Powertrain Control/Emissions Diagnosis

1999

On Board Diagnostics II Diesel

SECTION 4: Diagnostic Subroutines

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Hard Start/No Start Diagnostic Procedures

Econoline
Hard Start/No Start Diagnostics

Note: A hard start/no start concern with EOT Temp. below 15 C (60 F) perform Step 10 first.

1. Visual Engine/Chassis Inspection

Fuel Oil Coolant Electrical Hoses Leaks	
Method	**Check**
Visual	

2. Check Engine Oil Level
- Check for contaminants (fuel, coolant).
- Correct Grade/Viscosity.
- Miles/Hours on oil, correct level.
- Check level in reservoir.

Method	Check
Visual	

3. Intake/Exhaust Restriction
- Inspect air filter and ducts - exhaust system.
- Inspect exhaust back pressure device.

Method	Check
Visual	

4. Sufficient Clean Fuel
- Check if the Water in Fuel lamp has been illuminated.
- After verifying that there is fuel in the tank, drain a sample from fuel filter housing by key on, engine off.

Note: Fuel pump will only run for 20 seconds.

Method	Checks
Visual	

5. Electric Fuel Pump Pressure
- After verifying that there is fuel in the tank and the pump is being powered, Measure at the top of the left cylinder head with a (0-160 PSI) gauge.
- Key on, engine off - Pump will run for about 20 seconds.

Instrument	Spec.	Measurement
0-160 PSI Gauge	30 PSI min.	

If pressure falls low, Go to step 8c on the Performance side of this sheet to pinpoint the cause.

6. Perform KOEO On Demand Test
- Use NGS Tester.
- DTCs set during this test are current faults.

Note: IDM DTCs displayed here could be current or historical faults.

Diagnostic Trouble Codes	

7. Retrieve Continuous Trouble Codes
- DTCs retrieved during this test are historical faults.

Note: IDM historical DTCs can be clear here even if none are displayed.

Diagnostic Trouble Codes	

8. KOEO Injector Electrical Self-Test
- Use NGS Tester.
- All injectors will momentarily buzz, then individual injectors will buzz in sequence 1 through 8.
- IDM DTCs may be transmitted after test is completed.

Note: IDM DTCs can be historical if not cleared above.

Injector Trouble Codes	

9. NGS Tool - Data List Monitoring
- NGS Tester may reset below 9.5 volts.
- Select the parameters indicated from the NGS parameter list and monitor while cranking engine.

Parameter	Spec.	Measurement
V PWR	8 volt minimum	
You may need to use an outside power source for the NGS.		
RPM	100 RPM minimum	
ICP	500 PSI or 3.4 mPa min.	
Fuel PW	1 mS to 6 mS	

A - V PWR - If indicating a low voltage condition, check battery voltage, charging system or power and ground circuits to the PCM.
GO TO PINPOINT TEST A

B - RPM - Low RPM could be an indication of starting/charging system problems, No RPM indicated with the engine cranking - could be CMP circuit fault, check for Diagnostic Trouble Codes.
GO TO PINPOINT TEST DF

C - ICP - A minimum of 500 PSI (3.4 mPa) is required before the injectors are enabled. No or low oil in the reservoir, system leakage, injector O-rings or faulty IPR could cause pressure loss.
Go to Section 4 step 9c in the PC/ED Manual for a detailed description on how to perform this test.

Note: If a no RPM Signal is received, IPR duty-cycle will default to 14%.

D - FUEL PW - Even though a 1 to 6 mS Fuel PW is shown on the NGS to be sent to the IDM, it's possible that the IDM did not get the signal, due to a fault on either CID or FDCS circuits or even the IDM.

10. Glow Plug System Operation

Relay Operation

- Glow Plug ON time is dependent on oil temperature and altitude. The Glow Plug relay comes on between 1 to 120 sec. and does not come on at all if oil Temp is above 30°C (86°F).
- Verify that B+ is being supplied on the large BK/WH wire going to the Glow Plug relay.
- Install a voltmeter to the glow plug feed terminal (terminal with two brown wires) or (center terminal on the shunt for California).
- Turn key to run position, measure "ON" time.
- Using the NGS GPCTM and EOT pids, verify sufficient glow plug "ON" time and voltage. (Dependent on oil temperature and altitude)

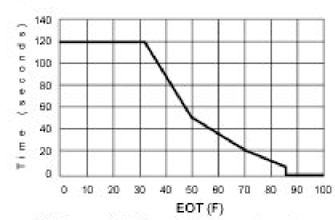
9 -12 volts	Spec.	Measurement
Relay On time	1 to 120 seconds	

Note: Wait to Start Lamp "On" time (1-10 sec.) is independent from Glow Plug Relay "On" time

Glow Plug Operation

- Measure Glow Plug Resistance to Bat. Ground.
- Remove both 9 pin connectors from valve covers.
- Measure GP Harness Resistance to Relay.

Glow Plug Number	Glow Plug to Ground .1 to 2 ohms	Connector to Relay 0 to 1 ohms
#1		
#3		
#5		
#7		
#2		
#4		
#6		
#8		



- Add 5 seconds to glow plug on time when above 7000 feet in altitude, but not to exceed 120 seconds.

Alt Ctrl zoomable graphic Right-click on desired area to Zoom In, Zoom Out, and return to Original View. To print, right-click on graphic, select View SVG, then print from new window.

F-Series
Hard Start/No Start Diagnostics

Note: A hard start/no start concern with EOT Temp. below 15 C (60 F) perform Step 10 first.

1. Visual Engine/Chassis Inspection

Fuel Oil Coolant Electrical Hoses Leaks	
Method	**Check**
Visual	

2. Check Engine Oil Level
- Check for contaminants (fuel, coolant).
- Correct Grade/Viscosity.
- Miles/Hours on oil, correct level.
- Check level in reservoir.

Method	Check
Visual	

3. Intake/Exhaust Restriction
- Inspect air filter and ducts - exhaust system.
- Inspect exhaust back pressure device.

Method	Check
Visual	

4. Sufficient Clean Fuel
- Check if the Water in Fuel lamp has been illuminated.
- After verifying that there is fuel in the tank, drain a sample from fuel filter housing by key on, engine off.

Note: Fuel pump will only run for 20 seconds.

Method	Checks
Visual	

5. Electric Fuel Pump Pressure
- After verifying that there is fuel in the tank and the pump is being powered, Measure at the top of the right cylinder head with a (0-160 PSI) gauge.
- Key on, engine off - Pump will run for about 20 seconds.

Instrument	Spec.	Measurement
0-160 PSI Gauge	30 PSI min.	

If pressure falls low, Go to step 8c on the Performance side of this sheet to pinpoint the cause.

6. Perform KOEO On Demand Test
- Use NGS Tester.
- DTCs set during this test are current faults.

Note: IDM DTCs displayed here could be current or historical faults.

Diagnostic Trouble Codes	

7. Retrieve Continuous Trouble Codes
- DTCs retrieved during this test are historical faults.

Note: IDM historical DTCs can be clear here even if none are displayed.

Diagnostic Trouble Codes	

8. KOEO Injector Electrical Self-Test
- Use NGS Tester.
- All injectors will momentarily buzz, then individual injectors will buzz in sequence 1 through 8.
- IDM DTCs may be transmitted after test is completed.

Note: IDM DTCs can be historical if not cleared above.

Injector Trouble Codes	

9. NGS Tool - Data List Monitoring
- NGS Tester may reset below 9.5 volts.
- Select the parameters indicated from the NGS parameter list and monitor while cranking engine.

Parameter	Spec.	Measurement
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You may need to use an outside power source for the NGS.		
RPM	100 RPM minimum	
ICP	500 PSI or 3.4 mPa min.	
Fuel PW	1 mS to 6 mS	

A - V PWR - If indicating a low voltage condition, check battery voltage, charging system or power and ground circuits to the PCM.
GO TO PINPOINT TEST A

B - RPM - Low RPM could be an indication of starting/ charging system problems, No RPM indicated with the engine cranking - could be CMP circuit fault, check for Diagnostic Trouble Codes.
GO TO PINPOINT TEST DF

C - ICP - A minimum of 500 PSI (3.4 mPa) is required before the injectors are enabled. No or low oil in the reservoir, system leakage, injector O-rings or faulty IPR could cause pressure loss.
Go to Section 4 step 9c in the PC/ED Manual for a detailed description on how to perform this test.

Note: If a no RPM Signal is received, IPR duty-cycle will default to 14%.

D - FUEL PW - Even though a 1 to 6 mS Fuel PW is shown on the NGS to be sent to the IDM, it's possible that the IDM did not get the signal, due to a fault on either CID or FDCS circuits or even the IDM.

10. Glow Plug System Operation

Relay Operation
- Glow Plug ON time is dependent on oil temperature and altitude. The Glow Plug relay comes on between 1 to 120 sec. and does not come on at all if oil Temp is above 55 C (131 F).
- Verify that B+ is being supplied on the large BK/WH wire going to the Glow Plug relay.
- Install a voltmeter to the glow plug feed terminal (terminal with two brown wires) or (center terminal on the shunt for California).
- Turn key to run position, measure "ON" time.
- Using the NGS GPCTM and EOT pids, verify sufficient glow plug "ON" time and voltage.
(Dependent on oil temperature and altitude)

9 -12 volts	Spec.	Measurement
Relay On time	1 to 120 seconds	

Note: Wait to Start Lamp "On" time (1-10 sec.) is independent from Glow Plug Relay "On" time

Glow Plug Operation
- Remove both 9 pin connectors from valve covers.
- Measure Glow Plug Resistance to Bat. Ground.
- Measure GP Harness Resistance to Relay.

Glow Plug Number	Glow Plug to Ground .1 to 2 ohms	Connector to Relay 0 to 1 ohms
#1		
#3		
#5		
#7		
#2		
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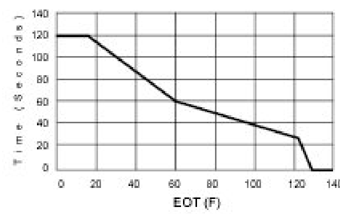
#8		



- Add 5 seconds to glow plug on time when above 7000 feet in altitude, but not to exceed 120 seconds.

1. Visual Engine/Chassis Inspection
Purpose:

This is a visual inspection to check the general condition of the engine and look for obvious causes of hard start or no start conditions.

1. Visual Engine/Chassis Inspection

Fuel Oil Coolant Electrical Hoses Leaks	
Method	**Check**
Visual	

DA1455-A

Recommended Procedure:

Inspect fuel system including fuel tank and fuel lines for kinks, bends and/or leakage. Check oil lines and high pressure pump in engine V for major oil leaks. Inspect for coolant leaks at radiator and heater hoses and check coolant level. Inspect MAP sensor and intercooler for pinched hoses and leaks. Inspect wiring for correct routing and make sure no rubbing or chafing has occurred. Inspect the in-line 42-way, injector driver module (IDM), powertrain control module (PCM) and sensor connectors to make sure they are completely seated and in good condition.

