuse 65 (30A) is OK. If OK, REPAIR circuit 601 (LB/PK).

CLEAR the DTCs. CARRY OUT the self-test with the brake pedal **Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator** not applied.

A3 CHECK THE CIRCUIT 1205 (BK) FOR AN OPEN

- Key in OFF position.

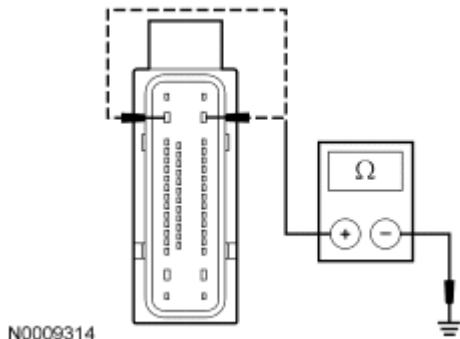


Fig. 2: Checking Circuit 1205 (BK) For An Open
Courtesy of FORD MOTOR CO.

- Measure the resistance between ground and:
 - ABS module C135-45, circuit 1205 (BK), harness side.
 - ABS module C135-16, circuit 1205 (BK), harness side.
- **Are the resistances less than 5 ohms?**
YES : Go to A4.
NO : REPAIR the affected circuit(s). REPEAT the self-test.

A4 CHECK FOR CORRECT ABS MODULE OPERATION

- Check ABS C135 for:
 - corrosion.
 - spread terminals.
 - pushed-out pins.
- Connect: ABS Module C135

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- Make sure the connector seats properly, then operate the system and verify the concern is still present.

- **Is the concern still present?**

YES : INSTALL a new ABS module. REFER to **Anti-Lock Brake System (ABS) Module**. CLEAR the DTCs. REPEAT the self-test.

NO : The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CARRY OUT the self-test with the **Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator** not applied.

Pinpoint Test B: DTCs C1095 and C1096 - ABS Hydraulic Pump Motor Circuit Failure/Open

Refer to appropriate SYSTEM WIRING DIAGRAM ARTICLE, Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

Fused battery voltage for ABS pump motor operation is supplied to the ABS module from the Bussed Electrical Center (BEC) fuse 8 (40A) along circuit 534 (YE/LG). Ground for the pump motor is provided along circuit 1205 (BK).

When the ignition key is turned to the ON position, the ABS module commands the Hydraulic Control Unit (HCU) pump on for 100 ms (± 6 ms) and is then commanded off. After 6 ms, the ABS module will read the voltage that is being generated by the HCU pump. If the voltage indicates the motor is spinning at less than 500 RPM, there may be a locked motor. If this condition is detected 4 times, DTC C1095 is set. The pump motor is checked for an open circuit 2 seconds after the most recent successful pump motor off command. If the pump motor feedback remains greater than 0.75 volt for more than 50 ms (± 6 ms) after these conditions have been met, DTC C1096 is set.

- DTC C1095 ABS Hydraulic Pump Motor Circuit Failure - If a short to voltage or ground is detected, if a locked up pump motor is detected or if there is an internal failure of the ABS module, DTC C1095 will be set.
- DTC C1096 ABS Hydraulic Pump Motor Circuit Open - If a short to voltage, a short to ground or an open is detected, if a locked up pump motor is detected or if there is an internal failure of the ABS module, DTC C1095 will be set.

This pinpoint test is intended to diagnose the following:

- Fuse
- Wiring, terminals or connectors
- Hydraulic pump motor
- ABS module

PINPOINT TEST B: DTCs C1095 AND C1096 - ABS HYDRAULIC PUMP MOTOR CIRCUIT FAILURE/OPEN

NOTE: Use the Flex Probe Kit for all test connections to prevent damage to the wiring

terminals. Do not use standard multi-meter probes.

B1 CHECK THE ABS PUMP MOTOR

- Key in ON position.
- **Is the ABS pump motor running all the time?**

YES : INSTALL a new ABS module and HCU. REFER to Anti-Lock Brake System (ABS) Module and Hydraulic Control Unit (HCU). CLEAR the DTCs. REPEAT the ABS self-test.

NO : Go to B2.

B2 CHECK THE PUMP MOTOR OUTPUT COMMAND (ABS_MTR)

- Connect the diagnostic tool.
- Enter the following diagnostic mode on the diagnostic tool: ABS DataLogger
- Toggle the ABS_MTR output command ON.
- **Does the ABS pump motor run for approximately 2 seconds?**

YES : TOGGLE the output command OFF.

CLEAR the DTCs. CHECK the yellow ABS warning indicator while driving the vehicle (brakes must not be applied) above 32 km/h (20 mph). If the yellow ABS warning indicator illuminates, RETRIEVE the DTCs.

If DTC C1096 is retrieved, go to B5.

If DTC C1095 is retrieved, INSTALL a new HCU. REFER to Hydraulic Control Unit (HCU).

For all other ABS module DTCs , go to the ABS Module DTC Chart.

CLEAR the DTCs. REPEAT the self-test.

NO : TOGGLE the output command OFF and Go to B3.

B3 CHECK THE VOLTAGE TO THE ABS MODULE

- Key in OFF position.
- Disconnect: ABS Module C135

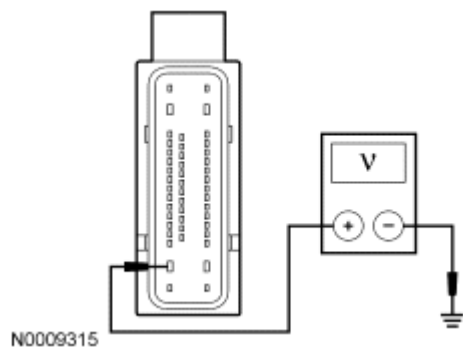


Fig. 3: Checking Voltage To ABS Module
Courtesy of FORD MOTOR CO.

- Measure the voltage between ABS module C135-31, circuit 534 (YE/LG), harness side and ground.
- **Is the voltage greater than 10 volts?**

YES : Go to B4.

NO : VERIFY BEC fuse 8 (40A) is OK. If OK, REPAIR circuit 534 (YE/LG). CLEAR the DTCs. REPEAT the self-test.

B4 CHECK CIRCUIT 1205 (BK) FOR AN OPEN

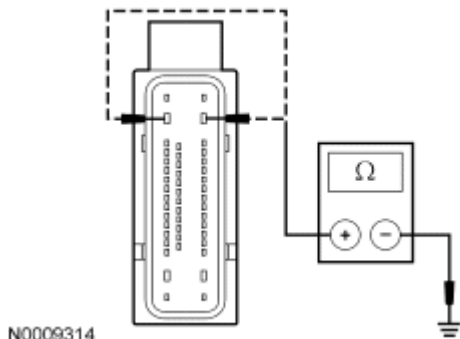


Fig. 4: Checking Circuit 1205 (BK) For An Open
Courtesy of FORD MOTOR CO.

- Measure the resistance between ground and:
 - ABS module C135-45, circuit 1205 (BK), harness side.
 - ABS module C135-16, circuit 1205 (BK), harness side.
- **Are the resistances less than 5 ohms?**

YES : INSTALL a new HCU. REFER to Hydraulic Control Unit (HCU). CLEAR the DTCs. REPEAT the self-test.

NO : REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

B5 CHECK FOR CORRECT ABS MODULE OPERATION

- Key in OFF position.
- Disconnect: ABS Module C135
- Check the connector for:
 - corrosion.
 - spread terminals.
 - pushed-out pins.
- Connect: ABS Module C135
- Make sure the connector seats properly, then operate the system and verify the concern is still present.
- **Is the concern still present?**

YES : INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module. CLEAR the DTCs. REPEAT the self-test.

NO : The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. CARRY OUT the self-test with the **Pinpoint Test F:**

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Spongy/Soft/Low Brake Pedal with No Warning Indicator not applied.

Pinpoint Test C: DTCs C1145, C1155, C1165 and C1175 - Wheel Speed Sensor Input Circuit Failure

Refer to appropriate SYSTEM WIRING DIAGRAM ARTICLE, Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The active wheel speed sensors generate a square wave signal that is sent to the ABS module. The wheel speed sensor circuitry connects to the ABS module through 2 wires and a connector at each wheel speed sensor. When the ignition is turned to the RUN position, the ABS module carries out a self-test by sending a reference voltage to all of the wheel speed sensors and their circuitry to determine if they are functional.

Voltage and ground signals are supplied to the wheel speed sensors from the ABS module.

DTC Description	Fault Trigger Condition
• DTC C1145 RF Wheel Speed Sensor Input Circuit Failure • DTC C1155 LF Wheel Speed Sensor Input Circuit Failure • DTC C1165 RR Wheel Speed Sensor Input Circuit Failure • DTC C1175 LR Wheel Speed Sensor Input Circuit Failure	When the vehicle speed exceeds 5 km/h (3 mph), if the ABS module detects an open, short to ground or voltage or a defective wheel speed sensor input circuit, the appropriate DTC will be set.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Wheel speed sensors
- Wheel speed sensor rings
- ABS module

PINPOINT TEST C: DTCs C1145, C1155, C1165 AND C1175 - WHEEL SPEED SENSOR INPUT CIRCUIT FAILURE

NOTE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

C1 CHECK FOR FAULT REPEATABILITY

- Connect the diagnostic tool.
- Key in ON position.
- Enter the following diagnostic mode on the diagnostic tool: ABS Clear Continuous DTCs

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- Drive the vehicle at least 16 km/h (10 mph).
- Retrieve and document continuous DTCs.
- **Is DTC C1145, C1155, C1165 or C1175 retrieved?**

YES : If the active wheel speed sensor tool is available, go to C2. If the active wheel speed sensor tool is not available, go to C4.

NO : INSPECT the wheel speed sensors, wheel speed sensor wiring and wheel speed sensor tone rings. REPAIR or INSTALL new as necessary. If any other DTCs are retrieved, go to the ABS Module DTC Chart.

C2 CHECK THE ABS MODULE OUTPUT USING THE SPECIAL TOOL

- Key in OFF position.
- Disconnect: Suspect Wheel Speed Sensor
- Connect the special tool to the wheel speed sensor connectors.
- Key in ON position.
- Select the correct system polarity on the special tool and turn the special tool power switch to the ON position.
- **Is the module output LED illuminated?**

YES : Go to C3.

NO : Go to C6.

C3 CHECK THE WHEEL SPEED SENSOR OUTPUT WITH THE SPECIAL TOOL

- Raise the suspect wheel until it can spin freely. Refer to **JACKING AND LIFTING** article.
- While monitoring the special tool, slowly spin the suspect wheel.
- **Do the sensor output LEDs illuminate and flash and is the current overload LED not illuminated?**

YES : The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

NO : If the current level LED is not illuminated and the sensor output LEDs do not illuminate or if the current level LED is illuminated red, INSTALL a new wheel speed sensor. REFER to **Wheel Speed Sensor - Front** or **Wheel Speed Sensor - Rear**. CLEAR the DTCs. REPEAT the self-test.

