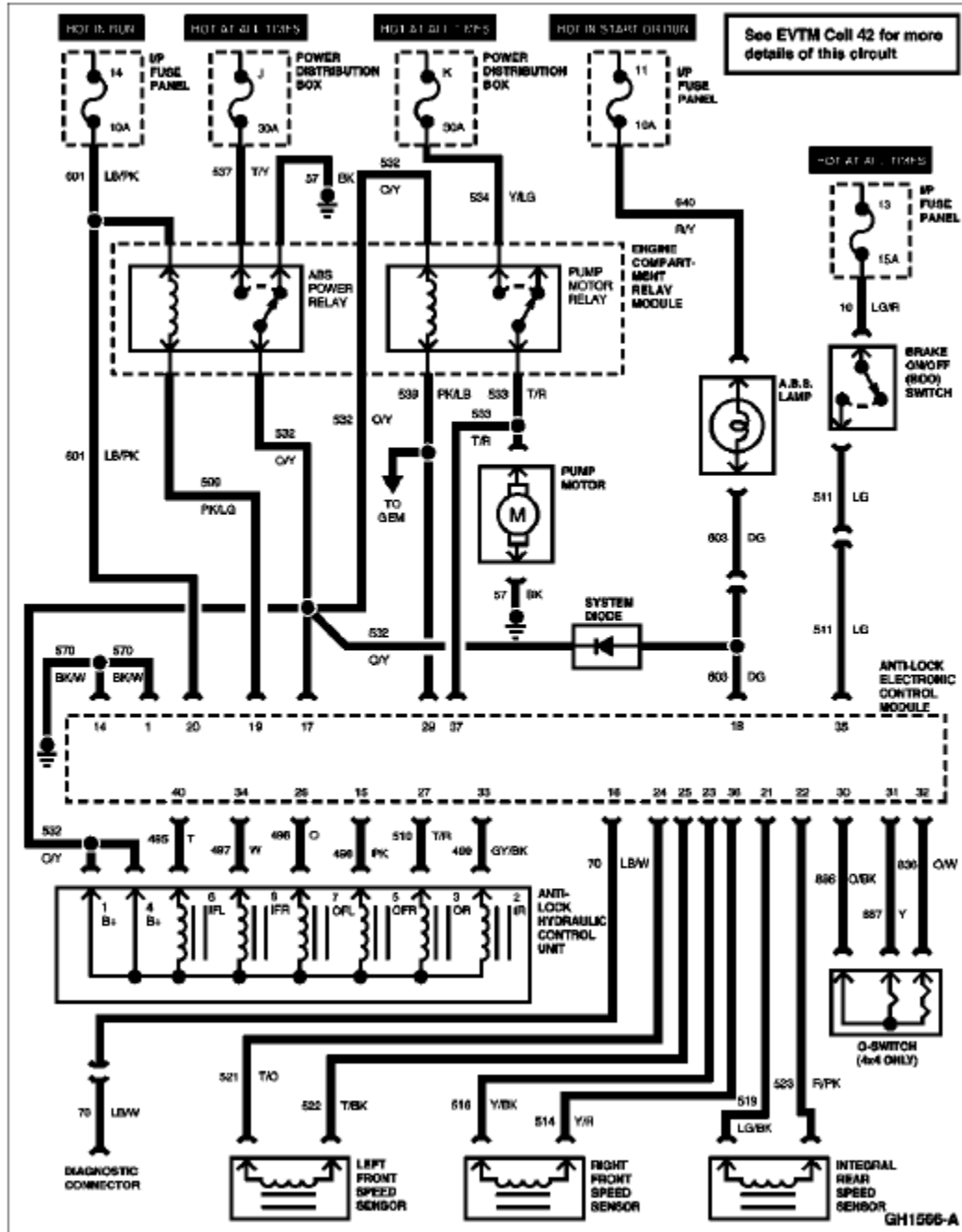
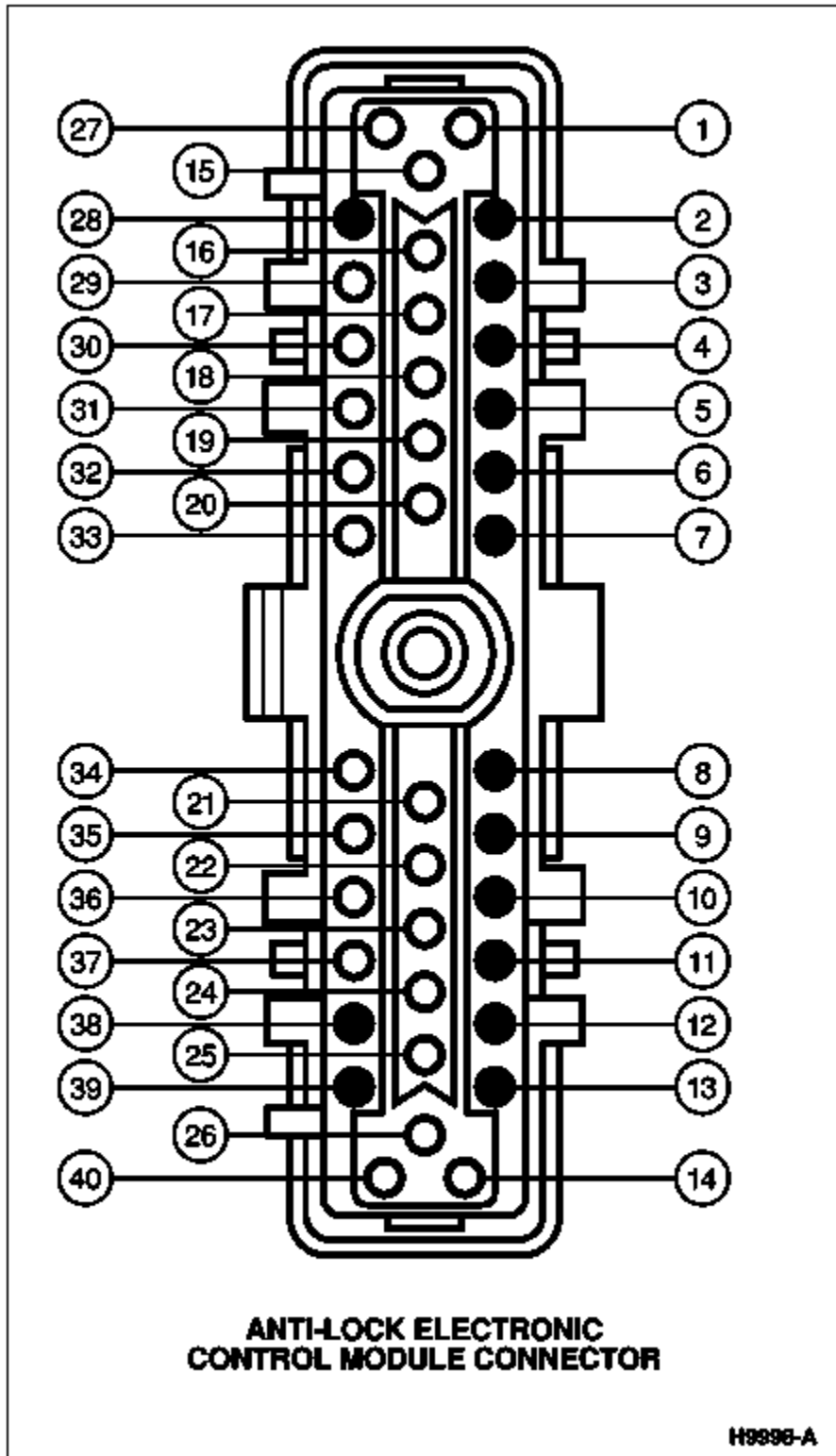


### Electrical Schematics

#### Brake, 4-Wheel Anti-Lock

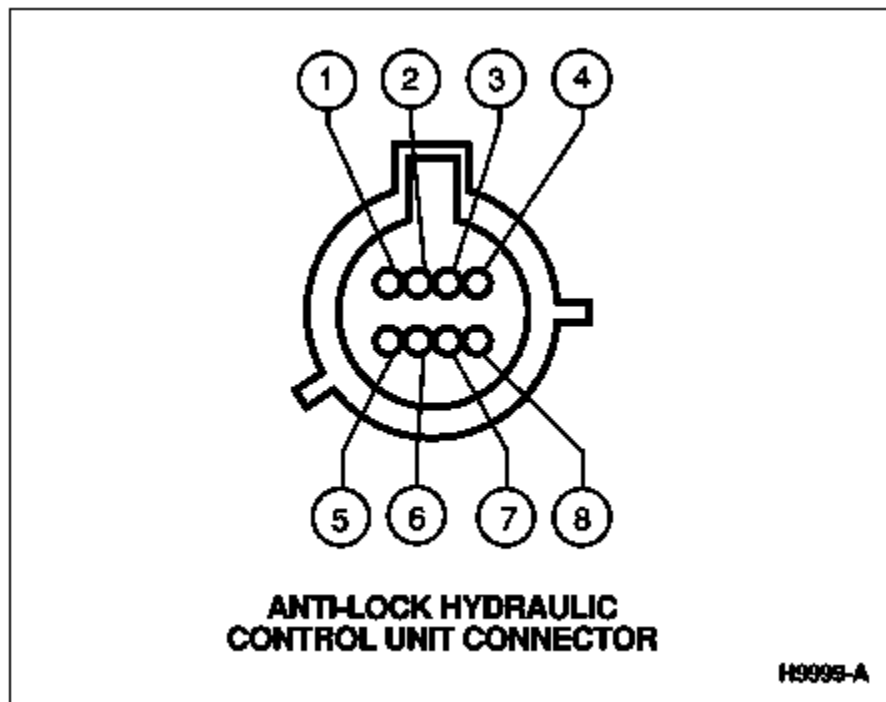


Anti-Lock Electronic Control Module

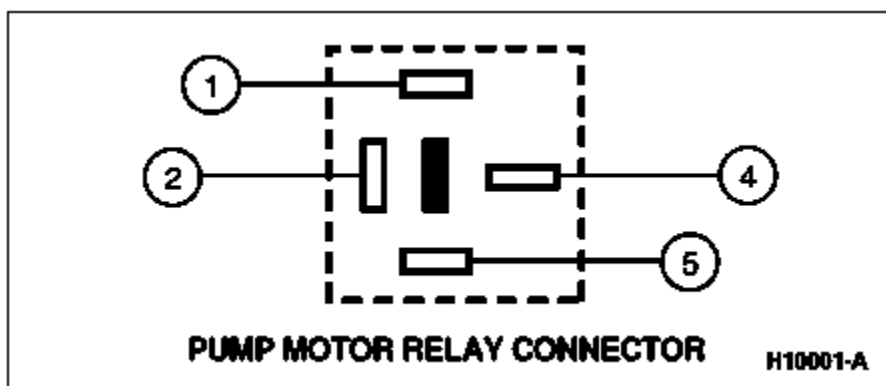
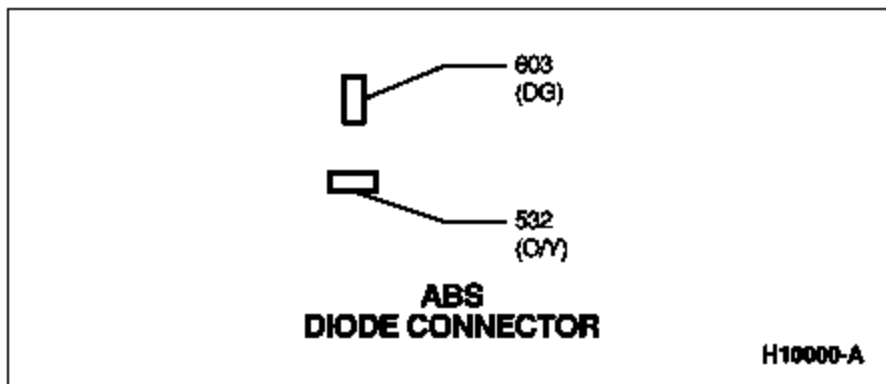


Pin Number	Circuit	Circuit Function
1	570 (BK/W)	ABS Ground
2	—	Not Used
3	—	Not Used
4	—	Not Used
5	—	Not Used
6	—	Not Used
7	—	Not Used
8	—	Not Used
9	—	Not Used
10	—	Not Used
11	—	Not Used
12	—	Not Used
13	—	Not Used
14	570 (BK/W)	ABS Ground
15	498 (PK)	Front Right Dump Solenoid
16	70 (LB/W)	ISO 9141
17	532 (O/Y)	Solenoid Battery Input
18	603 (DG)	ABS Lamp Return
19	599 (PK/LG)	Control Module to ABS Power Relay Coil Return
20	601 (LB/PK)	Hot in RUN
21	519 (LG/BK)	Control Module to Rear Sensor
22	523 (R/PK)	Control Module to Rear Sensor
23	516 (Y/BK)	Control Module to Right Front Sensor
24	521 (T/O)	Control Module to Left Front Sensor
25	522 (T/BK)	Control Module to Left Front Sensor
26	496 (O)	Front Left Dump Solenoid
27	510 (T/R)	Rear Dump Solenoid
28	—	Not Used
29	539 (PK/LB)	Control Module to Pump Relay Coil Return
30	886 (O/BK)	Control Module to G-Switch
31	887 (Y)	Control Module to G-Switch
32	836 (O/W)	Control Module to G-Switch
33	499 (GY/BK)	Rear Isolation Solenoid
34	497 (W)	Front Right Isolation Solenoid
35	511 (LG)	Stoplamp Switch
36	514 (Y/R)	Control Module to Right Front Sensor
37	533 (T/R)	Pump Motor Trigger Input

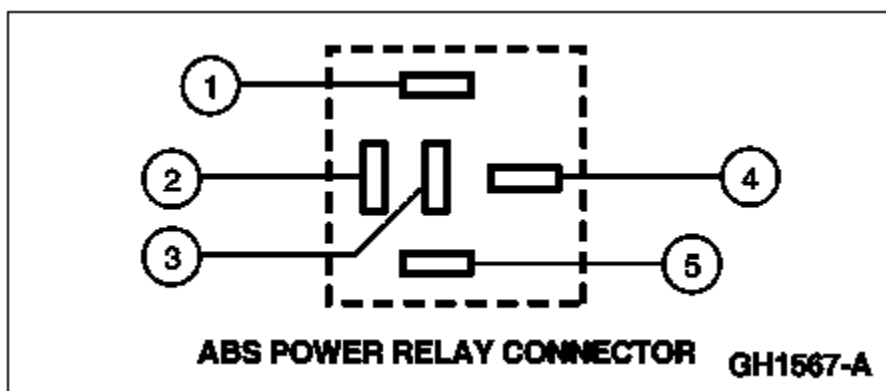
38	—	Not Used
39	—	Not Used
40	495 (T)	Front Left Isolation Solenoid



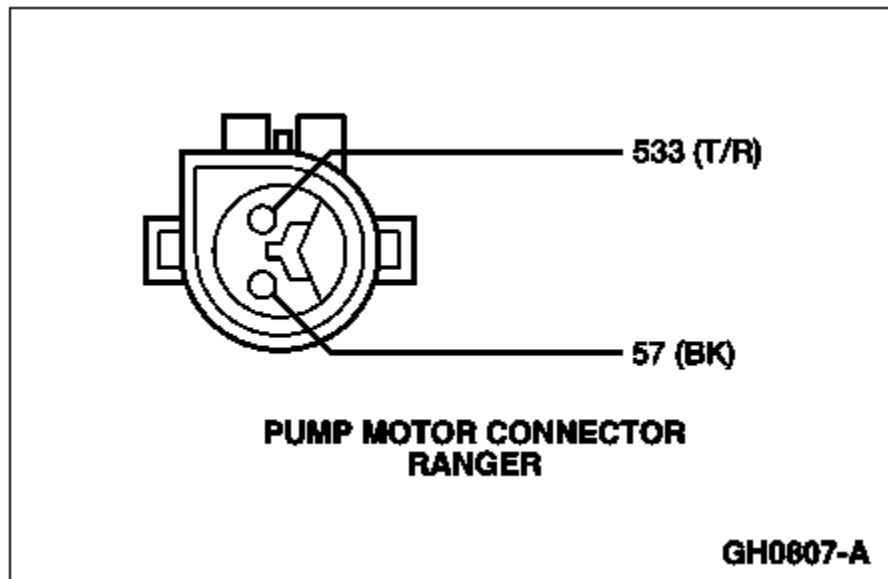
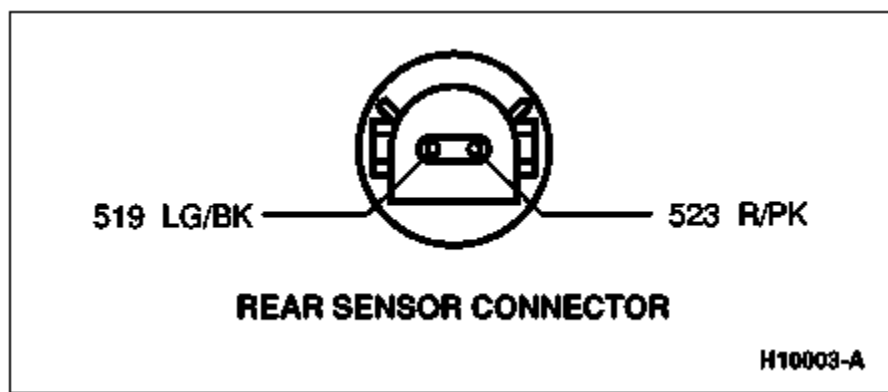
Pin Number	Circuit	Circuit Function
1	532 (O/Y)	Solenoid Battery Input
2	499 (GY/BK)	Rear Isolation Solenoid
3	510 (T/R)	Rear Dump Solenoid
4	532 (O/Y)	Solenoid Battery Input
5	498 (PK)	Front Right Dump Solenoid
6	495 (T)	Front Left Isolation Solenoid
7	496 (O)	Front Left Dump Solenoid
8	497 (W)	Front Right Isolation Solenoid

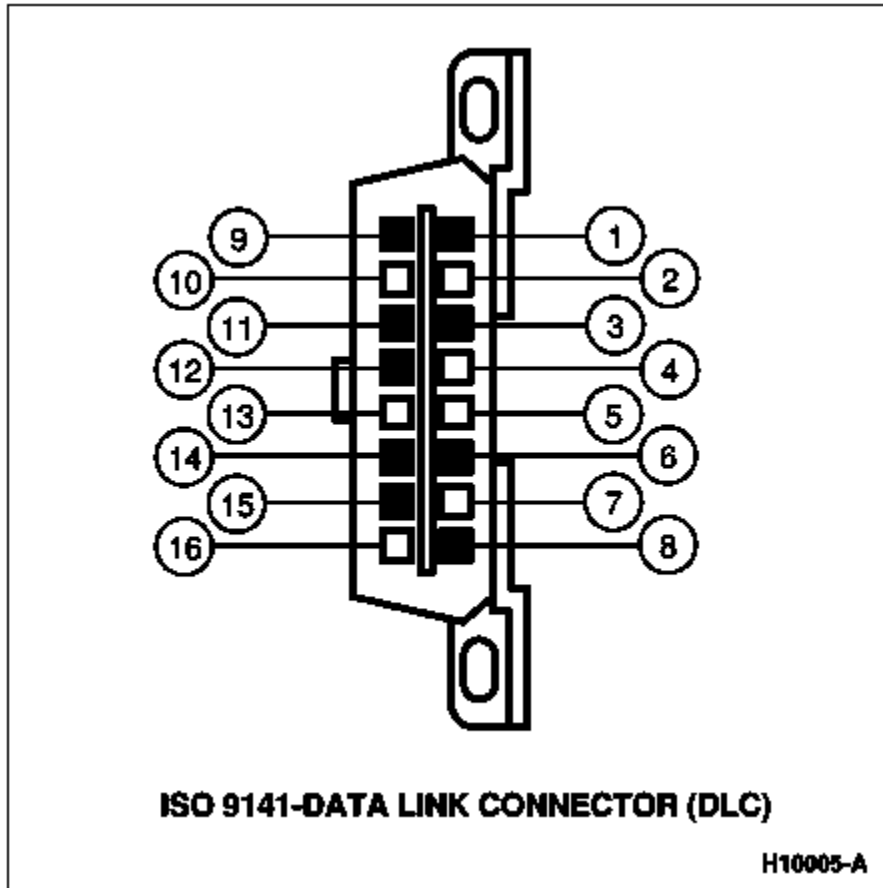


Pin Number	Circuit	Circuit Function
1	539 (PK/LB)	Relay Coil to Anti-Lock Electronic Control Module
2	534 (Y/LG)	Relay Switch Power Feed
3	—	Not Used
4	533 (T/R)	Relay Switch to Pump Motor
5	532 (O/Y)	Relay Coil Power Feed

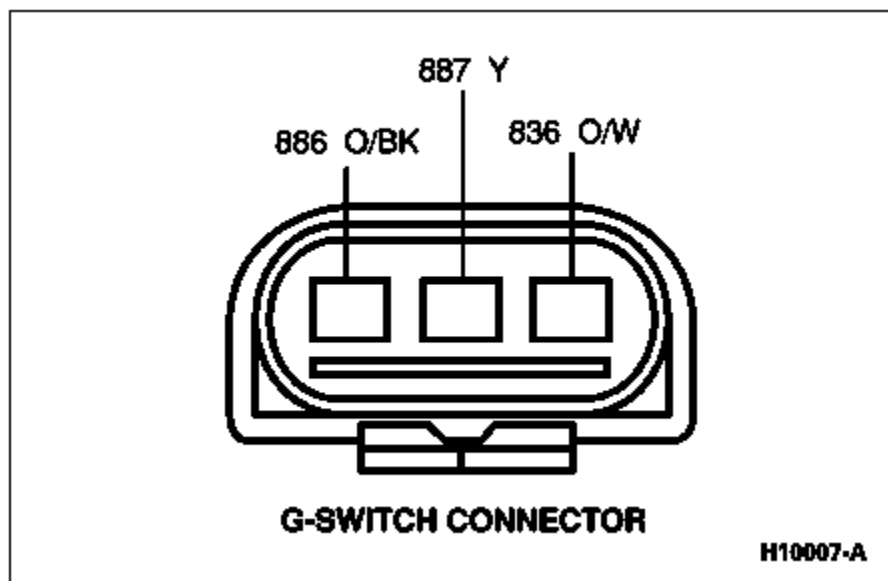
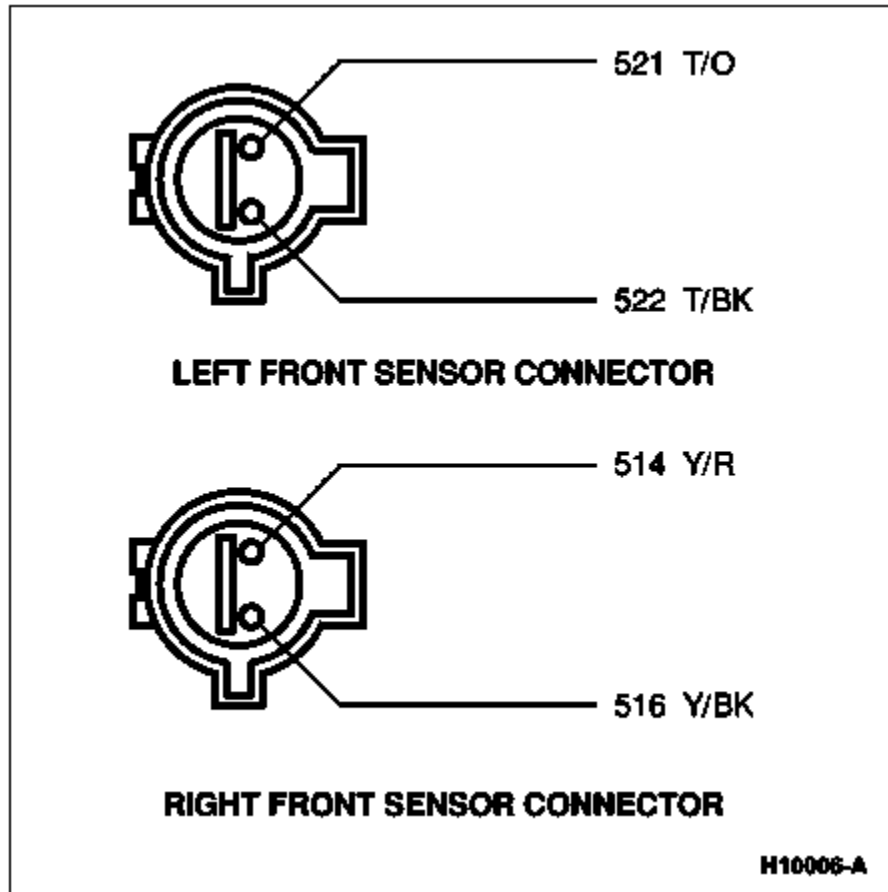


Pin Number	Circuit	Circuit Function
1	599 (PK/LG)	Relay Coil to Anti-Lock Electronic Control Module
2	537 (T/Y)	Relay Switch Power Feed
3	57 (BK)	Relay Switch Ground
4	532 (O/Y)	Relay Switch to Anti-Lock Electronic Control Module
5	601 (LB/PK)	Relay Coil Power Feed





Pin Number	Circuit	Circuit Function
1	—	Not Used
2	914 (T/O)	J1850 Bus (+)
3	—	Not Used
4	57 (BK)	Chassis Ground Feed
5	570 (BK/W)	Control Module Ground Feed
6	—	Not Used
7	70 (LB/W)	ISO 9141
8	—	Not Used
9	—	Not Used
10	915 (PK/LG)	J1850 Bus (-)
11	—	Not Used
12	—	Not Used
13	107 (P)	Reprogramming Power Supply
14	—	Not Used
15	—	Not Used
16	693 (O)	Battery Power







## Symptom Charts

- Unwarranted ABS Activity—Refer to [Symptom A](#).
- Wheels Lock Up—Refer to [Symptom B](#).
- Hard/Soft Brake Pedal—Refer to [Symptom C](#).
- Lack of Decel. (Med./Hard Braking)—Refer to [Symptom D](#).
- Vehicle Pulls During Braking—Refer to [Symptom E](#).
- ABS Warning Light ON Intermittently with Code System Pass—Refer to [Symptom F](#).