Possible Causes:

- Loose or leaking fuel supply lines could cause fuel system to lose prime.
- Kinked or blocked fuel supply lines will create fuel restriction.
- Massive fuel or oil leaks could contribute to no start conditions.
- Coolant leaks could indicate serious engine problems.
- Electronic connectors may be damaged or not installed properly causing a no start condition. The camshaft position (CMP) sensor and the injection pressure regulator (IPR) are the two most critical electronic sensors/actuators to inspect in no start situations.
- Pinched or open MAP sensor hose.
- Pinched or open intercooler hose.

Tools Required:

Inspection light

2. Check Engine Oil Level
Purpose:

To determine if there is enough oil or oil of sufficient quality to operate the injectors.

2. Check Engine Oil Level

- Check for contaminants (fuel, coolant)
- Correct Grade/Viscosity
- Miles/Hours on oil, correct level
- Check level in reservoir

Method	Check
Visual	

A22181-C

Recommended Procedure:

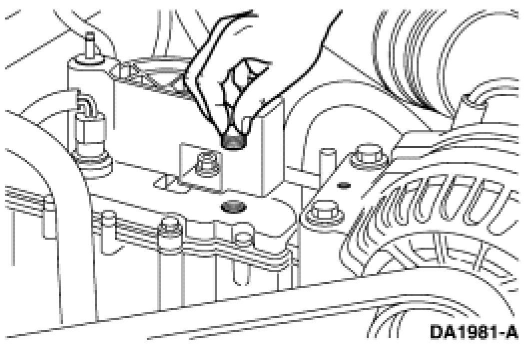
Check oil level with dipstick when vehicle is on level ground. If there is no oil or very little oil in the crankcase, the injectors will not operate.

If the oil level on the dipstick is overfull it is possible the engine was incorrectly serviced or fuel is diluting the oil and filling the crankcase. Usually if a substantial amount of fuel is in the oil it will have a fuel odor.

Inspect oil for color. A milky white oil indicates possible coolant contamination and will have an ethylene glycol odor.

Check service records for correct oil type and viscosity for the vehicle operating temperature. Single weight or 15W-40 oil is not recommended for cold ambient temperatures. 10W-30 oil is recommended for cold ambient temperatures. Oil that has had extended drain intervals will have increased viscosity (become thicker) and will make engine cranking more difficult and starting less reliable at temperatures below freezing. Refer to the lube oil chart in the Workshop Manual or Owner's Guide for the correct oil selection for temperature conditions.

The level in the oil reservoir should also be checked. Remove the inspection plug in top of reservoir and check to see if the oil reservoir is full. (A reservoir that drains back after the engine has not been operated for a period of time can cause a hard start and die condition.) Filling the reservoir will allow the system to prime faster facilitating starting.



Possible Causes:

- Loss of lube oil pressure
- Oil level low — oil leak, oil consumption, incorrect servicing
- Oil level high — incorrect servicing, fuel dilution from tandem fuel pump, fuel dilution from injector O-rings
- Oil contamination with coolant — oil cooler, head gasket, porosity
- Low reservoir level — engine built dry (not pressure lubed), prolonged period of not running, excessive cranking without starting

Tools Required:

1/4-inch drive ratchet or breaker bar to remove inspection plug

3. Intake/Exhaust Restriction
Purpose:

This is a visual inspection to determine if an air intake or exhaust restriction is contributing to a no start or hard start condition. If the engine does start with a high air intake or exhaust restriction, a considerable amount of black/blue smoke is produced.

3. Intake/Exhaust Restriction

- Inspect air filter and ducts - exhaust system.
- Inspect exhaust back pressure device.

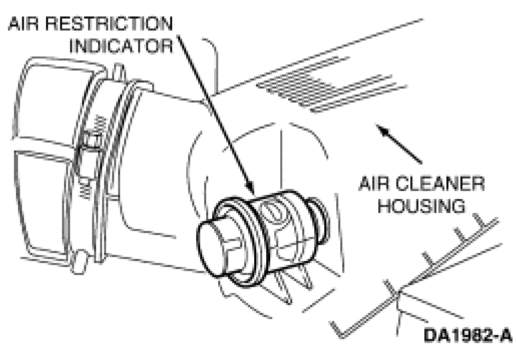
Method	Check
Visual	

DA1467-B

Recommended Procedure:

Inspect the air cleaner inlet and ducting to assure that it is not blocked or collapsed. Inspect the air cleaner housing and filter for proper installation. Inspect the filter minder to assure intake restriction is below the red marks.

Inspect the exhaust back pressure device bellcrank during cranking and assure that it is not closing. Inspect the exhaust system for damaged or blocked pipes. When the tang is against the stop, the valve is fully open.



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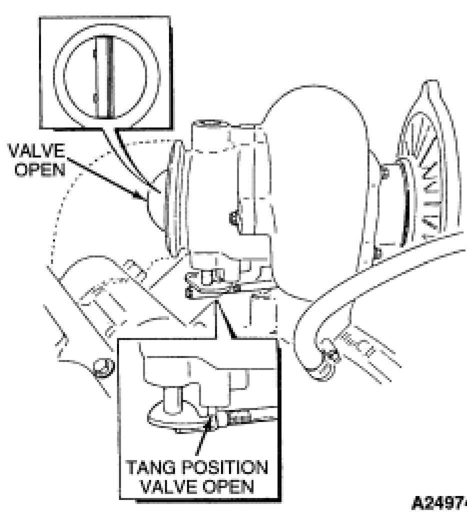


A24974-A

Possible Causes:

- Snow, plastic bags or other foreign material may restrict airflow at the air inlet.
- Misrouted air cleaner ducting.
- On engines recently repaired, rags or cap plugs may have been inadvertently left in an air inlet pipe.
- Exhaust back pressure device may be closing during cranking or stuck closed.
- Tailpipe or muffler may have collapsed or been damaged or the catalytic converter is clogged.

Tools Required:

None

4. Sufficient Clean Fuel

Purpose:

The purpose of this test is to see if the fuel system is getting sufficient clean fuel to start and run.

4. Sufficient Clean Fuel

- Check if the Water in Fuel lamp has been illuminated.
- After verifying that there is fuel in the tank, drain a sample from fuel filter housing by key on, engine off.

Note: Fuel pump will only run for 20 seconds.

Method	Checks
Visual	

DA1485-B

Recommended Procedure:

Route a hose from the fuel drain line to a clear container and open the drain. When the key is turned to the on position, the fuel pump will run for 20 seconds. Turn the key on and observe the fuel flowing into the container. Turn the key off when the container is half full.

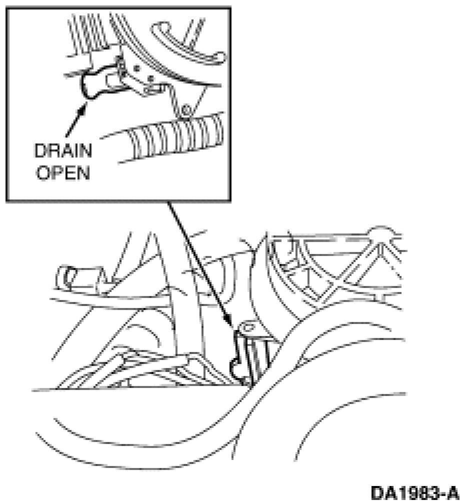
Observe the WATER IN FUEL lamp while cranking the engine. If the lamp is illuminated, the fuel is probably contaminated with water.

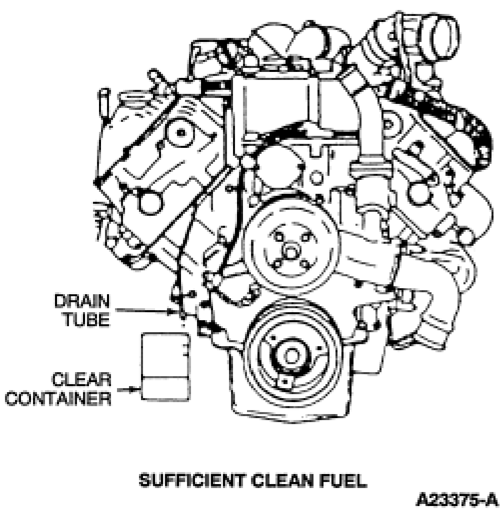
Flow out of the drain should be a steady stream. Insufficient flow could indicate fuel supply or fuel system problems.

Inspect fuel in the container. It should be straw colored, but not cloudy. It also should be free of water and contaminants. Dyed red or blue fuel indicates off-highway fuel.

If engine oil is present in the fuel it may indicate an injector O-ring leak and subsequent loss of rail pressure. If that is suspected, check rail pressure during engine cranking (Hard Start/No Start Diagnostic Procedures Step 9C).

Some sediment and water may be present in the fuel sample if the fuel filter has not been serviced for a prolonged period of time and/or if the sediment and water have not been drained recently. If that is the case, a second sample may be required to determine fuel quality.





Possible Causes:

- No fuel in tank.
- If equipped with a fuel line valve, it could be shut off.
- If equipped with dual tanks, the switch valve could be faulty.
- Fuel supply line could be broken or crimped.
- Fuel could be jelled (most likely in cold weather with No. 2 fuel).
- Pickup tube screen in tank could be clogged.

Cloudy fuel indicates that the fuel may not be a suitable grade for cold temperatures; excessive water or contaminants may indicate that the tank and fuel system may need to be flushed and cleaned.

Tools Required:

Clear container — approximately 1-quart

5. Electric Fuel Pump Pressure
Purpose:

To determine if there is sufficient fuel pressure for starting.

F-Series

5. Electric Fuel Pump Pressure

- After verifying that there is fuel in the tank and the pump is being powered.
- Measure at the top of the right cylinder head with a (0-160 PSI) gauge.
- Key on, engine off - Pump will run for about 20 seconds.

Instrument	Spec.	Measurement
0-160 PSI Gauge	30 PSI min.	

If pressure fails low, Go to step 8c on the Performance side of this sheet to pinpoint the cause.

Econoline

5. Electric Fuel Pump Pressure

- After verifying that there is fuel in the tank and the pump is being powered.
- Measure at the top of the left cylinder head with a (0-160 PSI) gauge.
- Key on, engine off - Pump will run for about 20 seconds.

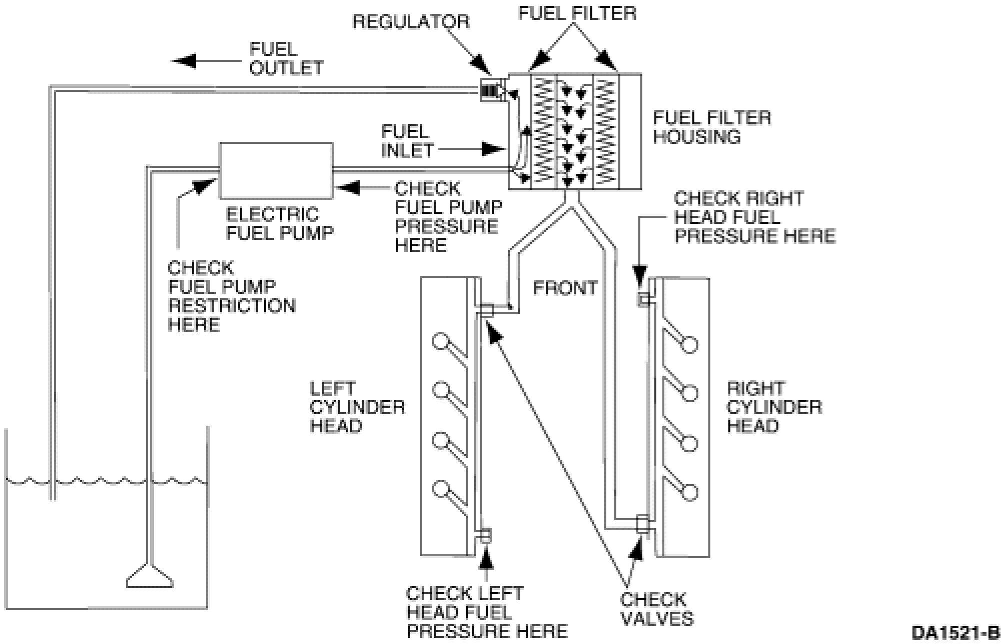
Instrument	Spec.	Measurement
0-160 PSI Gauge	30 PSI min.	