If the current level LED is not illuminated and the sensor output LEDs illuminate green but do not flash, INSPECT the wheel speed sensor tone rings and INSTALL new tone ring as necessary. REFER to **Wheel Speed Sensor Ring - Front** or **Wheel Speed Sensor Ring - Rear**. If the tone ring is OK, INSTALL a new wheel speed sensor. REFER to **Wheel Speed Sensor - Front** or **Wheel Speed Sensor - Rear**. CLEAR the DTCs. REPEAT the self-test.

C4 CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR A SHORT TO VOLTAGE

NOTE: Both circuits must be checked for each DTC.

- Key in OFF position.
- Disconnect: ABS Module C135

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- Disconnect: Suspect Wheel Speed Sensor
- Key in ON position.
- **For DTC C1145** , measure the voltage between:
 - ABS module C135-26, circuit 514 (YE/RD), harness side and ground.
 - ABS module C135-27, circuit 516 (YE/BK), harness side and ground.
- **For DTC C1155** , measure the voltage between:
 - ABS module C135-13, circuit 522 (TN/BK), harness side and ground.
 - ABS module C135-12, circuit 521 (TN/OG), harness side and ground.
- **For DTC C1165** , measure the voltage between:
 - ABS module C135-44, circuit 524 (PK/BK), harness side and ground.
 - ABS module C135-43, circuit 523 (RD/PK), harness side and ground.
- **For DTC C1175** , measure the voltage between:
 - ABS module C135-42, circuit 518 (LG/RD), harness side and ground.
 - ABS module C135-41, circuit 519 (LG/BK), harness side and ground.
- **Is any voltage present?**
 - YES** : REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.
 - NO** : Go to C5.

C5 CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR A SHORT TO GROUND

NOTE: **Both circuits must be checked for each DTC.**

- Key in OFF position.
- **For DTC C1145** , measure the resistance between:
 - ABS module C135-26, circuit 514 (YE/RD), harness side and ground.
 - ABS module C135-27, circuit 516 (YE/BK), harness side and ground.
- **For DTC C1155** , measure the resistance between:
 - ABS module C135-13, circuit 522 (TN/BK), harness side and ground.
 - ABS module C135-12, circuit 521 (TN/OG), harness side and ground.
- **For DTC C1165** , measure the resistance between:
 - ABS module C135-44, circuit 524 (PK/BK), harness side and ground.
 - ABS module C135-43, circuit 523 (RD/PK), harness side and ground.
- **For DTC C1175** , measure the resistance between:
 - ABS module C135-42, circuit 518 (LG/RD), harness side and ground.
 - ABS module C135-41, circuit 519 (LG/BK), harness side and ground.
- **Are the resistances greater than 10,000 ohms?**
 - YES** : Go to C6.
 - NO** : REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

C6 CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR AN OPEN

NOTE: Both circuits must be checked for each DTC.

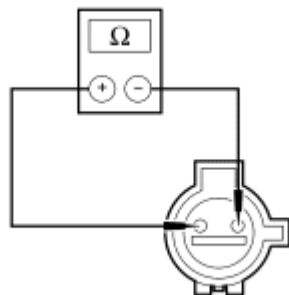
- Disconnect: ABS Module C135
- Disconnect: Suspect Wheel Speed Sensor
- **For DTC C1145** , measure the resistance between:
 - ABS module C135-26, circuit 514 (YE/RD), harness side and RH front wheel speed sensor C160-1, circuit 514 (YE/RD), harness side.
 - ABS module C135-27, circuit 516 (YE/BK), harness side and RH front wheel speed sensor C160-2, circuit 516 (YE/BK), harness side.
- **For DTC C1155** , measure the resistance between:
 - ABS module C135-13, circuit 522 (TN/BK), harness side and LH front wheel speed sensor C150-2, circuit 522 (TN/BK), harness side.
 - ABS module C135-12, circuit 521 (TN/OG), harness side and LH front wheel speed sensor C150-1, circuit 521 (TN/OG), harness side.
- **For DTC C1165** , measure the resistance between:
 - ABS module C135-44, circuit 524 (PK/BK), harness side and RH rear wheel speed sensor C3117-2, circuit 524 (PK/BK), harness side.
 - ABS module C135-43, circuit 523 (RD/PK), harness side and RH rear wheel speed sensor C3117-1, circuit 523 (RD/PK), harness side.
- **For DTC C1175** , measure the resistance between:
 - ABS module C135-42, circuit 518 (LG/RD), harness side and LH rear wheel speed sensor C3116-1, circuit 518 (LG/RD), harness side.
 - ABS module C135-41, circuit 519 (LG/BK), harness side and LH rear wheel speed sensor C3116-2, circuit 519 (LG/BK), harness side.

- **Are the resistances less than 5 ohms?**

YES : Go to C7.

NO : REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

C7 CHECK FOR SHORTED WHEEL SPEED SENSOR CIRCUITS



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Fig. 5: Checking For Shorted Wheel Speed Sensor Circuits
 Courtesy of FORD MOTOR CO.

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- Measure the resistance between the suspect wheel speed sensor pins, harness side with the meter in the 10 mega ohm range.

- **Is the resistance greater than 10,000 ohms?**

YES : Go to C8.

NO : REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

C8 CHECK THE ABS MODULE OUTPUT

- Connect: ABS Module C135
- Key in ON position.
- Measure the voltage between the suspect wheel speed sensor pins, harness side.
- **Is the voltage greater than 10 volts?**

YES : INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor - Front or Wheel Speed Sensor - Rear. CLEAR the DTCs. REPEAT the self-test.

NO : Go to C9.

C9 CHECK FOR CORRECT ABS MODULE OPERATION

- Key in OFF position.
- Disconnect: ABS Module C135
- Check the connector for:
 - corrosion.
 - spread terminals.
 - pushed-out pins.
- Connect: ABS Module C135
- Make sure the connector seats properly, then operate the system and verify the concern is still present.
- **Is the concern still present?**

YES : INSTALL a new ABS module. REFER to Anti-Lock Brake System (ABS) Module. CLEAR the DTCs. REPEAT the self-test.

NO : The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test D: DTCs C1222, C1233, C1234, C1235 and C1236 - Wheel Speed Sensor Input Signal Missing/Mismatch

Refer to appropriate SYSTEM WIRING DIAGRAM ARTICLE, Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The wheel speed sensor and sensor ring generate a square wave signal to the ABS module that is proportional to wheel speed. The ABS module compares wheel speed inputs from all wheel speed sensors to determine an impending wheel lockup. Incorrect tire size can set these DTCs as well.

DTC Description	Fault Trigger Condition

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• DTC C1222 Wheel Speed Mismatch	When the vehicle speed exceeds 20 km/h (12 mph), if the ABS module detects a difference between wheel speed sensor signals, DTC C1222 will be set. DTC C1222 can also be set by damaged tone rings, mismatched wheel and/or tire sizes or driving the vehicle on one or more deflated tires.
• DTC C1233 LF Wheel Speed Sensor Signal Fault • DTC C1234 RF Wheel Speed Sensor Signal Fault • DTC C1235 RR Wheel Speed Sensor Signal Fault • DTC C1236 LR Wheel Speed Sensor Signal Fault	When the vehicle speed exceeds 20 km/h (12 mph), if the ABS module does not receive a signal from the wheel speed sensor, the appropriate DTC will be set. These DTCs can also be set by an excessive wheel speed sensor-to-tone ring air gap or a damaged tone ring.

This pinpoint test is intended to diagnose the following:

- Wheel speed sensor
- Wheel speed sensor ring
- ABS module

PINPOINT TEST D: DTCs C1222, C1233, C1234, C1235 AND C1236 - WHEEL SPEED SENSOR INPUT SIGNAL MISSING/MISMATCH

NOTE: Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.

D1 CHECK THE DTCs FROM THE SELF-TEST

- Retrieve the recorded results from the ABS module continuous and on-demand self tests.
- **Are DTCs C1145, C1155, C1165 or C1175 present?**

YES : Go to **Pinpoint Test C.**

NO : **For DTC C1222** , go to D7. **For DTCs C1233, C1234, C1235 and C1236** , if the active wheel speed sensor tool is available, go to D3. If the active wheel speed sensor tool is not available, Go to D6. **For all other DTCs** , go to the ABS Module DTC Chart.

If no DTCs are present, go to D2.

D2 MONITOR THE WHEEL SPEED SENSOR PIDs

- Enter the following diagnostic mode on the diagnostic tool: ABS DataLogger
- Drive the vehicle at a constant speed and monitor the following wheel speed PIDs:
 - Left Front Wheel Speed Sensor (LF_WSPD)
 - Right Front Wheel Speed Sensor (RF_WSPD)
 - Left Rear Wheel Speed Sensor (LR_WSPD)

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- Right Rear Wheel Speed Sensor (RR_WSPD)

- **Are the wheel speed PIDs consistent with the vehicle speed and each other?**

YES : The system is operating correctly at this time. DRIVE the vehicle and CARRY OUT at least one ABS stop. If the ABS warning indicator illuminates, REFER to **Inspection and Verification**. If the ABS warning indicator does not illuminate, RETURN the vehicle to the customer.

NO : If the wheel speed PIDs are not consistent between each other, go to D7.

If the wheel speed PIDs are consistent between each other but do not match the vehicle speed and the active wheel speed sensor tool is available, go to D3. If the active wheel speed sensor tool is not available, go to D6.

D3 CHECK THE ABS MODULE OUTPUT USING THE ACTIVE WHEEL SPEED SENSOR TESTER

- Key in OFF position.
- Disconnect: Suspect Wheel Speed Sensor
- Connect the active wheel speed sensor tester to the wheel speed sensor connectors.
- Key in ON position.
- Select the correct system polarity on the active wheel speed sensor tester and turn the active wheel speed sensor tester power switch to the ON position.
- **Is the module output LED illuminated?**
 - YES** : Go to D5.
 - NO** : Go to D4.

D4 CHECK THE WHEEL SPEED SENSOR CIRCUITS FOR AN OPEN

NOTE: **Both circuits must be checked for each DTC.**

- Key in OFF position.
- **For DTC C1233** : measure the resistance between:
 - ABS module C135-13, circuit 522 (TN/BK), harness side and LF wheel speed sensor C150-2, circuit 522 (TN/BK), harness side.
 - ABS module C135-12, circuit 521 (TN/OG), harness side and LF wheel speed sensor C150-1, circuit 521 (TN/OG), harness side.
- **For DTC C1234** : measure the resistance between:
 - ABS module C135-26, circuit 514 (YE/RD), harness side and RF wheel speed sensor C160-1, circuit 514 (YE/RD), harness side.
 - ABS module C135-27, circuit 516 (YE/BK), harness side and RF wheel speed sensor C160-2, circuit 516 (YE/BK), harness side.
- **For DTC C1235** : measure the resistance between:
 - ABS module C135-44, circuit 524 (PK/BK), harness side and RR wheel speed sensor C3117-2, circuit 524 (PK/BK), harness side.
 - ABS module C135-43, circuit 523 (RD/PK), harness side and RR wheel speed sensor C3117-

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1, circuit 523 (RD/PK), harness side.