**WARNING: PERFORM INDICATED PINPOINT TEST OR DRIVE TEST STEPS ONLY — DO NOT PERFORM OTHER STEPS (ALTHOUGH WITHIN THE TEST BOX, YOU MAY APPEAR TO BE DIRECTED TO DO SO). ALWAYS RETURN TO THE SYMPTOM CONDITION CHART IF NO RESOLUTION IS REACHED BY PERFORMING A PARTICULAR TEST.**

### SYMPTOM A: UNWARRANTED ABS ACTIVITY

Condition	Possible Source	Action
<ul style="list-style-type: none"> <li>• Loss of Sensor Signal During Vehicle Deceleration. Sensor Signal Drops Out at Low Speed</li> </ul>	<ul style="list-style-type: none"> <li>• Tone ring is damaged.</li> <li>• Sensor output is weak.</li> <li>• Air gap too large.</li> </ul>	<ul style="list-style-type: none"> <li>• INSPECT both front wheel end tone rings and the rear axle tone ring.</li> <li>• Left Front Sensor — GO to <a href="#">Pinpoint Test LL</a>.</li> <li>• Right Front Sensor — GO to <a href="#">Pinpoint Test MM</a>.</li> <li>• Rear Axle Sensor — GO to <a href="#">Pinpoint Test NN</a>.</li> </ul>
<ul style="list-style-type: none"> <li>• Maladjusted Rear Brakes or "Grabby" Brake Shoe or Pad Linings</li> </ul>	<ul style="list-style-type: none"> <li>• Rear brake adjustment too tight.</li> <li>• Linings are "contaminated".</li> </ul>	<ul style="list-style-type: none"> <li>• REFER to <a href="#">Section 06-00</a>.</li> <li>• REFER to <a href="#">Section 06-00</a>.</li> </ul>

### SYMPTOM B: WHEELS LOCK UP

Condition	Possible Source	Action
<ul style="list-style-type: none"> <li>• Base Brake Mechanical Concern</li> </ul>	<ul style="list-style-type: none"> <li>• Damp or contaminated rear brake shoe linings, stuck/leaking wheel cylinder, over-adjusted rear brakes.</li> <li>• Hung-up parking brake.</li> <li>• Leaking rear axle seal.</li> </ul>	<ul style="list-style-type: none"> <li>• REFER to <a href="#">Section 06-00</a>.</li> <li>• REFER to <a href="#">Section 06-05</a>.</li> <li>• REFER to the appropriate section in Group 05.</li> </ul>

**SYMPTOM C: HARD OR SOFT BRAKE PEDAL**

Condition	Possible Source	Action
<ul style="list-style-type: none"> <li>Base Brake Hydraulic Concern (Soft)</li> </ul>	<ul style="list-style-type: none"> <li>Hydraulic leak in brake line or hose, fitting, master cylinder, wheel cylinder, or caliper.</li> <li>Air in brake system.</li> </ul>	<ul style="list-style-type: none"> <li>REFER to <a href="#">Section 06-00</a>.</li> <li>REFER to <a href="#">Section 06-00</a>.</li> </ul>
<ul style="list-style-type: none"> <li>Base Brake Mechanical Concern (Hard)</li> </ul>	<ul style="list-style-type: none"> <li>Little or no vacuum boost.</li> <li>Stuck or inoperative wheel cylinder or caliper.</li> <li>Pinched or crimped brake line or hose.</li> </ul>	<ul style="list-style-type: none"> <li>REFER to <a href="#">Section 06-00</a>.</li> </ul>

**SYMPTOM D: LACK OF DECELERATION DURING MEDIUM/HARD BRAKE APPLICATIONS**

Condition	Possible Source	Action
<ul style="list-style-type: none"> <li>Base Brake Hydraulic Concern</li> </ul>	<ul style="list-style-type: none"> <li>Hydraulic leak in brake line or hose, fitting, master cylinder, wheel cylinder, or caliper.</li> <li>Air in brake system.</li> </ul>	<ul style="list-style-type: none"> <li>REFER to <a href="#">Section 06-00</a>.</li> <li>REFER to <a href="#">Section 06-00</a>.</li> </ul>
<ul style="list-style-type: none"> <li>Base Brake Mechanical Concern</li> </ul>	<ul style="list-style-type: none"> <li>Little or no vacuum boost.</li> <li>Stuck or inoperative wheel cylinder or caliper.</li> <li>Pinched or crimped brake line or hose.</li> <li>Ineffective brake shoe or pad linings.</li> </ul>	<ul style="list-style-type: none"> <li>REFER to <a href="#">Section 06-00</a>.</li> </ul>

**SYMPTOM E: VEHICLE PULLS DURING BRAKING**

Condition	Possible Source	Action
<ul style="list-style-type: none"> <li>Base Brake Mechanical Concern</li> </ul>	<ul style="list-style-type: none"> <li>Improperly adjusted rear brake.</li> <li>Frozen or binding caliper (one side of vehicle).</li> <li>Uneven brake pad or shoe wear.</li> </ul>	<ul style="list-style-type: none"> <li>REFER to <a href="#">Section 06-00</a>.</li> <li>REFER to <a href="#">Section 06-00</a>.</li> <li>REFER to <a href="#">Section 06-00</a>.</li> </ul>
<ul style="list-style-type: none"> <li>Base Brake Hydraulic Concern</li> </ul>	<ul style="list-style-type: none"> <li>Pinched or crimped brake line or hose.</li> </ul>	<ul style="list-style-type: none"> <li>REFER to <a href="#">Section 06-00</a>.</li> </ul>

**SYMPTOM F: ABS WARNING LIGHT ON INTERMITTENTLY WITH SYSTEM PASS CODE**

Condition	Possible Source	Action

<ul style="list-style-type: none"> <li>• Intermittent Loss of Power to Anti-Lock Brake Control Module</li> </ul>	<ul style="list-style-type: none"> <li>• Ignition Circuit 601 loose or shorted.</li> <li>• Loose anti-lock brake control module grounds.</li> <li>• Loose power lug at power distribution box.</li> </ul>	<ul style="list-style-type: none"> <li>• INSPECT Circuit 601 from ignition switch to anti-lock brake control module harness connector for opens/shorts especially at the bulkhead connector. CORRECT as necessary.</li> <li>• INSPECT anti-lock brake control module grounds for looseness, corrosion or excessive dirt. CORRECT as necessary.</li> <li>• CORRECT condition.</li> </ul>
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### Inspection and Verification, System Precheck

**NOTE: It is imperative that this procedure be performed first. Failure to do so may result in incorrect diagnosis of problem, wasted time, and improper replacement of good components.**

If not using a Rotunda Fluke Frequency Meter, 105-R0053, higher wheel speed may be required in order for the frequency meter to function correctly.

The System Precheck is used to screen a vehicle for relatively simple diagnostic repairs such as loose connectors, blown fuses, etc. However, the System Precheck is also used to prepare the vehicle for further diagnostics. In addition, warning lamp faults are dealt with in this test.

### PINPOINT TEST PC: SYSTEM PRECHECK

#### PC1 PERFORM UNDERHOOD SYSTEM PRECHECK

- Verify that all of the following connectors are connected and the terminals are secure and free of contaminants or corrosion.
  - 40-pin ECU connector
  - 8-pin HCU connector
  - 2-pin pump motor connector
  - 2-pin front sensor connectors (2)
- Open power distribution box and verify that both the ABS power relay and pump motor relay and diode are fully seated.
- Gently pull on relay and diode terminals beneath power distribution box to make sure all are secure.
- Verify that both the system fuse and pump motor fuse are present and intact.
- Verify that the system ground eyelet at the left-hand radiator support is firmly attached to the weld stud and is free of corrosion and excessive dirt.

**Are all connections secure and fuses operational?**

Yes	No
GO to <a href="#">PC2</a> .	CORRECT condition. GO to <a href="#">PC2</a> .

## PC2 PERFORM UNDER-VEHICLE SYSTEM PRECHECK

- Verify that the 3-pin acceleration connector (4x4 only) and the 2-pin rear axle sensor connector are connected and the terminals are secure and free of contaminants or corrosion.

Are all connectors, terminals and grounds secure?

Yes	No
GO to <a href="#">PC3</a> .	REPAIR as required. GO to <a href="#">PC3</a> .

## PC3 CHECK ABS WARNING LIGHT SEQUENCE (KEY ON/ENGINE OFF)

- Observe ABS warning light on dash.
- Turn ignition to ON.

Does ABS warning light come on?

Yes	No
Light flashes. Diagnostic circuit grounded. CORRECT condition.	GO to <a href="#">PC7</a> .
Stays on for 3 seconds and goes out (normal bulb prove-out). GO to <a href="#">PC6</a> .	
Comes on and stays on (hard light). GO to <a href="#">PC4</a> .	

## PC4 CODE RETRIEVAL EQUIPMENT HOOKUP

- Verify that an ABS concern has been detected (ABS warning light ON).
- Key OFF.
- Using Rotunda New Generation Star (NGS) Tester 007-00500 or equivalent.
  - Connect tester to ISO-9141 connector located under steering column.

Is equipment hooked up properly?

Yes	No
GO to <a href="#">PC5</a> .	REATTEMPT <a href="#">PC4</a> . REPAIR as required.

## PC5 RETRIEVE ABS DIAGNOSTIC TROUBLE CODES

- Using Rotunda New Generation Star (NGS) Tester 007-00500 or equivalent:
  - Key in RUN.
  - Read out and record all diagnostic trouble codes.



**CAUTION:** Be sure to read out and record all codes. Failure to do so may result in improper diagnosis and unnecessary repairs.

Are codes present?

Yes	No
Starting with the first code recorded, GO to the pinpoint test for that code.	System pass. If previous action has been taken, concern most likely has been corrected and ABS system is OK. Otherwise, GO to <a href="#">Symptom Chart F</a> .  Cannot communicate. GO to <a href="#">Pinpoint Test V</a> .

### PC6 ROAD TEST VEHICLE

**NOTE:** Step PC6 is optional, for additional information only.

- Drive vehicle and observe ABS warning light.

Does ABS warning light come on during any of the following?

- When vehicle moves initially (light comes on at or near 6 mph)
- While driving under 40 km/h (25 mph)
- While driving at or over 40 km/h (25 mph)
- While in an anti-lock stop

Yes	No
<p>At or near 10 km/h (6 mph), concern most likely found during pump check. GO to <a href="#">PC4</a>. VERIFY pump diagnostic trouble code has been set.</p> <p>While driving under 40 km/h (25 mph), most likely cause is missing wheel speed sensor output. GO to <a href="#">PC4</a>. VERIFY sensor diagnostic trouble code has been set.</p> <p>While driving over 40 km/h (25 mph), most likely cause is an erratic wheel speed sensor output. GO to <a href="#">PC4</a>. VERIFY sensor diagnostic trouble code has been set.</p>	<p>Vehicle has abnormal ABS or brake system operation. GO to <a href="#">Symptom Chart</a>.</p> <p>No abnormal operation or symptoms detected. GO to <a href="#">PC4</a>. VERIFY No Code (System OK) is present.</p>

### PC7 ABS WARNING LIGHT DOES NOT PROVE OUT/CHECK BULB

- Inspect ABS warning light bulb in dash.

Is the bulb blown?

Yes	No

REPLACE bulb. GO to <a href="#">PC3</a> .	LEAVE bulb out. GO to <a href="#">PC8</a> .
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### PC8 VERIFY ABS WARNING LAMP FEED IS INTACT

- Key OFF.
- Insert 12V test light between ABS bulb socket (+) and a known good chassis ground.
- Key ON.

Does test light illuminate?

Yes	No
GO to <a href="#">PC9</a> .	REPAIR open circuit or short to ground on warning light feed. REINSERT bulb back into socket. GO to <a href="#">PC3</a> .

### PC9 VERIFY ABS WARNING LAMP GROUND BETWEEN BULB AND ABS DIODE

- Open power network box and remove ABS diode.
- Verify diode terminals are clean and firmly in place.
- Check for continuity between ABS bulb socket ground and diode terminal in power network box for Circuit 603 (DG).

Is there continuity?

Yes	No
GO to <a href="#">PC10</a> .	REPAIR open circuit in warning light ground or loose terminal. REINSERT ABS diode. GO to <a href="#">PC3</a> .

### PC10 VERIFY INTACT ABS WARNING LAMP GROUND BETWEEN ABS DIODE AND ABS POWER RELAY

- Remove ABS power relay.
- Verify relay terminals are clean and firmly in place.
- Check for continuity between ABS diode Circuit 532 (O/Y) and ABS Power Relay Circuit 532 (O/Y).

Is there continuity?

Yes	No
GO to <a href="#">PC11</a> .	REPAIR open circuit in Circuit 532 (O/Y) between ABS diode and ABS power relay or loose terminals. REINSERT ABS diode and system relay. GO to <a href="#">PC3</a> .

## PC11 CHECK GROUND BETWEEN ABS POWER RELAY AND CHASSIS GROUNDS

- Inspect chassis ground stud at left-hand radiator support for loose or corroded eyelets.
- Clean and tighten any loose or dirty ground eyelets.
- Check for continuity between ABS power relay Circuit 57 (BK) and left-hand radiator support chassis ground stud.

### Is there continuity?

Yes	No
REINSERT ABS power relay. REPLACE ABS warning bulb. REPEAT Steps <a href="#">PC8</a> -PC11 looking for intermittent condition (see <a href="#">Intermittent Diagnosis</a> ).	REPAIR open circuit between ABS power relay and chassis ground. REINSERT ABS power relay. GO to <a href="#">PC3</a> .

### Manually Clearing Diagnostic Codes

The Rotunda New Generation Star (NGS) Tester 007-00500 is used to clear diagnostic trouble codes (DTCs) by performing the ABS code clear procedure. **No other manual method can be used to clear DTCs .**

### Automatic Memory Erasing

A diagnostic trouble code will be automatically erased if no system concerns occur for 80 ignition cycles.

### Warning Lamp Indicators

The anti-lock brake system uses one amber ABS warning light to alert the driver of malfunctions in the system.

The amber ABS warning light will come on for numerous reasons. It warns the driver that the ABS has been disabled. Normal power-assisted braking remains but the wheels can lock during a panic stop while the indicator is on. Certain procedures must be followed to find the concern in this situation. They are explained in this section.

If system is OK, Code System Pass will be present.

### On-Board Diagnostics

The anti-lock brake control module is capable of performing on-board diagnostics using Rotunda NGS Tester 007-00500 or equivalent.

The anti-lock brake control module monitors system operation and can store all defined diagnostic trouble codes in its memory. It is important to understand that there are some concerns the anti-lock brake control module cannot recognize. Therefore, if a symptom exists and no diagnostic trouble codes are stored by the anti-lock brake control module, other diagnostic steps must be followed.

The module cannot store a diagnostic trouble code if there is no power to the module. This concern can be found by following the System Precheck procedures.



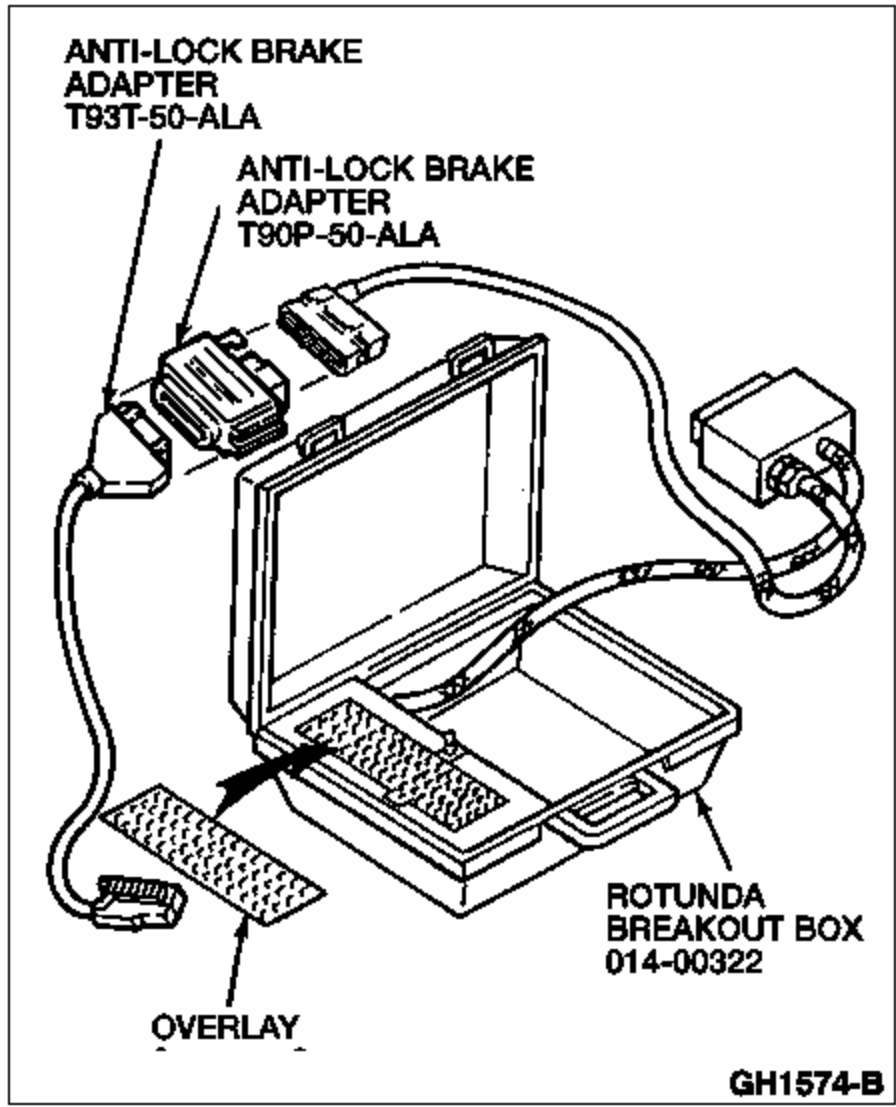
### **Diagnostic Trouble Codes, Retrieving**

The diagnostic trouble codes can be retrieved from the anti-lock brake control module in the following manner.

1. Connect the New Generation Star (NGS) Tester or equivalent to the ISO-9141 connector located under the steering column.
2. Turn on the tester and follow the menus provided to perform ABS code retrieval.
3. Record all the codes. "System Pass" indicates that no codes are stored.

### **Breakout Box Function**

1. Disconnect the 40-pin plug from the anti-lock brake control module.
2. Connect the Anti-Lock Brake Adapter T93T-50-ALA to the 40-pin plug on the vehicle harness.
3. Connect the adapter's 60-pin plug to the Breakout Box cable.
4. Install overlay box.
5. Refer to pinpoint test procedures for specific repair directions.





## Anti-Lock Electrical Quick Check Chart

This chart is used as a reference and is meant to be used in conjunction with the Rotunda Breakout Box 014-00322 or equivalent, the overlay and Anti-Lock Brake Adapter T93T-50-ALA.

Many of the values given for various components depend on the presence of a good ground at Pin 1.

**NOTE: The Pin 1 chassis ground must be verified as sound before any quick electrical check involving Pin 1 may be used. At any time, any known good chassis ground may be substituted for a Pin 1 designation.**

**NOTE: Connections between components must be verified as sound before replacement of affected components. Failure to observe above will often lead to improper replacement of components and incorrect resolution of concern. Replacement of good components will not resolve a vehicle wiring concern.**

Keep in mind that a measurement falling outside the specification can mean one of two things:

1. The wiring between two components is worn or damaged, or
2. The component is not electrically correct.

**NOTE: Perform the following measurements with Rotunda Digital/Analog Volt-Ohmmeter 105-R0053 or equivalent. Check DVOM accuracy.**

### ANTI-LOCK QUICK CHECK CHART

**NOTE: The correct overlay MUST be installed before making electrical checks.**

Measure Between				
Item to Be Tested	Ignition Mode	Pin Number(s)	Scale/Range	Specification
Anti-Lock Brake Control Module	Off	1 + Chassis Gnd	Ohms	Continuity
Ground Check	Off	14 + Chassis Gnd	Ohms	Continuity
	Off	17 + Chassis Gnd	Ohms	Continuity
Battery Power to Anti-Lock Brake Control Module Check	On	20 + 1	Volts	9.5V Minimum
Jumper Pins 1 + 19 (Energizing ABS Power Relay)	On	17 + 1	Volts	9.5V Minimum
Power from ABS Power Relay				Verify ABS Warning Lamp is OFF
ABS Power Relay Coil	Off	19 + 20	Ohms	52-68 Ohms
Pump Motor Relay Coil	Off	17 + 29	Ohms	52-68 Ohms
ABS Warning Light Ground Through System Relay	Off	17 + 1	Ohms	Continuity
IFR Isolation (Inlet) Valve	Off	17 + 34	Ohms	5-8 Ohms

Resistance				
IFL Isolations (Inlet) Valve Resistance	Off	17 + 40	Ohms	5-8 Ohms
IRA Isolation (Inlet) Valve Resistance	Off	17 + 33	Ohms	5-8 Ohms
OFR Dump (Outlet) Valve Resistance	Off	17 + 15	Ohms	3-6 Ohms
OFL Dump (Outlet) Valve Resistance	Off	17 + 26	Ohms	3-6 Ohms
ORA Dump (Outlet) Valve Resistance	Off	17 + 27	Ohms	3-6 Ohms
FR Wheel Speed Sensor Resistance	Off	23 + 36	k Ohms	1.0-1.4 k Ohms
FL Wheel Speed Sensor Resistance	Off	24 + 25	k Ohms	1.0-1.4 k Ohms
Sensor Output				
Rotate Front Wheels and Rear Axle @ 60 rpm				
FR (4x4)	Off	23 + 36	Hz and mV	5.8 mV/Hz or Greater
FR (4x2)	Off	23 + 36	Hz and mV	5.0 mV/Hz or Greater
FL (4x4)	Off	24 + 25	Hz and mV	5.8 mV/Hz or Greater
FL (4x2)	Off	24 + 25	Hz and mV	5.0 mV/Hz or Greater
Diode	Off	18 (Meter Polarity +) or 17 (Meter Polarity -)	Diode Check	0.5 Volts
Remove ABS Power Relay	Off	18 (Meter Polarity +) or 17 (Meter Polarity -)	Diode Check	Infinity m Ohms

**Note:** Check for continuity between Pin 1 and chassis ground or invalid results may be obtained. Results not matching specification indicate either a wiring or component concern. Further analysis is needed before any component is replaced. Refer to pinpoint tests for proper diagnostic procedures.

**Note:** To check wheel speed sensor output, measurements of BOTH the frequency and the voltage output must be taken. The actual speed the wheels are turning is not important — the result of voltage output divided by the frequency will not change with wheel speed. However, it is crucial that both the frequency measurement and the voltage output measurement be taken at the SAME wheel speed. If not using a Rotunda Fluke Frequency Meter 105-R0053, higher wheel speed may be required in order for the frequency meter to function correctly.



## Drive Test

### Purpose

This drive test will be used when either of two conditions exists.

1. Recommended Repair Verification

This drive procedure can be used after all vehicle repairs. Because the anti-lock brake control module is unable to detect some system concerns until the vehicle is being driven in a certain way, this drive test can be helpful in developing further confidence in the 4WABS system operation before delivery to the customer.

2. Symptom Evaluation Drive

When a vehicle is brought to the dealer, the customer may only have a general concern about the way the vehicle is braking. In these situations there may not be a clear system concern to troubleshoot. This drive test is designed to produce common system concern symptoms. Use this drive test to determine a symptom. Once a symptom is found, a symptom troubleshooting procedure can be followed to repair the vehicle.

### Drive Description

This is designed to be a generic drive test that is used for three purposes listed below.

1. To verify a repair of the ABS system on a vehicle.
2. To attempt to recreate an intermittent concern.
3. To attempt to detect a symptom when a diagnostic trouble code or a concern symptom is not known.

## PINPOINT TEST DT1: DRIVE TEST — CODE SYSTEM PASS

### DT1.1 LOW SPEED ABS STOP

**NOTE: Wetting down the area where stop is to be performed will aid this test.**

- Drive vehicle at approximately 16 km/h (10 mph).
- Spike brake pedal hard enough to lock all four wheels.

**NOTE: Momentary lockup is permissible.**

#### Does ABS cycle?

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Yes	No
ABS light is not on. GO to <a href="#">Symptom B</a> , Wheel Lockup.	Other symptoms are detected. GO to <a href="#">DT1.6</a> .
ABS light comes on and stays on. GO to <a href="#">DT1.7</a> .	ABS light is not on. GO to <a href="#">DT1.2</a> .

## DT1.2 CHECK FOR UNWARRANTED ABS ACTIVITY

- Drive vehicle at approximately 32 km/h (20 mph).
- Perform a light to medium (normal traffic) stop.
- Turn off the windshield wipers if they are on. Feel for pulsation in the brake pedal.

**NOTE:** In this event, the vehicle may pull as soon as the pump motor begins to run. If the vehicle does pull when the pump motor turns on, the front sensor opposite the pull should be checked using the [UNWARRANTED ABS ACTIVITY](#) Symptom Chart. If the pump motor turns on and no pull is felt, the rear speed sensor should be checked using the [UNWARRANTED ABS ACTIVITY](#) Symptom Chart.

- If a vehicle pulls immediately upon braking and the pump motor does not run, use the [VEHICLE PULLS WHILE BRAKING](#) Symptom to diagnose the concern.

Does the pump motor turn on and are brake pedal pulsations felt any time during the stop?

Yes	No
ABS light is not on. GO to <a href="#">Symptom A</a> , Unwarranted ABS Activity.	Other symptoms are detected. GO to <a href="#">DT1.6</a> .
ABS light comes on and stays on. GO to <a href="#">DT1.7</a> .	ABS light is not on. GO to <a href="#">DT1.3</a> .

## DT1.3 CHECK FOR HIGH SENSOR GAP

- Clear all codes.
- Key OFF.
- Start vehicle and select Drive Low (Automatic) or 1st forward gear (Manual).
- Allow vehicle to creep forward at idle for at least 45 seconds.

Does the ABS warning light come on?

Yes	No
GO to <a href="#">DT1.8</a> .	GO to <a href="#">DT1.4</a> .

## DT1.4 CHECK FOR marginally HIGH SENSOR GAP

- Clear all codes.



- Key OFF.
- Start vehicle and accelerate slowly to 40 km/h (25 mph). Let at least 45 seconds elapse before reaching 40 km/h (25 mph).

**Does the ABS warning light come on?**

Yes	No
GO to <a href="#">DT1.8</a> .	GO to <a href="#">DT1.5</a> .

## DT1.5 DRIVE TEST IS COMPLETE

**Has customer concern been addressed and corrected by previous actions?**

Yes	No
STOP. Vehicle ABS function has been verified.	GO to <a href="#">Intermittent Test</a> .

## DT1.6 DETERMINE NEXT DIAGNOSTIC STEP BASED ON BRAKE SYMPTOM

- Hard or soft brake pedal.
- Lack of sufficient vehicle deceleration upon brake application.
- Vehicle pulls during braking and pump motor does NOT run.

**Are any of the above symptoms present?**

Yes	No
GO to <a href="#">Symptom Chart</a> .	Concern is NOT in the ABS system. REFER to <a href="#">Section 06-00</a> for diagnosis.

## DT1.7 OBTAIN DIAGNOSTIC TROUBLE CODE

- Obtain ABS diagnostic trouble code.

**Is the diagnostic trouble code the same as before and the ENTIRE pinpoint test for the code completed?**

Yes	No
PERFORM <a href="#">Intermittent Diagnosis</a> .	Pinpoint test is NOT complete. RETURN to the last step completed in the pinpoint test.  Code obtained is NOT the same. GO to the pinpoint for the code obtained.  No code or Code System Pass is obtained. GO to <a href="#">System Precheck</a> .

**DT1.8 DETERMINE WHICH SENSOR SIGNAL IS INCORRECT**

- Obtain diagnostic trouble code.

Is code obtained C1155, C1145, C1230, C1158, C1148, C1229, C1258, C1259, C1260, C1233, C1234, C1237?

Yes	No
GO to appropriate sensor output pinpoint test.	Code System Pass is not obtained. GO to the pinpoint test for the code obtained.  No code or Code System Pass is obtained. GO to <a href="#">Inspection and Verification System Precheck</a> .

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## Intermittent Diagnostic Guidelines

As previously mentioned, intermittent concerns are the most difficult concerns to diagnose.

An understanding of code storage and automatic code erasure is important.

First, codes can only be stored if the anti-lock brake control module has power. The anti-lock brake control module gets primary power from the ignition feed into Pin 20. If this voltage is missing or less than 9.5V, the anti-lock brake control module will not initialize and therefore, a code cannot be stored. A System Pass (system OK) will be present whenever the module sees the required voltage assuming no other failures are present.

A previously stored diagnostic trouble code will be automatically erased if no system concerns occur for 80 ignition cycles.

Therefore, some codes read out in the System Precheck may not result in any trouble found in the pinpoint test performed. In most cases, this is an indication of an intermittent electrical concern.

To minimize misdiagnosis, use the [Intermittent Diagnosis Procedure](#) if no resolution has been reached by the end of a particular pinpoint test.

If you are at this point because the warning light is on and you have been unable to obtain any code, go to [Pinpoint Test V](#). This procedure is only meant to address those problems that have been reduced to an intermittent wiring concern.

## PINPOINT TEST ID: INTERMITTENT DIAGNOSIS PROCEDURE

### ID1 CLEAR CODES, RECONNECT COMPONENTS

- Remove the Rotunda Breakout Box 014-00322 or equivalent.
- Reinstall any components removed and remake all connections.
- Clear all codes.
- Key ON.

Does the ABS warning light prove out?

Yes	No
GO to <a href="#">ID3</a> .	GO to <a href="#">ID2</a> .

### ID2 SERVICE CONNECTOR/TERMINAL CONCERN

- Most likely concern is at one of the affected component connectors such that terminals unseat or

back out upon installation. At EACH affected connection, including intermediate connections, look for:

- Bent terminals.
- Damaged connector terminal locks.
- Damaged connector wedge.

**NOTE: If one of the above conditions is found, check the tightness of the affected circuit once the connection is remade. If the wire is too tight (short), damage is likely to recur once vehicle is given back to the customer. Service the wire as necessary to correct tight wire conditions.**

Are any of the above conditions noted?

Yes	No
SERVICE connector and terminal as necessary. GO to <a href="#">ID5</a> .	GO to <a href="#">ID6</a> .

### ID3 WIGGLE TEST

- Leave key ON.
- Wiggle an affected circuit in one location only.

**NOTE: Start at one component and wiggle connector by connector until the whole circuit has been tested.**

- Observe ABS warning light.

Is the ABS warning light on?

Yes	No
Key off. GO to <a href="#">ID5</a> .	GO to <a href="#">ID4</a> .

### ID4 VERIFY ALL CIRCUITS HAVE BEEN TESTED

Have all affected circuits for the code being serviced been tested?

Yes	No
Key off. GO to <a href="#">ID6</a> .	GO to <a href="#">ID3</a> and CHECK next circuit.

### ID5 RETRIEVE CODE

- Retrieve code.

Is this code different than the code being serviced?

Yes	No
	REPAIR the wire, terminal, or connector as

GO to the appropriate pinpoint test.	necessary. RETURN to the pinpoint test and PROCEED.
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## ID6 VERIFY ALL APPROPRIATE DIAGNOSTIC PROCEDURES HAVE BEEN RUN

- Has the System Precheck been run and a code been retrieved?

**NOTE: If only some tests were performed, go to the pinpoint step last completed and continue.**

**Have all steps of the pinpoint and symptom tests for the codes being serviced been performed?**

Yes	No
RETURN to the pinpoint test and PROCEED.	RETURN to procedure(s) not yet performed and PROCEED.