If pressure fails low, Go to step 8c on the Performance side of this sheet to pinpoint the cause.

DA1480-B

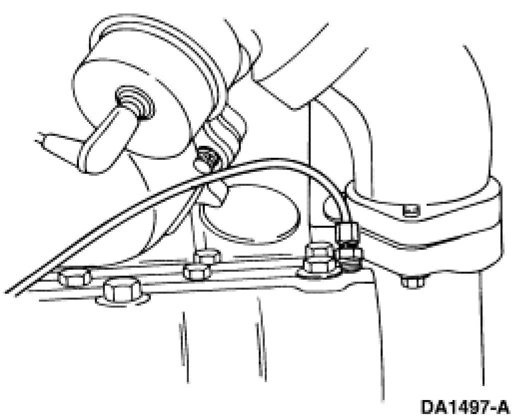
Recommended Procedure:

First verify that there is fuel in the tank and battery voltage going to the fuel pump, using a digital multimeter connected between the two circuits going to the pump. Battery voltage will be present for approximately 20 seconds after the ignition key is turned on. If no voltage is present, go to Pinpoint Test FK .



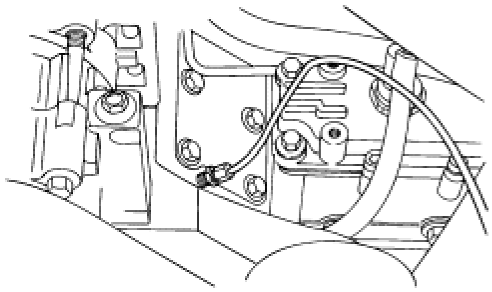
Econoline

Remove the doghouse cover and remove the 1/8-inch pipe plug from the top rear of left head. Install Gauge (0-160 psi) Bar 014-00761 or equivalent. Measure pressure in crank or run. If pressure measures below specification (30 psi), perform test steps 8a-d in Performance Diagnostic Procedures in this section.



F-Series

Remove the 1/8-inch pipe plug from the top front of the right head. Install Gauge (0-160 psi) Bar 014-00761 or equivalent. Measure pressure in crank or run. If pressure measures below specification (30 psi), perform test steps 8a-d in Performance Diagnostic Procedures in this section.



DA1498-A

6. Perform KOEO On-Demand Self Test
Purpose:

To determine if the PCM has detected any fault conditions that would cause a hard start or no start condition.

6. Perform KOEO On Demand Test

- Use NGS Tester.
- DTCs set during this test are current faults.

Note: IDM DTCs displayed here could be current or historical faults.

Diagnostic Trouble Codes	

DA0836-C

Note: The IDM stores both historical and hard IDM fault codes. To retrieve IDM fault codes, you must run KOEO On-Demand Self Test or KOEO Injector Electrical Test. To ensure that the DTC is a hard fault, you must first clear Continuous DTCs (be sure to record all DTCs before clearing) even though IDM codes do not show up on the Continuous display. Rerun KOEO On-Demand Self Test, if an IDM DTC is set a hard fault has occurred.

Recommended Procedure:

Connect the NGS Tester to the data link connector (DLC) under the dash. Turn off accessories. If vehicle is equipped with an auxiliary powertrain control (rpm control), it must be turned off to perform self tests.

- Perform the necessary vehicle preparation and visual inspection. Refer to Quick Test Operation .
- SELECT CORRECT VEHICLE, YEAR and MODEL.
- Select DIAGNOSTIC DATA LINK.
- Select PCM — POWERTRAIN CONTROL MODULE.
- Select DIAGNOSTIC TEST MODE.
- Select KOEO ON-DEMAND SELF TEST.
- Turn key on.
- Follow operating instructions from the menu.

- Record DTCs and follow appropriate pinpoint test.
- After test, cycle key to off before running other tests or driving vehicle.

Note: If performing repeated self tests, it may be necessary to unplug glow plug relay to keep battery from going dead. Ignore glow plug codes while glow plug relay is unplugged.

Possible Causes:

The most likely PCM detectable faults that will cause a no start or hard start condition are:

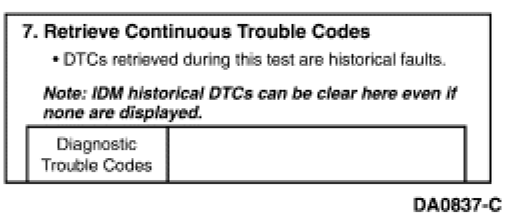
- CMP sensor inactive faults.
- IPR output circuit check fault.
- FDCS, CID and IDM ENABLE circuit faults.

Tools Required:

New Generation Star (NGS) Tester 007-00500 or equivalent

7. Retrieve/Clear Continuous DTCs
Purpose:

To determine if the PCM has detected any historical or intermittent fault conditions that would cause a hard start/no start symptom. The condition that caused a continuous DTC may no longer exist.



Note: The IDM stores both historical and hard IDM fault codes. To retrieve IDM fault codes, you must run KOEO On-Demand Self Test or KOEO Injector Electrical Test. To ensure that the DTC is a hard fault, you must first clear Continuous DTCs (be sure to record all DTCs before clearing) even though IDM codes do not show up on the Continuous display. Rerun KOEO On-Demand Self Test if an IDM DTC is set. This is a hard fault.

Recommended Procedure:

Connect the NGS Tester to the DLC under the dash. Turn off accessories. If vehicle is equipped with an auxiliary powertrain control (rpm control), it must be turned off to perform self tests.

- Perform the necessary vehicle preparation and visual inspection. Refer to Quick Test Operation .
- SELECT CORRECT VEHICLE, YEAR and MODEL.
- Select DIAGNOSTIC DATA LINK.

- Select PCM — POWERTRAIN CONTROL MODULE.
- Select DIAGNOSTIC TEST MODE.
- Select RETRIEVE/CLEAR CONTINUOUS DTCs
- Turn key on.
- Follow operating instructions from the menu.
- Record DTCs and follow appropriate pinpoint test for continuous code diagnostics.
- Continuous DTCs must be cleared after repair is made.

If performing repeated self tests, it may be necessary to unplug glow plug relay to keep battery from going dead. Ignore any glow plug codes while glow plug relay is unplugged.

Tools Required:

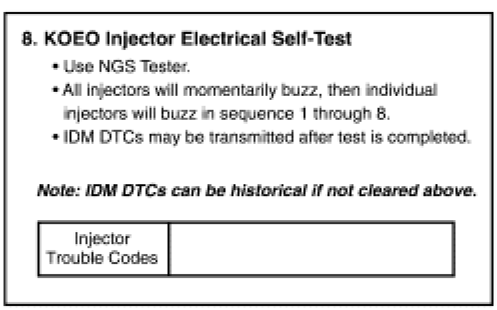
New Generation Star (NGS) Tester 007-00500 or equivalent

8. KOEO Injector Electrical Self Test

Note: If unable to perform KOEO Injector Electrical Self Test, disconnect IDM connector and check injector high and low side for shorts or opens.

Purpose:

To determine if the injector solenoids and valves are operating by buzzing all injectors together and then each injector in numerical sequence (1 through 8).



8. KOEO Injector Electrical Self-Test

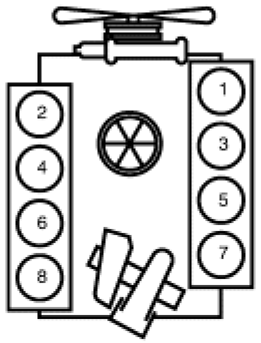
- Use NGS Tester.
- All injectors will momentarily buzz, then individual injectors will buzz in sequence 1 through 8.
- IDM DTCs may be transmitted after test is completed.

Note: IDM DTCs can be historical if not cleared above.

Injector Trouble Codes	

DA0838-C

7.3L DI Engine, Cylinder and Fuel Injector Location



Recommended Procedure:

Note: If no DTCs are present and the KOEO Injector Electrical Self Test aborts while trying to perform, go to Pinpoint Test NA, StepNA29 .

Note: This test determines if the injector circuits and solenoids are electrically operating without fault. All injectors will first buzz together for approximately 2 seconds, then each injector will buzz for approximately 1 second in numerical order (1 through 8). The IDM stores all historical IDM fault codes; to ensure that the DTC is a hard fault, you must first clear continuous DTCs (be sure to record all IDM fault codes before clearing). After clearing, rerun self test; a fault must be present at the time of testing for the KOEO Injector Electrical Self Test to detect the fault. If a fault is detected, a DTC will be output on the data link at the end of the test when requested by a scan tool. Only a hard fault code (DTC) will be displayed.

Connect the NGS Tester to the DLC under the dash. Turn off accessories. If vehicle is equipped with an auxiliary powertrain control (rpm control), it must be turned off to perform self tests.

- Perform the necessary vehicle preparation and visual inspection. Refer to Quick Test Operation .
- SELECT CORRECT VEHICLE, YEAR and MODEL.
- Select DIAGNOSTIC DATA LINK.
- Select PCM — POWERTRAIN CONTROL MODULE.
- Select DIAGNOSTIC TEST MODE.
- Select KOEO INJECTOR ELECTRICAL SELF TEST.
- Follow operating instructions from the menu.
- Record DTCs and follow appropriate pinpoint test.
- After test, cycle key to off before running other tests or driving vehicle.

Possible Causes:

- Open or shorted injector circuits
- Bad injector connector
- Open or shorted CID or FDCS circuits
- Open injector solenoid
- IDM powering or ground circuits
- Defective IDM

Tools Required:

New Generation Star (NGS) Tester 007-00500 or equivalent

9a. Check VPWR During Cranking
Purpose:

To verify PCM power-up during cranking. Lack of power to PCM can cause a no-start condition as well as fault code loss.

9. NGS Tool - Data List Monitoring

- NGS Tester may reset below 9.5 volts.
- Select the parameters indicated from the NGS parameter list and monitor while cranking engine.

Parameter	Spec.	Measurement
V PWR	8 volt minimum	
You may need to use an outside power source for the NGS.		
RPM	100 RPM minimum	
ICP	500 PSI or 3.4 mPa min.	
Fuel PW	1 mS to 6 mS	

A- V PWR - If indicating a low voltage condition, check battery voltage, charging system or power and ground circuits to the PCM.
GO TO PINPOINT TEST A

DA1457-B

Recommended Procedure:

Install NGS Tester. Access VPWR PID on NGS Tester and monitor while cranking the engine.