- **For DTC C1236** : measure the resistance between:

- ABS module C135-42, circuit 518 (LG/RD), harness side and LR wheel speed sensor C3116-1, circuit 518 (LG/RD), harness side.
- ABS module C135-41, circuit 519 (LG/BK), harness side and LR wheel speed sensor C3116-2, circuit 519 (LG/BK), harness side.

- **Are the resistances less than 5 ohms?**

YES : Go to D10.

NO : REPAIR the affected circuit(s). CLEAR the DTCs. REPEAT the self-test.

D5 CHECK THE WHEEL SPEED SENSOR OUTPUT WITH THE SPECIAL TOOL

- Raise the suspect wheel until it can spin freely. Refer to **JACKING AND LIFTING** article.
- While monitoring the Rotunda Active Wheel Speed Sensor Tester, slowly spin the suspect wheel.
- **Do the sensor output LEDs illuminate and flash and is the current overload LED not illuminated?**

YES : INSPECT the wheel speed sensor tone ring for damage and looseness. INSTALL new components as necessary. If the tone ring is OK, the concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

NO : If the current level LED is not illuminated and the sensor output LEDs do not illuminate or if the current level LED is illuminated red, INSTALL a new wheel speed sensor. REFER to **Wheel Speed Sensor - Front** or **Wheel Speed Sensor - Rear**. CLEAR the DTCs. REPEAT the self-test.

If the current level LED is not illuminated and the sensor output LEDs illuminate green but do not flash, INSPECT the wheel speed sensor tone ring and INSTALL a new tone ring as necessary. REFER to **Wheel Speed Sensor Ring - Front** or **Wheel Speed Sensor Ring - Rear**. If the tone ring is OK, INSTALL a new wheel speed sensor. REFER to **Wheel Speed Sensor - Front** or **Wheel Speed Sensor - Rear**. CLEAR the DTCs. REPEAT the self-test.

D6 CHECK THE WHEEL SPEED SENSOR OUTPUT

NOTE: The ignition switch must be in the OFF position until the connections are made or a DTC will set and the ABS warning indicator will illuminate and the ABS module will no longer supply voltage to the wheel speed sensors. If this happens, turn the ignition switch to the OFF position and make sure that no jumper connections are shorted to ground or shorted together. Turn the ignition switch to the ON position and wait for the ABS warning indicator to prove out.

- Disconnect: Suspect Wheel Speed Sensor

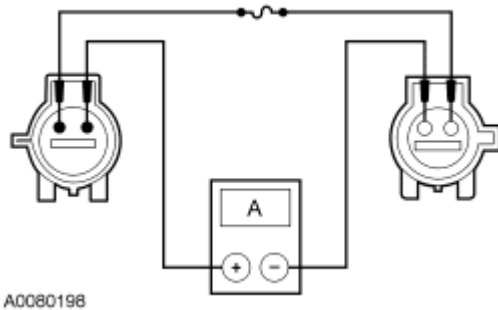


Fig. 6: Checking Wheel Speed Sensor Output
Courtesy of FORD MOTOR CO.

- Connect a fused (5A) jumper wire between the suspect wheel speed sensor, component side, and the wheel speed sensor, harness side, as follows:
 - **For DTC C1233** : LH front wheel speed sensor C150-1, circuit 521 (TN/OG), harness side and LH front wheel speed sensor C150 pin 1, circuit 521 (TN/OG), component side.
 - **For DTC C1234** : RH front wheel speed sensor C160-1, circuit 514 (YE/RD), harness side and RH front wheel speed sensor C160 pin 1, circuit 514 (YE/RD), component side.
 - **For DTC C1235** : RH rear wheel speed sensor C3117-1, circuit 523 (RD/PK), harness side and RH rear wheel speed sensor C3117 pin 1, circuit 523 (RD/PK), component side.
 - **For DTC C1236** : LH rear wheel speed sensor C3116-1, circuit 518 (LG/RD), harness side and LH rear wheel speed sensor C3116 pin 1, circuit 518 (LG/RD), component side.
- Connect a digital multi-meter between the suspect wheel speed sensor, component side, and the wheel speed sensor, harness side, as follows:
 - **For DTC C1233** : LH front wheel speed sensor C150-2, circuit 522 (TN/BK), harness side and LH front wheel speed sensor C150 pin 2, circuit 522 (TN/BK), component side.
 - **For DTC C1234** : RH front wheel speed sensor C160-2, circuit 516 (YE/BK), harness side and RH front wheel speed sensor C160 pin 2, circuit 516 (YE/BK), component side.
 - **For DTC C1235** : RH rear wheel speed sensor C3117-2, circuit 524 (PK/BK), harness side and RH rear wheel speed sensor C3117 pin 2, circuit 524 (PK/BK), component side.
 - **For DTC C1236** : LH rear wheel speed sensor C3116-2, circuit 519 (LG/BK), harness side and LH rear wheel speed sensor C3116 pin 2, circuit 519 (LG/BK), component side.
- Key in ACCESSORY position.

NOTE: **The wheel must be moved very slowly to allow the meter to read the high and low current as the sensor tone ring openings pass the sensor.**

- Measure the current while slightly rotating the wheel using incremental turns.
- **Does the digital multi-meter switch between the low state (5-8 mA) and the high state (11-18 mA)?**

YES : Go to D8.

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NO : INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor - Front or Wheel Speed Sensor - Rear. CLEAR the DTCs. REPEAT the self-test.

D7 CHECK THE WHEEL SPEED SENSOR MOUNTING

- With the vehicle in NEUTRAL, position it on a hoist. Refer to JACKING AND LIFTING article.

NOTE: Examine the wheel speed sensor wire carefully, using a good light source. Failure to verify damage in the wheel speed sensor wire can lead to unnecessary installation of a new component.

- Inspect the wheel speed sensor for looseness.
- **Is the wheel speed sensor and mounting OK?**

YES : Go to D8.

NO : TIGHTEN the wheel speed sensor to specification, REFER to SPECIFICATIONS. CLEAR the DTCs. REPEAT the self-test.

D8 CHECK THE WHEEL SPEED SENSOR AND HARNESS FOR DAMAGE

NOTE: Examine the wheel speed sensor wire carefully, using a good light source. Failure to verify damage in the wheel speed sensor wire can lead to unnecessary installation of a new component.

- Inspect the wheel speed sensor and attached wire harness for general damage.
- **Is the wheel speed sensor and harness OK?**

YES : Go to D9.

NO : INSTALL a new wheel speed sensor. REFER to Wheel Speed Sensor - Front or Wheel Speed Sensor - Rear. CLEAR the DTC. REPEAT the self-test.

D9 CHECK FOR WHEEL SPEED SENSOR TONE RING FOR DAMAGE

- If necessary, remove the wheel speed sensor. Refer to Wheel Speed Sensor - Front or Wheel Speed Sensor - Rear.
- Inspect the wheel speed sensor ring for damaged or missing teeth. Rotate the wheel to verify that no teeth are missing.
- **Is the wheel speed sensor ring OK?**

YES : Go to D10.

NO : INSTALL a new wheel speed sensor ring. REFER to Wheel Speed Sensor Ring - Front or Wheel Speed Sensor Ring - Rear. CLEAR the DTCs. REPEAT the self-test.

D10 CHECK FOR CORRECT ABS MODULE OPERATION

- Key in OFF position.
- Disconnect: ABS Module C135
- Check the connector for:
 - corrosion.
 - spread terminals.

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- pushed-out pins.
- Connect: ABS Module C135
- Make sure the connector seats properly, then operate the system and verify the concern is still present.
- **Is the concern still present?**

YES : INSPECT the wheel speed sensor tone ring for damage and looseness. INSTALL new components as necessary. If the tone ring is OK, INSTALL a new ABS module. REFER to **Anti-Lock Brake System (ABS) Module**. CLEAR the DTCs. REPEAT the self-test.

NO : The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test E: DTC C1446 - Brake Switch Circuit Failure

Refer to appropriate SYSTEM WIRING DIAGRAM ARTICLE, Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The normally-closed Brake Pedal Position (BPP) switch (also known as the speed control deactivation switch) receives fused battery voltage from Bussed Electrical Center (BEC) fuse 47 (15A) along circuit 391 (RD/YE) when the ignition key is turned to the RUN position. This voltage is sent through the BPP switch to the ABS module and the PCM along circuit 535 (LB/RD). When the brake pedal is applied, the BPP opens and the voltage signal is no longer referenced by the ABS module and PCM.

When the fluid level in the brake master cylinder reservoir reaches a predetermined level, the brake fluid level switch closes and voltage is sent to the Smart Junction Box (SJB). The SJB then sends a message to the ABS module along the High Speed Controller Area Network (HS-CAN) bus network.

- DTC C1446 Brake Switch Circuit Failure - If during normal operation the ABS module determines that the BPP information is invalid when compared to other inputs (brake pressure transducer and wheel speed sensors) or if the brake pedal message is missing completely, DTC C1446 will be set. Also, a low brake fluid level in the master cylinder reservoir or an open, short to ground or short to voltage in the brake fluid level switch that the SJB interprets as a low fluid condition will cause DTC C1446 to be set.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- BPP switch
- ABS module

PINPOINT TEST E: DTC C1446 - BRAKE SWITCH CIRCUIT FAILURE

NOTE: Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.

E1 MONITOR THE RED BRAKE WARNING INDICATOR

- Key in ON position.
- Observe the red brake warning indicator while turning the ignition switch from OFF to RUN.
- **Does the indicator illuminate for a brief period and then extinguish?**

YES : Go to E2.

NO : REFER to **INSTRUMENT CLUSTER (IC), MESSAGE CENTER, AND WARNING CHIMES** article to diagnose the red brake warning indicator.

E2 CHECK THE ABS MODULE AND THE SJB FOR COMMUNICATION DTCs

- Connect the diagnostic tool.
 - Enter the following diagnostic mode on the diagnostic tool: Self Test ABS Module
 - Retrieve and record any ABS module communication DTCs.
 - Enter the following diagnostic mode on the diagnostic tool: Self Test SJB
 - Retrieve and record any SJB communication DTCs.
 - **Are any communication DTCs present in the ABS module and/or the SJB?**
- YES :** For ABS module communication DTCs, REFER to the ABS Module DTC Chart.

For SJB communication DTCs, REFER to the Master DTC Chart in **MULTIFUNCTION ELECTRONIC MODULES** article.

NO : Go to E3.

E3 CHECK FOR BPP SWITCH VOLTAGE TO THE ABS MODULE

- Key in OFF position.
- Disconnect: ABS Module C135
- Key in ON position.