**DIAGNOSTIC TROUBLE CODE INDEX****DIAGNOSTIC TROUBLE CODE INDEX**

<b>DTC</b>	<b>Concern</b>	<b>Sets At</b>	<b>Pinpoint Test</b>
B1342	Anti-Lock Brake Control Module Failure	Key On	Replace Anti-Lock Brake Control Module
C1101	ABS Hydraulic Valve Circuit Failure	Key On	A
C1185	ABS Power Relay Output Circuit Failure	Key On	B
B1317	Battery Voltage High	Key On	C
B1318	Battery Voltage Low	Key On	D
C1198	LF Inlet Valve Coil Circuit Failure	Key On	E
C1194	LF Outlet Valve Coil Circuit Failure	Key On	F
C1214	RF Inlet Valve Coil Circuit Failure	Key On	G
C1210	RF Outlet Valve Coil Circuit Failure	Key On	H
C1206	Rear Axle Inlet Valve Coil Circuit Failure	Key On	J
C1202	Rear Axle Outlet Valve Coil Circuit Failure	Key On	K
C1155	LF Wheel Speed Sensor Input Circuit Failure	Key On	L
C1158	LF Wheel Speed Sensor Coherency Fault	40 km/h (25 mph)	LL
C1258	LF Wheel Speed Comparison Failure	19 km/h (12 mph)	LL
C1233	LF Wheel Speed Sensor Input Missing	>2 Min.	LL
C1145	RF Wheel Speed Sensor Input Circuit Failure	Key On	M
C1148	RF Wheel Speed Sensor Coherency Fault	40 km/h (25 mph)	MM
C1259	RF Wheel Speed Comparison Fault	19 km/h (12 mph)	MM
C1234	RF Wheel Speed Sensor Input Missing	>2 Min.	MM
C1230	Rear Axle Wheel Speed Sensor Input Circuit Failure	Key On	N
C1229	Rear Axle Wheel Speed Sensor Coherency Fault	40 km/h (25 mph)	NN
C1260	Rear Axle Wheel Speed Sensor Wheel Speed Comparison Fault	19 km/h (12 mph)	NN
C1237	Rear Axle Wheel Speed Sensor Input Missing	>2 Min.	NN
C1096	ABS Hydraulic Pump Motor Circuit	7 km/h (4 mph)	S
C1102	ABS Acceleration Switch Circuit Failure	See NOTE Below	T
C1095	ABS Hydraulic Pump Motor Circuit Failure	Key On	U

**Note:** DTC C1102 indicates a G-Switch circuit failure. If the yellow ABS warning lamp comes on at key ON, check for a ground short on Pins 30, 31, or 32. If the yellow ABS lamp comes on at approximately 32 km/h (20 mph), there is either: 1) a battery short on Pins 30, 31 or 32; 2) an open on Pins 30 and 31; or 3) an open on Pin 32. If the yellow ABS lamp comes on after driving the vehicle for 2 minutes at approximately 72 km/h (45 mph), check for an open on Pin 30 or 31 (one pin only).

The G-Switch is installed on 4x4 vehicles only. If an anti-lock brake control module from a 4x4 vehicle is installed on a 4x2 vehicle, the DTC 1102 will be stored and the yellow ABS lamp will be illuminated. The anti-lock brake control module can be reprogrammed with the New Generation Star (NGS) Tester.

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## Pinpoint Tests

**NOTE: Do not proceed to any pinpoint test unless directed to do so.**

These tests are specific for each code. However, jumping to a pinpoint test as a first step can be misleading. The tests have been written under the assumption that the System Precheck has been performed and passed.

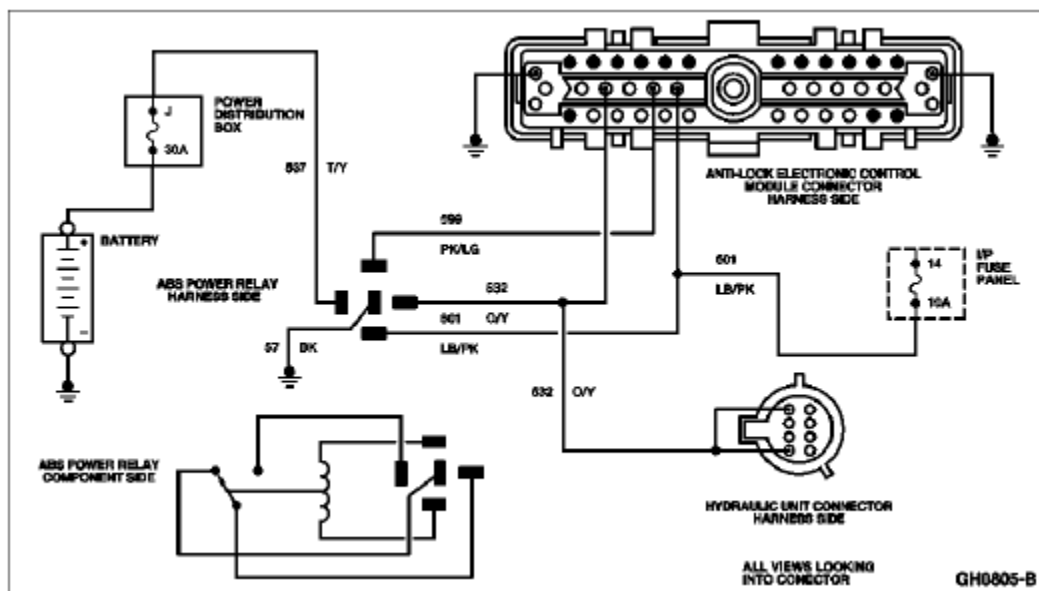
At times, running completely through the pinpoint test will not lead to problem resolution. Often, the concern is due to an intermittent connection, termination, or circuit concern. Refer to the [Intermittent Diagnosis Guides](#) in this section when situations like this arise.

It should be also noted that several circuits pass through one or more interconnections between components. These are also areas of potential concern and should be considered.

**NOTE: Use Rotunda New Generation Star (NGS) Tester 007-00500 or equivalent to perform electrical tests.**

### PINPOINT TEST A: ABS HYDRAULIC VALVE CIRCUIT FAILURE (CODE C1101)

#### Affected Circuit(s)/Electrical Component(s)



#### Description



DTC C1101 is generated when the ECU detects an intermittent circuit failure in the HCU valves or valve wiring harness.

### Possible Contributing Component/Vehicle Wiring Faults

#### DTC C1101

- Intermittent valve failures.
- Intermittent wiring condition in Circuit 532 (O/Y) to both Pins 1 and 4 of the 8-pin HCU valve block connector.

### A1 MEASURE VALVE RESISTANCE AT HCU

- Disconnect 8-pin connector from HCU.
- Measure resistance between the following on the COMPONENT side of the 8-way:
  - Pin 1, Pin 4 and Pin 2 (RA Inlet) 5-8 Ohms
  - Pin 1, Pin 4 and Pin 3 (RA Outlet) 3-6 Ohms
  - Pin 1, Pin 4 and Pin 5 (FR Inlet) 5-8 Ohms
  - Pin 1, Pin 4 and Pin 6 (FR Outlet) 3-6 Ohms
  - Pin 1, Pin 4 and Pin 7 (FL Inlet) 5-8 Ohms
  - Pin 1, Pin 4 and Pin 8 (FL Outlet) 3-6 Ohms

**NOTE: The valve resistance will change rapidly. While monitoring valve coil resistance, tap the anti-lock hydraulic control unit lightly with a rubber mallet to simulate conditions of rough road driving.**

Does the resistance on any valve move out of specification at any time?

Yes	No
High or low valve resistance detected. REPLACE HCU. PERFORM ABS brake bleed procedure with bleeder box. GO to <a href="#">A5</a> .	GO to <a href="#">A2</a> .

### A2 TEST FOR INTERMITTENT INTERNAL VALVE BLOCK SHORT

- Measure resistance between the following on the COMPONENT side of the HCU 8-pin connector:
  - Pin 1 and valve block.
  - Pin 4 and valve block.

**NOTE: The valve resistance will change rapidly. While monitoring valve coil resistance, tap the anti-lock hydraulic control unit lightly with a rubber mallet to simulate conditions of rough road driving.**

Is the measured resistance less than 10M ohms at any time?

Yes	No
REPLACE HCU. PERFORM ABS brake bleed procedure with bleeder box. GO to <a href="#">A5</a> .	GO to <a href="#">A3</a> .

### A3 CHECK FOR INTERMITTENT BATTERY VOLTAGE AT HCU CONNECTOR

**NOTE:** The voltage reading will change rapidly.

- Install breakout box (BOB). Ensure that correct overlay is installed.
- Jumper BOB Pin 19 to Pin 1 or Pin 14.
- Set up DVOM to measure voltage between BOB Pin 17 and Pin 1 or Pin 14.
- While monitoring the voltage, tap the anti-lock hydraulic control unit lightly with a rubber mallet to simulate conditions of rough road driving.

**Does the voltage fall below 9 volts at any time?**

Yes	No
REPAIR source of high resistance or open circuit in one of the following: Circuit 532 (O/Y) between HCU and ABS power relay, Circuit 537 (T/Y) between battery and ABS power relay. GO to <a href="#">A5</a> .	GO to <a href="#">A4</a> .

### A4 CONCLUDE INTERMITTENT DIAGNOSIS

- Perform [Pinpoint Test ID](#), Intermittent Diagnosis Procedure for the affected circuits. Refer to the mini-schematic.

**Is wiring fault located?**

Yes	No
REPAIR wiring fault as required. GO to <a href="#">A5</a> .	REPLACE ECU. GO to <a href="#">A5</a> .

### A5 VERIFY CONCERN IS RESOLVED

- Key OFF.
- Reconnect and reassemble all components.
- Install NGS Tester.
- Key ON. Clear codes.
- Drive over rough road and through a car wash.
- Pull codes.

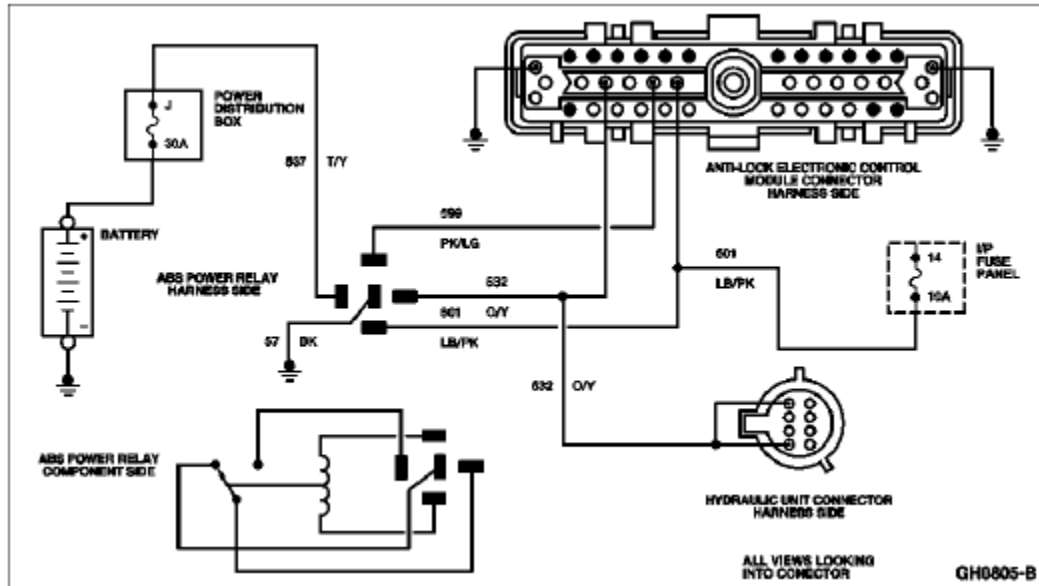
**Is System Pass obtained?**

Yes	No
STOP. Repair is complete.	Same code is present. REPEAT <a href="#">A1</a> to CHECK for second related concern.  A new code is present. GO to the appropriate

pinpoint test.

## PINPOINT TEST B: ABS POWER RELAY CIRCUIT OUTPUT FAILURE (CODE C1185)

### Affected Circuit(s)/Electrical Component(s)



### Description

DTC C1185 is generated when the ECU detects an open or ground short on Circuits 537 (T/Y), 599 (PK/LG) or 532 (O/Y).

### Possible Contributing Component/Vehicle Wiring Faults

DTC C1185

- Open or short to ground on Circuits 537 (T/Y), 599 (PK/LG) or 532 (O/Y).
- Open in Circuit 601 (LB/BK) to relay coil only. Circuit 601 to module intact.
- 30 amp fuse open.
- ABS power relay coil or contacts open.

### B1 CHECK FOR VOLTAGE AT PIN 17

- Measure and record battery voltage.
- Install breakout box (BOB). Ensure that correct overlay is installed.

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- Jumper breakout box Pin 19 to Pin 1 or Pin 14.
- Key ON. Measure voltage at BOB Pin 17.

Is voltage between 9.5 and 18 volts and within .5 volts of battery voltage?

Yes	No
GO to <a href="#">B2</a> .	GO to <a href="#">B4</a> .

## B2 VERIFY DTC C1185

- Key OFF.
- Reconnect ECU.
- Key ON.

Is ABS light on?

Yes	No
GO to <a href="#">B3</a> .	Intermittent fault. REFER to <a href="#">Pinpoint Test ID</a> , Intermittent Diagnosis Procedure for all affected circuits (REFER to mini-schematic).

## B3 RETRIEVE DTCS

- Connect NGS Tester and pull DTCS.

Is DTC C1185 present?

Yes	No
REPLACE ECU. GO to <a href="#">B14</a> .	GO to appropriate pinpoint test.

## B4 CHECK 30A FUSE

- Inspect 30A fuse for open.

Is fuse OK?

Yes	No
GO to <a href="#">B7</a> .	GO to <a href="#">B5</a> .

## B5 CHECK CIRCUIT 537 (T/Y) FOR GROUND SHORT

- Remove ABS power relay.
- Check for ground short on Circuit 537 (T/Y) between 30A fuse and relay connector.

**Is a ground short detected?**

Yes	No
REPAIR as required. GO to <a href="#">B14</a> .	GO to <a href="#">B6</a> .

**B6 CHECK CIRCUIT 532 (O/Y) FOR GROUND SHORT**

- Remove ABS power relay.
- Disconnect 8-way HCU valve connector.
- Check for ground short on Circuit 532 (O/Y) between relay connector, BOB Pin 17, and HCU 8-way connector Pins 1 and 4.

**Is a ground short detected?**

Yes	No
REPAIR as required. GO to <a href="#">B14</a> .	REPLACE relay. GO to <a href="#">B14</a> .

**B7 CHECK POWER TO 30A FUSE**

- Remove 30A fuse.
- Key ON. Measure voltage at power side of fuse.
- Key OFF.

**Is B+ present?**

Yes	No
GO to <a href="#">B8</a> .	REPAIR power feed to 30A fuse. REFER to EVTm for power distribution. GO to <a href="#">B14</a> .

**B8 CHECK CIRCUIT 537 (T/Y) FOR OPEN**

- Key OFF.
- Remove ABS power relay.
- Measure resistance between relay and 30A fuse along Circuit 537 (T/Y).
- Install fuse.

**Is resistance less than 1 ohm?**

Yes	No
GO to <a href="#">B9</a> .	REPAIR open/high resistance in Circuit 537 (T/Y) as required. GO to <a href="#">B14</a> .

**B9 CHECK CIRCUIT 599 (PK/LG) FOR GROUND SHORT**

- Key OFF.
- Check for ground short at Circuit 599 (PK/LG) (BOB Pin 19).

**Is circuit OK?**

Yes	No
GO to <a href="#">B10</a> .	REPAIR Circuit 599 (PK/LG) for ground short. GO to <a href="#">B14</a> .

**B10 CHECK CIRCUIT 599 (PK/LG) FOR OPEN**

- Key OFF.
- Measure resistance between ABS power relay and BOB Pin 19 along Circuit 599 (PK/LG).

**Is resistance less than 1 ohm?**

Yes	No
GO to <a href="#">B11</a> .	REPAIR open/high resistance in Circuit 599 (PK/LG) as required. GO to <a href="#">B14</a> .

**B11 CHECK CIRCUIT 532 (O/Y) FOR OPEN**

- Key OFF.
- Measure resistance between ABS power relay and BOB Pin 17 along Circuit 532 (O/Y).

**Is resistance less than 1 ohm?**

Yes	No
GO to <a href="#">B12</a> .	REPAIR open/high resistance in Circuit 532 (O/Y) as required. GO to <a href="#">B14</a> .

**B12 CHECK RELAY COIL**

- Remove ABS power relay.
- Measure resistance across relay coil (terminals 85 and 86).

**Is resistance between 60 and 80 ohms?**

Yes	No
GO to <a href="#">B13</a> .	REPLACE relay. GO to <a href="#">B14</a> .

**B13 CHECK VOLTAGE TO RELAY COIL**

- Key ON. Measure voltage at Circuit 601 (LB/BK) on ABS power relay connector.

- Key OFF.

**Is B+ present?**

Yes	No
REPLACE ABS power relay. RETEST.	REPAIR open in Circuit 601 (LB/BK) between splice and relay. REFER to mini-schematic. GO to <a href="#">B14</a> .

**B14 VERIFY CONCERN IS RESOLVED**

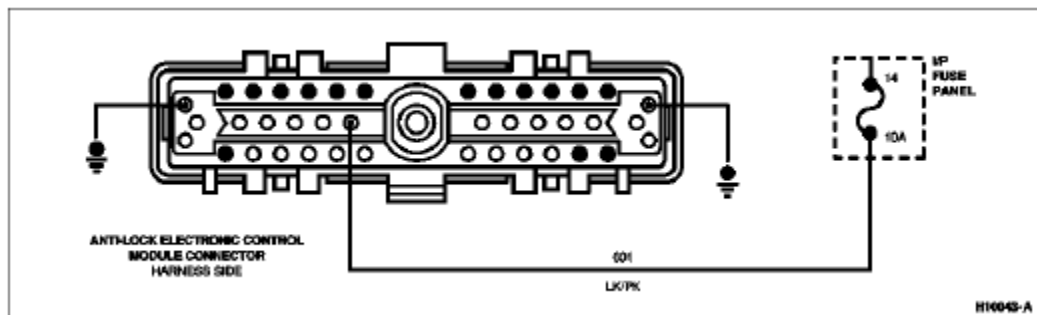
- Key OFF.
- Reconnect and reassemble all components.
- Connect NGS Tester.
- Key ON. Clear codes.
- Perform Drive Test DT1.
- Pull codes.

**Is System Pass obtained?**

Yes	No
STOP. Repair is complete.	Same code is present. REPEAT <a href="#">B1</a> to CHECK for second related concern.  A new code is present. GO to the appropriate pinpoint test.

**PINPOINT TEST C: BATTERY VOLTAGE HIGH (CODE B1317)**

**Affected Circuit(s)/Electrical Component(s)**



**Description**

DTC B1317 is generated when the ECU detects system voltage was greater than 18.0 volts for more than 5 seconds.

### Possible Contributing Component/Vehicle Wiring Faults

DTC B1317

- 24 volt jump.
- Charging system over-voltage condition.

## C1 CHECK RECENT VEHICLE HISTORY

- The most likely cause for DTC B1317 is jump-starting the vehicle with a 24 volt system used on many towing repairs.

**Has the vehicle been jump-started by a towing service within the past two weeks?**

Yes	No
STOP. Repair is complete.	GO to <a href="#">C2</a> .

## C2 MEASURE VOLTAGE AT PIN 20

- Key ON, engine running. Measure voltage at BOB Pin 20.

**Is voltage 18 volts or greater?**

Yes	No
REPAIR charging system for over-voltage condition.	GO to <a href="#">C3</a> .

## C3 CHECK ECU

- Key OFF.
- Reconnect and reassemble all components.
- Install NGS Tester.
- Key ON. Clear codes.
- Key OFF.
- Key ON, pull codes.

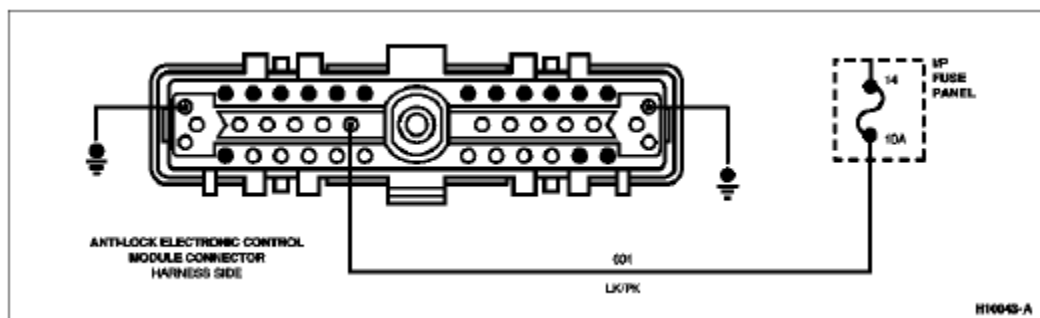
**Is System Pass obtained?**

Yes	No
REPAIR charging system for intermittent over-voltage condition.	DTC B1317 is present. REPLACE ECU. A new code is present. GO to the appropriate pinpoint test.



## PINPOINT TEST D: BATTERY VOLTAGE LOW (CODE B1318)

### Affected Circuit(s)/Electrical Component(s)



### Description

DTC B1318 is generated when the ECU detects system voltage was less than 9.5 volts for more than 5 seconds.

### Possible Contributing Component/Vehicle Wiring Faults

DTC B1318

- Charging system under-voltage condition.
- Excessive resistance in ECU ground circuits (Pins 1 and 14).
- Excessive resistance in Circuit 601 (LB/PK) to Pin 20.

### D1 MEASURE BATTERY VOLTAGE B+

- Measure and record battery voltage

Is battery voltage greater than 9.5 volts?

Yes	No
GO to <a href="#">D2</a> .	REPAIR charging system for under-voltage condition.

### D2 VERIFY DTC B1318

- Connect NGS Tester.
- Key ON, clear codes.
- Key OFF.
- Key ON, pull codes.

#### Is DTC B1318 present?

Yes	No
GO to <a href="#">D3</a> .	A new code is present. GO to appropriate pinpoint test.  System Pass is obtained. Concern is intermittent. PERFORM <a href="#">Pinpoint Test ID</a> , Intermittent Diagnosis Procedure on all affected circuits. REFER to mini-schematic.

### D3 CHECK ECU GROUND

- Install breakout box (BOB). Ensure that correct overlay is installed.
- Inspect ground stud for corrosion.
- Measure resistance between BOB Pins 1 and 14 and chassis ground.

#### Is resistance less than 0.5 ohm?

Yes	No
REPLACE ECU. GO to <a href="#">D4</a> .	REPAIR high resistance in ECU ground circuit. GO to <a href="#">D4</a> .

### D4 VERIFY CONCERN IS RESOLVED

- Key OFF.
- Reconnect and reassemble all components.
- Install NGS Tester.
- Key ON. Clear codes.
- Perform [Drive Test DT1](#).
- Pull codes.

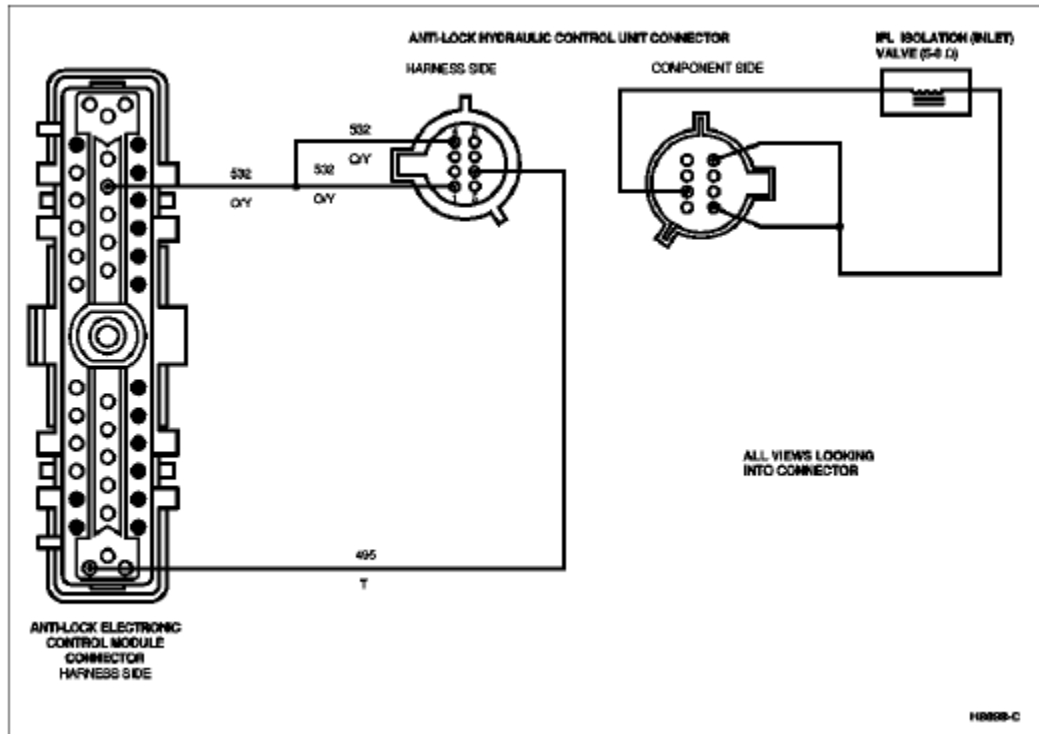
#### Is System Pass obtained?

Yes	No
STOP. Repair is complete.	Same code is present. REPEAT <a href="#">D1</a> to CHECK for second related concern.  A new code is present. GO to the appropriate pinpoint test.

## PINPOINT TEST E: LF INLET SOLENOID VALVE CONCERN DIAGNOSIS (CODE

**C1198)****Possible Code(s)**

DTC C1198 — Open circuit to valve block or anti-lock brake control module, open or shorted valve coil or internal anti-lock electronic control module defect.

**Affected Circuit(s)/Electrical Component(s)****Description**

Code C1198 is generated by the ECU's detection of an open or shorted Circuit 495 (T) and by an open or shorted inlet front left (IFL) valve coil or an open or shorted driver in the anti-lock brake control module.

**Possible Contributing Component/Vehicle Wiring Concerns**

- Intermittent open Circuit 495 (T).
- Terminal backout in anti-lock brake control module connector Pins 17 and 40.
- Terminal backout in valve block connector Pins 1, 4 and 6.
- Open or shorted inlet front left (IFL) valve coil.
- Open or shorted driver in anti-lock brake control module.

**E1 DIAGNOSTIC TROUBLE CODE C1198: CHECK VALVE COIL, CIRCUIT 495 (T) AND THE ANTI-LOCK ELECTRONIC CONTROL MODULE**

- Ignition OFF.
- Install Rotunda Breakout Box 014-00322 or equivalent and Overlay.
- Verify terminals at Pins 17 and 40 are clean and secure in the anti-lock brake control module harness connector.
- Measure resistance between Pins 17 and 40.

Is reading between 5 and 8 ohms?

Yes	No
GO to <a href="#">E5</a> .	GO to <a href="#">E2</a> .

## E2 CHECK VALVE COIL

- Disconnect 8-pin valve block connector.
- Verify terminals on both halves of the 8-way connector are clean and secure.
- Measure resistance between Pins 1 and 6 and Pins 4 and 6 on the valve block.

Are both readings between 5 and 8 ohms?

Yes	No
REMOVE ABS power relay. REPAIR open or short to ground in Circuits 495 (T) and 532 (O/Y) between valve block harness connector and anti-lock brake control module connector. INSTALL relay. GO to <a href="#">E4</a> .	REPLACE HCU. GO to <a href="#">E4</a> .

## E3 CHECK IF ALL STEPS HAVE BEEN COMPLETED

- This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified.



**CAUTION:** If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.

Have all prior diagnostic steps been completed as described above?

Yes	No
REPLACE anti-lock brake control module. GO to <a href="#">E4</a> .	GO to last diagnostic step completed and CONTINUE.

## E4 CHECK FOR CODE REPEATABILITY

- Clear all codes.
- Key OFF.
- Key ON.

- Retrieve code(s).

**Is Code System Pass set?**

Yes	No
<p>Concern has been corrected. Go to <a href="#">E5</a>.</p>	<p>Code C1198 still exists. GO to <a href="#">E3</a>.</p> <p>Different code is set. GO to appropriate pinpoint test.</p> <p>Code C1198 still exists and anti-lock brake control module has been replaced.</p> <p><b>NOTE: The anti-lock system is disabled with the Rotunda Breakout Box 014-00322 or equivalent installed.</b></p> <p>INSTALL Rotunda Breakout Box 014-00322 with overlay. REPEAT Test Step <a href="#">E1</a> while DRIVING vehicle. LOOK for any change in indicated continuity (turning on the DVOM beeper will help).</p> <p>INSPECT Circuits 532 and 495 along their entire length from the sensor connector to the anti-lock brake control module harness connector for chafing or any other damage that could lead to any open or shorted condition. REPAIR as required.</p>

**E5 VERIFY INTEGRITY OF VEHICLE WIRING**

**NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.**

- Refer to [Pinpoint Test ID](#), Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic.