Possible Causes:

- Low battery voltage
- Charging system problem
- Power circuit and ground faults to the PCM

Refer to Pinpoint Test A to diagnose a voltage concern.

Note: Battery voltage below 9.5 volts can cause the NGS Tester to reset. If the NGS Tester resets during a self test or while PID monitoring, it may be necessary to install a battery charger to maintain the correct voltage.

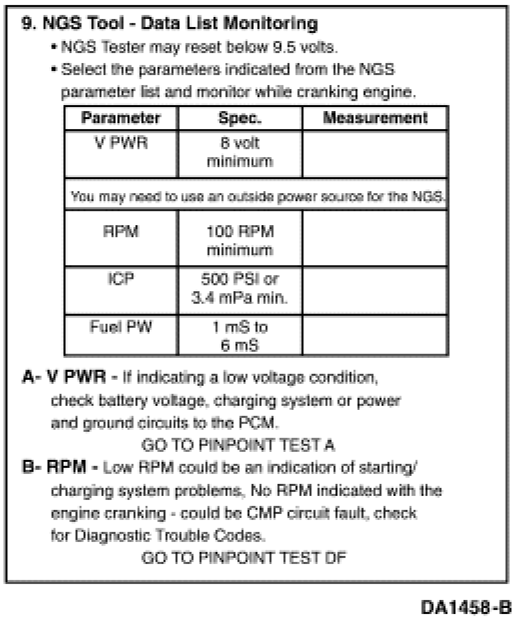
Tools Required:

New Generation Star (NGS) Tester 007-00500 or equivalent

9b. Check RPM Signal While Cranking

Purpose:

To determine if the CMP sensor and circuit are functioning.



9. NGS Tool - Data List Monitoring

- NGS Tester may reset below 9.5 volts.
- Select the parameters indicated from the NGS parameter list and monitor while cranking engine.

Parameter	Spec.	Measurement
V PWR	8 volt minimum	
You may need to use an outside power source for the NGS.		
RPM	100 RPM minimum	
ICP	500 PSI or 3.4 mPa min.	
Fuel PW	1 mS to 6 mS	

A- V PWR - If indicating a low voltage condition, check battery voltage, charging system or power and ground circuits to the PCM.
GO TO PINPOINT TEST A

B- RPM - Low RPM could be an indication of starting/ charging system problems. No RPM indicated with the engine cranking - could be CMP circuit fault, check for Diagnostic Trouble Codes.
GO TO PINPOINT TEST DF

DA1458-B

Recommended Procedure:
Possible Causes:

- Weak battery or starter
- Faulty wire harness connection
- Poor CMP ground connection
- Incorrect CMP sensor to target wheel spacing
- Defective CMP sensor

Refer to Pinpoint Test DF for CMP sensor diagnosis.

Tools Required:

New Generation Star (NGS) Tester 007-00500 or equivalent

9c. Monitor ICP While Cranking
Purpose:

To determine if the injection control system can supply enough injection control pressure to sustain starting.

9. NGS Tool - Data List Monitoring

- NGS Tester may reset below 9.5 volts.
- Select the parameters indicated from the NGS parameter list and monitor while cranking engine.

Parameter	Spec.	Measurement
V PWR	8 volt minimum	
You may need to use an outside power source for the NGS.		
RPM	100 RPM minimum	
ICP	500 PSI or 3.4 mPa min.	
Fuel PW	1 mS to 6 mS	

A- V PWR - If indicating a low voltage condition, check battery voltage, charging system or power and ground circuits to the PCM.
GO TO PINPOINT TEST A

B- RPM - Low RPM could be an indication of starting/ charging system problems, No RPM indicated with the engine cranking - could be CMP circuit fault, check for Diagnostic Trouble Codes.
GO TO PINPOINT TEST DF

C- ICP - A minimum of 500 PSI (3.4 mPa) is required before the injectors are enabled. No or low oil in the reservoir, system leakage, injector O-rings or faulty IPR could cause pressure loss.
Go to Section 4, step 9c in the PC/ED Manual for a detailed description on how to perform this test.
Note: If a no RPM Signal is received, IPR duty-cycle will default to 14%

DA1459-B

Recommended Procedure:

Install NGS Tester. Access ICP and IPR PIDs on NGS Tester, and monitor PID readings while cranking the engine.

Note: CMP signal is required before IPR is commanded above 14%.

If ICP does not meet the minimum specification of 3450 kPa (500 psi), the injectors will not be enabled by the PCM because of insufficient rail pressure.

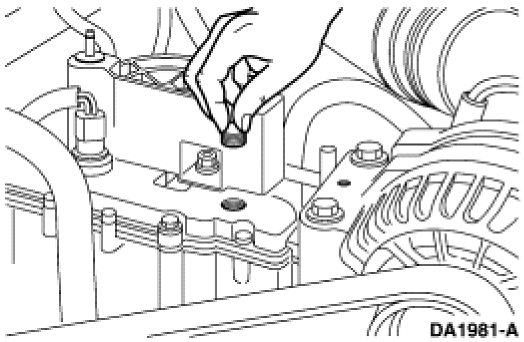
If IPR goes above 14%, ICP pressure should easily go above 3450 kPa (500 psi) provided that the oil reservoir is full, the IPR valve is not stuck open, the high pressure pump is building pressure and there is not an injection control pressure leak between the high pressure pump and all of the injectors.

Possible Causes:

- Injection control pressure system leak
- Oil reservoir level low
- IPR failure
- Faulty high pressure pump
- Injector O-ring leaking

Injection Control Pressure Leak Test

Removing the ICP sensor and inspecting the level in the oil rail will determine if oil is being supplied to the rail. Removing the inspection plug in the top of the reservoir will help determine if the reservoir is full. A reservoir that drains back after the engine has not been operated for a long period of time can cause a hard start condition. If reservoir empties after filling, verify it is being supplied oil from the low pressure oiling system.



Purpose:

Isolate the cause of low injection control pressure.

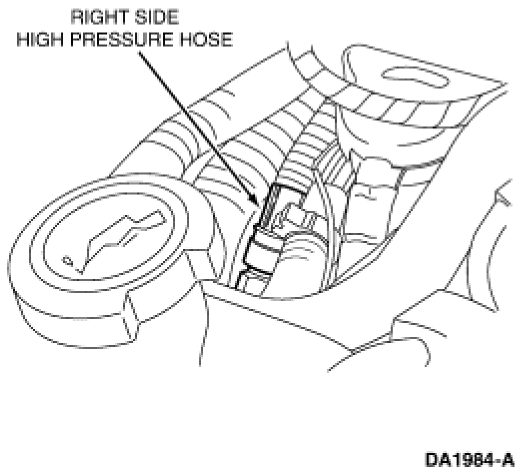
Recommended Procedure:
Right Cylinder Head Check

Remove the high pressure hose from the right cylinder head using Quick Disconnect Tool 303-625, and cover the fitting on the cylinder head with the appropriate cap from the Fuel/Oil/Turbo Protector Cap Set T94T-9395-AH. Install the plug from the Oil High Pressure Leakage Test Adapter Set 303-S626 into the high pressure hose to block it off. Crank the engine and monitor the ICP PID. If the ICP Adapter Cable D94T-50-A is connected to the ICP sensor, connect a digital multimeter between signal return and ICP signal wires on the adapter cable. Crank the engine and monitor the signal. The digital multimeter should read 1 to 4 volts.

CAUTION: The engine may start!

If the engine starts or if injection control pressure is now within specification, the injection control pressure leak has been isolated to the right cylinder head. Inspect the fuel to see if oil is in the fuel. If no oil is present in the fuel, remove the valve cover, crank the engine and inspect the injector body and injector bore area for leakage.

CAUTION: Oil is under high pressure!

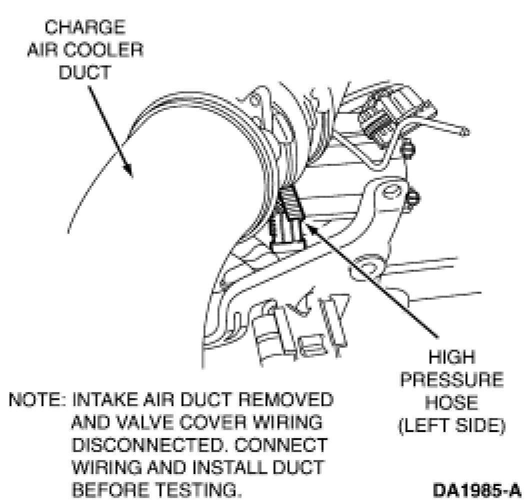


Left Cylinder Head Check

Remove the cap and plug, then reinstall the high pressure hose to the right cylinder head. Remove the high pressure hose from the left cylinder head using Quick Disconnect Tool 303-625, and cover the fitting on the cylinder head with the appropriate cap from the Fuel/Oil/Turbo Protector Cap Set T94T-9395-AH. Install the ICP adapter from the Oil High Pressure Leakage Test Adapter Set 303-S626 into the high pressure hose. Remove the ICP sensor and install the sensor in the end of the ICP adapter. Connect the ICP/EBP Adapter Cable D94T-50-A to the ICP sensor. Connect a digital multimeter between the signal return and ICP signal wires of the adapter cable. Crank the engine and monitor the signal. The digital multimeter should read 1 to 4 volts.

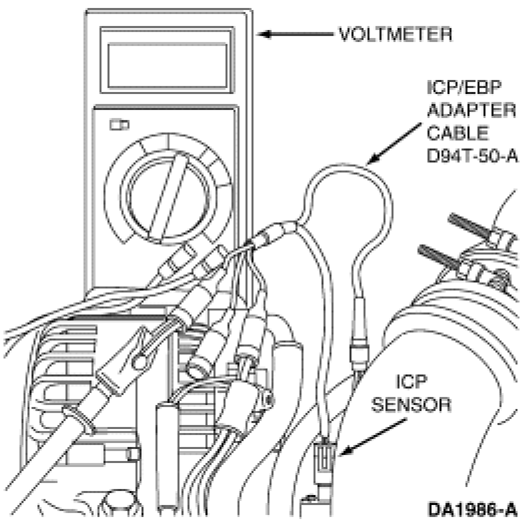
CAUTION: The engine may start!

If the engine starts or if injection control pressure is now within specification, the injection control pressure leak has been isolated to the left cylinder head.



IPR and High-Pressure Pump Test

If injection control pressure is still low after ruling out both cylinder heads as the source of injection control pressure leakage, perform the following steps to isolate the cause. Leave the ICP sensor and ICP adapter connected to the left high-pressure hose. Remove the high-pressure hose from the right cylinder head and cover the fitting on the cylinder head with the appropriate cap from the Fuel/Oil/Turbo Protector Cap Set T94T-9395-AH. Install the plug from the Oil High Pressure Leakage Test Adapter Set 303-S626 into the high-pressure hose to block it off. With the high-pressure pump effectively deadheaded, crank the engine and monitor the signal. If injection control pressure is not within specification, replace the Injection Pressure Regulator (IPR) with a known good IPR and retest. If a low pressure condition still exists, the problem is most likely with the high-pressure pump or the high-pressure pump drive gear.