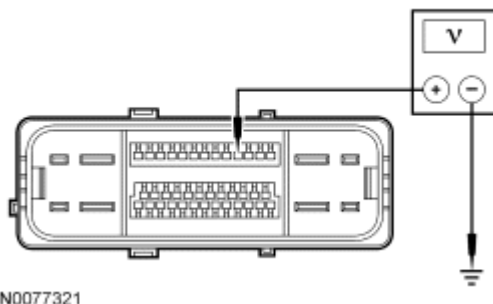


Fig. 7: Measuring Voltage Between ABS Module C135-6, Circuit 535 (LB/RD), Harness Side & Ground

Courtesy of FORD MOTOR CO.

- While pressing and releasing the brake pedal, measure the voltage between ABS module C135-6, circuit 535 (LB/RD), harness side and ground.
- **Is the voltage greater than 10 volts with the pedal released and 0 volt with the pedal pressed?**

YES : Go to E12.

NO : Go to E4.

E4 ISOLATE THE BPP SWITCH

- Key in OFF position.
- Disconnect: BPP Switch C278 (also known as the speed control deactivator switch)
- While pressing and releasing the brake pedal, measure the resistance between BPP switch connector C278 pin-1, component side, and BPP switch C278 pin-2, component side.
- **Is the resistance greater than 10,000 ohms with the pedal pressed and less than 5 ohms with the brake pedal released?**

YES : Go to E5.

NO : INSTALL a new BPP switch. REFER to Speed Control Deactivator Switch Removal and Installation in **SPEED CONTROL** article. CLEAR the DTC. REPEAT the self-test.

E5 CHECK CIRCUIT 535 (LB/RD) FOR AN OPEN

- Key in OFF position.
- Disconnect: PCM C175b

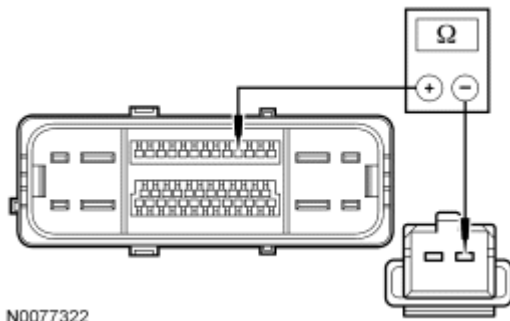


Fig. 8: Measuring Resistance Between ABS Module C135-6, Circuit 535 (LB/RD) & BPP Switch C278-1

Courtesy of FORD MOTOR CO.

- Measure the resistance between ABS module C135-6, circuit 535 (LB/RD), harness side and BPP switch C278-1, circuit 535 (LB/RD), harness side.
- **Is the resistance less than 5 ohms?**

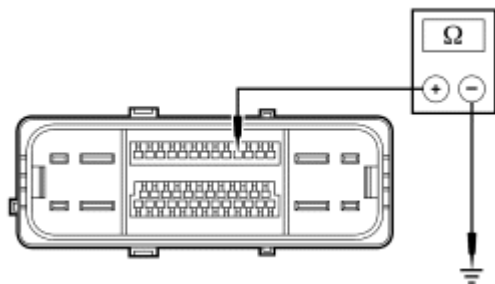
YES : Go to E6.

NO : REPAIR circuit 535 (LB/RD). CLEAR the DTC. REPEAT the self-test.

E6 CHECK CIRCUIT 535 (LB/RD) FOR A SHORT TO GROUND

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N0077323

Fig. 9: Measuring Resistance Between ABS Module C135-6, Circuit 535 (LB/RD), Harness Side & Ground

Courtesy of FORD MOTOR CO.

- Measure the resistance between ABS module C135-6, circuit 535 (LB/RD), harness side and ground.

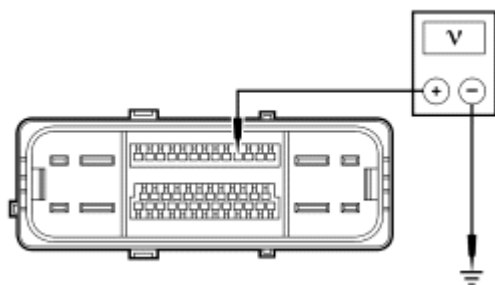
- **Is the resistance greater than 10,000 ohms?**

YES : Go to E7.

NO : REPAIR circuit 535 (LB/RD). CLEAR the DTC. REPEAT the self-test.

E7 CHECK CIRCUIT 535 (LB/RD) FOR A SHORT TO VOLTAGE

- Key in ON position.



N0078560

Fig. 10: Measuring Resistance Between ABS Module C135-6, Circuit 535 (LB/RD), Harness Side & Ground

Courtesy of FORD MOTOR CO.

- Measure the voltage between ABS module C135-6, circuit 535 (LB/RD), harness side and ground.

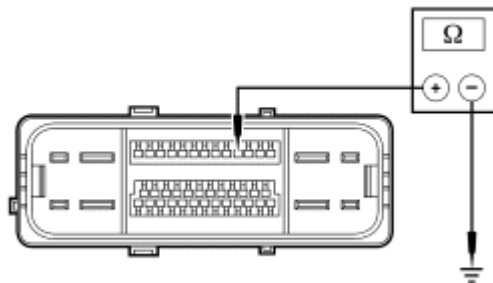
- **Is any voltage present?**

YES : REPAIR circuit 535 (LB/RD). CLEAR the DTC. REPEAT the self-test.

NO : Go to E8.

E8 CHECK THE PCM FOR A SHORT TO GROUND

- Key in OFF position.
- Connect: PCM C175b



N0077323

Fig. 11: Measuring Resistance Between ABS Module C135-6, Circuit 535 (LB/RD), Harness Side & Ground

Courtesy of FORD MOTOR CO.

- Measure the resistance between ABS module C135-6, circuit 535 (LB/RD), harness side and ground.

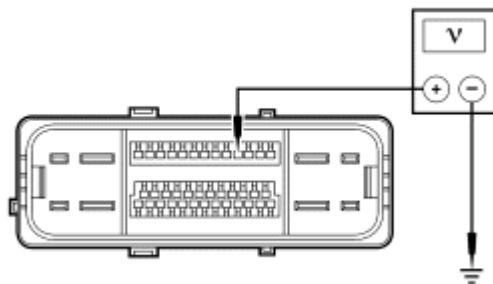
- **Is the resistance greater than 10,000 ohms?**

YES : Go to E9.

NO : INSTALL a new PCM. REFER to **ELECTRONIC ENGINE CONTROLS** article. CLEAR the DTC. REPEAT the self-test.

E9 CHECK THE PCM FOR A SHORT TO VOLTAGE

- Key in ON position.



N0078560

Fig. 12: Measuring Resistance Between ABS Module C135-6, Circuit 535 (LB/RD), Harness Side & Ground

Courtesy of FORD MOTOR CO.

- Measure the voltage between ABS module C135-6, circuit 535 (LB/RD), harness side and ground.
- **Is any voltage present?**

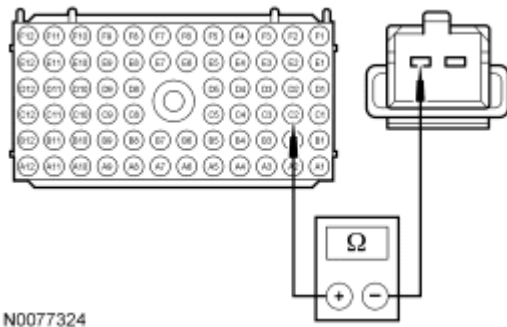
YES : INSTALL a new PCM. REFER to **ELECTRONIC ENGINE CONTROLS** article. CLEAR the DTC. REPEAT the self-test.

NO : Go to E10.

E10 CHECK CIRCUIT 391 (RD/YE) FOR AN OPEN

- Key in OFF position.

- Disconnect: BEC C1035a



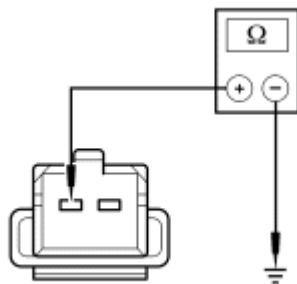
N0077324

Fig. 13: Measuring Resistance Between BPP Switch C278-2, Circuit 391 (RD/YE) & BEC C1035A-C2

Courtesy of FORD MOTOR CO.

- Measure the resistance between BPP switch C278-2, circuit 391 (RD/YE), harness side and BEC C1035a-C2, circuit 391 (RD/YE), harness side.
- **Is the resistance less than 5 ohms?**
YES : Go to E11.
NO : VERIFY BEC fuse 47 (15A) is OK. If OK, REPAIR circuit 391 (RD/YE). CLEAR the DTC. REPEAT the self-test.

E11 CHECK CIRCUIT 391 (RD/YE) FOR A SHORT TO GROUND



N0077325

Fig. 14: Measuring Resistance Between BPP Switch C278-2, Circuit 391 (RD/YE), Harness Side & Ground

Courtesy of FORD MOTOR CO.

- Measure the resistance between BPP switch C278-2, circuit 391 (RD/YE), harness side and ground.
- **Is the resistance greater than 10,000 ohms?**
YES : INSTALL a new BPP switch. REFER to speed control deactivator switch in **SPEED CONTROL** article. CLEAR the DTCs. REPEAT the self-test.
NO : REPAIR circuit 391 (RD/YE). CLEAR the DTC. REPEAT the self-test.

E12 CHECK FOR CORRECT ABS MODULE OPERATION

- Key in OFF position.

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- Disconnect: ABS Module C135
- Check the ABS module connector for:
 - corrosion.
 - pushed-out pins.
 - spread terminals.
- Connect: ABS Module C135
- Make sure the ABS module connector seats correctly, then operate the system and verify if the concern is still present.
- **Is the concern still present?**
 - YES :** INSTALL a new ABS module. REFER to **Anti-Lock Brake System (ABS) Module**. CLEAR the DTCs. REPEAT the self-test.
 - NO :** The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test with the **Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator** not applied.

Pinpoint Test F: Spongy/Soft/Low Brake Pedal with No Warning Indicator

Normal Operation

The brake pedal should be firm when applied.

This pinpoint test is intended to diagnose the following:

- Base brake system
- Hydraulic Control Unit (HCU)

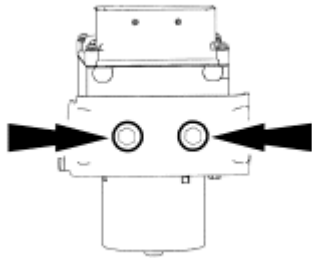
PINPOINT TEST F: SPONGY/SOFT/LOW BRAKE PEDAL WITH NO WARNING INDICATOR

F1 CHECK THE BASE BRAKE COMPONENTS

- Visually inspect the brake hoses and tubes from the HCU to the brake calipers.
- Visually inspect the calipers and brake components.
- **Are any of these components damaged or leaking?**
 - YES :** REPAIR or INSTALL new components as necessary. TEST the system for normal operation.
 - NO :** Go to F2.

F2 CHECK FOR A LEAKING DUMP VALVE

- Key in OFF position.