**Is resolution achieved?**

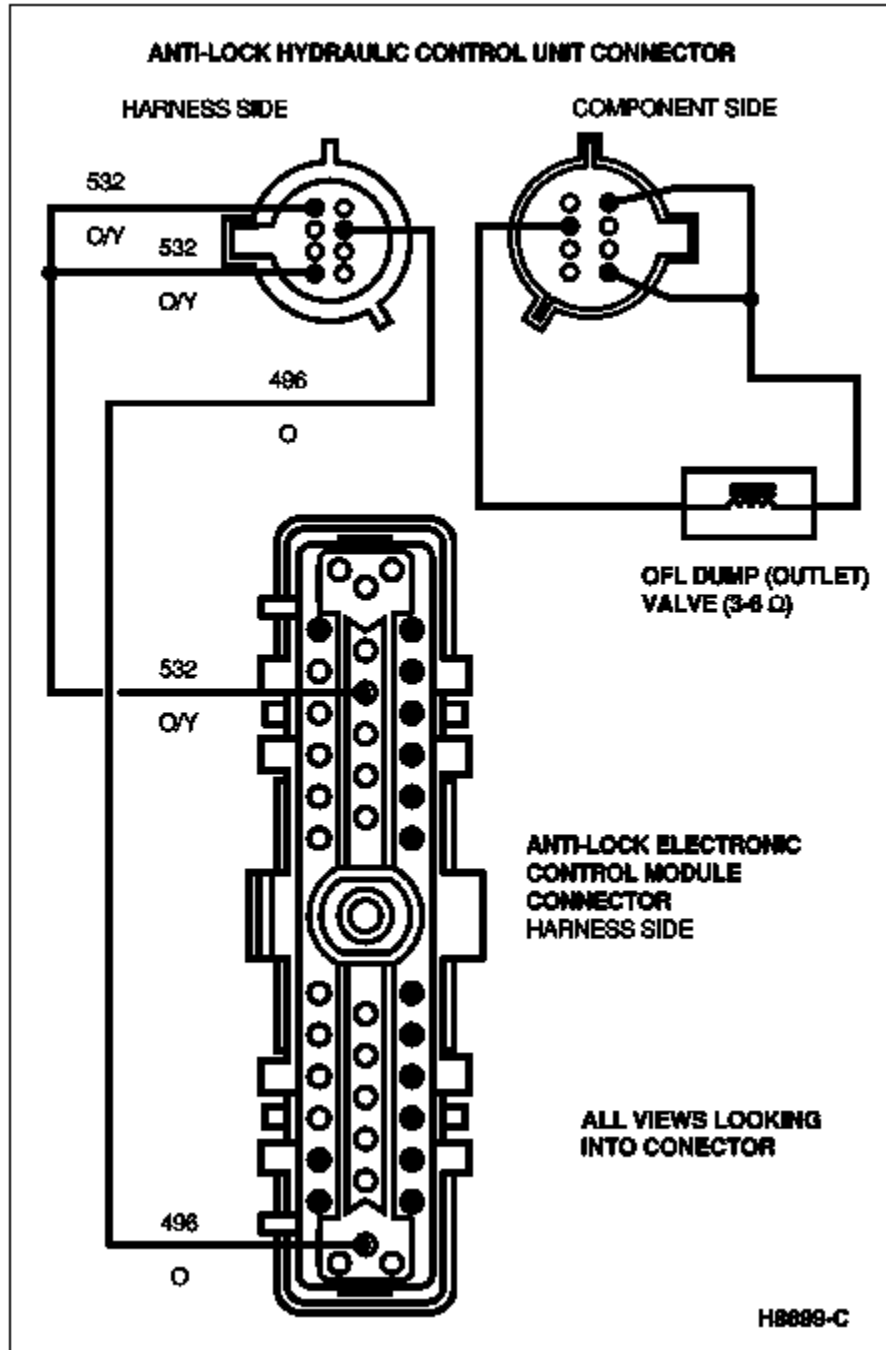
Yes	No
<p>GO to <a href="#">E4</a> for system OK verification.</p>	<p>Most likely concern is HCU. REPLACE HCU. PERFORM anti-lock bleed procedure. GO to <a href="#">E4</a>.</p>

**PINPOINT TEST F: LF OUTLET SOLENOID CONCERN DIAGNOSIS (CODE C1194)**

**Possible Code(s)**

C1194 — Open circuit to valve block or anti-lock brake control module, open or shorted valve coil or internal anti-lock electronic control module damage.

**Affected Circuit(s)/Electrical Component(s)**



**Description**

Code C1194 is generated by the anti-lock electronic control module's detection of an open or shorted Circuit 496 (O) and by an open or shorted outlet front left (OFL) valve coil or an open or shorted driver in the anti-lock brake control module.

### Possible Contributing Component/Vehicle Wiring Concerns

- Intermittent open Circuit 496 (O).
- Terminal backout in anti-lock brake control module connector Pins 17 and 26.
- Terminal backout in valve block connector Pins 1, 4, and 7.
- Open or shorted outlet front left (OFL) valve coil.
- Open or shorted driver in anti-lock brake control module.

### F1 DIAGNOSTIC TROUBLE CODE C1194: CHECK VALVE COIL, CIRCUIT 496 AND THE ANTI-LOCK ELECTRONIC CONTROL MODULE

- Ignition OFF.
- Install Rotunda Breakout Box 014-00322 or equivalent and Overlay.
- Verify terminals at Pins 17 and 26 are clean and secure in the anti-lock brake control module harness connector.
- Measure resistance between Pins 17 and 26.

Is reading between 3 and 6 ohms?

Yes	No
GO to <a href="#">F5</a> .	GO to <a href="#">F2</a> .

### F2 CHECK VALVE COIL

- Disconnect 8-pin valve block connector.
- Verify terminals on both halves of the valve block 8-way connector are clean and secure.
- Measure resistance between Pins 1 and 7 and Pins 4 and 7 on the valve block.

Are both readings between 3 and 6 ohms?

Yes	No
REMOVE ABS power relay. SERVICE open or short to ground in Circuits 496 (O) and 532 (O/Y) between valve block harness connector and anti-lock brake control module connector. INSTALL relay. GO to <a href="#">F4</a> .	REPLACE HCU. GO to <a href="#">F4</a> .

### F3 CHECK IF ALL STEPS HAVE BEEN COMPLETED

- This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified.



**CAUTION:** If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.

**Have all prior diagnostic steps been completed as described above?**

Yes	No
REPLACE anti-lock brake control module. GO to <a href="#">F4</a> .	GO to last diagnostic step completed and CONTINUE.

**F4 CHECK FOR CODE REPEATABILITY**

- Clear all codes.
- Key OFF.
- Key ON.
- Retrieve code(s).

**Is Code System Pass set?**

Yes	No
Concern has been corrected. GO to <a href="#">F5</a> .	<p>Code C1194 still exists. GO to <a href="#">F3</a>.</p> <p>Different code is set. GO to appropriate pinpoint test.</p> <p>Code C1194 still exists and ECU has been replaced.</p> <p><b>NOTE: The anti-lock system is disabled with the Rotunda Breakout Box 014-00322 or equivalent installed.</b></p> <p>INSTALL Rotunda Breakout Box 014-00322 with overlay. REPEAT Test Step <a href="#">F1</a> while DRIVING vehicle. LOOK for any change in indicated continuity (turning on the DVOM beeper will help).</p> <p>INSPECT Circuits 532 (O/Y) and 496 (O) along their entire length from the sensor connector to the anti-lock brake control module harness connector for chafing or any other damage that could lead to any open or shorted condition. REPAIR as required.</p>

**F5 VERIFY INTEGRITY OF VEHICLE WIRING**

**NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.**

- Refer to [Pinpoint Test ID](#), Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic.

**Is resolution achieved?**



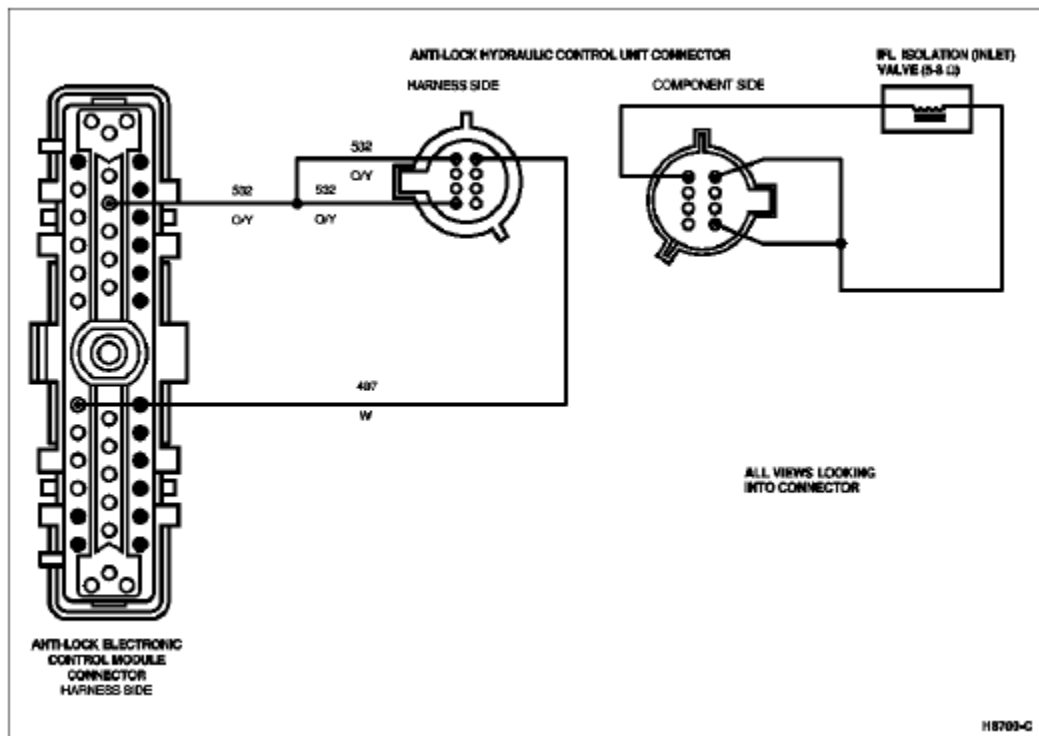
Yes	No
GO to <a href="#">F4</a> for system OK verification.	Most likely concern is in HCU. REPLACE HCU and PERFORM anti-lock bleed procedure. GO to <a href="#">F4</a> .

## PINPOINT TEST G: RF INLET SOLENOID VALVE CONCERN DIAGNOSIS (CODE C1214)

### Possible Code(s)

C1214 — Open circuit to valve block or anti-lock brake control module, open or shorted valve coil or internal anti-lock electronic control module damage.

### Affected Circuit(s)/Electrical Component(s)



### Description

Code C1214 is generated by the anti-lock electronic control module's detection of an open or shorted Circuit 497 (W) and by an open or shorted inlet front right (IFR) valve coil or an open or shorted driver in the anti-lock brake control module.

### Possible Contributing Component/Vehicle Wiring Concerns

- Intermittent open Circuit 497 (W).

- Terminal backout in anti-lock brake control module connector Pins 17 and 34.
- Terminal backout in valve block connector Pins 1, 4, and 8.
- Open or shorted inlet front right (IFR) valve coil.
- Open or shorted driver in anti-lock brake control module.

### G1 DIAGNOSTIC TROUBLE CODE C1214: CHECK VALVE COIL CIRCUIT 497 (W) AND THE ECU

- Ignition OFF.
- Install Rotunda Breakout Box 014-00322 or equivalent and Overlay.
- Verify terminals at Pins 17 and 34 are clean and secure in the anti-lock brake control module harness connector.
- Measure resistance between Pins 17 and 34.

Is reading between 5 and 8 ohms?

Yes	No
GO to <a href="#">G5</a> .	GO to <a href="#">G2</a> .

### G2 CHECK VALVE COIL

- Disconnect 8-pin valve block connector.
- Verify terminals on both halves of the valve block 8-way connector are clean and secure.
- Measure resistance between Pins 1 and 8 and Pins 4 and 8 on the valve block.

Are both readings between 5 and 8 ohms?

Yes	No
REMOVE ABS power relay. REPAIR open or short to ground in Circuits 497 (W) and 532 (O/Y) between valve block harness connector and anti-lock brake control module connector. INSTALL relay. GO to <a href="#">G3</a> .	REPLACE HCU. GO to <a href="#">G4</a> .

### G3 CHECK IF ALL STEPS HAVE BEEN COMPLETED

- This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified.



**CAUTION:** If not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.

Have all prior diagnostic steps been completed as described above?

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Yes	No
REPLACE anti-lock brake control module. GO to <a href="#">G4</a> .	GO to last diagnostic step completed and CONTINUE.

### G4 CHECK FOR CODE REPEATABILITY

- Clear all codes.
- Key OFF.
- Key ON.
- Retrieve code(s).

#### Is Code System Pass set?

Yes	No
Concern has been corrected. GO to <a href="#">G5</a> .	<p>Code C1214 still exists. GO to <a href="#">G3</a>.</p> <p>Different code is set. GO to appropriate pinpoint test.</p> <p>Code C1214 still exists and ECU has been replaced.</p> <p><b>NOTE: The anti-lock system is disabled with the Rotunda Breakout Box 014-00322 or equivalent installed.</b></p> <p>INSTALL Rotunda Breakout Box 014-00322 with overlay. REPEAT Test Step <a href="#">G1</a> while driving vehicle. LOOK for any change in indicated continuity (turning on the DVOM beeper will help).</p> <p>INSPECT Circuits 532 (O/Y) and 497 (W) along their entire length from the sensor connector to the anti-lock brake control module harness connector for chafing or any other damage that could lead to any open or shorted condition. REPAIR as required.</p>

### G5 VERIFY INTEGRITY OF VEHICLE WIRING

**NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.**

- Refer to [Pinpoint Test ID](#), Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic.

#### Is resolution achieved?

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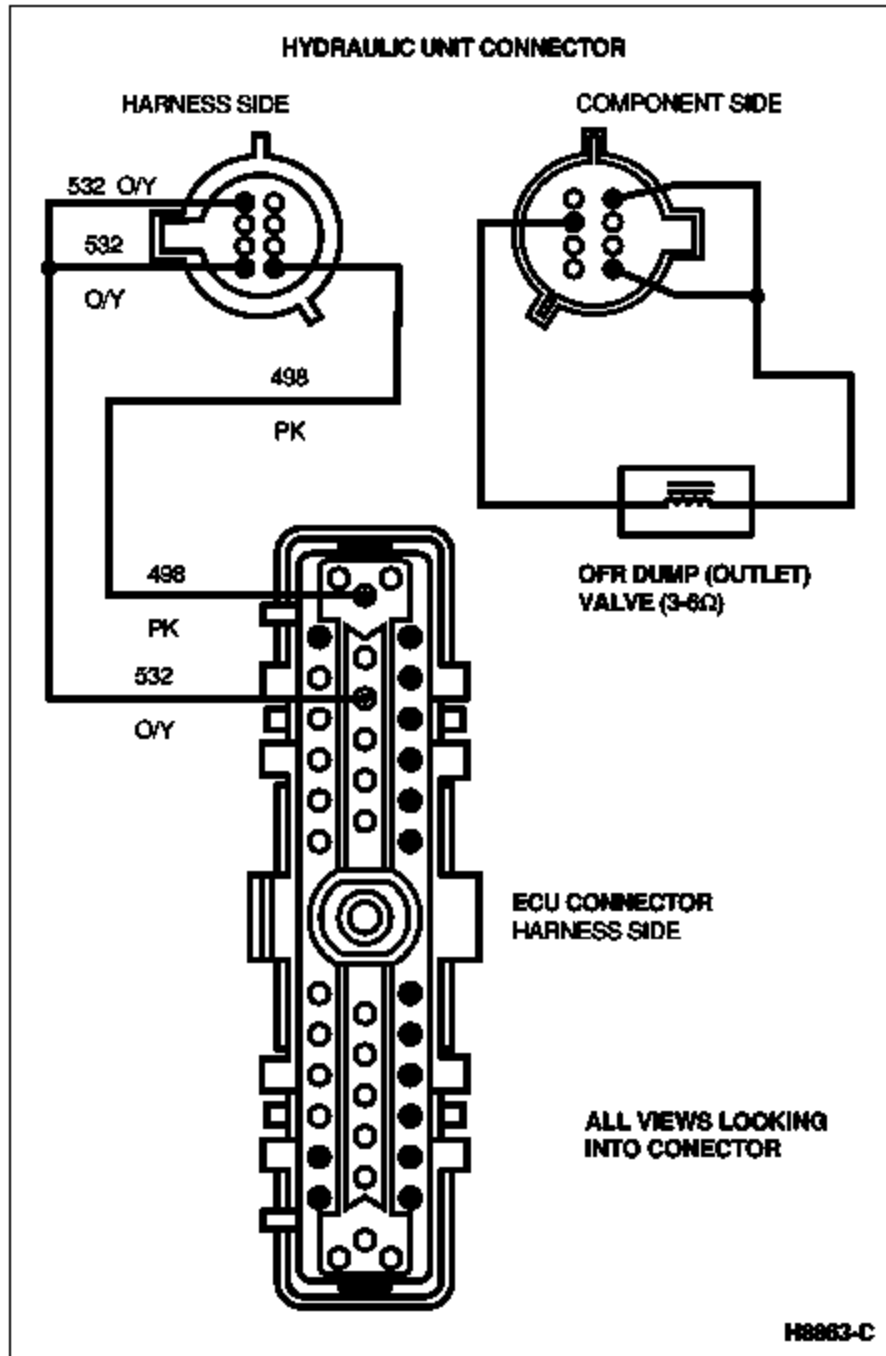
Yes	No
GO to <a href="#">G4</a> for system OK verification.	Most likely concern is in HCU. REPLACE HCU and PERFORM anti-lock bleed procedure. GO to <a href="#">G4</a> .

## **PINPOINT TEST H: RF OUTLET SOLENOID VALVE CONCERN DIAGNOSIS (CODE C1210)**

### **Possible Code(s)**

C1210 — Open circuit to valve block or anti-lock brake control module, open or shorted valve coil or internal anti-lock electronic control module damage.

### **Affected Circuit(s)/Electrical Component(s)**



### Description

Code C1210 is generated by the anti-lock electronic control module's detection of an open or shorted Circuit 498 (PK) and by an open or shorted outlet front right (OFR) valve coil or an open or shorted driver in the anti-lock brake control module.

### Possible Contributing Component/Vehicle Wiring Concerns

- Intermittent open Circuit 498 (PK).
- Terminal backout in anti-lock brake control module connector Pins 17 and 15.

- Terminal backout in valve block connector Pins 1, 4, and 5.
- Open or shorted outlet front right (OFR) valve coil.
- Open or shorted driver in anti-lock brake control module.

## H1 DIAGNOSTIC TROUBLE CODE C1210: CHECK VALVE COIL, CIRCUIT 498 AND THE ANTI-LOCK ELECTRONIC CONTROL MODULE

- Ignition OFF.
- Install Rotunda Breakout Box 014-00322 or equivalent and Overlay.
- Verify terminals at Pins 17 and 15 are clean and secure in the anti-lock brake control module harness connector.
- Measure resistance between Pins 17 and 15.

Is reading between 3 and 6 ohms?

Yes	No
GO to <a href="#">H5</a> .	GO to <a href="#">H2</a> .

## H2 CHECK VALVE COIL

- Disconnect 8-pin valve block connector.
- Verify terminals on both halves of the valve block 8-way connector are clean and secure.
- Measure resistance between Pins 1 and 5 and Pins 4 and 5 on the valve block.

Are both readings between 3 and 6 ohms?

Yes	No
REMOVE ABS power relay. REPAIR open or short to ground in Circuits 498 (PK) and 532 (O/Y) between valve block harness connector and anti-lock brake control module connector. INSTALL relay. GO to <a href="#">H4</a> .	REPLACE HCU. GO to <a href="#">H4</a> .

## H3 CHECK IF ALL STEPS HAVE BEEN COMPLETED

- This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified.



**CAUTION:** If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.

Have all prior diagnostic steps been completed as described above?

Yes	No

REPLACE anti-lock brake control module. GO to <a href="#">H4</a> .	GO to last diagnostic step completed and CONTINUE.
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### H4 CHECK FOR CODE REPEATABILITY

- Clear all codes.
- Key OFF.
- Key ON.
- Retrieve code(s).

#### Is Code System Pass set?

Yes	No
Concern has been corrected. GO to <a href="#">H5</a> .	<p>Code C1210 still exists. GO to <a href="#">H3</a>.</p> <p>Different code is set. GO to appropriate pinpoint test.</p> <p>Code C1210 still exists and anti-lock brake control module has been replaced.</p> <p><b>NOTE: The anti-lock system is disabled with the Rotunda Breakout Box 014-00322 or equivalent installed.</b></p> <p>INSTALL Rotunda Breakout Box 014-00322 with overlay. REPEAT Test Step <a href="#">H1</a> while driving vehicle. LOOK for any change in indicated continuity (turning on the DVOM beeper will help).</p> <p>INSPECT Circuits 532 (O/Y) and 498 (PK) along their entire length from the sensor connector to the anti-lock brake control module harness connector for chafing or any other damage that could lead to any open or shorted condition. REPAIR as required.</p>

### H5 VERIFY INTEGRITY OF VEHICLE WIRING

**NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.**

- Refer to [Pinpoint Test ID](#), Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic.

#### Is resolution achieved?

Yes	No

GO to [H4](#) for system OK verification.

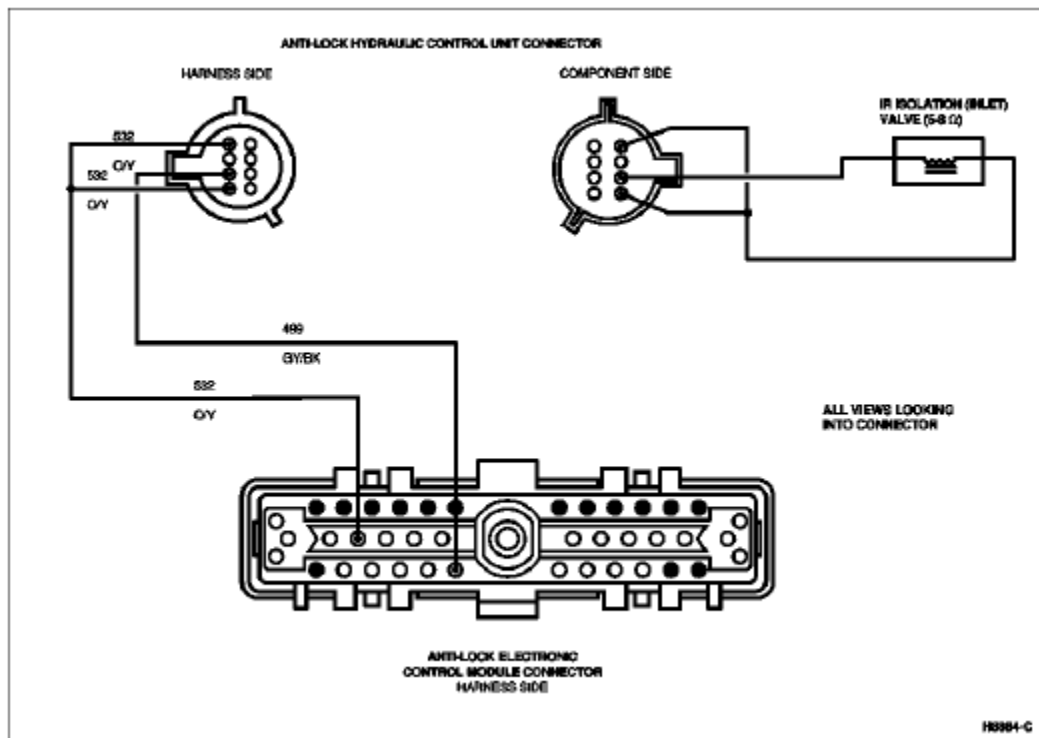
Most likely concern was in HCU. REPLACE HCU and PERFORM anti-lock bleed procedure. GO to [H4](#).

## PINPOINT TEST J: REAR AXLE INLET SOLENOID VALVE CONCERN DIAGNOSIS (CODE C1206)

### Possible Code(s)

C1206 — Open circuit to valve block or anti-lock brake control module, open or shorted valve coil or internal anti-lock electronic control module damage.

### Affected Circuit(s)/Electrical Component(s)



### Description

Code C1206 is generated by the anti-lock electronic control module's detection of an open or shorted Circuit 499 (GY/BK) and by an open or shorted inlet rear axle (IRA) valve coil or an open or shorted driver in the anti-lock brake control module.

### Possible Contributing Component/Vehicle Wiring Concerns

- Intermittent open Circuit 499 (GY/BK).
- Terminal backout in ECU connector Pins 17 and 33.



- Terminal backout in valve block connector Pins 1, 4, and 2.
- Open or shorted inlet rear axle (IRA) valve coil.
- Open or shorted driver in anti-lock brake control module.

### J1 DIAGNOSTIC TROUBLE CODE C1206: CHECK VALVE COIL, CIRCUIT 499 (GY/BK) AND THE ANTI-LOCK ELECTRONIC CONTROL MODULE

- Ignition OFF.
- Install Rotunda Breakout Box 014-00322 or equivalent and Overlay.
- Verify terminals at Pins 17 and 33 are clean and secure in the anti-lock brake control module harness connector.
- Measure resistance between Pins 17 and 33.

Is reading between 5 and 8 ohms?

Yes	No
GO to <a href="#">J5</a> .	GO to <a href="#">J2</a> .

### J2 CHECK VALVE COIL

- Disconnect 8-pin valve block connector.
- Verify terminals in both halves of the valve block 8-way connector are clean and secure.
- Measure resistance between Pins 1 and 2 and Pins 4 and 2 on the valve block.

Are both readings between 5 and 8 ohms?

Yes	No
REMOVE ABS power relay. REPAIR open or short to ground in Circuits 499 (GY/BK) or 532 (O/Y) between valve block harness connector and anti-lock brake control module connector. GO to <a href="#">J4</a> .	REPLACE HCU. GO to <a href="#">J4</a> .

### J3 CHECK IF ALL STEPS HAVE BEEN COMPLETED

- This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified.



**CAUTION:** If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.

Have all prior diagnostic steps been completed as described above?

Yes	No

REPLACE anti-lock brake control module. GO to <a href="#">J4</a> .	GO to last diagnostic step completed and CONTINUE.
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### J4 CHECK FOR CODE REPEATABILITY

- Clear all codes.
- Key OFF.
- Key ON.
- Retrieve code(s).

Is Code System Pass set?

Yes	No
Concern has been corrected. GO to <a href="#">J5</a> .	<p>Code C1206 still exists. GO to <a href="#">J3</a>.</p> <p>Different code is set. GO to appropriate pinpoint test.</p> <p>Code C1206 still exists and anti-lock brake control module has been replaced.</p> <p><b>NOTE: The anti-lock system is disabled with the Rotunda Breakout Box 014-00322 or equivalent installed.</b></p> <p>INSTALL Rotunda Breakout Box 014-00322 with overlay. REPEAT Test Step <a href="#">J1</a> while driving vehicle. LOOK for any change in indicated continuity (turning on the DVOM beeper will help).</p> <p>INSPECT Circuits 532 (O/Y) and 499 (GY/BK) along their entire length from the sensor connector to the anti-lock brake control module harness connector for chafing or any other damage that could lead to any open or shorted condition. REPAIR as required.</p>

### J5 VERIFY INTEGRITY OF VEHICLE WIRING

**NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.**

- Refer to [Pinpoint Test ID](#), Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic.

Is resolution achieved?

Yes	No

GO to [J4](#) for system OK verification.