Tools Required:

- Fuel/Oil/Turbo Protector Cap Set 303-493 (T94T-9395-AH)
- ICP/EBP Adapter Cable 418-D003 (D94T-50-A) or equivalent
- Oil High Pressure Leakage Test Adapter Set 303-S626 (D94T-6600-A) or equivalent
- 23 Multimeter 105-00050 or equivalent
- 1/4-inch drive ratchet or breaker bar to remove inspection plug
- Quick Disconnect Tool 303-625

9d. Check Fuel Pulse Width (FUEL PW) While Cranking
Purpose:

To verify that the Fuel Delivery Command Signal (FDCS) system is functioning correctly.

9. NGS Tool-Data List Monitoring

- NGS Tester may reset below 9.5 volts.
- Select the parameters indicated from the NGS parameter list and monitor while cranking engine.

Parameter	Spec.	Measurement
V PWR	8 volt minimum	
RPM	100 RPM minimum	
ICP	500 PSI or 3.4 mPa min.	
FUEL PW	1 mS to 6 mS	

A- V PWR - If indicating a low voltage condition, check battery voltage, charging system or power and ground circuits to the PCM.

GO TO PINPOINT TEST A

B- RPM - Low RPM could be an indication of starting/ charging system problems, No RPM indicated with the engine cranking-could be CMP circuit fault, check for Diagnostic Trouble Codes.

GO TO PINPOINT TEST DF

C- ICP - A minimum of 500 PSI (3.4 mPa) is required before the injectors are enabled. No or low oil in the reservoir, system leakage, faulty IPR or high pressure pump could cause pressure loss.

Note: CMP signal is required before IPR is commanded above 14%

D- FUEL PW - Even though a 1 to 6 mS FUEL PW is shown on the NGS to be sent to the IDM, its possible that the IDM did not get the signal, due to a fault on either CID or FDCS circuits or even the IDM.

A0064933

Recommended Procedure:

Install NGS Tester. Access FUEL PW PID on NGS Tester and monitor while cranking engine.

No fuel command signal when ICP, RPM and VPWR signals are correct usually indicates a loss of CMP sync signal. Refer to Pinpoint TestDF for CMP sensor diagnosis.

A 1-6 mS fuel pulse width (FUEL PW) will be sent by the PCM to the IDM if system voltage does not go below 8 volts during cranking, engine cranking speed is above 100 rpm and injection control pressure is above 3450 kPa (500 psi). Even though a 1-6 mS fuel pulse width is shown on the NGS to be sent to the IDM, it is possible the IDM did not get the signal, due to a fault on either the CID or FDCS circuits or even the IDM. Note that low fuel pressure or no glow plugs could still be the cause of the No Start or Hard Start condition. A 0.60-ms fuel pulse width (a no fueling pulse) will be sent by the PCM when a sync pulse has not been received from the CMP sensor and if insufficient injection control pressure is present. This 0.60-ms fuel pulse width will not allow injectors to be enabled, but does keep the IDM and PCM synchronized until sufficient injection control pressure is realized.

Possible Causes:

- FDCS and CID circuitry
- PCM
- IDM

Tools Required:

New Generation Star (NGS) Tester 007-00500 or equivalent

10. Glow Plug System Operation
Purpose:

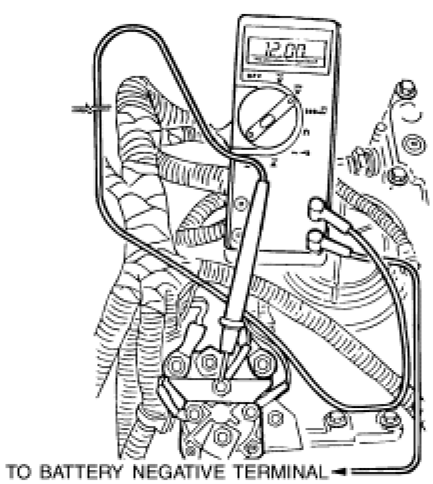
To determine if the glow plug system operation is sufficient to permit starting.

Alt Ctrl zoomable graphic Right-click on desired area to Zoom In, Zoom Out, and return to Original View.
To print, right-click on graphic, select View SVG, then print from new window.

Recommended Procedure:
Relay Operation

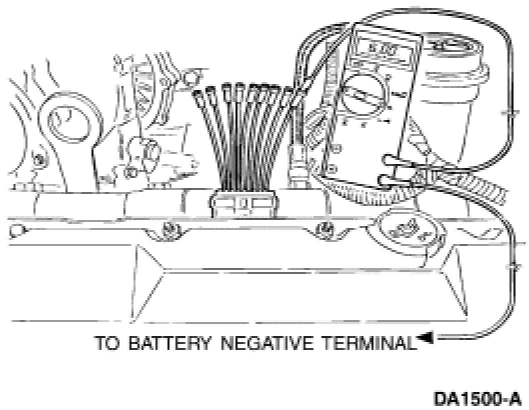
Install a digital multimeter on the glow plug feed side of the glow plug relay (large stud with two wires connected). Turn the ignition key to the ON position but do not attempt to start. Note the time in seconds from when the key is turned on and the glow plug relay energizes until the glow plug relay de-energizes. The relay does not come on if EOT is above 55° C (131°F) for F-Series and 30° C (86°F) for Econoline. The glow plug relay makes a loud click noise which is easily heard when it energizes and de-energizes. Compare the times measured to the table (time will be affected by engine temperature, battery condition and vehicle altitude). The voltage at the glow plug feed terminal may vary from 9 to 12 volts depending upon battery condition.

If battery voltage is not present, check for B+ at the power supply terminal (terminal with single large wire). Power for glow plug power supply is supplied from the starter relay through two fusible links at solenoid.



DA1499-A

Disconnect all of the glow plug/injector harness connectors from the valve cover gaskets. With the Rotunda Glow Plug Injector Adapter 134-00132 or equivalent installed, measure glow plug resistance to ground (preferably B-). A resistance measurement of 0.1-2 ohms indicates a good glow plug.



Glow Plug Harness Continuity

Measure for continuity from the connector harness to the glow plug feed terminal on the glow plug relay. Resistance should be less than 0.1-1 ohm.

California Only

For California only, the glow plug system monitor will start when the glow plugs are commanded on for over 30 seconds and the battery voltage is between 11.5-14 volts. A glow plug code will be stored in continuous memory if one or more glow plugs are not being powered.

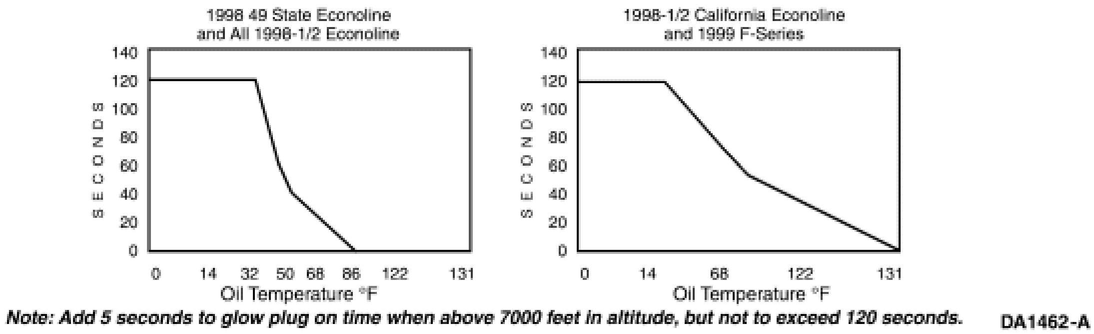
Note: Look very carefully for poor connections, burnt looking or loose fitting pins that will cause high resistance and set a code.

The Glow Plug Monitor Self Test (California only) is a functional test of the glow plug system performed on demand with the engine running and the A/C off. The PCM will activate the glow plug relay and monitor the glow plug circuits. A fault must be present at the time of testing for the test to detect a fault. If one bank is reading less than 39 amps, a fault will be detected and a Diagnostic Trouble Code (DTC) will be output on the scan tool. If a fault code is set, it is a hard fault.

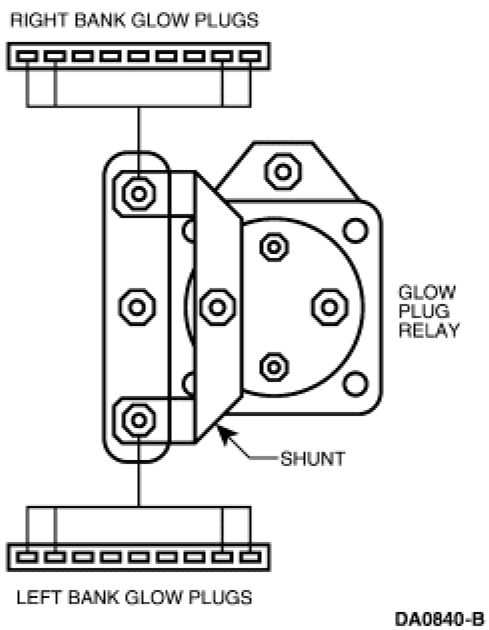
California or 49-State

The glow plug on time is dependent on oil temperature and altitude. The glow plug relay comes on between 1-120 seconds and does not come on at all if oil temperature is above 30°C (86°F) for Econoline or 55°C (131°F) for F-Series. By using the NGS you can run the Output State Self Test which will cycle the glow plug relay on for 5 seconds the first time only that the accelerator pedal is pressed. This self test does not set any codes.

You can verify glow plug on time (and amps for California) by monitoring NGS PIDS: EOT, GPCTM (California GPMR and GPML). The wait to start lamp ON time (1-10 seconds) is independent from glow plug relay ON time.



Incorrect measurements will result if all glow plug/injector connectors to valve cover are not disconnected.



Possible Causes:

Insufficient glow plug ON time will not allow enough heat to accumulate in the combustion chamber to easily facilitate starting. If the glow plug system ON time does not meet any of the specifications in the accompanying chart the problem is most likely a faulty wire harness connection, ground connections or glow plug relay.

Note: Look very carefully for poor connections, burnt looking or loose fitting pins that will cause high resistance.

- Glow plug relay.
- Powering circuit to glow plug relay (fusible links from starter relay) .
- Glow plug relay to valve cover connector circuits.
- Valve cover gasket.
- Under valve cover (UVC) harness.

- Glow plugs.

Tools Required:

- Multimeter 105-00050 or equivalent
- Glow Plug Injection Adapter 134-00132 or equivalent
- New Generation Star (NGS) Tester 007-00500 or equivalent

Performance Diagnostic Procedures

Econoline Performance Diagnostics

1. Visual Engine/Chassis Inspection

- Verify that there are no fluid or pressure leaks.
- Inspect all wire connections for damage.
- Inspect MAP, WGC hoses and Intake for leaks.

Fuel Oil Coolant Electrical Hoses Leaks	
Method	Check
Visual	

2. Sufficient Clean Fuel

- Check if the Water in Fuel lamp has been illuminated.
- After verifying that there is fuel in the tank, drain a sample from fuel filter housing by key on, engine off.

Note: Fuel pump will only run for 20 seconds.

Method	Check
Visual	

3. Check Engine Oil Level

- Check for contaminants (fuel, coolant).
- Correct Grade/Viscosity.
- Miles/Hours on oil, correct level.

Method	Check
Visual	

4. Intake Restriction

- Check filter minder or Measure at WOT w/magnehelic gauge.