N0012765

Fig. 15: Locating Rubber Boots From 2 HCU Low Pressure Accumulators
Courtesy of FORD MOTOR CO.

- Remove the rubber boots from the 2 HCU low pressure accumulators and insert a clean steel implement (such as a paper clip or a small screwdriver) into each low pressure accumulator.
- Key in ON position.

NOTE: A leaking dump valve is similar to the master cylinder bypass condition. It is important that the pedal be quickly and forcefully applied to rule out master cylinder bypass as a condition.

- Have an assistant press hard on the brake pedal while observing the steel implements.
- **Do either of the implements move out 6.35 mm (0.25 in) or more?**

YES : INSTALL a new HCU. REFER to Hydraulic Control Unit (HCU).

NO : REMOVE the steel implements. INSTALL the rubber boots on each low pressure accumulator. REFER to BRAKE SYSTEM - GENERAL INFORMATION article to continue diagnosis of the base brake system.

Pinpoint Test G: Poor Vehicle Tracking During Anti-lock Function

Normal Operation

The operating voltage required to operate the ABS module, hydraulic pump and isolation valves is in a range between 10 and 16 volts.

Fused ignition voltage is supplied to the ABS module from Smart Junction Box (SJB) fuse 18 (10A) along circuit 1844 (LG/RD). Fused battery voltage is supplied to the ABS module from Bussed Electrical Center (BEC) fuse 65 (30A) along circuit 601 (LB/BK) and BEC fuse 8 (40A) along circuit 534 (YE/LG). Ground is provided to the ABS module along circuit 1205 (BK). There are 2 ground circuits (one for the ABS module and one for the hydraulic pump motor) both share the same circuit number and wire color.

This pinpoint test is intended to diagnose the following:

- Base brake system
- Hydraulic Control Unit (HCU)

PINPOINT TEST G: POOR VEHICLE TRACKING DURING ANTI-LOCK FUNCTION**G1 CHECK THE BASE BRAKE COMPONENTS**

- Eliminate the base brake system as the cause of the concern.
- **Is the base brake system operating correctly?**

YES : Go to G2.

NO : REPAIR the base brake system. REFER to **BRAKE SYSTEM - GENERAL INFORMATION** article. TEST the system for normal operation.

G2 BLEED THE ABS HCU

- Bleed the HCU. Refer to Component Bleeding in **BRAKE SYSTEM - GENERAL INFORMATION** article.
- Test drive the vehicle.
- **Does the vehicle track correctly?**

YES : The brake system is operating correctly. The concern may have been caused by air in the hydraulic system or a sticky valve.

NO : Go to G3.

G3 CHECK THE ABS INLET VALVE (CLOSED POSITION)

- Key in ON position.
- With the vehicle in NEUTRAL, position it on a hoist. Refer to **JACKING AND LIFTING** article.
- Check all the wheels to make sure they spin freely (the transmission must be in NEUTRAL).
- Enter the following diagnostic mode on the diagnostic tool: ABS DataLogger: Left Front Inlet Valve (ABSLF_I) Output Command
- Toggle the ABSLF_I output command ON.
- Apply moderate brake pedal effort.
- Have an assistant attempt to rotate the LF wheel.
- **Does the LF wheel rotate?**

YES : TOGGLE the ABSLF_I output command OFF. Go to G4.

NO : TOGGLE the ABSLF_I output command OFF. INSTALL a new HCU. REFER to **Hydraulic Control Unit (HCU)**. TEST the system for normal operation.

G4 CHECK THE ABS INLET VALVE (OPEN POSITION)

- Apply moderate brake pedal effort.
- Have an assistant attempt to rotate the LF wheel.
- **Does the LF wheel rotate?**

YES : INSTALL a new HCU. REFER to **Hydraulic Control Unit (HCU)**. TEST the system for normal operation.

NO : Go to G5.

G5 CHECK THE ABS OUTPUT VALVE (OPEN POSITION)

- Apply moderate brake pedal effort.
- Enter the following diagnostic mode on the diagnostic tool: ABS DataLogger

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- Left Front Inlet Valve (ABSLF_I) Output Command
- Pump Motor (ABS_MTR) Output Command
- Left Front Outlet Valve (ABSLF_O) Output Command
- Toggle the ABSLF_I output command ON.
- Toggle the ABS_MTR output command ON for 6 seconds. (The output command must be toggled ON 3 times. Each toggle runs the pump for 2 seconds.)
- Toggle the ABSLF_O output command ON.
- Toggle the ABSLF_O output command OFF. Repeat 3 times.
- While the output commands are toggled ON, have an assistant attempt to rotate the LF wheel.
- **Does the LF wheel rotate?**

YES : TOGGLE all output commands OFF. Go to G6.

NO : TOGGLE all output commands OFF. INSTALL a new HCU. REFER to **Hydraulic Control Unit (HCU)**. TEST the system for normal operation.

G6 CHECK THE ABS INLET AND OUTLET VALVES (CLOSED POSITION)

- Apply moderate brake pedal effort.
- Have an assistant attempt to rotate the LF wheel.
- **Does the LF wheel rotate?**

YES : INSTALL a new HCU. REFER to **Hydraulic Control Unit (HCU)**. TEST the system for normal operation.

NO : REPEAT this procedure (beginning with Step G2) for the RF, LR and RR wheels using the appropriate output commands. If no failure occurs, the system is operating normally.

Pinpoint Test H: The Traction Control System Cannot be Disabled

Refer to appropriate SYSTEM WIRING DIAGRAM ARTICLE, Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

The traction control system can be disabled by the driver pressing the traction control switch located in the instrument panel next to the hazard flasher switch. The traction control switch is a normally-open momentary contact switch and is hard-wired to the instrument cluster along circuit 1412 (WH/PK). The switch is grounded along circuit 1205 (BK). When the traction control switch is pressed, circuit 1412 (WH/PK) and circuit 1205 (BK) are momentarily connected together. The instrument cluster detects this ground and sends a voltage to the traction control switch through circuit 939 (VT) to illuminate the traction control switch at the same time the instrument cluster sends a message over the High Speed Controller Area Network (HS-CAN) bus to the ABS module to disable the traction control system. The system will remain disabled until the traction control switch is pressed again or when the ignition key is cycled from ON to OFF and then back to ON again.

- DTC C1093 Traction Control Disable Switch Circuit Failure - If during the instrument cluster on-demand self test the instrument cluster detects a short to ground on circuit 1412 (WH/PK), then DTC C1093 will be set. This is usually due to the traction control switch being pressed during the self-test.

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This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Traction control switch
- Instrument cluster
- ABS module

PINPOINT TEST H: THE TRACTION CONTROL SYSTEM CANNOT BE DISABLED

NOTE: Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.

H1 CHECK FOR INSTRUMENT CLUSTER DTCs

- Connect the diagnostic tool.
- Key in ON position.
- Enter the following diagnostic mode on the diagnostic tool: Self Test Instrument Cluster
- Using the scan tool, carry out the instrument cluster self-test. Retrieve and record any DTCs.
- **Is DTC C1093 present?**

YES : Go to H7.

NO : For all other instrument cluster DTCs, REFER to the Master DTC Chart in **MULTIFUNCTION ELECTRONIC MODULES** article.

If no instrument cluster DTCs are present, go to H2.

H2 CHECK THE TRACTION CONTROL SWITCH

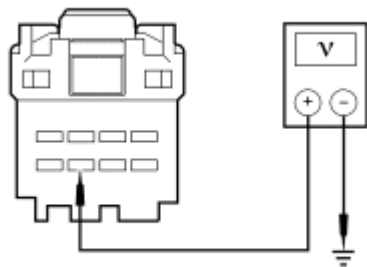
- Disconnect: Traction Control Switch C2039
- Measure the resistance between traction control switch C2039 pin-1 and pin-7 while pressing and releasing the traction control switch.
- **Is the resistance less than 5 ohms with the switch pressed and greater than 10,000 ohms with the switch released?**

YES : Go to H3.

NO : INSTALL a new traction control switch. REFER to **Traction Control Switch**. CLEAR the DTCs. REPEAT the self-test.

H3 CHECK THE VOLTAGE TO THE TRACTION CONTROL SWITCH FROM THE INSTRUMENT CLUSTER

- Key in ON position.



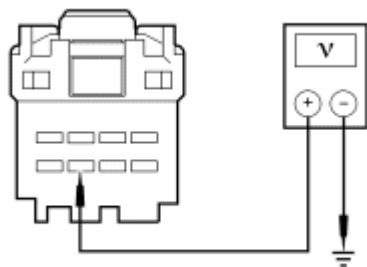
N0072094

Fig. 16: Checking Voltage To Traction Control Switch From Instrument Cluster
Courtesy of FORD MOTOR CO.

- Measure the voltage between traction control switch C2039-7, circuit 1412 (WH/PK), harness side and ground.
- **Is the voltage greater than 9.5 volts?**
YES : Go to H4.
NO : Go to H6.

H4 CHECK CIRCUIT 1412 (WH/PK) FOR A SHORT TO VOLTAGE

- Key in OFF position.
- Disconnect: Instrument Cluster C220
- Key in ON position.



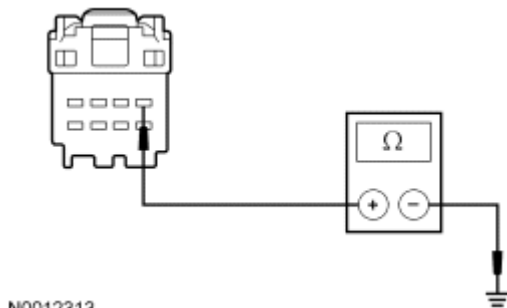
N0072094

Fig. 17: Checking Circuit 1412 (WH/PK) For A Short To Voltage
Courtesy of FORD MOTOR CO.

- Measure the voltage between traction control switch C2039-7, circuit 1412 (WH/PK), harness side and ground.
- **Is any voltage present?**
YES : REPAIR circuit 1412 (WH/PK). CLEAR the DTCs. REPEAT the self-test.
NO : Go to H5.

H5 CHECK CIRCUIT 1205 (BK) FOR AN OPEN

- Key in OFF position.



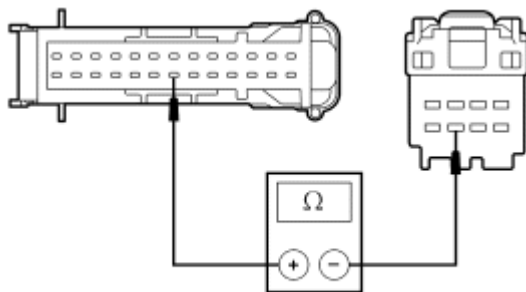
N0012313

Fig. 18: Checking Circuit 1205 (BK) For Open
Courtesy of FORD MOTOR CO.

- Measure the resistance between traction control switch C2039-1, circuit 1205 (BK), harness side and ground.
- **Is the resistance less than 5 ohms?**
YES : Go to H8.
NO : REPAIR circuit 1205 (BK). CLEAR the DTCs. REPEAT the self-test.