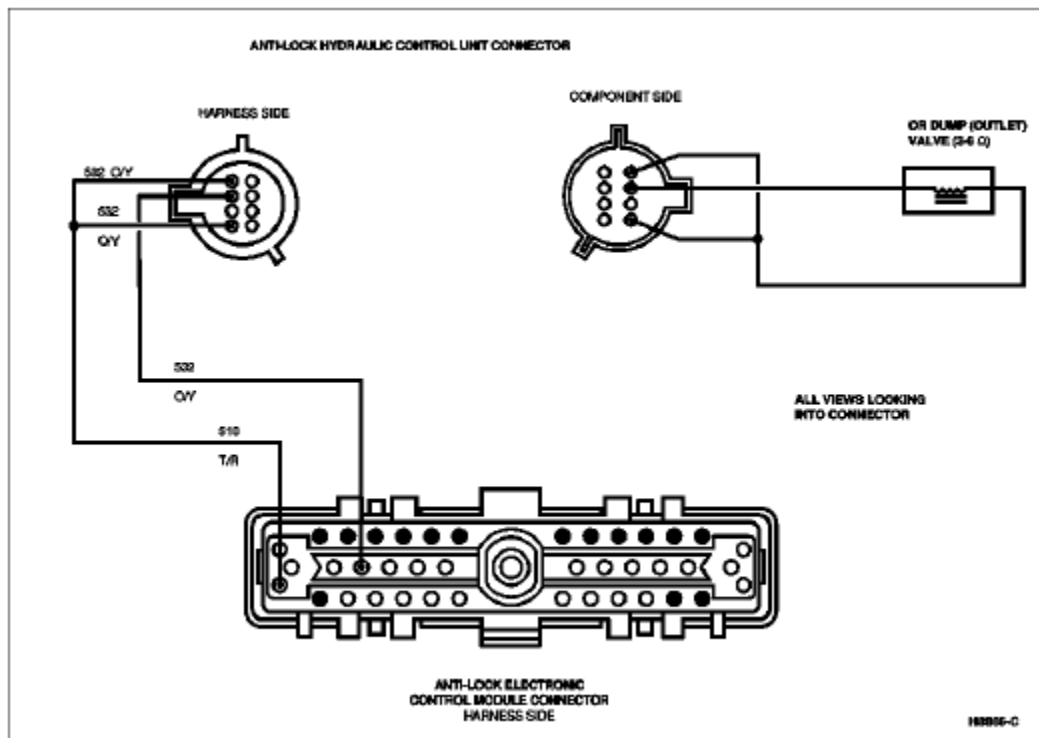
Most likely concern is in HCU. REPLACE HCU and PERFORM anti-lock bleed procedure. GO to [J4](#).

## PINPOINT TEST K: REAR AXLE OUTLET SOLENOID CONCERN DIAGNOSIS (CODE C1202)

### Possible Code(s)

C1202 — Open circuit to valve block or anti-lock brake control module, open or shorted valve coil or internal anti-lock electronic control module damage.

### Affected Circuit(s)/Electrical Component(s)



### Description

Code C1202 is generated by the anti-lock electronic control module's detection of an open or shorted Circuit 510 (T/R) and by an open or shorted outlet rear axle (ORA) valve coil or an open or shorted driver in the anti-lock brake control module.

### Possible Contributing Component/Vehicle Wiring Concerns

- Intermittent open Circuit 510 (T/R).
- Terminal backout in anti-lock brake control module connector Pins 17 and 27.

- Terminal backout in valve block connector Pins 1, 4, and 3.
- Open or shorted outlet rear axle (ORA) valve coil.
- Open or shorted driver in anti-lock brake control module.

### K1 DIAGNOSTIC TROUBLE CODE C1202: CHECK VALVE COIL, CIRCUIT 510 (T/R) AND THE ANTI-LOCK ELECTRONIC CONTROL MODULE

- Ignition OFF.
- Install Rotunda Breakout Box 014-00322 or equivalent and Overlay.
- Verify terminals at Pins 17 and 27 are clean and secure in the anti-lock brake control module connector.
- Measure resistance between Pins 17 and 27.

Is reading between 3 and 6 ohms?

Yes	No
GO to <a href="#">K5</a> .	GO to <a href="#">K2</a> .

### K2 CHECK VALVE COIL

- Disconnect 8-pin valve block connector.
- Verify terminals on both halves of the valve block 8-way connector are clean and secure.
- Measure resistance between Pins 1 and 3 and Pins 4 and 3 on the valve block.

Are both readings between 3 and 6 ohms?

Yes	No
REMOVE ABS power relay. REPAIR open or short to ground in Circuits 510 (T/R) or 532 (O/Y) between valve block harness connector and anti-lock brake control module connector. INSTALL relay. GO to <a href="#">K4</a> .	REPLACE HCU.

### K3 CHECK IF ALL STEPS HAVE BEEN COMPLETED

- This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified.



**CAUTION:** If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.

Have all prior diagnostic steps been completed as described above?

Yes	No

REPLACE anti-lock brake control module. GO to <a href="#">K4</a> .	GO to last diagnostic step completed and CONTINUE.
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### K4 CHECK FOR CODE REPEATABILITY

- Clear all codes.
- Key OFF.
- Key ON.
- Retrieve code(s).

Is Code System Pass set?

Yes	No
Concern has been corrected. GO to <a href="#">K5</a> .	<p>Code C1202 still exists. GO to <a href="#">K3</a>.</p> <p>Different code is set. GO to appropriate pinpoint test.</p> <p>Code C1202 still exists and Step K2 is complete.</p> <p><b>NOTE: The anti-lock system is disabled with the Rotunda Breakout Box 014-00322 or equivalent installed.</b></p> <p>INSTALL Rotunda Breakout Box 014-00322 with overlay. REPEAT Test Step <a href="#">K1</a> while driving vehicle. LOOK for any change in indicated continuity (turning on the DVOM beeper will help).</p> <p>INSPECT Circuits 532 (O/Y) and 499 (GY/BK) along their entire length from the sensor connector to the anti-lock brake control module harness connector for chafing or any other damage that could lead to any open or shorted condition. REPAIR as required.</p>

### K5 VERIFY INTEGRITY OF VEHICLE WIRING

**NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.**

- Refer to [Pinpoint Test ID](#), Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic.

Is resolution achieved?

Yes	No

GO to [K4](#) for system OK verification.

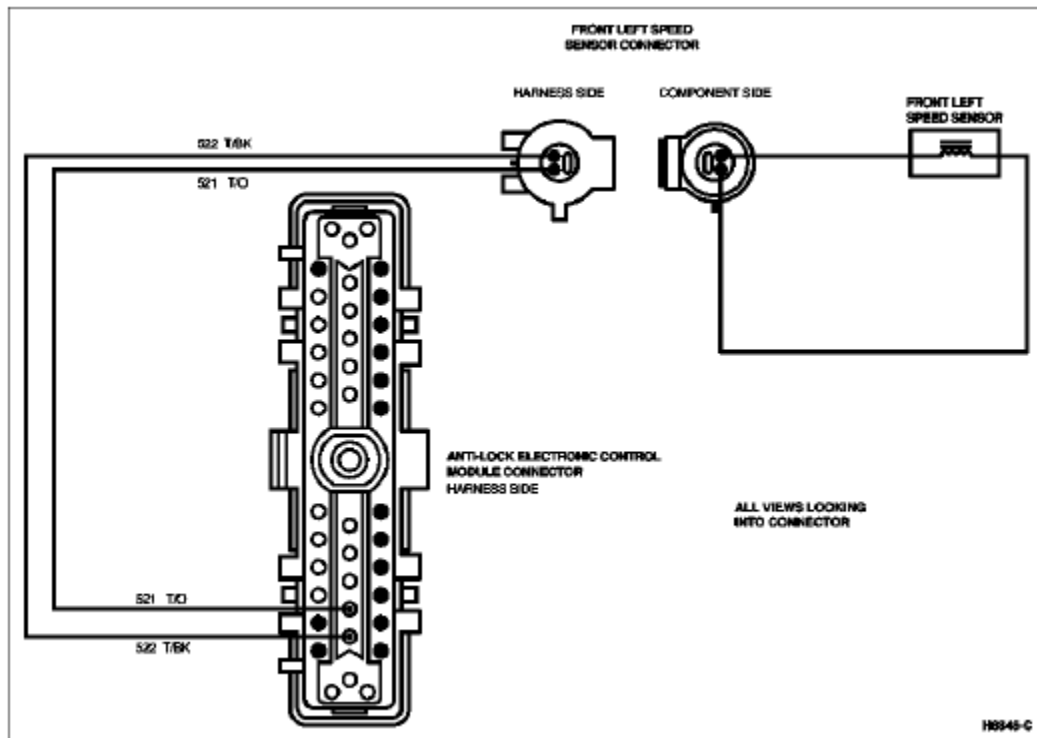
Most likely concern is in HCU. REPLACE HCU and PERFORM anti-lock bleed procedure. GO to [K4](#).

## PINPOINT TEST L: LF WHEEL SPEED SENSOR INPUT CIRCUIT FAILURE (STATIC) (CODE C1155)

### Possible Code(s)

C1155 — Electrically shorted or open front left speed sensor circuit or coil.

### Affected Circuit(s)/Electrical Component(s)



### Description

Code C1155 is generated by the anti-lock electronic control module's detection of an open or shorted wheel speed sensor coil or an open or shorted condition in Circuits 521 (T/O) or 522 (T/BK) between the wheel speed sensor and the anti-lock brake control module. If this fault is detected during the anti-lock electronic control module's self-check after KEY ON, the ABS warning lamp will come on immediately. This is generally an indication of a constant wiring or component fault. If the ABS warning lamp proves out normally and comes on later when the vehicle is driven, this is generally an indication of an intermittent wiring or component fault.

### Possible Contributing Component/Vehicle Wiring Concerns

- Poor connection at front left wheel sensor
- Terminal damage or backout in anti-lock brake control module connector Pins 24 or 25
- Terminal damage or backout in two-pin sensor connector
- Open or shorted front left speed sensor coil
- Open or shorted Circuit 521 (T/O) or 522 (T/BK)
- Improper front left wheel speed sensor cable routing leading to above
- Defective front left wheel speed sensor electrical test circuit in anti-lock brake control module

## L1 DIAGNOSTIC TROUBLE CODE C1155: CHECK FRONT LEFT SPEED SENSOR ELECTRICAL FAULT

- Ignition OFF.
- Install Rotunda Breakout Box 014-00322 or equivalent and Overlay.
- Measure resistance between Pins 24 and 25.

Is reading between 1.0-1.4 k Ohms?

Yes	No
GO to <a href="#">L8</a> .	GO to <a href="#">L2</a> .

## L2 CHECK RESISTANCE AT FRONT LEFT WHEEL SPEED SENSOR

- Disconnect left front speed sensor connector.
- Measure resistance between the two pins on the speed sensor component connector.

Is reading between 1.0-1.4 k Ohms?

Yes	No
Speed sensor checks good. GO to <a href="#">L3</a> .	REPLACE speed sensor. GO to <a href="#">L11</a> .

## L3 CHECK CIRCUIT 521 (T/O) CONTINUITY

- Measure resistance between Pin 24 on the Rotunda Breakout Box 014-00322 or equivalent and wheel speed sensor harness connector pin for Circuit 521 (T/O).

Is there continuity (zero or near zero ohms)?

Yes	No
Circuit 521 (T/O) checks OK. GO to <a href="#">L4</a> .	REPAIR open or high resistance on Circuit 521 (T/O). GO to <a href="#">L11</a> .

## L4 CHECK CIRCUIT 522 (T/BK) CONTINUITY

- Measure resistance between Pin 25 on the Rotunda Breakout Box 014-00322 or equivalent and wheel speed sensor harness connector pin for Circuit 522 (T/BK).

**Is there continuity (zero or near zero ohms)?**

Yes	No
Circuit 522 (T/BK) checks OK. GO to <a href="#">L5</a> .	REPAIR open or high resistance on Circuit 522 (T/BK). GO to <a href="#">L11</a> .

## L5 CHECK CIRCUIT 521 (T/O) SHORT TO GROUND

- Measure resistance between Pins 1 and 24 on the Rotunda Breakout Box 014-00322 or equivalent.

**Is there continuity?**

Yes	No
REPAIR short to ground on Circuit 521 (T/O). GO to <a href="#">L11</a> .	Circuit 521 (T/O) checks OK. GO to <a href="#">L6</a> .

## L6 CHECK CIRCUIT 522 (T/BK) SHORT TO GROUND

- Measure resistance between Pins 1 and 25 on the Rotunda Breakout Box 014-00322 or equivalent.

**Is there less than 10 ohms measured?**

Yes	No
REPAIR short to ground on Circuit 522 (T/BK). GO to <a href="#">L7</a> .	Circuit 522 (T/BK) checks OK. GO to <a href="#">L8</a> .

## L7 CHECK FOR SHORT TO CAN

- Measure resistance between spindle near sensor can and either coil circuit at sensor connector.

**Is resistance less than 10 ohms?**

Yes	No
Internal short in speed sensor detected. REPLACE speed sensor. GO to <a href="#">L11</a> .	GO to <a href="#">L8</a> .

## L8 CHECK WHEEL END ROUTING FOR DAMAGE

- Inspect the wheel speed sensor cable at the affected wheel end for chafing or other wiring damage.

**Is damage found?**

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Yes	No
REPLACE speed sensor. CORRECT any obvious routing issues. GO to <a href="#">L11</a> .	GO to <a href="#">L9</a> .

## L9 CHECK FOR WIRING INTERMITTENTS

**NOTE:** If the above steps have been completed, the **MOST LIKELY** cause of the concern is wiring related.

- Refer to [Pinpoint Test ID](#), Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic.

Is resolution obtained?

Yes	No
GO to <a href="#">L11</a> for system verification.	Wiring system has been verified as intact. GO to <a href="#">L10</a> .

## L10 CHECK IF ALL STEPS HAVE BEEN COMPLETED

- This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified.



**CAUTION:** If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.

Have all prior diagnostic steps been completed as described above?

Yes	No
REPLACE speed sensor. GO to <a href="#">L11</a> for system verification. If no resolution, REPLACE anti-lock brake control module. GO to <a href="#">L11</a> for system verification.	GO to last diagnostic step completed and CONTINUE.

## L11 CHECK FOR CODE REPEATABILITY

- Remove Rotunda Breakout Box 014-00322 or equivalent and reinstall all components.
- Clear all codes.
- Key OFF.
- Key ON.
- Retrieve code(s).

Is Code System Pass set?

Yes	No

STOP. Concern has been corrected.

Code being repaired still exists. Concern has NOT been corrected. RETURN to last diagnostic step completed and PROCEED.

Different code is set. GO to appropriate pinpoint test.

Code being serviced still exists and Test L9 is completed.

**NOTE: The anti-lock system is disabled with the Rotunda Breakout Box 014-00322 or equivalent installed.**

INSTALL Rotunda Breakout Box 014-00322 or equivalent with Overlay. REPEAT Test Steps [L3](#)-L6 while driving vehicle. LOOK for any change in indicated continuity (turning on the DVOM beeper will help).

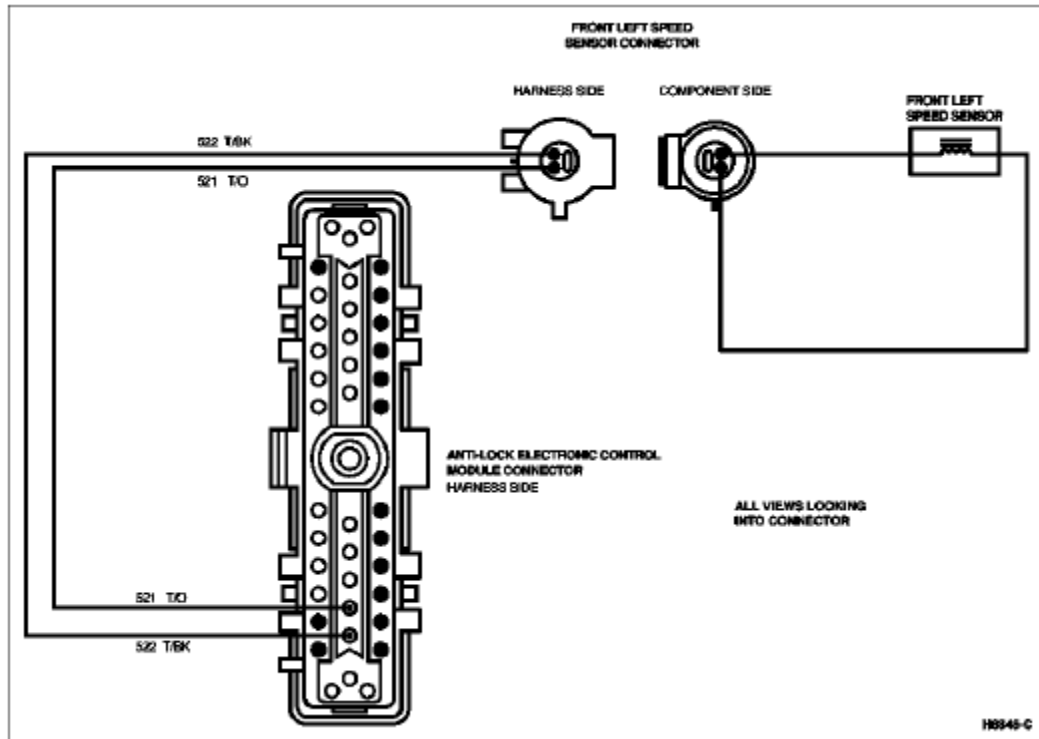
INSPECT Circuits 521 (T/O) and 522 (T/BK) along their entire length from the speed sensor connector to the anti-lock brake control module harness connector for chafing or any other damage that could lead to any open or shorted condition. REPAIR as required.

## **PINPOINT TEST LL: LF WHEEL SPEED SENSOR COHERENCY FAULT (DYNAMIC) (CODES C1158, C1258, and C1233)**

### **Possible Code(s)**

C1158, C1258, C1233

### **Affected Circuit(s)/Electrical Component(s)**



## Description

Codes C1158, C1258, and C1233 are generated by the anti-lock electronic control module's detection of a missing, erratic, or otherwise improper wheel speed signal from the left front wheel speed sensor. The codes are set for specific faults at various vehicle speeds that are as follows:

Code C1158: Anti-lock brake control module detects that the front left wheel speed information is erratic.

Code C1258: Anti-lock brake control module detects that the front left wheel speed information does not match the right front and rear axle wheel speed information.

Code C1233: Anti-lock brake control module detects that the front left wheel speed signal has dropped out when it was previously there. This code is not dependent upon vehicle speed.

Codes C1158, C1258 and C1233 CANNOT be set with the vehicle stationary. The vehicle should be driven when attempting to duplicate the concern. If Code C1158, C1258 or C1233 is set, then the ABS warning lamp will come on and will remain on until the vehicle is shut off. However, if the condition is corrected, the ABS warning lamp will be turned off by the anti-lock brake control module and the system will again be operational.

## Possible Contributing Component/Vehicle Wiring Concerns

- Damaged/missing tone ring teeth or missing tone ring
- Air gap too small or too large
- Excessive rear axle vibration
- Weak speed sensor
- Loose speed sensor
- INTERMITTENT short or open in Circuit 521 (T/O) or 522 (T/BK)

**NOTE: If above codes are stored with C1155, check for intermittent short to ground or open. If above codes only are stored, the concern is output related and it is not necessary to check for intermittent open/short conditions.**

- Disturbances caused by electrical interference induced into the sensor circuit from nearby ungrounded source (static charges)
- Defective trigger circuit in anti-lock brake control module

**LL1 DIAGNOSTIC TROUBLE CODES C1158, C1258 or C1233: INSPECT SPEED SENSOR MOUNTING/TONE RING**

- Install Rotunda Breakout Box 014-00322 or equivalent and Overlay.
- Raise vehicle on hoist.
- Inspect the left front tone ring for any damaged or missing teeth. Rotate wheel to ensure all teeth are checked.
- Inspect the speed sensor mounting in the wheel end for looseness.



**CAUTION: Examine the ring carefully with good light. Failure to catch issues with the tone ring will lead to unnecessary component replacement and wasted diagnosis time.**

**Is tone ring damage or sensor looseness found?**

Yes	No
Tone ring is damaged or missing. REPLACE tone ring. GO to <a href="#">LL5</a> to CHECK for proper sensor output.  Sensor is loose. TIGHTEN speed sensor bolt to specifications. GO to <a href="#">LL5</a> to CHECK for proper sensor output.	GO to <a href="#">LL2</a> .

**LL2 CHECK FRONT LEFT SPEED SENSOR OUTPUT AT ANTI-LOCK ELECTRONIC CONTROL MODULE**

- Lower vehicle so that wheels are just far enough off the ground to permit all wheels to turn.
- Remove left front wheel. Knock back the front disc brake caliper so that the wheel can move as freely as possible. Remount the wheel.
- 4x2s ONLY, spin front left wheel and maintain a constant speed of 60 rpm (1 revolution per second).
- 4x4s ONLY, place in 4x4 low mode. Start engine and allow wheels to spin and stabilize at engine idle speed.

**NOTE: Perform the following measurements with Rotunda 105-R0053 Digital/Analog Volt-Ohmmeter or equivalent. If not using Rotunda 105-R0053 or Fluke Frequency Meter, higher wheel speed may be required in order for the frequency meter to function correctly.**

- Set the Rotunda Digital/Analog Volt-Ohmmeter 105-R0053 or equivalent, to the frequency counter (Hz) setting. Measure and record the frequency between Pins 24 and 25 on the Rotunda Breakout Box 014-00322 or equivalent.

- Change the meter to the A/C mV setting. Measure and record the voltage output between Pins 24 and 25 on the Rotunda Breakout Box 014-00322 or equivalent.

**NOTE: Measurements of BOTH the frequency and the voltage output must be taken. The actual speed the wheels are turning is not important — the result of voltage output divided by the frequency will not change with wheel speed. However, it is crucial that both the frequency measurement and the voltage measurement be taken at the SAME wheel speed.**

- Determine the sensor output in mV/Hz:
- Output — A/C Voltage/Frequency

**Is the sensor output greater than 5.0 mV/Hz (4x2), 5.8 mV/Hz (4x4)?**

Yes	No
Output at anti-lock brake control module indicates that the air gap and speed sensor strength are OK. GO to <a href="#">LL7</a> .	Speed sensor output at anti-lock brake control module is insufficient. GO to <a href="#">LL3</a> .

### LL3 CHECK FRONT LEFT SENSOR OUTPUT AT SPEED SENSOR

- Disconnect the speed sensor connector at the left radiator support.
- 4x2s ONLY, spin front left wheel and maintain a constant speed of 60 rpm (1 revolution per second).
- 4x4s ONLY, place in 4x4 low mode. Key ON and allow wheels to spin and stabilize at engine idle speed.
- Set the meter to the frequency counter (Hz) setting. Measure and record the frequency between the two pins of the speed sensor component connector.

**NOTE: Measurements of BOTH the frequency and the voltage output must be taken. The actual speed the wheels are turning is not important — the result of voltage output divided by the frequency will not change with wheel speed. However, it is crucial that both the frequency measurement and the voltage measurement be taken at the SAME wheel speed.**

- Change the meter to the A/C mV setting. Measure and record the voltage output between the two pins of the speed sensor component connector.
- Determine the sensor output in mV/Hz:
- Output — A/C Voltage/Frequency

**Is the sensor output greater than 5.0 mV/Hz (4x2), 5.8 mV/Hz (4x4)?**

Yes	No
Output indicates that air gap and speed sensor strength are OK at the speed sensor. GO to <a href="#">LL7</a> .	GO to <a href="#">LL4</a> .

### LL4 CHECK SPEED SENSOR/TONE RING AIR GAP

- Remove the speed sensor from the front wheel hub and spindle.
- Inspect mounting boss and speed sensor mounting plate for any metal flash or debris. Clean as necessary.

- Remount speed sensor securely.
- Measure the air gap between the speed sensor and tone ring teeth. Repeat in at least two more wheel positions to ensure that gap does not vary as the wheel is turned.

**NOTE: Feeler gauges can be mounted to a welding rod and inserted between the vanes of the front disc brake hub and rotor to measure air gap precisely.**

**Is the gap consistent and less than 1.78mm (0.070 inch)?**

Yes	No
REPLACE speed sensor. GO to <a href="#">LL5</a> .	Gap is greater than 1.78mm (0.070 inch). Air gap is too large. REPLACE tone ring. GO to <a href="#">LL5</a> .  Gap is not consistent. Tone ring is not pressed on straight or axle end play is too great. GO to <a href="#">LL6</a> .

## LL5 RECHECK FRONT LEFT SPEED SENSOR OUTPUT

- 4x2s ONLY, spin front left wheel and maintain a constant speed of 60 RPM (1 revolution per second).
- 4x4s ONLY, place in 4x4 low mode. Start engine and allow wheels to spin and stabilize at engine idle speed.
- Set the meter to the frequency counter (Hz) setting. Measure and record the frequency between the two pins of the sensor component connector.

**NOTE: Measurements of BOTH the frequency and the voltage output must be taken. The actual speed the wheels are turning is not important — the result of voltage output divided by the frequency will not change with wheel speed. However, it is crucial that both the frequency measurement and the voltage measurement be taken at the SAME wheel speed.**

- Change the meter to the A/C mV setting. Measure and record the voltage output between the two pins of the sensor component connector.
- Determine the sensor output in mV/Hz:
- Output — A/C Voltage/Frequency

**Is sensor output greater than 5.0 mV/Hz 4x2, or 5.8 mV/Hz 4x4?**

Yes	No
Output is now OK. Concern is most likely resolved. A drive test is recommended to VERIFY sensor output is OK for customer driving conditions.	VERIFY tone ring is pressed straight and fully onto the rotor hub. CORRECT as needed. REPEAT <a href="#">LL5</a> . If no resolution, REPLACE speed sensor. DO NOT leave this test until output is OK.

## LL6 RESOLVE INCONSISTENT AIR GAP CONCERN

- Remove the front disc brake hub and rotor and inspect the tone ring/hub mounting surface. Verify the tone ring is pressed straight and fully onto the hub. Correct before proceeding.
- Reinstall the front disc brake hub and rotor.

- Verify wheel end play is within allowable limits (refer to [Section 04-01A](#) or [Section 04-01B](#)). Correct as necessary.
- Measure the air gap between the speed sensor and tone ring teeth. Repeat in at least two more wheel positions to ensure that gap does not vary as the wheel is turned.

**NOTE: Feeler gauges can be mounted to a welding rod and inserted between the vanes of the front disc brake hub and rotor to measure air gap precisely.**

**Is the gap consistent and less than 1.78mm (0.070 inch)?**

Yes	No
GO to <a href="#">LL5</a> to RECHECK speed sensor output.	<p>Gap is greater than 1.78mm (0.070 inch). Air gap is too large. GO to <a href="#">LL4</a> to RESOLVE large air gap concern.</p> <p>Gap is not consistent. REPEAT <a href="#">LL6</a>. DO NOT leave this step until a consistent air gap is obtained.</p>

## LL7 CHECK FOR WIRING INTERMITTENTS

**NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.**

- Refer to [Pinpoint Test ID](#), Intermittent Diagnosis Procedure and perform for Circuits 521 (T/O) and 522 (T/BK).

**Is resolution obtained?**

Yes	No
Concern is most likely resolved. A drive test is recommended to VERIFY speed sensor output is OK during customer driving conditions.	GO to <a href="#">LL8</a> .

## LL8 CHECK IF ALL STEPS HAVE BEEN COMPLETED

- This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified.



**CAUTION: If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.**

**Have all prior diagnostic steps been completed as described above?**

Yes	No
REPLACE speed sensor. GO to <a href="#">LL9</a> for drive test. If no resolution, REPLACE anti-lock brake control module. GO to <a href="#">LL9</a> for drive test.	GO to last diagnostic step completed and CONTINUE.

## LL9 SPEED SENSOR OUTPUT DRIVE TEST

- Reinstall all components and remove Rotunda Breakout Box 014-00322 or equivalent.
- Clear all codes.
- Key OFF.
- Key ON.
- Drive vehicle and perform the following:
  - Complete at least one hard left and one hard right turn.
  - Travel over a stretch of rough road at normal vehicle speed.
  - Perform one hard acceleration from a stop.
- Retrieve code(s).

### Is Code System Pass set?

Yes	No
STOP. Repair is complete.	Code being repaired still exists. GO to <a href="#">LL8</a> .  Different code is set (other than C1158, C1258 or C1233). GO to appropriate pinpoint test.  Code being repaired still exists and anti-lock brake control module has been replaced. GO to <a href="#">LL10</a> .

## LL10 POSSIBLE CONDITIONS NOT CHECKED

At this point the following have been verified or are true if the above steps are complete:

- Sensor strength is OK.
- Tone ring is intact with no damaged teeth and is correctly seated against the rotor hub.
- Air gap is within allowable limits and is consistent as the wheel rotates.
- Wiring between speed sensor and anti-lock brake control module is intact.
- The anti-lock brake control module has been replaced.
- The speed sensor has been replaced.
- The following are time consuming and should be performed only after all previous options have been exhausted.
- Verify Circuits 521 (T/O) and 522 (T/BK) are twisted throughout the wire loom. If the wires are not twisted, the anti-lock brake control module may be sensitive to any outside interference.
- Excessive axle vibration, especially over rough road can cause this issue. Verify front axle is not excessively noisy or otherwise performing abnormally.

**NOTE: Blips or fallout indicate intermittent issue.**

### Does signal rise consistently and evenly?

Yes	No
STOP. Repair is complete.	GO to <a href="#">LL8</a> .