Instrument	Spec.	Check
Magnehelic/ Filter Minder	2"-25" H_2O	

5. Perform KOEO On Demand Test

- Use NGS Tester.
- DTCs set during this test are current faults.

Note: IDM DTCs displayed here could be current or historical faults.

Diagnostic Trouble Codes	

6. Retrieve Continuous Trouble Codes

- DTCs retrieved during this test are historical faults.

Note: IDM historical DTCs can be clear here even if none are displayed.

Diagnostic Trouble Codes	

7. KOEO Injector Electrical Self-Test

- Use NGS Tester.
- All injectors will momentarily buzz, then individual injectors will buzz in sequence 1 through 8.

Note: IDM DTCs can be historical if not cleared above.

Injector Trouble Codes	

8a. Fuel Pressure at the left head

- Verify that fuel is in the tank and the pump is being powered.
- Measure fuel pressure at the rear of left head.

CAUTION: Secure test hose away from turbo and exhaust.

- Road Test - with a full load on the engine.

Instrument	Spec.	Measurement
0-160 PSI Gauge	30 PSI min.	

- ***If fuel pressure falls low, Go to step 8c.***
- ***If pressure is above min. spec., Go to step 8b.***

8b. Fuel Pressure at the right head

- Measure fuel pressure at the front of right head.
- Test under full load, but don't brake torque engine any longer than 10 sec.

Instrument	Spec.	Measurement
0-160 PSI Gauge	30 PSI min.	

- ***If fuel pressure is below min. spec., replace right check valve***
- ***If fuel pressure is above min. spec., Go to step 9.***

8c. Electric Fuel Pump Pressure

- Measure at fuel outlet from Electric fuel pump.
- Road Test - with a full load on the engine.

Instrument	Spec.	Measurement
0-160 PSI Gauge	30-80 PSI	

- ***If fuel pressure falls low, Go to step 8d.***
- ***If fuel pressure is above min. spec., replace left check valve.***

8d. Electric Fuel Pump Inlet Restriction

- Measure WOT at fuel inlet to Electric fuel pump for restriction.

Instrument	Spec.	Measurement
0-30" Hg vacuum G	6" Hg MAX	

- ***If fuel line is restricted above 6" Hg, check for Blockage between pump and fuel tank.***
- ***If fuel line is not restricted, inspect regulator valve condition and for debris. If OK, replace pump.***

9. Perform KOER On Demand Test

- This will test both ICP and EBP systems for fault.

KOER DTC	

10a. Injection Control Pressure Tests (Oil Aeration - Poor idle quality)

- All acc. off, Monitor ICP and RPM with NGS Tester.
- Hold engine speed at 3400 RPM for 3 minutes.

Parameter	High RPM	Measurement
ICP	1250 PSI MAX@ 3400 RPM	

- ***If ICP signal increases above 1250 PSI after 3 minutes, anti-foam oil additives may have become depleted from oil; change oil and re-test.***

10b. Low Idle Stability (ICP Pressure)

- Check at low idle.
- Monitor ICP and RPM with the NGS Tester.

Low Idle

Parameter	Spec. @ 650 RPM	Measurement
ICP	400 to 600 PSI	
Take reading before disconnecting ICP		

If engine RPM is unstable, disconnect the ICP sensor.

Note: ICP will default to 725 when disconnected.

- ***If RPM is still unstable, change IPR and re-test.***
- ***If RPM smoothes out, the ICP signal is at fault.***

11. Crankcase Pressure Test

- Assure engine is at normal operating temp.
- Measure at oil fill with adapter and orifice tool P.N. 5631 & 014-00743 installed.
- Block breather tube on left valve cover.
- Measure at WOT under no load.

Instrument	Spec.	Measurement
Magnehelic 0 to 60" H_2O	less than 4" H_2O	

If more then 4" H_2O, Refer base engine in Shop Manual

12. Cylinder Contribution Test

- Ensure that EOT is at above 70 F min.
- Turn A/C and all accessories off.
- Select Cylinder Contribution from the test menu.

Note: The newly designed test will run at an idle for about 110 sec. and you will not feel any change throughout the test.

CCT Trouble Codes	

13. Exhaust Restriction

- Visually inspect exhaust system for damage.
- Verify EBP device is open at WOT in park or neutral.
- Monitor EBP with the NGS Tester with the engine temperature at 170 F minimum at 3400 RPM.

Parameter	Spec.	Measurement
EBP	34 PSI MAX @ 3400 RPM	

14. Boost Pressure Test

- Verify that MAP hose is not open, plugged or pinched.
- Monitor MGP (manifold gauge pressure) and RPM with the NGS Tester.
- Road Test - select appropriate gear to obtain desired engine speed at full load throttle position. Best accomplished climbing hill or truck fully loaded.

Parameter	Spec.	Measurement
MGP	13 PSI G MIN	

Measure between 2500 to 3000 RPM

F-Series
Performance Diagnostics

1. Visual Engine/Chassis Inspection

- Verify that there are no fluid or pressure leaks.
- Inspect all wire connections for damage.
- Inspect MAP, WGC hoses and Intake for leaks.

Fuel Oil Coolant Electrical Hoses Leaks	
Method	**Check**
Visual	

2. Sufficient Clean Fuel

- Check if the Water in Fuel lamp has been illuminated.
- After verifying that there is fuel in the tank, drain a sample from fuel filter housing by key on, engine off.

Note: Fuel pump will only run for 20 seconds.

Method	Check
Visual	

3. Check Engine Oil Level

- Check for contaminants (fuel, coolant).
- Correct Grade/Viscosity.
- Miles/Hours on oil, correct level.

Method	Check
Visual	

4. Intake Restriction

- Check filter minder
  or Measure at WOT w/magnehelic gauge.

Instrument	Spec.	Check
Magnehelic/ Filter Minder	2"-25" H_2O	

5. Perform KOEO On Demand Test

- Use NGS Tester.
- DTCs set during this test are current faults.

Note: IDM DTCs displayed here could be current or historical faults.

Diagnostic Trouble Codes	

6. Retrieve Continuous Trouble Codes

- DTCs retrieved during this test are historical faults.

Note: IDM historical DTCs can be clear here even if none are displayed.

Diagnostic Trouble Codes	

7. KOEO Injector Electrical Self-Test

- Use NGS Tester.
- All injectors will momentarily buzz, then individual injectors will buzz in sequence 1 through 8.

Note: IDM DTCs can be historical if not cleared above.

Injector Trouble Codes	

8a. Fuel Pressure at the right head

- Verify that fuel is in the tank and the pump is being powered.
- Measure fuel pressure at the Front of right head.
- Road Test - with a full load on the engine.

Instrument	Spec.	Measurement
0-160 PSI Gauge	30 PSI min.	

- ***If fuel pressure falls low, Go to step 8c.***
- ***If pressure is above min. spec., Go to step 8b.***

- Measure fuel pressure at the rear of left head.

CAUTION: Secure test hose away from turbo and exhaust.

- Road Test - with a full load on the engine.

Instrument	Spec.	Measurement
0-160 PSI Gauge	30 PSI min.	

- ***If fuel pressure is below min. spec., replace left check valve.***
- ***If fuel pressure is above min. spec., Go to step 9.***

8c. Electric Fuel Pump Pressure

- Measure at fuel outlet from Electric fuel pump.
- Road Test - with a full load on the engine.

Instrument	Spec.	Measurement
0-160 PSI Gauge	30-80 PSI	

- ***If fuel pressure falls low, Go to step 8d.***
- ***If fuel pressure is above min. spec., replace left check valve.***

8d. Electric Fuel Pump Inlet Restriction

- Measure WOT at fuel inlet to Electric fuel pump for restriction.

Instrument	Spec.	Measurement
0-30" Hg vacuum G	6" Hg MAX	

- ***If fuel line is restricted above 6" Hg, check for Blockage between pump and fuel tank.***
- ***If fuel line is not restricted, inspect regulator valve condition and for debris. If OK, replace pump.***

9. Perform KOER On Demand Test

- This will test both ICP and EBP systems for fault.

KOER DTC	

10a. Injection Control Pressure Tests (Oil Aeration - Poor idle quality)

- All acc. off, Monitor ICP and RPM with NGS Tester.
- Hold engine speed at 3400 RPM for 3 minutes.

Parameter	High RPM	Measurement
ICP	1250 PSI MAX @ 3400 RPM	

- ***If ICP signal increases above 1250 PSI after 3 minutes, anti-foam oil additives may have become depleted from oil; change oil and re-test.***

10b. Low Idle Stability (ICP Pressure)

- Check at low idle.
- Monitor ICP and RPM with the NGS Tester.

Low Idle

Parameter	Spec. @ 650 RPM	Measurement
ICP	400 to 600 PSI	
Take reading before disconnecting ICP		

If engine RPM is unstable, disconnect the ICP sensor.

Note: ICP will default to 725 when disconnected.

- ***If RPM is still unstable, change IPR and re-test.***
- ***If RPM smoothes out, the ICP signal is at fault.***

11. Crankcase Pressure Test

- Assure engine is at normal operating temp.
- Measure at oil fill with adapter and orifice tool P.N. 5631 & 014-00743 installed.
- Block breather tube on left valve cover.
- Measure at WOT under no load.

Instrument	Spec.	Measurement
Magnehelic 0 to 60" H_2O	less than 4" H_2O	

If more then 4" H_2O, Refer base engine in Shop Manual

12. Cylinder Contribution Test

- Ensure that EOT is at above 70 F min.
- Turn A/C and all accessories off.
- Select Cylinder Contribution from the test menu.

Note: The newly designed test will run at an idle for about 110 sec. and you will not feel any change throughout the test.

CCT Trouble Codes	

13. Exhaust Restriction

- Visually inspect exhaust system for damage.
- Verify EBP device is open at WOT in park or neutral.
- Monitor EBP with the NGS Tester with the engine temperature at 170 F minimum at 3400 RPM.

Parameter	Spec.	Measurement
EBP	34 PSI MAX @ 3400 RPM	

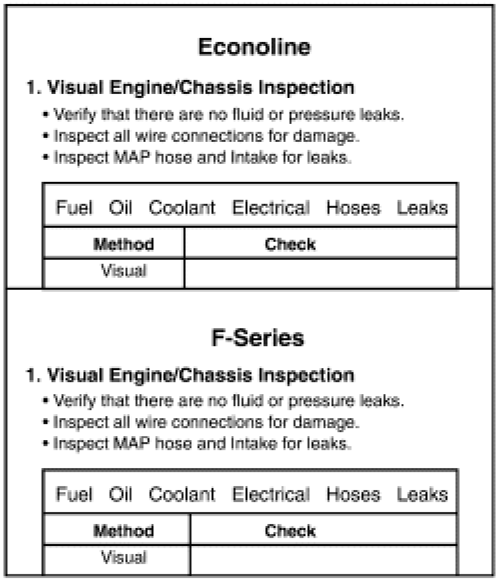
14. Boost Pressure Test

- Verify that MAP hose is not open, plugged or pinched.
- Verify that inter cooler hoses or intake are not leaking.
- Verify that the green Waste gate hose is not plugged.
- Monitor MGP (manifold gauge pressure) and RPM with the NGS Tester.
- Road Test - select appropriate gear to obtain desired engine speed at full load throttle position. Best accomplished climbing hill or truck fully loaded.