H6 CHECK CIRCUIT 1412 (WH/PK) FOR AN OPEN

- Disconnect: Instrument Cluster C220



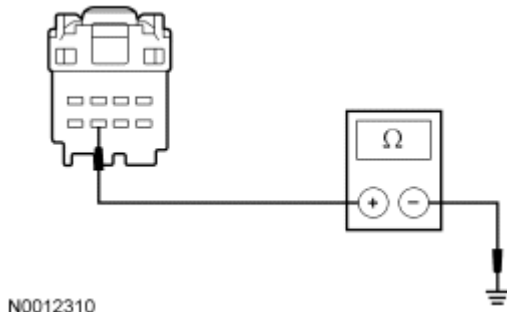
N0012312

Fig. 19: Checking Circuit 1412 (WH/PK) For Open
Courtesy of FORD MOTOR CO.

- Measure the resistance between instrument cluster C220-20, circuit 1412 (WH/PK), harness side and traction control switch C2039-7, circuit 1412 (WH/PK), harness side.
- **Is the resistance less than 5 ohms?**
YES : Go to H7.
NO : REPAIR circuit 1412 (WH/PK). CLEAR the DTCs. REPEAT the self-test.

H7 CHECK CIRCUIT 1412 (WH/PK) FOR A SHORT TO GROUND

- Key in OFF position.



N0012310

Fig. 20: Measuring Resistance Between Traction Control Switch C2039-7, Circuit 1412 (WH/PK) & Ground

Courtesy of FORD MOTOR CO.

- Measure the resistance between traction control switch C2039-7, circuit 1412 (WH/PK), harness side and ground.

- **Is the resistance greater than 10,000 ohms?**

YES : Go to H8.

NO : REPAIR circuit 1412 (WH/PK). CLEAR the DTCs. REPEAT the self-test.

H8 CHECK FOR CORRECT INSTRUMENT CLUSTER OPERATION

- Disconnect: Instrument Cluster C220
- Check the connector for:
 - corrosion.
 - spread terminals.
 - pushed-out pins.
- Connect: Instrument Cluster C220
- Make sure the connector seats correctly then operate the system and verify the concern is still present.
- **Is the concern still present?**

YES : INSTALL a new instrument cluster. REFER to **INSTRUMENT CLUSTER (IC), MESSAGE CENTER, AND WARNING CHIMES** article. CLEAR the DTCs. REPEAT the self-test.

NO : The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

Pinpoint Test I: The Traction Control System is Inoperative

Refer to appropriate SYSTEM WIRING DIAGRAM ARTICLE, Vehicle Dynamic Systems for schematic and connector information.

Normal Operation

Traction control utilizes ABS components to detect and control excessive rear wheel spin on low-traction surfaces. On high-traction surfaces, traction control will permit a controlled amount of rear wheel spin in the

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interest of quick acceleration. The traction control strategy will utilize throttle position information provided by the PCM over the High Speed Controller Area Network (HS-CAN) and front wheel speed sensor input to determine if it is necessary for traction control to intervene.

If the rear wheels begin to spin on a low-traction surface, the ABS module will use the Hydraulic Control Unit (HCU) to modulate brake fluid pressure to the rear brake calipers. At the same time, the ABS module sends a message to the PCM over the HS-CAN bus to modulate engine torque. Engine torque modulation is achieved by regulating fuel and spark to the cylinders. Once the rear wheels return to the desired speed, the ABS module stops modulating the brake fluid pressure and stops sending the message to the PCM.

This pinpoint test is intended to diagnose the following:

- Wiring, terminals or connectors
- Instrument cluster
- ABS module

PINPOINT TEST I: THE TRACTION CONTROL SYSTEM IS INOPERATIVE

NOTE: **Use the Flex Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multi-meter probes.**

I1 CHECK HS-CAN BUS

- Connect the diagnostic tool.
- Key in ON position.
- Enter the following diagnostic mode on the diagnostic tool: Network Test
- Using the scan tool, carry out the network test. Retrieve and record any DTCs.
- **Does the network test fail or are any communication DTCs present?**
YES : REFER to **MODULE COMMUNICATIONS NETWORK** article to diagnose the communication concern.
NO : Go to I2.

I2 CHECK FOR INSTRUMENT CLUSTER DTCs

- Enter the following diagnostic mode on the diagnostic tool: Self Test Instrument Cluster
- Using the scan tool, carry out the instrument cluster self-test. Retrieve and record any instrument cluster DTCs.
- **Are any instrument cluster DTCs present?**
YES : Go to the **INSTRUMENT CLUSTER DTC CHART**.
NO : Go to I3.

I3 CHECK FOR ABS MODULE DTCs

- Enter the following diagnostic mode on the diagnostic tool: Self Test ABS
- Using the scan tool, carry out the ABS module self-test. Retrieve and record any ABS module DTCs.
- **Are any ABS module DTCs present?**

YES : Go to the **ABS MODULE DTC CHART.**

NO : Go to I4.

I4 CHECK FOR CORRECT ABS MODULE OPERATION

- Key in OFF position.
- Disconnect: ABS Module C135
- Check the connector for:
 - corrosion.
 - spread terminals.
 - pushed-out pins.
- Connect: ABS Module C135
- Make sure the connector seats properly, then operate the system and verify the concern is still present.
- **Is the concern still present?**

YES : INSPECT the wheel speed sensor tone ring for damage and looseness. INSTALL new components as necessary. If the tone ring is OK, INSTALL a new ABS module. REFER to **Anti-Lock Brake System (ABS) Module.** CLEAR the DTCs. REPEAT the self-test.

NO : The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CLEAR the DTCs. REPEAT the self-test.

REMOVAL AND INSTALLATION

ANTI-LOCK BRAKE SYSTEM (ABS) MODULE

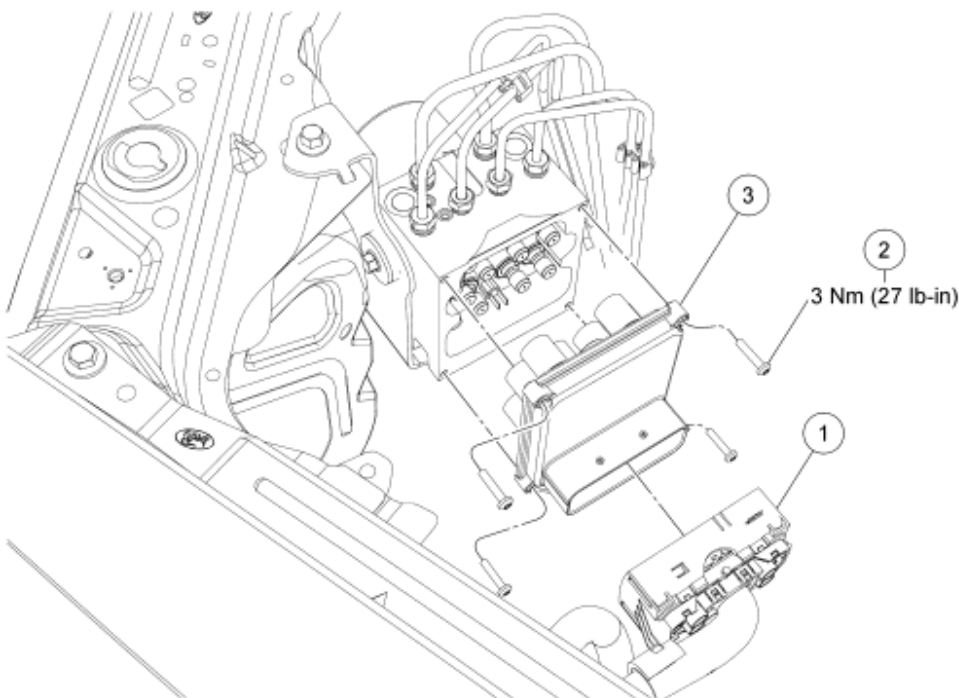


Fig. 21: Exploded View Of Anti-Lock Brake System (ABS) Module With Torque Specification
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	-	ABS module electrical connector (part of 14A005)
2	ZD061	ABS module screw (4 required)
3	2C219	ABS module

REMOVAL AND INSTALLATION

NOTE: **Electronic modules are sensitive to electrical charges. The anti-lock brake system (ABS) module can be damaged if exposed to these charges.**

1. Remove the air cleaner assembly. For additional information, refer to INTAKE AIR DISTRIBUTION AND FILTERING article.
2. Disconnect the ABS module electrical connector.
3. Remove the 4 screws and the ABS module.
 - To install, tighten to 3 Nm (27 lb-in) in the sequence shown.

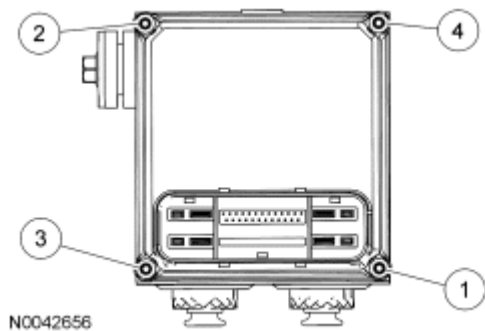


Fig. 22: Identifying ABS Module Screws Tightening Sequence
Courtesy of FORD MOTOR CO.

4. To install, reverse the removal procedure.

HYDRAULIC CONTROL UNIT (HCU)

Material

Item	Specification
High Performance DOT 3 Motor Vehicle Brake Fluid PM-1-C (US); CPM-1-C (Canada)	WSS-M6C62-A or WSS-M6C65-A1