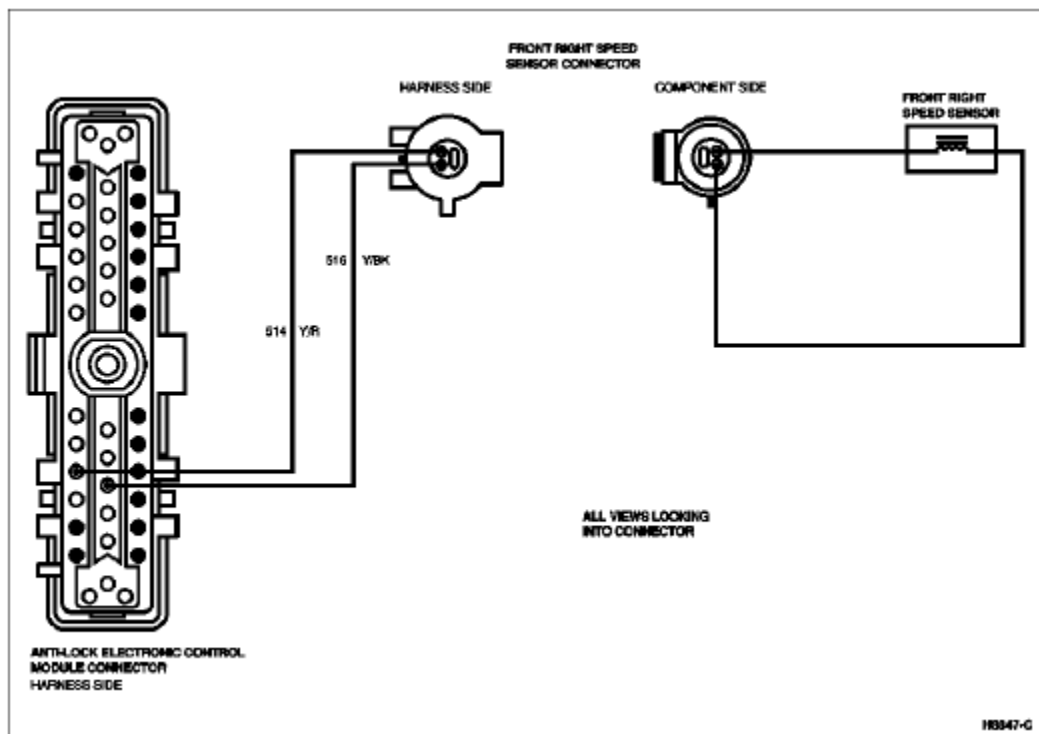


## PINPOINT TEST M: RF WHEEL SPEED SENSOR INPUT CIRCUIT FAILURE (STATIC) (CODE C1145)

### Possible Code(s)

C1145 — Electrically shorted or open front right speed sensor circuit or coil.

### Affected Circuit(s)/Electrical Component(s)



### Description

Code C1145 is generated by the anti-lock electronic control module's detection of an open or shorted wheel speed sensor coil or an open or shorted condition in Circuits 514 (Y/T) or 516 (Y/BK) between the wheel speed sensor and the anti-lock brake control module. If this fault is detected during the anti-lock electronic control module's self-check after key ON, the ABS warning lamp will come on immediately. This is generally an indication of a constant wiring or component fault. If the ABS warning lamp proves out normally and comes on later when the vehicle is driven, this is generally an indication of an intermittent wiring or component fault.

### Possible Contributing Component/Vehicle Wiring Concerns

- Poor connection at front right wheel sensor
- Terminal damage or backout in anti-lock brake control module connector Pins 36 or 23
- Terminal damage or backout in two-pin sensor connector
- Open or shorted front right speed sensor coil
- Open or shorted Circuit 514 (Y/R) or 516 (Y/BK)

- Improper front right wheel speed sensor cable routing leading to above
- Defective front right wheel speed sensor electrical test circuit in anti-lock brake control module

## M1 DIAGNOSTIC TROUBLE CODE C1145: CHECK FRONT RIGHT SPEED SENSOR ELECTRICAL FAULT

- Ignition OFF.
- Install Rotunda Breakout Box 014-00322 or equivalent and Overlay.
- Measure resistance between Pins 36 and 23.

Is reading between 1.0-1.4 k Ohms?

Yes	No
GO to <a href="#">M7</a> .	GO to <a href="#">M2</a> .

## M2 CHECK RESISTANCE AT FRONT RIGHT WHEEL SPEED SENSOR

- Disconnect right front speed sensor connector.
- Measure resistance between the two Pins on the speed sensor component connector.

Is reading between 1.0-1.4 k Ohms?

Yes	No
Speed sensor checks good. GO to <a href="#">M3</a> .	REPLACE speed sensor. GO to <a href="#">M10</a> .

## M3 CHECK CIRCUIT 514 (Y/R) CONTINUITY

- Measure resistance between Pin 36 on the Rotunda Breakout Box 014-00322 or equivalent and wheel speed sensor harness connector pin for Circuit 514 (Y/R).

Is there continuity (zero or near zero ohms)?

Yes	No
Circuit 514 (Y/R) checks OK. GO to <a href="#">M4</a> .	REPAIR open or high resistance on Circuit 514 (Y/R). GO to <a href="#">M10</a> .

## M4 CHECK CIRCUIT 516 (Y/BK) CONTINUITY

- Measure resistance between Pin 23 on the Rotunda Breakout Box 014-00322 or equivalent and wheel speed sensor harness connector pin for Circuit 516 (Y/BK).

Is there continuity (zero or near zero ohms)?

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Yes	No
Circuit 516 (Y/BK) checks OK. GO to <a href="#">M5</a> .	REPAIR open or high resistance on Circuit 516 (Y/BK). GO to <a href="#">M10</a> .

### M5 CHECK CIRCUIT 514 (Y/R) SHORT TO GROUND

- Measure resistance between Pins 1 and 36 on the Rotunda Breakout Box 014-00322 or equivalent.

Is there continuity (zero or near zero ohms)?

Yes	No
REPAIR short to ground on Circuit 514 (Y/R). GO to <a href="#">M10</a> .	Circuit 514 (Y/R) checks OK. GO to <a href="#">M6</a> .

### M6 CHECK CIRCUIT 516 (Y/BK) SHORT TO GROUND

- Measure resistance between Pins 1 and 23 on the Rotunda Breakout Box 014-00322 or equivalent.

Is there continuity (zero or near zero ohms)?

Yes	No
REPAIR short to ground on Circuit 516 (Y/BK). GO to <a href="#">M10</a> .	Circuit 516 (Y/BK) checks OK. GO to <a href="#">M7</a> .

### M7 CHECK FOR SHORT TO CAN

- Measure resistance between spindle near sensor can and either coil circuit at sensor connector.

Is resistance less than 10 ohms?

Yes	No
REPLACE speed sensor. CORRECT any obvious routing issues. GO to <a href="#">M10</a> .	GO to <a href="#">M8</a> .

### M8 CHECK FOR WIRING INTERMITTENTS

**NOTE:** If the above steps have been completed, the **MOST LIKELY** cause of the concern is wiring related.

- Refer to [Pinpoint Test ID](#), Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic.

Is resolution obtained?

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Yes	No
GO to <a href="#">M10</a> for system verification.	Wiring system has been verified as intact. GO to <a href="#">M9</a> .

## M9 CHECK IF ALL STEPS HAVE BEEN COMPLETED

- This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified.



**CAUTION:** If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.

Have all prior diagnostic steps been completed as described above?

Yes	No
REPLACE speed sensor. GO to <a href="#">M10</a> for system verification. If no resolution, REPLACE anti-lock brake control module. GO to <a href="#">M10</a> for system verification.	GO to last diagnostic step completed and CONTINUE.

## M10 CHECK FOR CODE REPEATABILITY

- Remove Rotunda Breakout Box 014-00322 or equivalent and reinstall all components.
- Clear all codes.
- Key OFF.
- Key ON.
- Retrieve code(s).

Is Code System Pass set?

Yes	No
STOP. Concern has been corrected.	<p>Code being repaired still exists. Concern has NOT been corrected. RETURN to last diagnostic step completed and PROCEED.</p> <p>Different code is set. GO to appropriate pinpoint test.</p> <p>Code being repaired still exists and Test M8 is completed.</p> <p><b>NOTE: The anti-lock system is disabled with the Rotunda Breakout Box 014-00322 or equivalent installed.</b></p> <p>INSTALL Rotunda Breakout Box 014-00322 or equivalent with Overlay. REPEAT Test Steps</p>

**M3** -M6 while driving vehicle. LOOK for any change in indicated continuity (turning on the DVOM beeper will help).

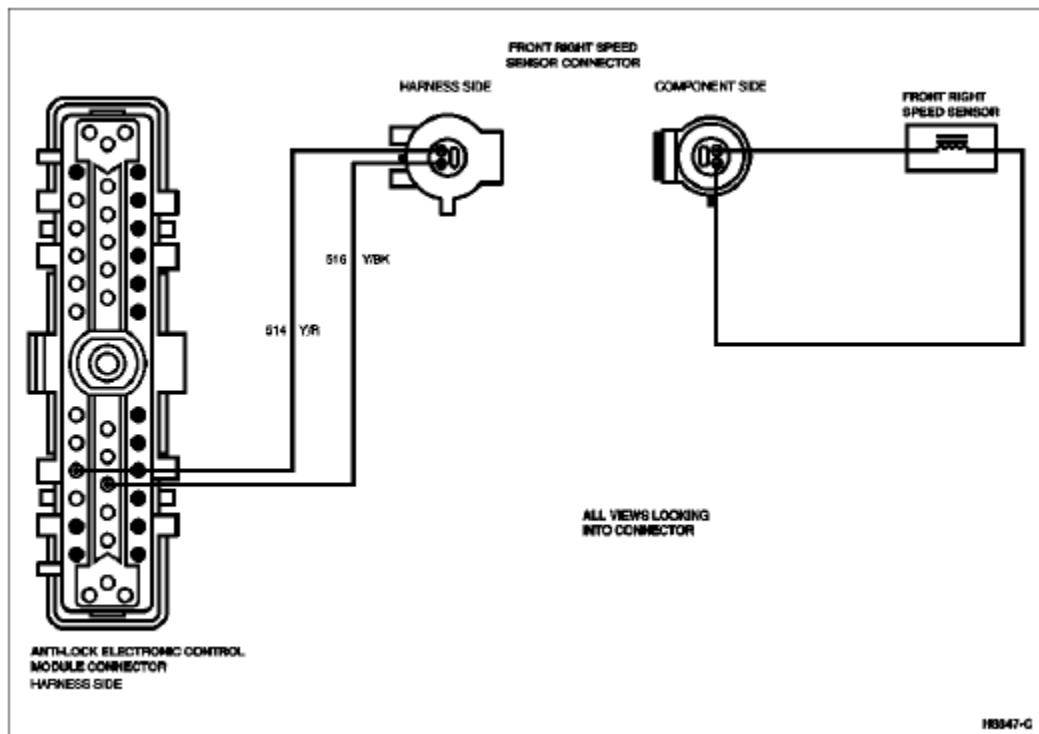
INSPECT Circuits 514 (Y/R) and 516 (Y/BK) along their entire length from the speed sensor connector to the anti-lock brake control module harness connector for chafing or any other damage that could lead to any open or shorted condition. REPAIR as required.

## PINPOINT TEST MM: RF WHEEL SPEED SENSOR COHERENCY FAULT (DYNAMIC) (CODES C1148, C1259 and C1234)

### Possible Code(s)

C1148, C1259 or C1234

### Affected Circuit(s)/Electrical Component(s)



### Description

Codes C1148, C1259 and C1234 are generated by the anti-lock electronic control module's detection of a missing, erratic, or otherwise improper wheel speed signal from the right front wheel speed sensor. The codes are set for specific faults at various vehicle speeds that are as follows:

Code C1148: Anti-lock brake control module detects that the front right wheel speed information is erratic.

Code C1259: Anti-lock brake control module detects that the front right wheel speed information does not match the left front and rear axle wheel speed information.

Code C1234: Anti-lock brake control module detects that the front right wheel speed signal has dropped out when it was previously there. This code is not dependent upon vehicle speed.

Codes C1148, C1259 and C1234 CANNOT be set with the vehicle stationary. The vehicle should be driven when attempting to duplicate the concern. If Codes C1148, C1259 or C1234 are set, then the ABS warning lamp will come on and will remain on until the vehicle is shut off. However, if the condition is corrected, the ABS warning lamp will be turned off by the anti-lock brake control module and the system will again be operational.

### Possible Contributing Component/Vehicle Wiring Concerns

- Damaged/missing tone ring teeth or missing tone ring
- Air gap too small or too large
- Excessive axle vibration
- Weak speed sensor
- Loose speed sensor
- INTERMITTENT short or open in Circuit 514 (Y/R) or 516 (Y/BK)

**NOTE: If above codes are stored with C1155, check for intermittent short to ground or open. If above codes only are stored, the concern is output related and it is not necessary to check for intermittent open/short conditions.**

- Disturbances caused by ignition or Radio Frequency Interference (RFI)
- Defective trigger circuit in anti-lock brake control module

### MM1 DIAGNOSTIC TROUBLE CODES C1148, C1259 or C1234: INSPECT SPEED SENSOR MOUNTING/TONE RING

- Install Rotunda Breakout Box 014-00322 or equivalent and Overlay.
- Raise vehicle on hoist.
- Inspect the right front tone ring for damaged or missing teeth. Rotate wheel to ensure all teeth are checked.
- Inspect the speed sensor mounting in the wheel end for looseness.



**CAUTION: Examine the ring carefully with good light. Failure to catch issues with the tone ring will lead to unnecessary component replacement and wasted diagnostic time.**

Is tone ring damage or speed sensor looseness found?

Yes	No
Tone ring is damaged or missing. REPLACE tone ring. GO to <a href="#">MM5</a> to CHECK for proper speed sensor output.	GO to <a href="#">MM2</a> .

Speed sensor is loose. TIGHTEN speed sensor bolt to specifications. GO to [MM5](#) to CHECK for proper speed sensor output.

### MM2 CHECK FRONT RIGHT SPEED SENSOR OUTPUT AT ANTI-LOCK ELECTRONIC CONTROL MODULE

- Lower vehicle so that wheels are just far enough off the ground to permit all wheels to turn.
- Remove right front wheel. Knock back the disc brake caliper so that the wheel can move as freely as possible. Remount the wheel.
- 4x2s ONLY, spin front right wheel and maintain a constant speed of 60 rpm (1 re volution per second).
- 4x4s ONLY, place in 4x4 low mode. Key ON and allow wheels to spin and stabilize at engine idle speed.

**NOTE: Perform the following measurements with Rotunda 105-R0053 Digital/Analog Volt-Ohmmeter or equivalent. If not using Rotunda 105-R0053 or Fluke Frequency Meter, higher wheel speed may be required in order for the frequency meter to function correctly.**

- Set the Rotunda Digital/Analog Volt-Ohmmeter 105-R0053 or equivalent, to the frequency counter (Hz) setting. Measure and record the frequency between Pins 36 and 23 on the Rotunda Breakout Box 014-00322 or equivalent.
- Change the meter to the A/C mV setting. Measure and record the voltage output between Pins 36 and 23 on the Rotunda Breakout Box 014-00322 or equivalent.
- Determine the sensor output in mV/Hz:
- Output — A/C Voltage/Frequency

**NOTE: Measurements of BOTH the frequency and the voltage output must be taken. The actual speed the wheels are turning is not important — the result of voltage output divided by the frequency will not change with wheel speed. However, it is crucial that both the frequency measurement and the voltage measurement be taken at the SAME wheel speed.**

Is the sensor output greater than 5.0 mV/Hz (4x2), 5.8 mV/Hz (4x4)?

Yes	No
Output at anti-lock brake control module indicates that the air gap and speed sensor strength are OK. GO to <a href="#">MM7</a> .	Speed sensor output at anti-lock brake control module is insufficient. GO to <a href="#">MM3</a> .

### MM3 CHECK FRONT RIGHT SPEED SENSOR OUTPUT AT SPEED SENSOR

- Disconnect the sensor connector at the RH radiator support.
- 4x2s ONLY, spin front right wheel and maintain a constant speed of 60 rpm (1 revolution per second).
- 4x4s ONLY, place in 4x4 low mode. Start engine and allow wheels to spin and stabilize at engine idle speed.
- Set the meter to the frequency counter (Hz) setting. Measure and record the frequency between the two pins of the speed sensor component connector.
- Change the meter to the A/C mV setting. Measure and record the voltage output between the two pins of the speed sensor component connector.

- Determine the speed sensor output in mV/Hz:
- Output — A/C Voltage/Frequency

**NOTE: Measurements of BOTH the frequency and the voltage output must be taken. The actual speed the wheels are turning is not important — the result of voltage output divided by the frequency will not change with wheel speed. However, it is crucial that both the frequency measurement and the voltage measurement be taken at the SAME wheel speed.**

**Is the speed sensor output greater than 5.0 mV/Hz (4x2), 5.8 mV/Hz (4x4)?**

Yes	No
Output indicates that air gap and sensor strength are OK at the speed sensor. GO to <a href="#">MM7</a> .	GO to <a href="#">MM4</a> .

### MM4 CHECK SPEED SENSOR/TONE RING AIR GAP

- Remove the speed sensor from the wheel end.
- Inspect mounting boss and speed sensor mounting plate for any metal flash or debris. Clean as necessary.
- Remount speed sensor securely.
- Measure the air gap between the speed sensor and tone ring teeth. Repeat in at least two more wheel positions to ensure that gap does not vary as the wheel is turned.

**NOTE: Feeler gauges can be mounted to a welding rod and inserted between the vanes of the front disc brake hub and rotor to measure air gap precisely.**

**Is the gap consistent and less than 1.78mm (0.070 inch)?**

Yes	No
REPLACE speed sensor. GO to <a href="#">MM5</a> .	<p>Gap is greater than 1.78mm (0.070 inch). Air gap is too large. REPLACE tone ring. GO to <a href="#">MM5</a>.</p> <p>Gap is not consistent. Tone ring is not pressed on straight or axle end play is too great. GO to <a href="#">MM6</a>.</p>

### MM5 RECHECK FRONT RIGHT SENSOR OUTPUT

- 4x2s ONLY, spin front right wheel and maintain a constant speed of 60 rpm (1 revolution per second).
- 4x4s ONLY, place in 4x4 low mode. Start engine and allow wheels to spin and stabilize at engine idle speed.
- Set the meter to the frequency counter (Hz) setting. Measure and record the frequency between the two pins of the speed sensor component connector.
- Change the meter to the A/C mV setting. Measure and record the voltage output between the two pins of the speed sensor component connector.
- Determine the speed sensor output in mV/Hz:
- Output — A/C Voltage/Frequency



**NOTE: Measurements of BOTH the frequency and the voltage output must be taken. The actual speed the wheels are turning is not important — the result of voltage output divided by the frequency will not change with wheel speed. However, it is crucial that both the frequency measurement and the voltage measurement be taken at the SAME wheel speed.**

**Is the sensor output greater than 5.8 mV/Hz (4x4)?**

Yes	No
Output is now OK. Concern is most likely resolved. A drive test is recommended to VERIFY speed sensor output is OK for customer driving conditions.	VERIFY tone ring is pressed straight and fully onto the rotor hub. CORRECT as needed. REPEAT <a href="#">MM5</a> . If no resolution, REPLACE speed sensor. DO NOT leave this test until output is OK.

## MM6 RESOLVE INCONSISTENT AIR GAP CONCERN

- Remove the front disc brake hub and rotor and inspect the tone ring/hub mounting surface. Verify the tone ring is pressed straight and fully onto the hub. Correct before proceeding.
- Reinstall the front disc brake hub and rotor.
- Verify wheel end play is within allowable limits (refer to [Section 04-01A](#) or [Section 04-01B](#)). Correct as necessary.
- Measure the air gap between the speed sensor and tone ring teeth. Repeat in at least two more wheel positions to ensure that gap does not vary as the wheel is turned.

**NOTE: Feeler gauges can be mounted to a welding rod and inserted between the vanes of the front disc brake hub and rotor to measure air gap precisely.**

**Is the gap consistent and less than 1.78mm (0.070 inch)?**

Yes	No
GO to <a href="#">MM5</a> to RECHECK speed sensor output.	Gap is greater than 1.78mm (0.070 inch). Air gap is too large. GO to <a href="#">MM4</a> to resolve large air gap concern.  Gap is not consistent. REPEAT <a href="#">MM6</a> . DO NOT leave this step until a consistent air gap is obtained.

## MM7 CHECK FOR WIRING INTERMITTENTS

**NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.**

- Refer to [Pinpoint Test ID](#), Intermittent Diagnosis Procedures and perform for Circuits 514 (Y/R) and 516 (Y/BK).

**Is resolution obtained?**

Yes	No
Concern is most likely resolved. A drive test is	

recommended to VERIFY speed sensor output is OK during customer driving conditions.	GO to <a href="#">MM8</a> .
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## MM8 CHECK IF ALL STEPS HAVE BEEN COMPLETED

- This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified.



**CAUTION:** If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.

Have all prior diagnostic steps been completed as described above?

Yes	No
REPLACE speed sensor. GO to <a href="#">MM9</a> for drive test. If no resolution, REPLACE anti-lock brake control module. GO to <a href="#">MM9</a> for drive test.	GO to last diagnostic step completed and CONTINUE.

## MM9 SPEED SENSOR OUTPUT DRIVE TEST

- Reinstall all components and remove Rotunda Breakout Box 014-00322 or equivalent.
- Clear all codes.
- Key OFF.
- Key ON.
- Drive vehicles and perform the following:
  - Complete at least one hard left and one hard right turn.
  - Travel over stretch of rough road at normal vehicle speed.
  - Perform one hard acceleration from a stop.
- Retrieve code(s).

Is Code System Pass set?

Yes	No
STOP. Repair is complete.	Code being repaired still exists. GO to <a href="#">MM8</a> .  Different code is set (other than C1148, C1259 or C1234). GO to appropriate pinpoint test.  Code being repaired still exists and anti-lock brake control module has been replaced. GO to <a href="#">MM10</a> .

## MM10 POSSIBLE CONDITIONS NOT CHECKED

At this point the following have been verified or are true if the above steps are complete:

- Speed sensor strength is OK.
- Tone ring is intact with no damaged teeth and is correctly seated against the rotor hub.
- Air gap is within allowable limits and is consistent as the wheel rotates.
- Wiring between sensor and anti-lock brake control module is intact.
- The anti-lock brake control module has been replaced.
- The speed sensor has been replaced.
- The following are time consuming and should be performed only after all previous options have been exhausted.
- Verify Circuits 514 (Y/R) and 516 (Y/BK) are twisted throughout the wire loom. If the wires are not twisted, the anti-lock brake control module may be sensitive to any outside interference.
- Excessive axle vibration, especially over rough road can cause this issue. Verify front axle is not excessively noisy or otherwise performing abnormally.

**NOTE: Blips or fallout indicate intermittent issue.**

**Does signal rise consistently and evenly?**

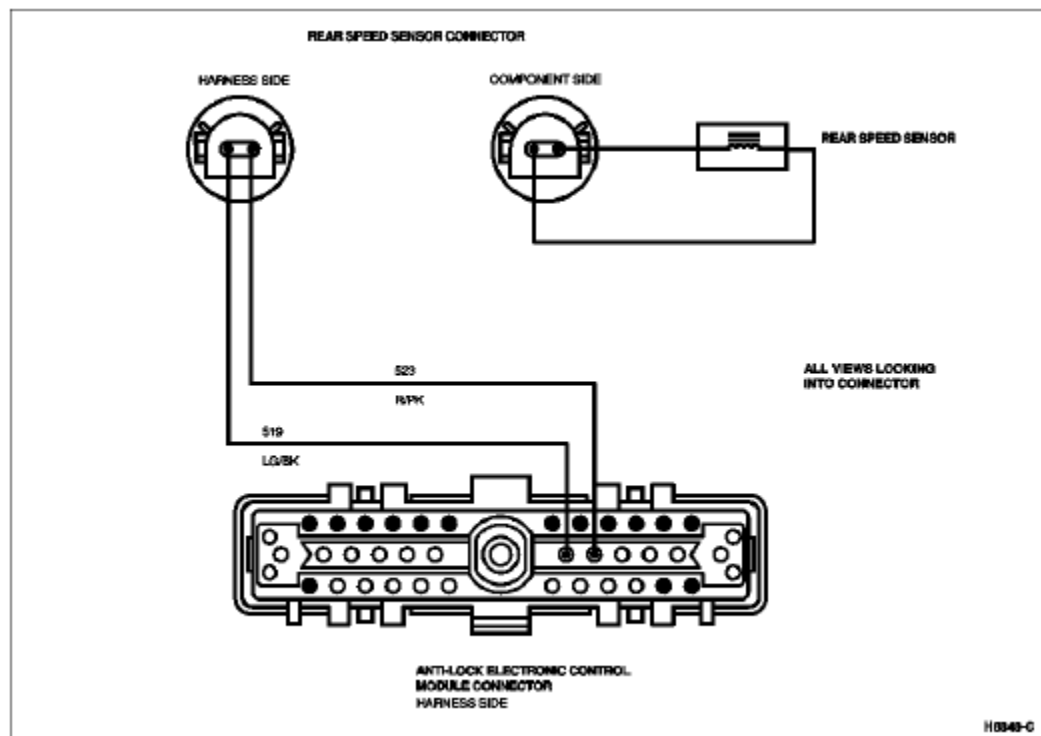
Yes	No
STOP. Repair is complete.	GO to <a href="#">MM8</a> .

## **PINPOINT TEST N: REAR AXLE SPEED SENSOR INPUT CIRCUIT FAILURE (STATIC) (CODE C1230)**

### **Possible Code(s)**

C1230 — Electrically shorted or open rear axle speed sensor circuit or coil.

### **Affected Circuit(s)/Electrical Component(s)**



## Description

Code C1230 is generated by the anti-lock electronic control module's detection of an open or shorted rear axle speed sensor coil or an open or shorted condition in Circuits 523 (R/PK) or 519 (LG/BK) between the wheel speed sensor and the anti-lock brake control module. If this fault is detected during the anti-lock electronic control module's self-check after key ON, the ABS warning lamp will come on immediately. This is generally an indication of a constant wiring or component fault. If the ABS warning lamp proves out normally and comes on later when the vehicle is driven, this is generally an indication of an intermittent wiring or component fault.

## Possible Contributing Component/Vehicle Wiring Concerns

- Poor connection at rear axle speed sensor
- Terminal damage or backout in anti-lock brake control module connector Pins 21 or 22
- Terminal damage or backout in two-pin sensor connector
- Open or shorted rear axle speed sensor coil
- Open or shorted Circuit 523 (R/PK) or 519 (LG/BK)
- Improper rear axle speed sensor cable routing leading to above
- Defective rear axle speed sensor electrical test circuit in anti-lock brake control module

## N1 DIAGNOSTIC TROUBLE CODE C1230: CHECK REAR AXLE SPEED SENSOR ELECTRICAL FAULT

- Ignition OFF.
- Install Rotunda Breakout Box 014-00322 or equivalent and Overlay.

- Measure resistance between Pins 22 and 21.

**Is reading between 800 and 1400 ohms?**

Yes	No
GO to <a href="#">N7</a> .	GO to <a href="#">N2</a> .

## N2 CHECK RESISTANCE AT REAR AXLE SPEED SENSOR

- Disconnect rear axle speed sensor connector.
- Measure resistance between the two pins on the speed sensor.

**Is reading between 800 and 1400 ohms?**

Yes	No
Speed sensor checks good. GO to <a href="#">N3</a> .	REPLACE speed sensor. GO to <a href="#">N11</a> .

## N3 CHECK CIRCUIT 523 (R/PK) CONTINUITY

- Measure resistance between Pin 22 on the Rotunda Breakout Box 014-00322 or equivalent and wheel speed sensor harness connector pin for Circuit 523 (R/PK).

**Is there continuity (zero or near zero ohms)?**

Yes	No
Circuit 523 (R/PK) checks OK. GO to <a href="#">N4</a> .	REPAIR open or high resistance on Circuit 523 (R/PK). GO to <a href="#">N11</a> .

## N4 CHECK CIRCUIT 519 (LG/BK) CONTINUITY

- Measure resistance between Pin 21 on the Rotunda Breakout Box 014-00322 or equivalent and wheel speed sensor harness connector pin for Circuit 519 (LG/BK).

**Is there continuity (zero or near zero ohms)?**

Yes	No
Circuit 519 (LG/BK) checks OK. GO to <a href="#">N5</a> .	REPAIR open or high resistance on Circuit 519 (LG/BK). GO to <a href="#">N11</a> .

## N5 CHECK CIRCUIT 523 (R/PK) SHORT TO GROUND

- Measure resistance between Pins 1 and 22 on the Rotunda Breakout Box 014-00322 or equivalent.

**Are there less than 10 ohms measured?**

---

Yes	No
REPAIR short to ground on Circuit 523 (R/PK). GO to <a href="#">N11</a> .	Circuit 523 (R/PK) checks OK. GO to <a href="#">N6</a> .

## N6 CHECK CIRCUIT 519 (LG/BK) SHORT TO GROUND

- Measure resistance between Pins 1 and 21 on the Rotunda Breakout Box 014-00322 or equivalent.