Parameter	Spec.	Measurement
MGP	16 PSI G MIN	

Measure between 2500 to 3000 RPM

1. Visual Engine/Chassis Inspection



DA1455-B

Purpose:

This is a visual inspection to check the general condition of the engine and chassis. Look for obvious causes of a loss in performance.

Recommended Procedure:

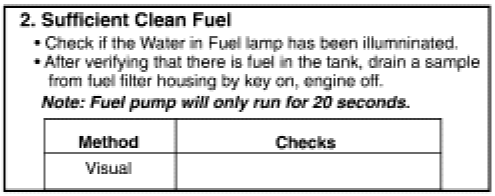
- Inspect for a hole in the MAP sensor hose or a pinched hose.
- Inspect fuel system, including the fuel tank, fuel pump, fuel filter housing and fuel lines, for kinks, bends or leakage.
- Inspect oil lines and high pressure oil pump in engine V for major oil leaks.
- Inspect for coolant leaks at the radiator and coolant hoses. Also check coolant level.
- Inspect wiring for correct routing, and make sure no rubbing or chafing has occurred.
- Inspect all sensors, and make sure outputs from the PCM are properly connected.

Added Checks (F-Series):

- Inspect intercooler hoses for leaks.
- Inspect wastegate control solenoid and hoses.

2. Sufficient Clean Fuel
Purpose:

The purpose of this test is to see if the fuel system is getting sufficient clean fuel to operate correctly.


2. Sufficient Clean Fuel

- Check if the Water in Fuel lamp has been illuminated.
- After verifying that there is fuel in the tank, drain a sample from fuel filter housing by key on, engine off.

Note: Fuel pump will only run for 20 seconds.

Method	Checks
Visual	

DA2059-A

Recommended Procedure:

Route a hose from the fuel drain line to a clear container and open the drain. Idle the engine and observe the fuel flowing into the container. Shut the engine off when the container is half full.

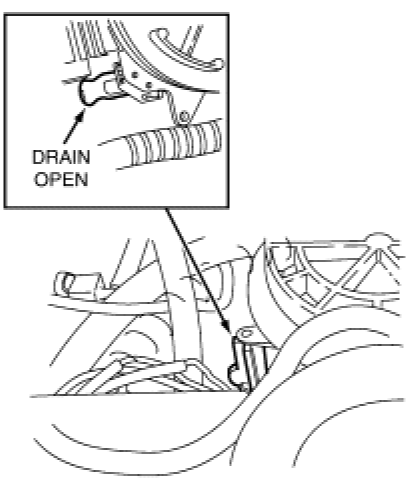
Observe WATER IN FUEL light while cranking. If the lamp is illuminated the fuel is probably contaminated with water.

Flow out of the drain should be a steady stream. Insufficient flow could indicate fuel supply or fuel system problems.

Inspect fuel in the container, it should be straw colored but not cloudy. It also should be free of water and contaminants. Dyed red or blue fuel indicates off-highway fuel.

If engine oil is present in the fuel it may indicate an injector O-ring leak and subsequent loss of rail pressure. If that is suspected, check rail pressure during engine cranking (refer to Hard Start/No Start Diagnostic Procedures Step 9C).

Some sediment and water may be present in the fuel sample if the fuel filter has not been serviced for a prolonged period of time and/or if the sediment and water have not been drained recently. If that is the case a second sample may be required to determine fuel quality.



DA1983-A

Possible Causes:

- No fuel in tank.

- If equipped with a fuel line valve, it could be shut off.
- If equipped with dual tanks, the switch valve could be faulty.
- Fuel supply line could be broken or crimped.
- Fuel could be jelled (most likely in cold weather with No. 2 fuel).
- Pickup tube screen in tank could be clogged.

Cloudy fuel indicates that the fuel may not be a suitable grade for cold temperatures. Excessive water or contaminants may indicate that the tank and fuel system may need to be flushed and cleaned.

Tools Required:

Clear container — approximately 1-quart

3. Check Engine Oil Level
Purpose:

To determine if there is enough oil or oil of sufficient quality to operate the injectors.

3. Check Engine Oil Level

- Check for contaminants (fuel, coolant).
- Correct Grade/Viscosity.
- Miles/Hours on oil, correct level.

Method	Check
Visual	

DA1466-C

Recommended Procedure:

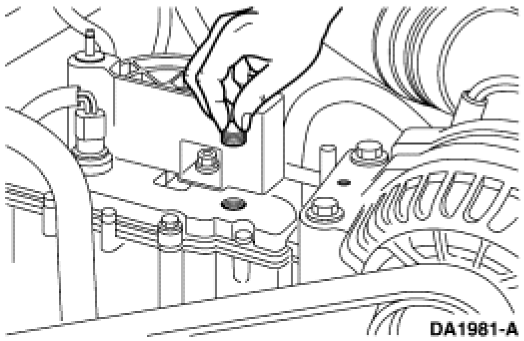
Check oil level with oil level dipstick. If there is no oil or very little oil in the crankcase, the injectors will not operate.

If the oil level is overfull, it is possible the engine was incorrectly serviced or fuel is diluting the oil and filling the crankcase. If a substantial amount of fuel is in the oil, it will have a fuel odor.

Inspect oil for color. A milky white oil indicates possible coolant contamination which will have an ethylene glycol odor.

Check service records for correct oil type and viscosity for the vehicle operating temperature. Single weight or 15W-40 oil is not recommended for cold ambient temperatures. 10W-30 oil is recommended for cold ambient temperatures. Oil that has had extended drain intervals will have increased viscosity (become thicker) and will make engine cranking more difficult and starting less reliable at temperatures below freezing. Refer to the lube oil chart in the service manual or operator's manual for the correct oil selection for temperature conditions.

The level in the oil reservoir should also be checked. Remove the inspection plug in top of reservoir and check to see if the oil reservoir is full (a reservoir that drains back after the engine has not been operated for a period of time can cause a hard start or a start and die condition). Filling the reservoir will allow the system to prime faster, facilitating starting.



Possible Causes:

- Oil level low — oil leak, oil consumption, incorrect servicing
- Oil level high — incorrect servicing, fuel dilution from tandem fuel pump, fuel dilution from injector O-rings
- Oil contamination with coolant — oil cooler, head gasket, porosity
- Low reservoir level — engine built dry (not pressure lubed), prolonged period of not running, leaking check valve in high pressure pump

Tools Required:

1/4-inch drive ratchet or breaker bar to remove inspection plug

4. Intake Restriction
Purpose:

This is a visual inspection to determine if an air intake restriction is contributing to a low power condition. If the engine does have a high air intake restriction, a considerable amount of black or blue smoke may be produced.

4. Intake Restriction
- Check filter minder, or Measure at WOT w/magnehelic gauge.

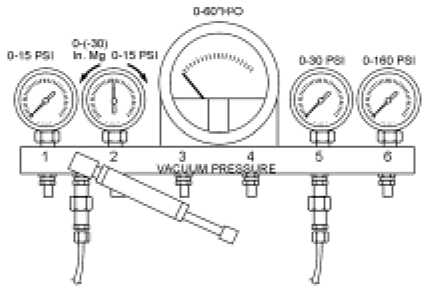
Instrument	Spec.	Check
Magnehelic/ Filter Minder	2"-25" H_2O	

DA2060-A

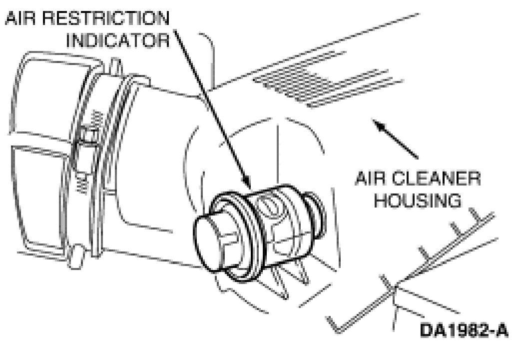
Recommended Procedure:

Inspect the air cleaner inlet and ducting to assure that it is not blocked or collapsed. Inspect the air cleaner housing and filter for proper installation.

If necessary, use Pressure Adapter Kit 014-00761 or equivalent to install a Magnehelic® gauge on the port on the air cleaner and measure restriction at high idle.



A23383-A



DA1982-A

Possible Causes:

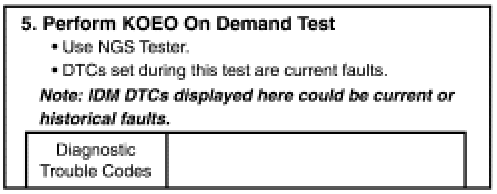
- Snow, plastic bags or other foreign material may restrict airflow at the air inlet.
- Misrouted air cleaner ducting.
- On engines recently repaired, rags or cap plugs may have been inadvertently left in an air inlet pipe.

Tools Required:

Magnehelic® gauge (part of Pressure Adapter Kit 014-00761 or equivalent)

5. Perform KOEO On-Demand Self Test
Purpose:

To determine if the PCM has detected any fault conditions that would cause a performance problem.



DA2061-A

Note: The IDM stores both historical and hard IDM fault codes. To retrieve IDM fault codes, you must run KOEO On-Demand Self Test or KOEO Injector Electrical Test. To ensure that the DTC is a hard fault, you must first clear Continuous DTCs (be sure to record all DTCs before clearing) even though IDM codes do not show up on the Continuous display.

Recommended Procedure:

Connect the NGS Tester to the DLC under the dash. Turn off accessories. If vehicle is equipped with an auxiliary powertrain control (rpm control), it must be turned off to perform self tests.

- Perform the necessary vehicle preparation and visual inspection. Refer to Quick Test Operation .
- SELECT CORRECT VEHICLE, YEAR and MODEL.
- Select DIAGNOSTIC DATA LINK.
- Select PCM — POWERTRAIN CONTROL MODULE.
- Select DIAGNOSTIC TEST MODE.
- Select KOEO ON DEMAND SELF TEST.
- Turn key on.
- Follow operating instructions from the menu.
- Record DTCs and follow appropriate pinpoint test.
- After test, cycle key to off before running other tests or driving vehicle.

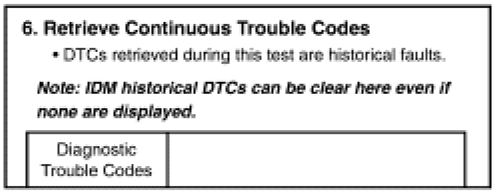
If performing repeated self tests, it may be necessary to unplug glow plug relay to keep battery from going dead. Ignore any glow plug codes while glow plug relay is unplugged.

Tools Required:

New Generation Star (NGS) Tester 007-00500 or equivalent

6. Retrieve Continuous DTCs
Purpose:

To determine if the PCM has detected any historical or intermittent fault conditions that would cause a performance symptom. The condition that caused a continuous DTC may no longer exist.



DA0842-C

Note: The IDM stores both historical and hard IDM fault codes. To retrieve IDM fault codes, you must run KOEO On-Demand Self Test or KOEO Injector Electrical Test. To ensure that the DTC is a hard fault, you must first clear Continuous DTCs (be sure to record all DTCs before clearing) even though IDM codes do not show up on the Continuous display.