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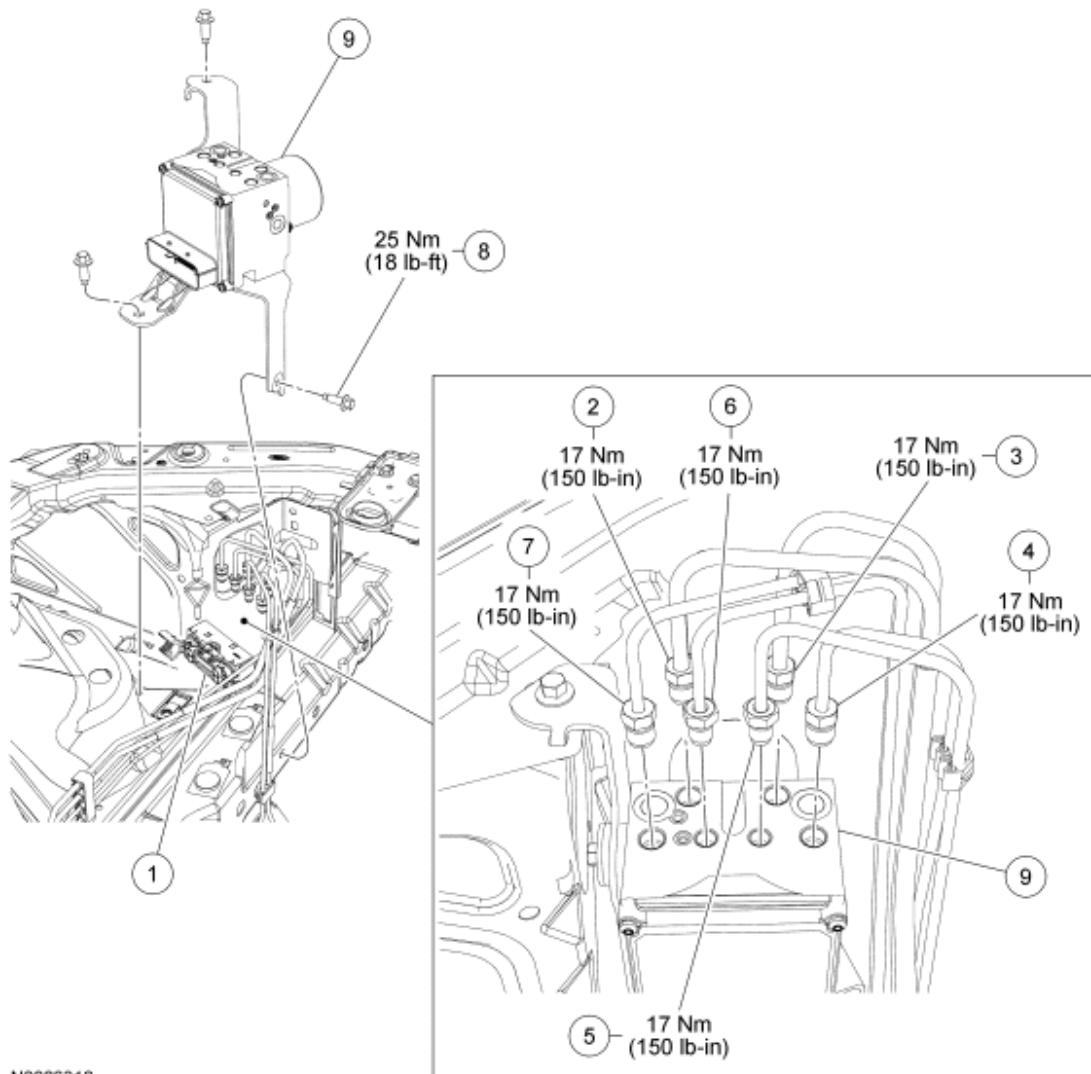


Fig. 23: Exploded View Of Hydraulic Control Unit (HCU) With Torque Specifications
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	-	ABS module electrical connector (part of 14A005)
2	-	Master cylinder primary brake tube (part of 2269)
3	-	Master cylinder secondary brake tube (part of 2269)
4	-	RH front brake tube (part of 2C296B)
5	-	LH front brake tube (part of 2C296A)
6	-	RH rear brake tube fitting (part of 2C360)
7	-	LH rear brake tube fitting (part of 2C360)
8	W500223	Hydraulic Control Unit (HCU) bracket-to-frame bolt (3 required)
9	2C215	HCU

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REMOVAL AND INSTALLATION

WARNING: Do not use any fluid other than clean brake fluid meeting manufacturer's specification. Additionally, do not use brake fluid that has been previously drained. Following these instructions will help prevent system contamination, brake component damage and the risk of serious personal injury.

WARNING: Carefully read cautionary information on product label. For EMERGENCY MEDICAL INFORMATION seek medical advice. In the USA or Canada on Ford/Motorcraft products call: 1-800-959-3673. For additional information, consult the product Material Safety Data Sheet (MSDS) if available. Failure to follow these instructions may result in serious personal injury.

NOTE: Do not spill brake fluid on painted or plastic surfaces or damage to the surface may occur. If brake fluid is spilled onto a painted or plastic surface, immediately wash the surface with water.

1. Remove the air cleaner assembly. For additional information, refer to INTAKE AIR DISTRIBUTION AND FILTERING article.
2. Disconnect the ABS module electrical connector.

NOTE: Brake tubes must be installed in the same location as removed.

3. Loosen the 6 brake tube-to-Hydraulic Control Unit (HCU) fittings, disconnect and position the brake tubes aside.
 - To install, tighten to 17 Nm (150 lb-in).
4. Remove the 3 HCU bracket-to-frame bolts.
 - To install, tighten to 25 Nm (18 lb-ft).
5. Remove the HCU assembly.
6. If necessary, remove the HCU bracket-to-HCU bolt and the bracket.
 - To install, tighten to 11 Nm (97 lb-in).
7. To install, reverse the removal procedure.
 - Bleed the brake system. For additional information, refer to BRAKE SYSTEM - GENERAL INFORMATION article.

WHEEL SPEED SENSOR - FRONT

2008 Ford Mustang

2008 BRAKES Vehicle Dynamic Systems - Mustang

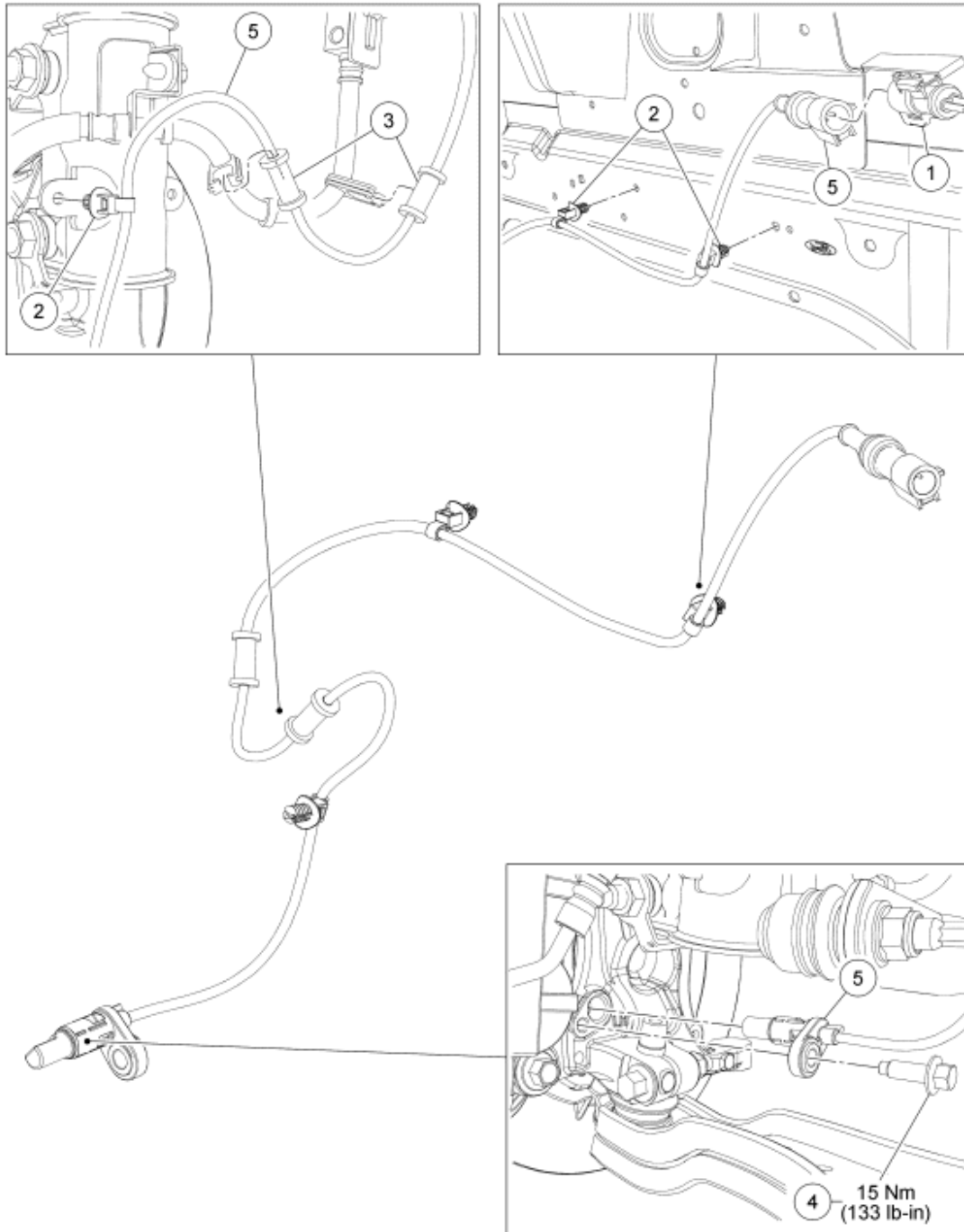


Fig. 24: Exploded View Of Front Wheel Speed Sensor With Torque Specification
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	-	Wheel speed sensor electrical connector (part of 14407)
2	-	Wheel speed sensor harness pin-type retainers (part of 2C204) (3 required)

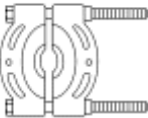
3	-	Wheel speed sensor grommet retainers (part of 2C204) (2 required)
4	W500223	Wheel speed sensor bolt
5	2C204	Wheel speed sensor

REMOVAL AND INSTALLATION

- With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING AND LIFTING** article.
- Disconnect the wheel speed sensor electrical connector.
- Disconnect the 3 wheel speed sensor harness pin-type retainers.
- Disconnect the 2 wheel speed sensor grommet retainers from the brake hose clips.
- Remove the wheel speed sensor bolt.
 - To install, tighten to 15 Nm (133 lb-in).
- Remove the wheel speed sensor and harness assembly.
- To install, reverse the removal procedure.

WHEEL SPEED SENSOR RING - FRONT

Special Tools

Illustration	Tool Name	Tool Number
 ST1713-A	Installer, Wheel Speed Sensor Ring	206-041 (T89P-20202-A)
 ST1895-A	Pinion Bearing Cone Remover	205-D002 (D79P-4621A)
 ST2039-A	Remover/Installer, Wheel Speed Sensor	206-033 (T88P-20202-A)

REMOVAL

- Remove the front hub and bearing assembly. For additional information, refer to **FRONT SUSPENSION** article.
- Using the Pinion Bearing Cone Remover and the Wheel Speed Sensor Ring Installer, remove the front wheel speed sensor ring from the front hub.

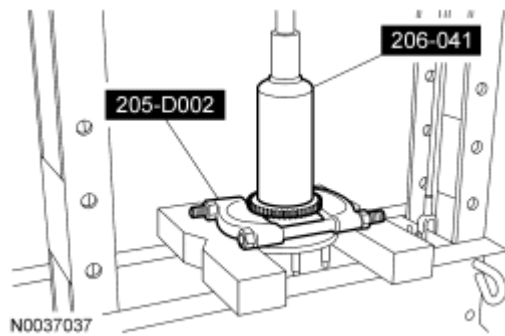


Fig. 25: Identifying Special Tools (205-D002 And 206-D41)
Courtesy of FORD MOTOR CO.