Is there continuity (zero or near zero ohms)?

Yes	No
REPAIR short to ground on Circuit 519 (LG/BK). GO to <a href="#">N11</a> .	Circuit 519 (LG/BK) checks OK. GO to <a href="#">N8</a> .

## N7 CHECK COIL CIRCUIT COMPONENT CONNECTOR RESISTANCE

- Remove speed sensor from rear axle housing.
- Measure resistance between speed sensor can and either coil circuit at component connector.

Is resistance less than 10 ohms?

Yes	No
Internal short in speed sensor detected. REPLACE speed sensor. GO to <a href="#">N11</a> .	GO to <a href="#">N8</a> .

## N8 CHECK SPEED SENSOR CABLE ROUTING FOR DAMAGE

- Inspect the rear axle speed sensor cable from the rear axle housing to the frame for chafing or other wire damage.

Is damage found?

Yes	No
REPAIR damage. CORRECT any obvious routing issues. GO to <a href="#">N11</a> .	GO to <a href="#">N9</a> .

## N9 CHECK FOR WIRING INTERMITTENTS

**NOTE:** If the above steps have been completed, the **MOST LIKELY** cause of the concern is wiring related.

- Refer to [Pinpoint Test ID](#), Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic.

**Is resolution obtained?**

Yes	No
GO to <a href="#">N11</a> for system verification.	Wiring system has been verified as intact. GO to <a href="#">N10</a> .

**N10 CHECK IF ALL STEPS HAVE BEEN COMPLETED**

**CAUTION:** If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.

- This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified.

**Have all prior diagnostic steps been completed as described above?**

Yes	No
REPLACE sensor. GO to <a href="#">N11</a> for system verification. If no resolution, REPLACE anti-lock brake control module. GO to <a href="#">N11</a> for system verification.	GO to last diagnostic step completed and CONTINUE.

**N11 CHECK FOR CODE REPEATABILITY**

- Remove breakout box and reinstall all components.
- Clear all codes.
- Key OFF.
- Key ON.
- Retrieve code.

**Is Code System Pass set?**

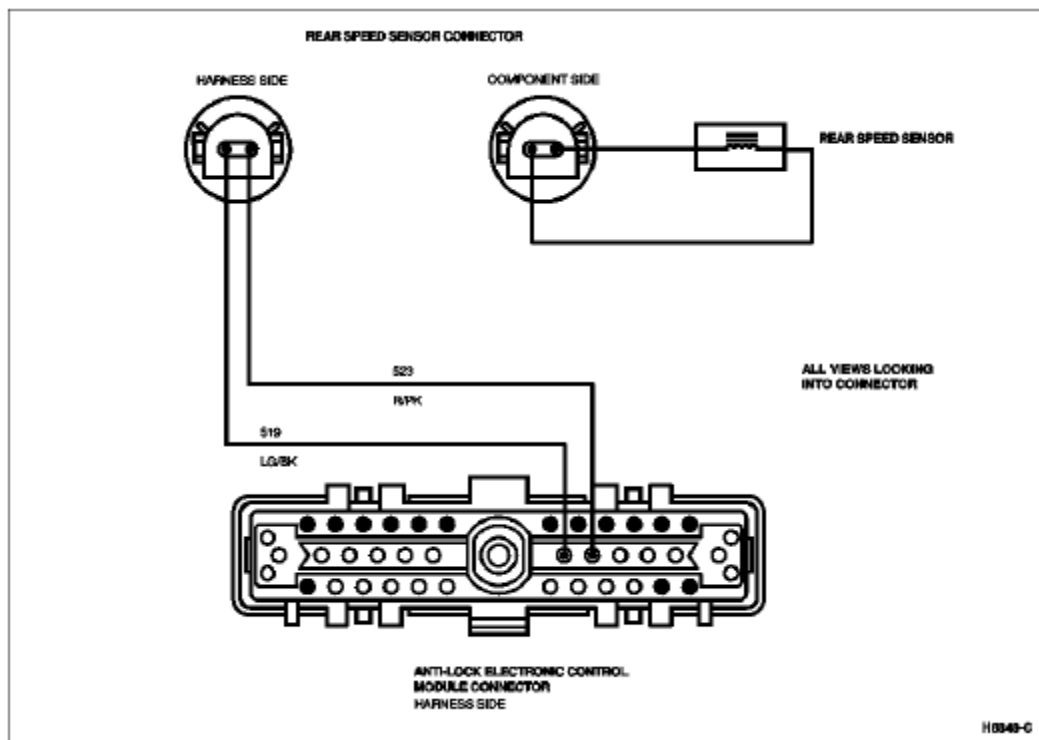
Yes	No
STOP. Concern has been corrected.	<p>Code being repaired still exists. Concern has NOT been corrected. RETURN to last diagnostic step completed and PROCEED.</p> <p>Different code is set. GO to appropriate pinpoint test.</p> <p>Code being repaired still exists and Test N9 is completed.</p> <p><b>NOTE: The anti-lock system is disabled with the Rotunda Breakout Box 014-00322 or equivalent installed.</b></p> <p>INSTALL breakout box with overlay. REPEAT</p>

Test Steps [N3](#) -N6 while driving vehicle. LOOK for any change in indicated continuity (turning on the DVOM beeper will help).

INSPECT Circuits 523 (R/PK) and 519 (LG/BK) along their entire length from the speed sensor connector to the anti-lock brake control module harness connector for chafing or any other damage that could lead to an open or shorted condition. REPAIR as required.

## PINPOINT TEST NN: REAR AXLE WHEEL SPEED SENSOR COHERENCY FAULT (DYNAMIC) (CODES C1229, C1260 and C1237)

### Affected Circuit(s)/Electrical Component(s)



### Description

Codes C1229, C1260, and C1237 are generated by the anti-lock electronic control module's detection of a missing, erratic, or otherwise improper wheel speed signal from the rear axle wheel speed sensor. The codes are set for specific faults at various vehicle speeds that are as follows:

Code C1229: Anti-lock brake control module detects that the rear axle wheel speed information is erratic. This code is only set at vehicle speeds greater than 40 km/h (25 mph).



Code C1260: Anti-lock brake control module detects that the rear axle wheel speed information does not match the left front and right front wheel speed information.

Code 1237: Anti-lock brake control module detects that the rear axle wheel speed signal has dropped out when it was previously there. This code is not dependent upon vehicle speed.

Codes C1229, C1260 and C1237 CANNOT be set with the vehicle stationary. The vehicle should be driven when attempting to duplicate the concern. If Codes C1229, C1260 or C1237 are set, then the ABS warning lamp will come on and will remain on until the vehicle is shut off. However, if the condition is corrected, the ABS warning lamp will be turned off by the anti-lock brake control module and the system will again be operational.

### Possible Contributing Component/Vehicle Wiring Concerns

- Damaged/missing tone ring teeth or missing tone ring
- Air gap too small or too large
- Excessive axle vibration
- Weak sensor
- Loose sensor
- INTERMITTENT short or open in Circuit 523 (R/PK) or 519 (LG/BK)

**NOTE: If above codes are stored with C1155, check for intermittent short to ground or open. If above codes only are stored, the concern is output related and it is not necessary to check for intermittent open/short conditions.**

- Disturbances caused by ignition or Radio Frequency Interference (RFI)
- Defective trigger circuit in anti-lock brake control module

### NN1 DIAGNOSTIC TROUBLE CODES C1229, C1260 or C1237: INSPECT SPEED SENSOR MOUNTING/TONE RING

- Install Rotunda Breakout Box 014-00322 or equivalent and Overlay.
- Raise vehicle on hoist.
- Inspect the rear axle tone ring for damaged or missing teeth. Rotate ring to ensure all teeth are checked.
- Inspect the speed sensor for debris on the rear axle housing mounting boss or on speed sensor mounting flange. Clean as necessary.
- Reinstall speed sensor and tighten to specification.



**CAUTION: Examine the ring carefully with good light. Failure to catch issues with the tone ring will lead to unnecessary component replacement and wasted diagnostic time.**

Is tone ring intact or debris found at speed sensor mounting?

Yes	No
Debris is found. REMOVE debris and GO to <a href="#">NN6</a> .	Tone ring is not intact. REPLACE tone ring. GO to <a href="#">NN6</a> to DRIVE TEST vehicle.  GO to <a href="#">NN2</a> .

## NN2 CHECK REAR AXLE SPEED SENSOR OUTPUT AT ANTI-LOCK ELECTRONIC CONTROL MODULE

- Lower vehicle so that wheels are just far enough off the ground to permit all wheels to turn.
- 4x4s ONLY, verify transfer case is in the 4x2 mode.
- Start engine and allow rear wheels to spin and stabilize at engine idle speed.

**NOTE: Perform the following measurements with Rotunda 105-R0053 Digital/Analog Volt-Ohmmeter or equivalent. If not using Rotunda 105-R0053 or Fluke Frequency Meter, higher wheel speed may be required in order for the frequency meter to function correctly.**

- Set the Rotunda Digital/Analog Volt-Ohmmeter 105-R0053 or equivalent, to the frequency counter (Hz) setting. Measure and record the frequency between Pins 21 and 22 on the Rotunda Breakout Box 014-00322 or equivalent.
- Change the meter to the A/C mV setting. Measure and record the voltage output between Pins 21 and 22 on the Rotunda Breakout Box 014-00322 or equivalent.
- Determine the speed sensor output in mV/Hz:
- Output — A/C Voltage/Frequency

**NOTE: Measurements of BOTH the frequency and the voltage output must be taken. The actual speed the wheels are turning is not important — the result of voltage output divided by the frequency will not change with wheel speed. However, it is crucial that both the frequency measurement and the voltage measurement be taken at the SAME wheel speed.**

Is the sensor output greater than 6.0 mV/Hz?

Yes	No
Output at anti-lock brake control module indicates that the air gap and sensor strength are OK. GO to <a href="#">NN4</a> .	Sensor output at ECU is insufficient. GO to <a href="#">NN3</a> .

## NN3 CHECK REAR AXLE SENSOR OUTPUT AT SPEED SENSOR

- Disconnect the speed sensor connector at the rear axle housing.
- If vehicle is not running, key ON and allow rear wheels to spin and stabilize at engine idle speed.
- Set the Rotunda Digital/Analog Volt-Ohmmeter 105-R0053 or equivalent, to the frequency counter (Hz) setting. Measure and record the frequency between the two pins of the speed sensor component connector.
- Change the meter to the A/C mV setting. Measure and record the voltage output between the two pins of the speed sensor.
- Determine the speed sensor output in mV/Hz:
- Output — A/C Voltage/Frequency

**NOTE: Measurements of BOTH the frequency and the voltage output must be taken. The actual speed the wheels are turning is not important — the result of voltage output divided by the frequency will not change with wheel speed. However, it is crucial that both the frequency measurement and the voltage measurement be taken at the SAME wheel speed.**

**Is the sensor output greater than 6.0 mV/Hz?**

Yes	No
Output indicates that air gap and speed sensor strength are OK at the sensor. GO to <a href="#">NN4</a> .	REPLACE sensor. REPEAT <a href="#">NN3</a> to RECHECK sensor output.

**NN4 CHECK FOR WIRING INTERMITTENTS**

**NOTE:** If the above steps have been completed, the **MOST LIKELY** cause of the concern is wiring related.

- Refer to [Pinpoint Test ID](#), Intermittent Diagnosis Procedure and perform for Circuits 523 (R/PK) and 519 (LG/BK).

**Is resolution obtained?**

Yes	No
Concern is most likely resolved. A drive test is recommended to VERIFY speed sensor output is OK during customer driving conditions.	GO to <a href="#">NN5</a> .

**NN5 CHECK IF ALL STEPS HAVE BEEN COMPLETED**

- This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified.



**CAUTION:** If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.

**Have all prior diagnostic steps been completed as described above?**

Yes	No
REPLACE speed sensor. GO to <a href="#">NN6</a> for drive test. If no resolution, REPLACE anti-lock brake control module. GO to <a href="#">NN6</a> for drive test.	GO to last diagnostic step completed and CONTINUE.

**NN6 SENSOR OUTPUT DRIVE TEST**

- Reinstall all components and remove Rotunda Breakout Box 014-00322 or equivalent.
- Clear all codes.
- Key OFF.
- Key ON.
- Drive vehicle and perform the following:
  - Complete at least one hard left and one hard right turn.
  - Travel over a stretch of rough road at normal vehicle speed.

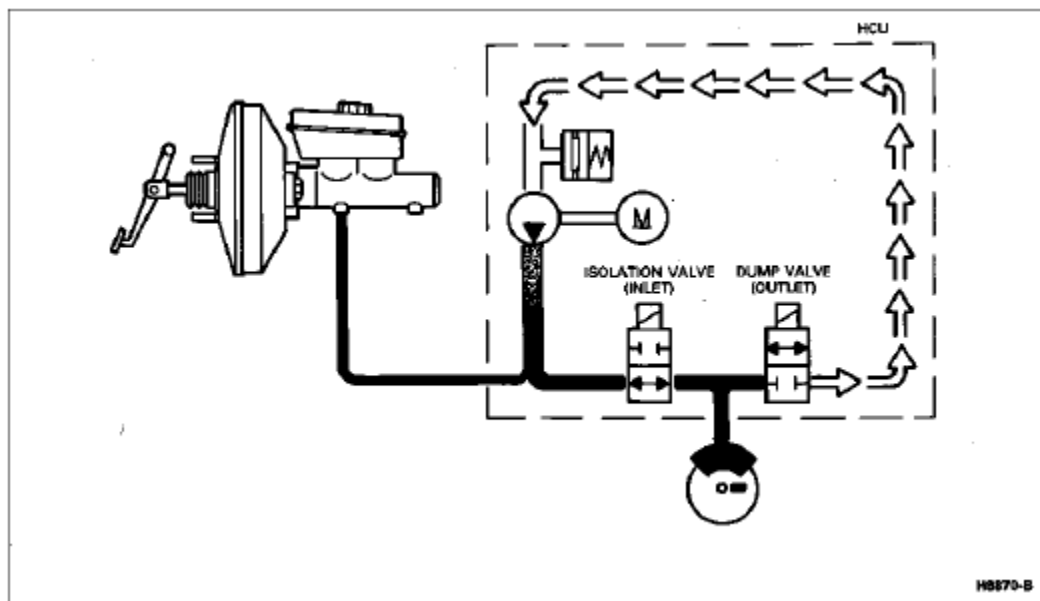
- Perform one hard acceleration from a stop.
- Retrieve code(s).

**Is Code System Pass set?**

Yes	No
<p>STOP. Repair is complete.</p>	<p>Code being repaired still exists. GO to <a href="#">NN5</a>.</p> <p>Different code is set (other than C1229, C1260 or C1237). GO to appropriate pinpoint test.</p> <p>Code being repaired still exists and anti-lock brake control module has been replaced.</p> <p>The following are time consuming and should be performed only after all previous options have been exhausted.</p> <p>Air gap between sensor and rear axle tone ring may be too large.</p> <p>VERIFY Circuits 523 (R/PK) and 519 (LG/BK) are twisted throughout the wire loom. If the wires are not twisted, the anti-lock brake control module may be sensitive to any outside interference.</p> <p>Excessive axle vibration, especially over rough road can cause this issue. VERIFY rear axle is not excessively noisy or otherwise performing abnormally. REPAIR as required.</p>

**PINPOINT TEST P: LF VALVE PAIR FUNCTION TEST**

**Affected Circuit(s)/Electrical Component(s)**



**Possible Contributing Component/Vehicle Wiring Concerns**

- Pinched or closed brake line or hose
- Worn or clogged front left outlet valve

**P1 CHECK BRAKE LINES/HOSES**

- Visually inspect brake lines from valve block to front left wheel.

Are they damaged?

Yes	No
REPLACE/REPAIR brake lines.	GO to <a href="#">P2</a> .

**P2 CHECK FRONT LEFT OUTLET VALVE**

- Key OFF.
- Install Rotunda Breakout Box 014-00322 or equivalent and Overlay.
- Jumper Pins 19, 26, 40, and 1 together on the Rotunda Breakout Box 014-00322 or equivalent.
- Raise vehicle so front left wheel is just off the ground.
- Press hard on the brake pedal and have an assistant try to turn the LH front wheel.

**NOTE: This condition is similar to the master cylinder bypass condition. It is important that the brake pedal be quickly and forcefully applied to rule out master cylinder bypass as the cause if a hydraulic leak is detected. Typically, master cylinder bypass only occurs at low line pressures.**

Does the wheel turn or the brake pedal drop slowly?



## Q1 CHECK BRAKE LINES/HOSES

- Visually inspect brake lines from valve block to right front wheel.

Are lines damaged?

Yes	No
REPAIR/REPLACE lines.	GO to <a href="#">Q2</a> .

## Q2 CHECK FRONT RIGHT OUTLET VALVE

- Key OFF.
- Install Rotunda Breakout Box 014-00322 or equivalent and Overlay.
- Jumper Pins 15, 19, 34, and 1 together on the Rotunda Breakout Box 014-00322 or equivalent.
- Raise vehicle so front right wheel is just off the ground.
- Press hard on the brake pedal and have an assistant try to turn the RH front wheel.

**NOTE:** This condition is similar to the master cylinder bypass condition. It is important that the brake pedal be quickly and forcefully applied to rule out master cylinder bypass as the cause if a hydraulic leak is detected. Typically, master cylinder bypass only occurs at low line pressures.

Does wheel turn or the pedal drop slowly?

Yes	No
REPLACE HCU. BLEED brake system. Refer to <a href="#">Section 06-06</a> .	GO to <a href="#">Q3</a> .

## Q3 CHECK FRONT RIGHT OUTLET VALVE OPERATION



**CAUTION:** Do not leave ignition on for more than 30 seconds with the jumper installed.

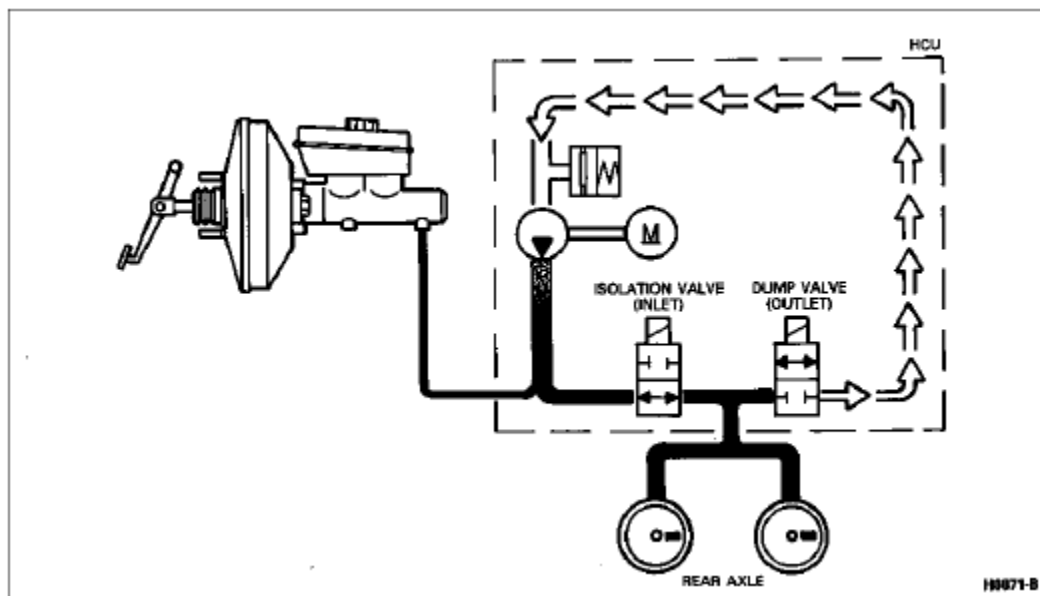
- Apply brake pedal force, turn ignition ON and have assistant try to turn wheel.

Does wheel turn now?

Yes	No
Valve is OK.	REPLACE HCU. BLEED brake system. REFER to <a href="#">Section 06-06</a> .

## PINPOINT TEST R: REAR AXLE VALVE PAIR FUNCTION TEST

Affected Circuit(s)/Electrical Component(s)



**Possible Contributing Component/Vehicle Wiring Concerns**

- Pinched or closed brake line or hose
- Worn or clogged rear axle outlet valve

**R1 CHECK BRAKE LINES**

- Visually inspect brake lines from valve block to rear wheel.

Are lines damaged?

Yes	No
REPAIR/REPLACE lines.	GO to <a href="#">R2</a> .

**R2 CHECK REAR AXLE OUTLET VALVE**

- Key OFF.
- Install Rotunda Breakout Box 014-00322 or equivalent and Overlay.
- Jumper Pins 19, 27, 33, and 1 together on the Rotunda Breakout Box 014-00322 or equivalent.
- Raise vehicle so rear wheels are just off the ground.
- Press hard on the brake pedal and have an assistant try to turn a rear wheel.

**NOTE: This condition 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 the cause if a hydraulic leak is detected. Typically, master cylinder bypass only occurs at low line pressures.**



Does the wheel turn or the brake pedal drop slowly?

Yes	No
REPLACE HCU. BLEED brake system. Refer to <a href="#">Section 06-06</a> .	GO to <a href="#">R3</a> .

### R3 CHECK REAR AXLE OUTLET VALVE OPERATION



**CAUTION:** Do not leave ignition on for more than 30 seconds with the jumper installed.

- Apply brake pedal force, turn ignition on and have assistant try to turn wheel.

Does wheel turn now?

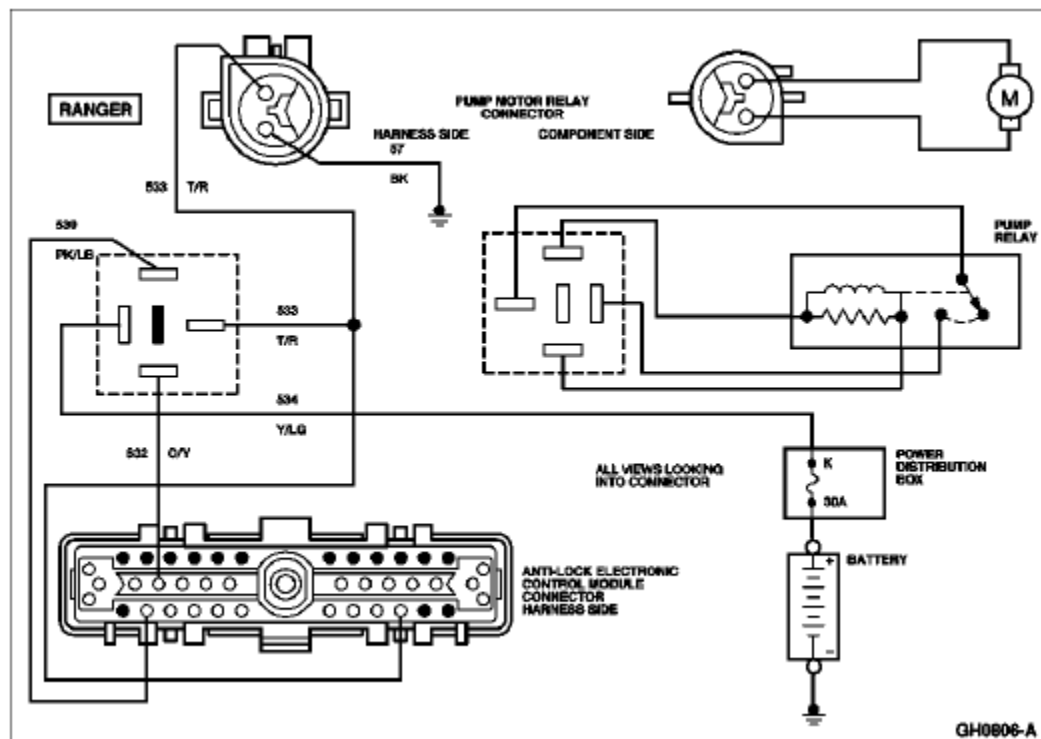
Yes	No
Valve is OK.	REPLACE HCU. BLEED brake system. REFER to <a href="#">Section 06-06</a> .

### PINPOINT TEST S: ABS HYDRAULIC PUMP MOTOR CIRCUIT OPEN (CODE C1096)

#### Possible Code(s)

C1096 — Open or intermittent connection to pump motor relay, damaged relay coil or contacts, damaged pump motor.

#### Affected Circuit(s)/Electrical Component(s)



## Description

Code C1096 is generated by the anti-lock brake control module.

## Possible Contributing Component/Vehicle Wiring Concerns

- Damaged pump motor.
- Terminal backout in anti-lock brake control module harness connector Pins 29 and 37
- Open or shorted pump motor relay coil
- Open contacts in pump motor relay
- Terminal backout in pump motor 2-way, Pins 1 or 2

## S1 VISUAL INSPECTION AND EQUIPMENT HOOK-UP

- Make sure the battery is OK. Refer to [Section 14-01](#).
- Inspect anti-lock brake control module pins, 30 amp pump motor feed fuse, battery and ground connections, relay connections and pump motor connections.
- Remove anti-lock brake control module, install Rotunda Breakout Box 014-00322 or equivalent and Overlay. Verify ground.
- Jumper Pins 1 and 19 together.
- Key ON (energize system relay).
- Jumper Pins 1 and 29 together (energize pump motor relay).

## Is pump motor running?

---

Yes	No
GO to <a href="#">S7</a> .	GO to <a href="#">S2</a> .

## S2 VOLTAGE CHECK 1 AND 2

- Disconnect 2-way connector.
- Using battery positive lead connect B+ to Pin 2 (533) and ground to Pin 1 (57) on HCU side of 2-way connector.

Does pump motor run?

Yes	No
GO to <a href="#">S3</a> .	REPLACE HCU. GO to <a href="#">S9</a> .

## S3 CHECK PIN 1 GROUND

- Check for continuity between Pin 1 on the harness side connector and a known good chassis ground.

Is there continuity?

Yes	No
GO to <a href="#">S4</a> .	REPAIR open in Circuit 57 (BK). GO to <a href="#">S9</a> .

## S4 CONTINUITY CHECK, CIRCUIT 533 (T/R)

- Key OFF.
- Disconnect pump motor relay.
- Check continuity on Circuit 533 (T/R) to Pin 2.

Is there continuity?

Yes	No
GO to <a href="#">S5</a> .	REPAIR open in Circuit 533 (T/R). GO to <a href="#">S9</a> .

## S5 CONTINUITY CHECK, PUMP MOTOR RELAY TO ABS POWER RELAY

- Remove ABS power relay.
- Check continuity between pump motor relay Circuit 532 (O/Y) and ABS power relay Circuit 532 (O/Y).

Is there continuity?

Yes	No
GO to <a href="#">S6</a> .	REPAIR Circuit 532 (O/Y). GO to <a href="#">S9</a> .

## S6 CONTINUITY CHECK, PUMP MOTOR RELAY CIRCUIT 534 (Y/LG)

- Disconnect battery negative cable.
- Check continuity from pump motor relay Circuit 534 (Y/LG) to battery (+) connection point.
- Reconnect battery negative cable when finished.

**NOTE: When the battery has been disconnected and reconnected, some abnormal drive symptoms may occur while the powertrain control module relearns its adaptive strategy. The vehicle may need to be driven 16 km (10 miles) or more to relearn the strategy.**

Is there continuity?

Yes	No
GO to <a href="#">S7</a> .	REPAIR open in Circuit 534 (Y/LG) or REPLACE 30A fuse. GO to <a href="#">S9</a> .

## S7 CONTINUITY CHECK, PUMP MOTOR RELAY CIRCUIT 539 (PK/LB)

- Check continuity from pump motor relay Circuit 539 (PK/LB) to Pin 29 on the Rotunda Breakout Box 014-00322 or equivalent.

Is there continuity?

Yes	No
REPLACE pump motor relay. GO to <a href="#">S9</a> .	REPAIR short to ground in Circuit 539 (PK/LB). GO to <a href="#">S9</a> .

## S8 CHECK IF ALL STEPS HAVE BEEN COMPLETED

- This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified.



**CAUTION: If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.**

Have all prior diagnostic steps been completed as described above?

Yes	No
REPLACE ECU. GO to <a href="#">S9</a> .	GO to last diagnostic step completed and CONTINUE.

## S9 CHECK FOR CODE REPEATABILITY

- Clear all codes.
- Key OFF.
- Key ON.
- Retrieve code(s).

#### Is Code System Pass set?

Yes	No
STOP. Concern has been corrected.	Code C1096 still exists. Concern has NOT been corrected. RETURN to the last diagnostic step completed and PROCEED.  Different code is set. GO to appropriate pinpoint test.  Code C1096 still exists and Step S8 is complete. GO to <a href="#">S10</a> .

### S10 VERIFY INTEGRITY OF VEHICLE WIRING

**NOTE:** If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.

- Refer to [Pinpoint Test ID](#), Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic.

#### Is resolution achieved?

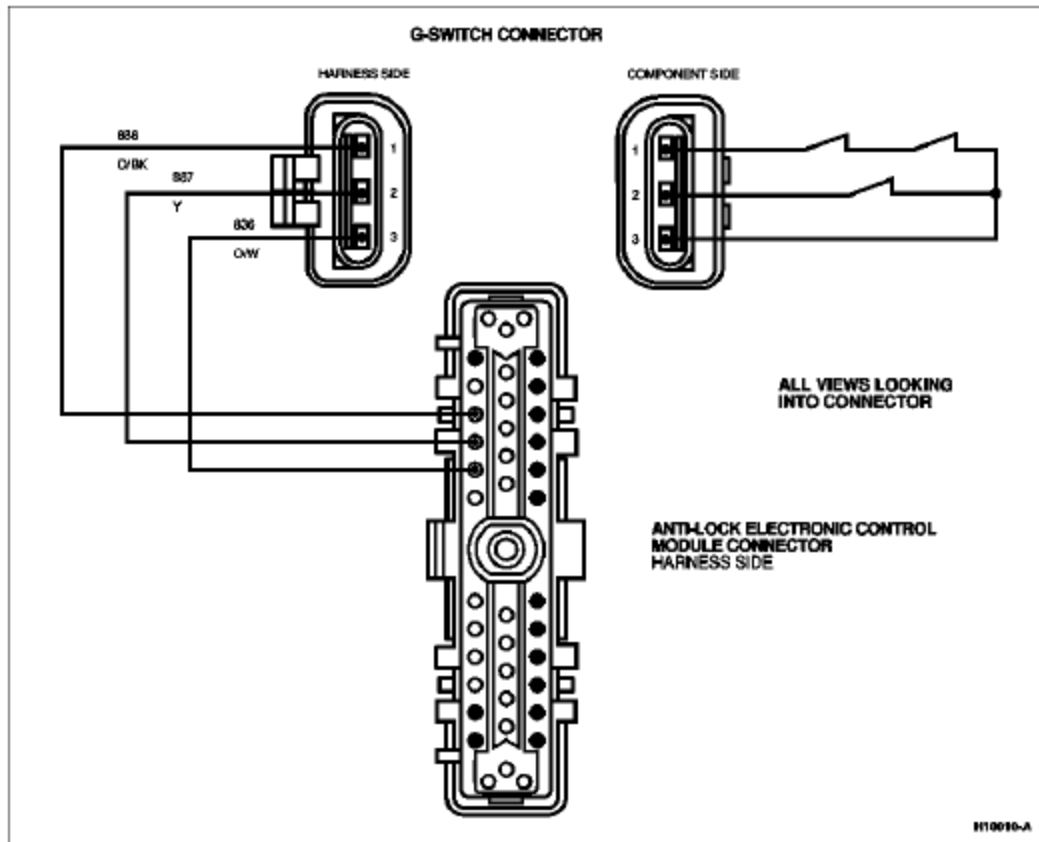
Yes	No
GO to <a href="#">S9</a> for system OK verification.	GO to <a href="#">S8</a> .

### PINPOINT TEST T: ABS ACCELERATION SWITCH CIRCUIT FAILURE (CODE C1102)

#### Possible Code(s)

C1102 — Intermittent or open connection between anti-lock brake control module and G-switch, damaged G-switch or circuit in anti-lock brake control module.

#### Affected Circuit(s)/Electrical Component(s)



## Description

Code C1102 is generated by the anti-lock electronic control module's detection of a circuit failure between the anti-lock brake control module and the G-switch and by a failed G-switch or internal anti-lock brake control module damage.

## Possible Contributing Component/Vehicle Wiring Concerns

- Terminal backout in anti-lock brake control module wiring harness connector Pins 30, 31 and 32.
- Worn or damaged G-switch.
- Worn or damaged anti-lock brake control module.
- G-switch terminal backout, Pins 1, 2 and 3.
- Short to ground in Circuits 836 (O/W), 886 (O/BK) and 887 (Y).
- Module initialized on 4x4 vehicle then installed on 4x2 vehicle.

**NOTE:** The ECU can be reinitialized with the New Generation Star (NGS) Tester.

## T1 SWITCH CHECK, DEFAULT G-SWITCH POSITION

- Disconnect G-switch harness connector.
- Remove the G-switch from the vehicle.
- Inspect harness connector and G-switch connector cavity for water or terminal corrosion.

- Place the G-switch on a level surface.
- Measure the resistance between G-switch Pin 1 (Circuit 886) and Pin 3 (Circuit 836).
- Measure the resistance between G-switch Pin 2 (Circuit 887) and Pin 3 (Circuit 836).

**Are both resistances measured less than 5 ohms?**

Yes	No
GO to <a href="#">T2</a> .	All switches should be closed. REPLACE G-switch. GO to <a href="#">T11</a> .

## **T2 SWITCH CHECK, G-SWITCH RAISED 38.0MM**

- Raise the front of the G-switch 38.0mm (1.5 in.). The arrow on the connector points toward the front.
- Measure the resistance between G-switch Pin 1 (Circuit 886) and Pin 3 (Circuit 836).

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

Yes	No
GO to <a href="#">T3</a> .	REPLACE G-switch. GO to <a href="#">T11</a> .

## **T3 SWITCH CHECK, G-SWITCH RAISED 25.4MM**

- Raise the rear of the G-switch 25.4mm (1.0 in.).
- Measure the resistance between G-switch Pin 2 (Circuit 887) and Pin 3 (Circuit 836).

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

Yes	No
G-switch is OK. GO to <a href="#">T4</a> .	REPLACE sensor. GO to <a href="#">T11</a> .

## **T4 CONTINUITY CHECK, CIRCUIT 836 (O/W) BETWEEN ANTI-LOCK ELECTRONIC CONTROL MODULE AND G-SWITCH HARNESS CONNECTOR**

- Install Rotunda Breakout Box 014-00322 or equivalent and Overlay.
- Measure the resistance between Pin 32 on the Rotunda Breakout Box 014-00322 or equivalent and G-switch harness connector Pin 3 (Circuit 836).

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

Yes	No
REPAIR Circuit 836 (O/W) between anti-lock brake control module and G-switch. GO to <a href="#">T11</a> .	GO to <a href="#">T5</a> .

## **T5 SHORT TO GROUND CHECK, CIRCUIT 836 (O/W) BETWEEN ANTI-LOCK**

## ELECTRONIC CONTROL MODULE AND G-SWITCH HARNESS CONNECTOR

- Measure the resistance between Pin 32 and Pin 1 or 14 on the Rotunda Breakout Box 014-00322 or equivalent.

Is the resistance greater than 5 ohms?

Yes	No
GO to <a href="#">T6</a> .	REPAIR short to ground in Circuit 836 (O/W) between anti-lock brake control module and acceleration sensor. GO to <a href="#">T11</a> .

## T6 CONTINUITY CHECK, CIRCUIT 886 (O/BK) BETWEEN ANTI-LOCK ELECTRONIC CONTROL MODULE AND G-SWITCH HARNESS CONNECTOR

- Measure the resistance between Pin 30 on the Rotunda Breakout Box 014-00322 or equivalent and G-switch harness connector Pin 1 (Circuit 886).

Is the resistance greater than 5 ohms?

Yes	No
REPAIR Circuit 886 (O/BK) between anti-lock brake control module and acceleration sensor. GO to <a href="#">T11</a> .	GO to <a href="#">T7</a> .

## T7 SHORT TO GROUND CHECK, CIRCUIT 886 (O/BK) BETWEEN ANTI-LOCK ELECTRONIC CONTROL MODULE AND G-SWITCH HARNESS CONNECTOR

- Measure the resistance between Pin 30 and Pin 1 or 14 on the Rotunda Breakout Box 014-00322 or equivalent.

Is the resistance greater than 5 ohms?

Yes	No
GO to <a href="#">T8</a> .	REPAIR short to ground in Circuit 886 (O/BK) between anti-lock brake control module and acceleration G-switch. GO to <a href="#">T11</a> .

## T8 CONTINUITY CHECK, CIRCUIT 887 (Y) BETWEEN ANTI-LOCK ELECTRONIC CONTROL MODULE AND G-SWITCH HARNESS CONNECTOR

- Measure the resistance between Pin 31 on the Rotunda Breakout Box 014-00322 or equivalent and G-switch harness connector Pin 2 (Circuit 887).

Is the resistance greater than 5 ohms?

Yes	No



REPAIR Circuit 887 (Y) between anti-lock brake control module and acceleration G-switch. GO to <a href="#">T11</a> .	GO to <a href="#">T9</a> .
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## T9 SHORT TO GROUND CHECK, CIRCUIT 887 (Y) BETWEEN ANTI-LOCK ELECTRONIC CONTROL MODULE AND G-SWITCH HARNESS CONNECTOR

- Measure the resistance between Pin 31 and Pin 1 or 14 on the Rotunda Breakout Box 014-00322 or equivalent .

Is the resistance greater than 5 ohms?

Yes	No
GO to <a href="#">T11</a> .	REPAIR short to ground in Circuit 887 (Y) between anti-lock brake control module and G-switch. GO to <a href="#">T11</a> .

## T10 VERIFY ALL STEPS HAVE BEEN COMPLETED

- This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified.



**CAUTION:** If the above is not complete, chances are that replacement of this or any component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.

Have all prior diagnostic steps been completed as described above?

Yes	No
REPLACE G-switch. GO to <a href="#">T11</a> . If no resolution, REPLACE anti-lock brake control module. GO to <a href="#">T11</a> .	GO to last diagnostic step completed and CONTINUE.

## T11 CHECK FOR CODE REPEATABILITY

- Remove Rotunda Breakout Box 014-00322 or equivalent and reinstall all components.
- Clear all codes.
- Key OFF.
- Key ON.
- Retrieve code(s).

Is Code System Pass set?

Yes	No
	Code C1102 still exists. Concern has NOT been corrected. RETURN to last diagnostic step

STOP. Concern has been corrected.	<p>completed and PROCEED.</p> <p>Different code is set. GO to appropriate pinpoint test.</p> <p>Code C1102 still exists and Step T9 is complete. GO to <a href="#">T12</a>.</p>
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## T12 VERIFY INTEGRITY OF VEHICLE WIRING

**NOTE: If the above steps have been completed, the MOST LIKELY cause of the concern is wiring related.**

- Refer to [Pinpoint Test ID](#), Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic.

**Is resolution achieved?**

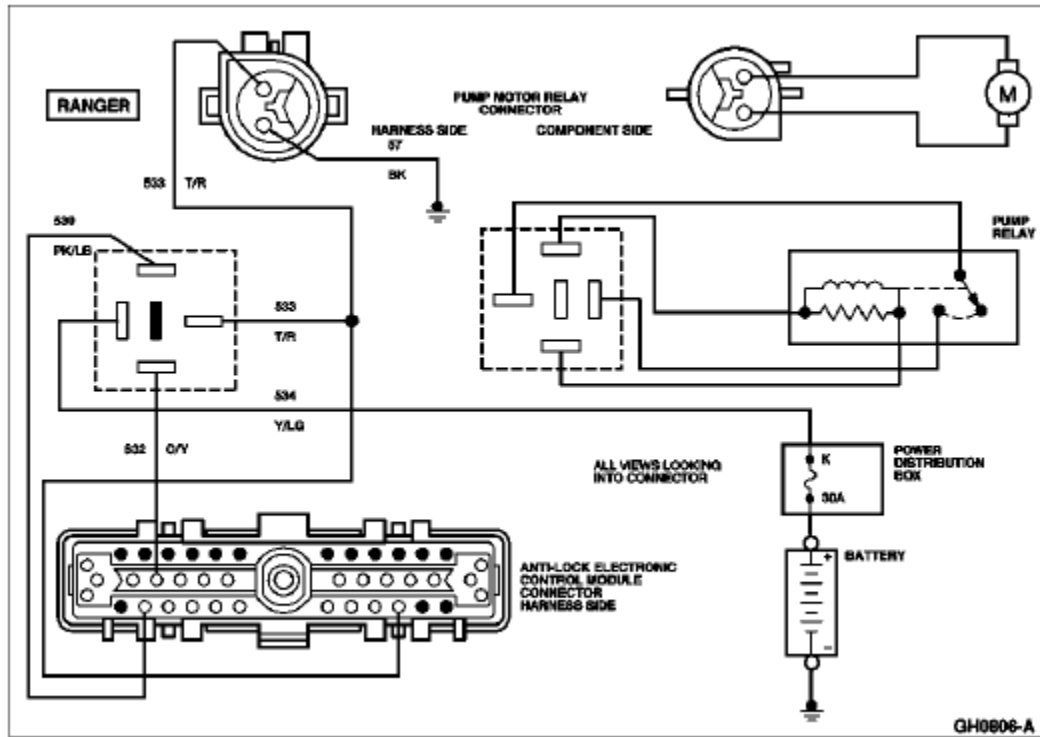
Yes	No
GO to <a href="#">T11</a> for system OK verification.	Go to <a href="#">T10</a> .

## PINPOINT TEST U: ABS HYDRAULIC PUMP MOTOR CIRCUIT FAILURE (CODE C1095)

### Possible Code(s)

C1095 — Pump motor running but not triggered by ECU.

### Affected Circuit(s)/Electrical Component(s)



**Description**

Code C1095 is generated by the anti-lock brake control module when the pump motor is running but is not triggered.

**Possible Contributing Component/Vehicle Wiring Concerns**

- Damaged trigger circuit in anti-lock brake control module
- Welded relay contacts
- Ground short on Circuit 539 (PK/LB)

**U1 PUMP MOTOR CHECK, KEY OFF**

- Make sure the battery is OK. Refer to [Section 14-01](#).
- Key OFF.

Is the pump motor running?

Yes	No
REPLACE pump motor relay. GO to <a href="#">U4</a> .	GO to <a href="#">U2</a> .

**U2 CHECK CIRCUIT 539 (PK/LB)**

- Remove anti-lock brake control module, install Rotunda Breakout Box 014-00322 or equivalent and Overlay. Verify Pin 1 is ground.
- Key ON.
- Jumper Pins 1 and 19 to energize main relay.
- Verify that contacts are not sticking or welded.

#### Is pump motor running?

Yes	No
REPAIR short to ground in Circuit 539 (PK/LB). GO to <a href="#">U4</a> .	GO to <a href="#">U4</a> .

### U3 CHECK IF ALL STEPS HAVE BEEN COMPLETED

- This step requires that a valid diagnostic trouble code has been obtained, ALL prior diagnostic steps have been completed, and the affected wiring integrity has been verified.



**CAUTION:** If the above is not complete, chances are that replacement of this or any other system component without specific direction will not, in most circumstances, resolve the concern and will consequently result in customer dissatisfaction.

#### Have all prior diagnostic steps been completed as described above?

Yes	No
REPLACE anti-lock brake control module. GO to <a href="#">U4</a> .	GO to last diagnostic step completed and CONTINUE.

### U4 CHECK FOR CODE REPEATABILITY

- Clear all codes.
- Key OFF.
- Key ON.
- Retrieve code(s).

#### Is Code System Pass set?

Yes	No
STOP. Concern has been corrected.	Code C1095 still exists. Concern has NOT been corrected. RETURN to the last diagnostic step completed and PROCEED.  Different code is set. GO to appropriate pinpoint test.  Code C1095 still exists and Step U2 is complete. GO to <a href="#">U5</a> .

## U5 VERIFY INTEGRITY OF VEHICLE WIRING

**NOTE:** If the above steps have been completed, the **MOST LIKELY** cause of the concern is wiring related.

- Refer to [Pinpoint Test ID](#), Intermittent Diagnosis Procedure and perform for ALL affected circuits as shown on the pinpoint test mini-schematic.

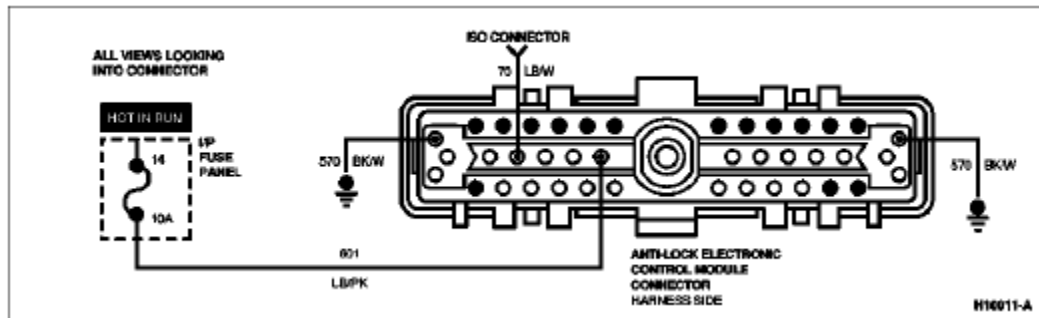
Is resolution achieved?

Yes	No
GO to <a href="#">U4</a> for system OK verification.	GO to <a href="#">U3</a> .

## PINPOINT TEST V: NO COMMUNICATION

Hard Light — No Code

Affected Circuit(s)/Electrical Components:



### Description

If no vehicle battery voltage is available to the anti-lock brake control module, or the voltage available is less than 9.5 volts, the anti-lock brake control module cannot initialize. As a result, the system relay cannot be energized and the ABS warning light remains on. No diagnostics are possible; therefore, no codes can be read.

### Possible Contributing Base Brake Component/Vehicle Wiring Concerns

- Worn or damaged ignition switch
- Open ignition feed circuit to anti-lock brake control module
- Low battery voltage (less than 8V)
- Blown ignition fuse
- Open system ground
- Poor ground connection Circuit 570 (BK/W)
- B+ short on Circuit 70 (LB/W)
- Ground short on Circuit 601 (LB/PK) (fuse 14 blown).

## V1 INSTALL ROTUNDA BREAKOUT BOX 014-00322 OR EQUIVALENT

- Install Rotunda Breakout Box 014-00322 or equivalent and Overlay.
- Open power distribution box and locate ignition fuse 14 (10A).
- Check fuse for continuity.
- Verify both fuse terminals in the power network box are clean and secure.

Is there continuity and are terminals clean and secure?

Yes	No
REINSTALL fuse. GO to <a href="#">V2</a> .	REPLACE fuse or SERVICE terminal as appropriate. GO to <a href="#">PC3</a> .

## V2 CHECK FOR B+ SHORT ON CIRCUIT 70 (LB/W)

- Key OFF.
- Measure voltage between Pins 1 and 16 at breakout box.

Is B+ present?

Yes	No
GO to <a href="#">V3</a> .	REPAIR B+ short on Circuit 70 (LB/W). GO to <a href="#">PC3</a> .

## V3 VERIFY ECU GROUND

- Key OFF.
- Inspect ground eyelet at left radiator support for excessive dirt, corrosion, or looseness. Clean and tighten as necessary.
- Check for continuity between Pin 1 and the ground eyelet at left radiator support.
- Check for continuity between Pin 14 and the ground stud at left radiator support.

Is there continuity at both pins?

Yes	No
GO to <a href="#">V4</a> .	REPAIR open circuit in ground between anti-lock brake control module harness connector and ground eyelet. GO to <a href="#">PC3</a> .

## V4 VERIFY DIAGNOSTIC LINE

- Key OFF.
- Measure resistance between NGS Tester Connector pin for Circuit 70 (LB/W) and Pin 16 on breakout

box.

**Is resistance measured less than 10 ohms?**

Yes	No
GO to <a href="#">V5</a> .	REPAIR or REPLACE open or high resistance issue in Circuit 70 (LB/W). GO to <a href="#">PC3</a> .

**V5 VERIFY DIAGNOSTIC GROUND**

- Key OFF.
- Measure resistance between NGS Tester Connector pin for Circuit 57 (BK) and known good chassis ground.

**Is resistance measured less than 10 ohms?**

Yes	No
GO to <a href="#">V6</a> .	REPAIR or REPLACE as necessary. GO to <a href="#">PC3</a> .

**V6 VERIFY PROPER VOLTAGE AT ANTI-LOCK ELECTRONIC CONTROL MODULE HARNESS CONNECTOR**

- Key ON.
- Measure voltage between Pins 20 and 1.

**Is there at least 9.5 volts?**

Yes	No
REPLACE anti-lock brake control module. GO to <a href="#">PC3</a> .	<p>There is voltage greater than 0 volts but less than 9.5 volts. Anti-lock brake control module cannot initialize due to insufficient voltage. Problem is NOT in ABS system. REFER to <a href="#">Section 14-00</a>.</p> <p>There is 0 volts. REPAIR open circuit between fuse 14 and anti-lock brake control module harness connector in 601 (LB/PK). GO to <a href="#">PC3</a>.</p>





## Hydraulic Control Unit (HCU)

### Removal

1. Remove the battery (10655) and battery tray (10732). Refer to [Section 14-01](#).
2. Raise and support the vehicle on a hoist.
3. From beneath the LH front fender apron (16055), remove the anti-lock hydraulic control unit bracket nut.
4. Lower the vehicle.
5. Disconnect the two anti-lock HCU electrical connectors.
6. **NOTE: To prevent contamination and brake fluid leakage after hydraulic tubes are disconnected, plug each tube and port.**

Disconnect the five HCU hydraulic connectors.

7. Remove the HCU bracket-to-inner fender screw and stud and remove HCU.

### Installation

To install, reverse the removal procedure.

Tighten the anti-lock HCU bracket-to-inner fender screw and stud to 11-13 Nm (91-122 lb-in).

Tighten the anti-lock HCU bracket nut to 11-13 Nm (91-122 lb-in).

Tighten the hydraulic brake tube to the HCU outlet port adapter nuts to 18-27 Nm (14-19 lb-ft).

Tighten the hydraulic brake tube to HCU inlet port nuts to 14-21 Nm (11-15 lb-ft).

Bleed the brake system. Refer to [Section 06-06](#).

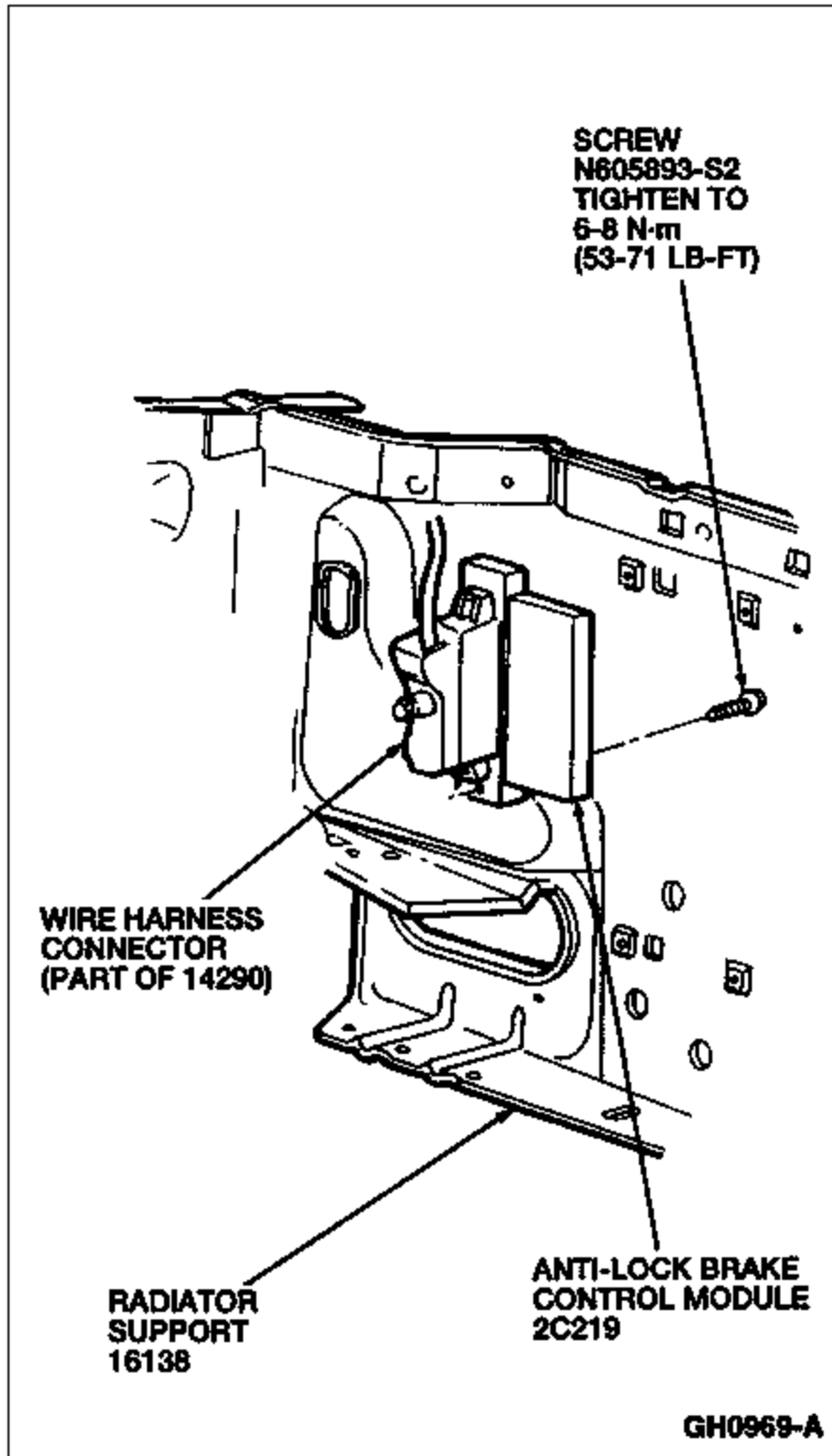
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## Control Module, Anti-Lock Brake, Ranger

### Removal

1. Disconnect the battery cables and remove the battery.
2. Locate the anti-lock brake control module electrical connector in front and to the right of the battery tray (10732). Disconnect the connector.



3. Remove the anti-lock brake control module-to-radiator support screw.
4. Slide the anti-lock brake control module to release the retaining tab and remove the module from the vehicle.

**Installation**

To install, reverse the removal procedure. Tighten the module-to-radiator support screw to 6-8 Nm (53-71 lb-in).

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*Section 06-09B: Brake, 4-Wheel Anti-Lock*  
**REMOVAL AND INSTALLATION**

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*1997 Ranger Workshop Manual*

## **Relay, Anti-Lock Brake**

### **Removal and Installation**

The anti-lock brake relays are located in a relay box attached to the LH inner fender, behind the battery. The ABS power relay uses five terminal sockets and the pump motor relay uses four. The relay box must be removed from the LH inner fender to remove the relays. The relays are pulled from and pressed into their respective sockets.

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## Brake Sensors

### Front

#### Removal

1. From under the vehicle, disconnect the speed sensor assembly two-pin connector from wiring harness.
2. Separate the speed sensor cable from brake hose clips.
3. Remove the speed sensor retaining bolt from front spindle and slide sensor out of mounting hole.

#### Installation

For installation, follow removal procedures in reverse order. Tighten retaining bolt to 8-10 Nm (68-92 lb-in).

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Section 06-09B: Brake, 4-Wheel Anti-Lock  
REMOVAL AND INSTALLATION

1997 Ranger Workshop Manual

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## Sensor Indicator, Anti-Lock Brake

### Front

#### Removal and Installation

For removal and installation of the front speed sensor indicator (4x4 only), refer to [Section 05-03A](#). Replace the rotor. Refer to [Section 06-03](#) (4x2).

### Rear

#### Removal and Installation

For removal and installation of the rear speed sensor indicator, refer to [Section 05-02A](#) or [Section 05-02B](#).

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## Brake Master Cylinder Reservoir Checking and Filling

Brake fluid level should not be more than 4mm (0.16 inch) below the MAX line on the side of the brake master cylinder reservoir (2K478). If brake fluid is low, the red BRAKE indicator will illuminate. To add brake fluid, clean and remove reservoir cap and pour clean brake fluid into the brake master cylinder reservoir. Fill to specification mentioned above. Use Ford High Performance DOT 3 Brake Fluid C6AZ-19542-AA or equivalent DOT 3 fluid meeting Ford specification ESA-M6C25-A, DOT3. If brake fluid has to be added often, check all hydraulic connections for leaks.

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Section 06-09B: Brake, 4-Wheel Anti-Lock  
SPECIFICATIONS

1997 Ranger Workshop Manual

## SPECIFICATIONS

### TORQUE SPECIFICATIONS

Description	Nm	Lb-Ft	Lb-In
Anti-Lock Brake Control Module Screw	6-8	—	53-71
Wheel Speed Sensor Bolt, Front	8-10	—	68-92
Anti-Lock Hydraulic Control Unit-to-Inner Fender Fasteners	11-13	—	91-122
Hydraulic Brake Tube Fittings	15-20	11-14	—
Speed Sensor Bolt, Rear	34-40	25-29	—
Wheel Lugnuts	135	100	—
HCU Bracket to Inner Fender Screw	11-13	—	91-122
HCU Bracket to Inner Fender Stud	11-13	—	91-122
HCU Bracket Nut	11-13	—	91-122
Hydraulic Brake Tube to HCU Outlet Port Nuts	18-27	14-19	—
Hydraulic Brake Tube to HCU Inlet Port Nuts	14-21	11-15	—