INSTALLATION

1. Using the Wheel Speed Sensor Remover/Installer, install the front wheel speed sensor ring to the front hub.

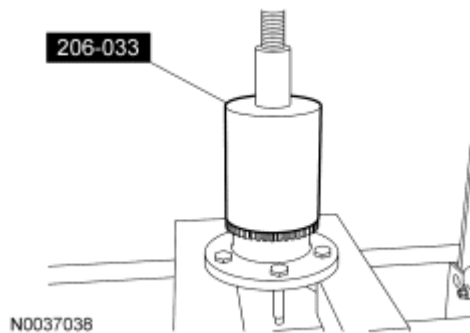


Fig. 26: Identifying Special Tools (206-033)
Courtesy of FORD MOTOR CO.

2. Install the front hub and bearing assembly. For additional information, refer to **FRONT SUSPENSION** article.

WHEEL SPEED SENSOR - REAR

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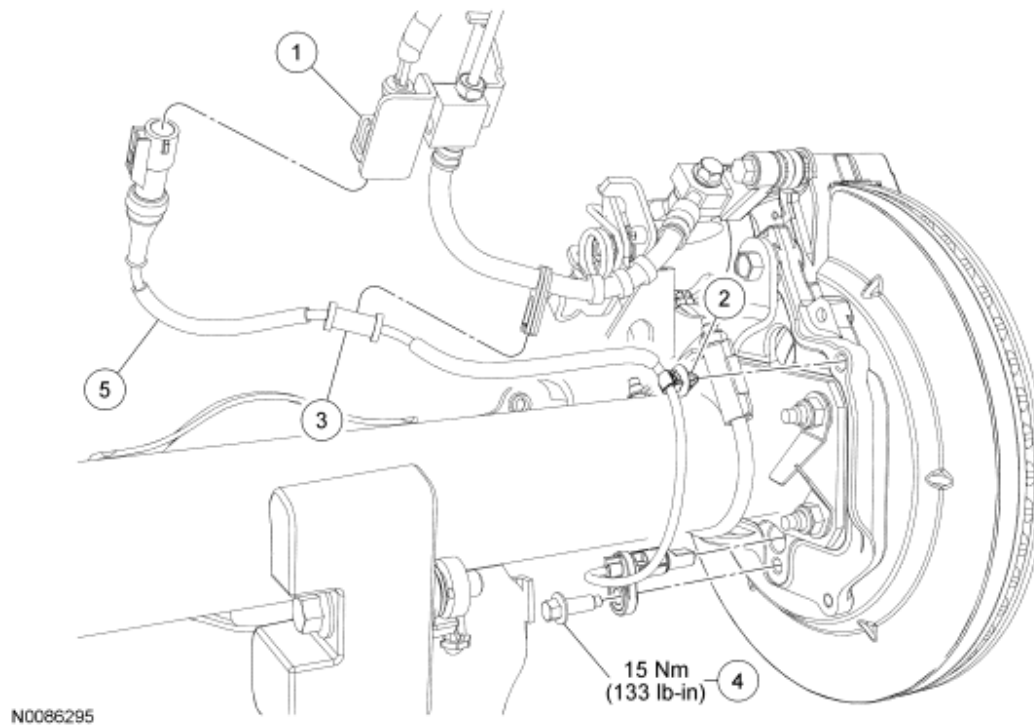


Fig. 27: Exploded View Of Rear Wheel Speed Sensor With Torque Specification
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	-	Wheel speed sensor electrical connector (part of 14407)
2	-	Wheel speed sensor harness pin-type retainer (part of 2C190)
3	-	Wheel speed sensor grommet retainer (part of 2C190)
4	W500223	Wheel speed sensor bolt
5	2C190	Wheel speed sensor

REMOVAL AND INSTALLATION

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to **JACKING AND LIFTING** article.
2. Disconnect the wheel speed sensor electrical connector.
3. Disconnect the 2 wheel speed sensor harness pin-type retainers.
4. Disconnect the wheel speed sensor grommet retainer from the brake hose clip.
5. Remove the wheel speed sensor bolt.
 - To install, tighten to 15 Nm (133 lb-in).
6. Remove the wheel speed sensor.
7. To install, reverse the removal procedure.

WHEEL SPEED SENSOR RING - REAR

Special Tools

Illustration	Tool Name	Tool Number
 ST1254-A	Axle Bearing/Seal Plate	205-090 (T75L-1165-B)
 ST1713-A	Installer, Wheel Speed Sensor Ring	206-041 (T89P-20202-A)
 ST1895-A	Pinion Bearing Cone Remover	205-D002 (D79P-4621A) or equivalent

REMOVAL

1. Remove the rear axle shaft. For additional information, refer to **REAR DRIVE AXLE/DIFFERENTIAL - FORD 7.5-INCH RING GEAR** article or **REAR DRIVE AXLE/DIFFERENTIAL - FORD 8.8-INCH RING GEAR** article.
2. Using the Pinion Bearing Cone Remover, remove the anti-lock brake sensor indicator from the axle shaft.

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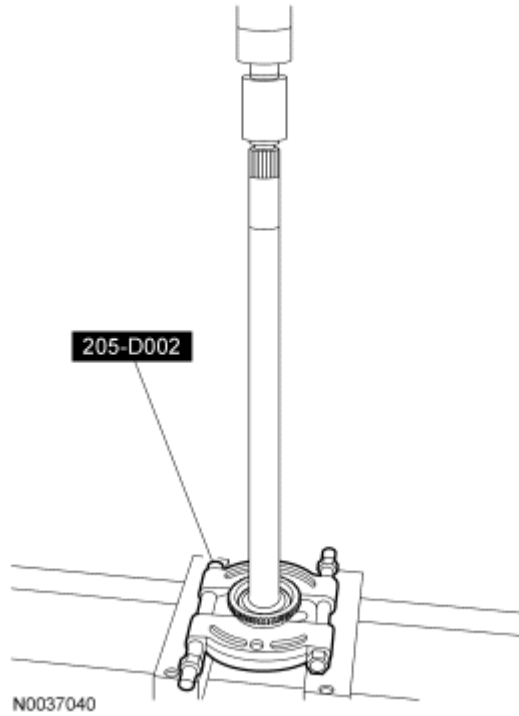
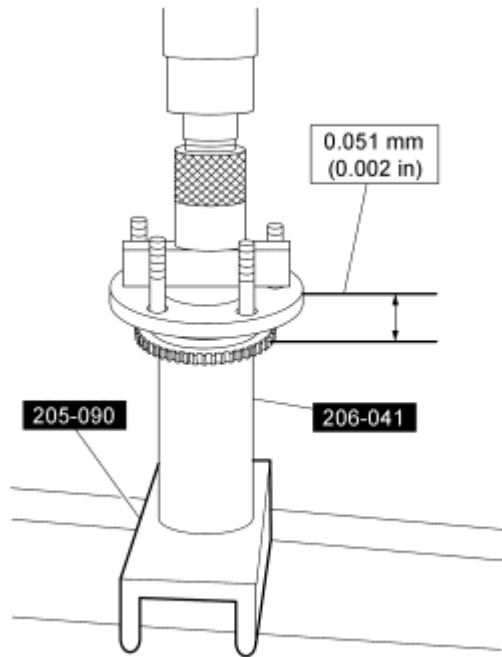


Fig. 28: Identifying Special Tools (205-D002)
Courtesy of FORD MOTOR CO.

INSTALLATION

1. Using the Axle Bearing/Seal Plate and the Wheel Speed Sensor Ring Installer, align the rear anti-lock brake sensor indicator to the rear axle shaft.

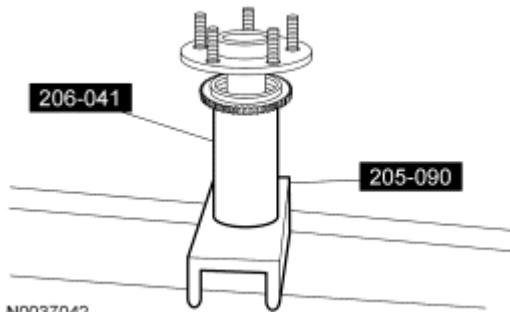


N0075773

Fig. 29: Aligning Rear Anti-Lock Brake Sensor Indicator To Rear Axle Shaft Using Special Tools 205-090 & 206-041

Courtesy of FORD MOTOR CO.

2. Using the Axle Bearing/Seal Plate and the Wheel Speed Sensor Ring Installer, press the rear anti-lock brake sensor on the rear axle shaft to specification.

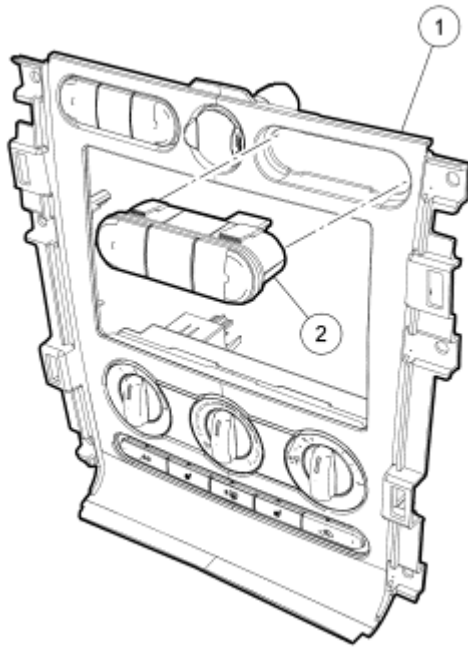


N0037042

Fig. 30: Pressing Rear Anti-Lock Brake Sensor On Rear Axle Shaft Using Special Tools 205-090 & 206-041

Courtesy of FORD MOTOR CO.

3. Install the rear axle shaft. For additional information, refer to **REAR DRIVE AXLE/DIFFERENTIAL - FORD 7.5-INCH RING GEAR** article.



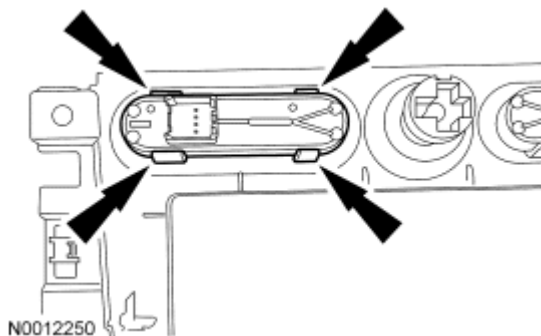
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Fig. 31: Exploded View Of Traction Control Switch
Courtesy of FORD MOTOR CO.

Item	Part Number	Description
1	6304302	Instrument panel center finish panel
2	13D730	Traction control switch

REMOVAL AND INSTALLATION

1. Remove the instrument panel center finish panel. For additional information, refer to **INSTRUMENT PANEL AND CONSOLE** article.
2. Press the retaining tabs and remove the switch block.



N0012250

Fig. 32: Locating Switch Block
Courtesy of FORD MOTOR CO.

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3. To install, reverse the removal procedure.