Recommended Procedure:

Connect the NGS Tester to the DLC under the dash. Turn off accessories. If vehicle is equipped with an auxiliary powertrain control (rpm control), it must be turned off to perform self tests.

- Perform the necessary vehicle preparation and visual inspection. Refer to Quick Test Operation .
- SELECT CORRECT VEHICLE, YEAR and MODEL.
- Select DIAGNOSTIC DATA LINK.
- Select PCM — POWERTRAIN CONTROL MODULE.
- Select DIAGNOSTIC TEST MODE.
- Select RETRIEVE/CLEAR CONTINUOUS DTCs.
- Turn key on.
- Follow operating instructions from the menu.
- Record DTCs and follow appropriate pinpoint test for continuous code diagnostics.
- After test, cycle key to off before running other tests or driving vehicle.
- Continuous DTCs must be cleared after repair is made.

If performing repeated self tests, it may be necessary to unplug glow plug relay to keep battery from going dead. Ignore any glow plug codes while glow plug relay is unplugged.

Tools Required:

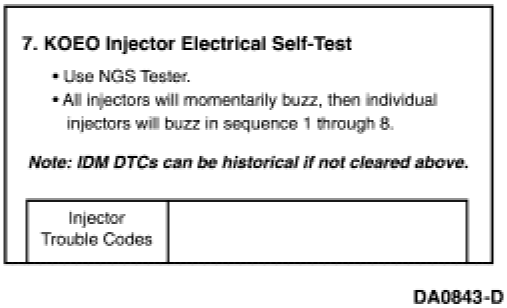
New Generation Star (NGS) Tester 007-00500 or equivalent

7. KOEO Injector Electrical Self Test

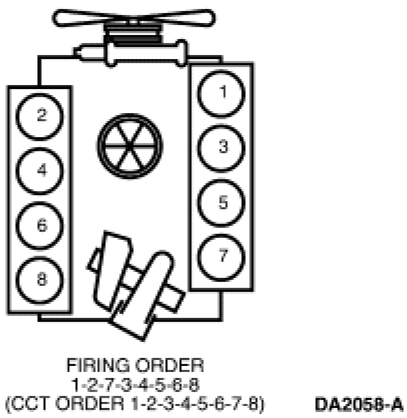
Note: If unable to perform KOEO Injector Electrical Self Test, disconnect IDM connector and check injector high and low sides for shorts or opens.

Purpose:

To determine if the injector solenoids and valves are operating by buzzing all injectors together, then each injector in numerical sequence (1 through 8).



7.3L DI Engine, Cylinder and Fuel Injector Location



This test determines if the injector circuits and solenoids are electrically operating without fault. All injectors will first buzz together for approximately 2 seconds, then each injector will buzz for approximately 1 second in numerical order (1 through 8). The IDM stores all historical IDM fault codes; to ensure that the DTC is a hard fault, you must first clear continuous DTCs (be sure to record all IDM fault codes before clearing). After clearing, rerun self test; a fault must be present at the time of testing for the KOEO Injector Electrical Self Test to detect the fault. If a fault is detected, a DTC will be output on the data link at the end of the test when requested by a scan tool. Only a hard fault code (DTC) will be displayed.

Recommended Procedure:

Note: If no DTCs are present and the KOEO Injector Electrical Self Test aborts while trying to perform, go to Pinpoint Test NA — Step NA29 .

Connect the NGS Tester to the DLC under the dash. Turn off accessories. If vehicle is equipped with an auxiliary powertrain control (rpm control), it must be turned off to perform self tests.

- Perform the necessary vehicle preparation and visual inspection. Refer to Quick Test Operation .
- SELECT CORRECT VEHICLE, YEAR and MODEL.
- Select DIAGNOSTIC DATA LINK.
- Select PCM — POWERTRAIN CONTROL MODULE.
- Select DIAGNOSTIC TEST MODE.

- Select KOEO INJECTOR ELECTRICAL SELF TEST.
- Follow operating instructions from the menu.
- Record DTCs and follow appropriate pinpoint test.
- After test, cycle key to off before running other tests or driving vehicle.

If performing repeated self tests, it may be necessary to unplug glow plug relay to keep battery from going dead. Ignore any glow plug codes while glow plug relay is unplugged.

Possible Causes:

- Open injector wire
- Damaged injector connector
- Shorted wire or connector
- Open injector solenoid
- Defective IDM

Tools Required:

New Generation Star (NGS) Tester 007-00500 or equivalent

8a. Fuel Pressure Test
Purpose:

To determine if fuel system is producing specified pressure at the fuel rails.

F-Series

8a. Fuel Pressure at the right head

- Verify that fuel is in the tank and the pump is being powered.
- Measure fuel pressure at the Front of right head.
- Road Test - with a full load on the engine.

Instrument	Spec.	Measurement
1-160 PSI Gauge	30 PSI min.	

- ***If fuel pressure falls low, Go to step 8c.***
- ***If pressure is above min. spec., Go to step 8b.***

Econoline

8a. Fuel Pressure at the left head

- Verify that fuel is in the tank and the pump is being powered.
- Measure fuel pressure at the rear of left head.

CAUTION: Secure test hose away from turbo and exhaust.

- Road Test - with a full load on the engine.

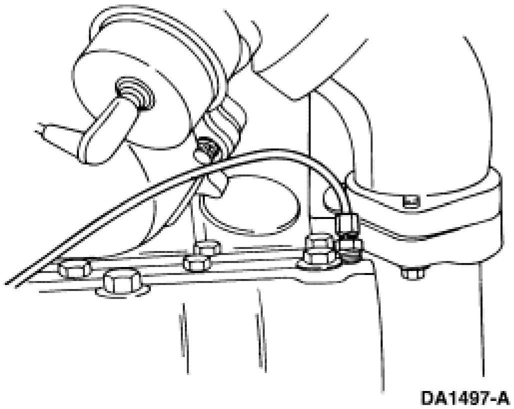
Instrument	Spec.	Measurement
1-160 PSI Gauge	30 PSI min.	

- ***If fuel pressure falls low, Go to step 8c.***
- ***If pressure is above min. spec., Go to step 8b.***

DA1486-B

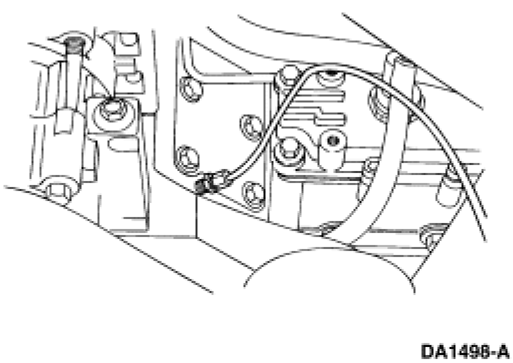
Recommended Procedure:
Econoline

Remove the doghouse cover and remove the 1/8-inch pipe plug from the top rear of left head. Install Gauge (0-160 psi) Bar 014-00761 or equivalent. Run engine at idle and check for leaks from the line to the gauge. Measure pressure with a full load on the engine. If pressure is not within 207-552 kPa (30-80 psi), replace fuel filter. Retest and if still below specification, replace left head check valve, which is located on the front of the left head between the fuel inlet line and the head.



F-Series

Remove the 1/8-inch pipe plug from the top front of the right head. Install Gauge (0-160 psi) Bar 014-00761 or equivalent. Run engine at idle and check for leaks from the line to the gauge. Measure pressure with a full load on the engine. If pressure is not within 207-552 kPa (30-80 psi), replace fuel filter. Retest and if still below specification, replace right head check valve, which is located on the rear of the right head between the fuel inlet line and the head.



Possible Causes:

- Fuel filter
- Head check valve

8b. Fuel Pressure Test
Purpose:

To determine if fuel system is producing specified pressure at the fuel rails.

F-Series

8b. Fuel Pressure at the left head

- Measure fuel pressure at the rear of left head

CAUTION: Secure test hose away from turbo and exhaust.

- Road Test - with a full load on the engine.

Instrument	Spec.	Measurement
1-160 PSI Gauge	30 PSI min.	

- ***If fuel pressure is below min. spec, replace left check valve.***
- ***If pressure is above min. spec., Go to step 9.***

Econoline

8b. Fuel Pressure at the right head

- Measure fuel pressure at the front of right head
- Test under full load, but don't brake torque engine any longer than 10 sec.

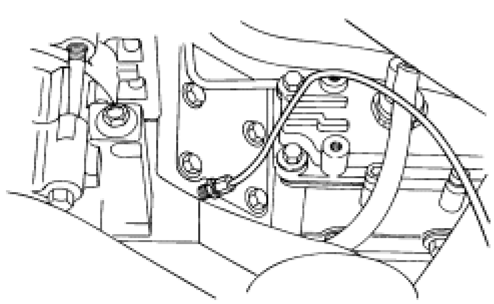
Instrument	Spec.	Measurement
1-160 PSI Gauge	30 PSI min.	

- ***If fuel pressure is below min. spec, replace right check valve.***
- ***If pressure is above min. spec., Go to step 9.***

DA1487-B

Recommended Procedure:
Econoline

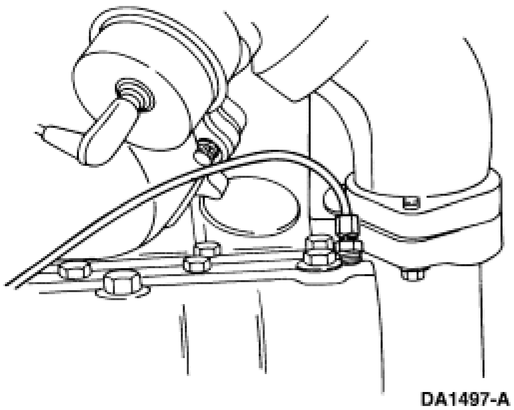
If necessary remove the alternator and bracket from the right side of the engine to remove the 1/8-inch pipe plug from the top front of right head. Install Gauge (0-160 psi) Bar 014-00761 or equivalent. Run engine at idle and check for leaks from the line to the gauge. Measure pressure with a full load on the engine. **DO NOT** brake torque engine more than 10 seconds. After testing move the transmission range selector lever to N (NEUTRAL), and run the engine for about 15 seconds to allow the torque converter to cool. If fuel pressure is not within 207-552 kPa (30-80 psi), replace right head check valve, which is located on the rear of the right head between the fuel inlet line and the head.



DA1498-A

F-Series

Remove the 1/8-inch pipe plug from the top rear of the left head. Install Gauge (0-160 psi) Bar 014-00761 or equivalent. Run engine at idle, and check for leaks from the line to the gauge. Measure pressure with a full load on the engine. If fuel pressure is not within 207-552 kPa (30-80 psi), replace left head check valve, which is located on the front of the left head between the fuel inlet line and the head.



DA1497-A

8c. Electric Fuel Pump Pressure Test
Purpose:

To determine if electric fuel pump is producing specified pressure.

8c. Electric Fuel Pump Pressure

- Measure at fuel outlet from Electric fuel pump.
- Road Test - with a full load on the engine.

Instrument	Spec.	Measurement
0-160 PSI Gauge	30-80 PSI	

- ***If fuel pressure falls low, Go to step 8d.***
- ***If fuel pressure is above min. spec., replace left check valve.***

DA1488-B

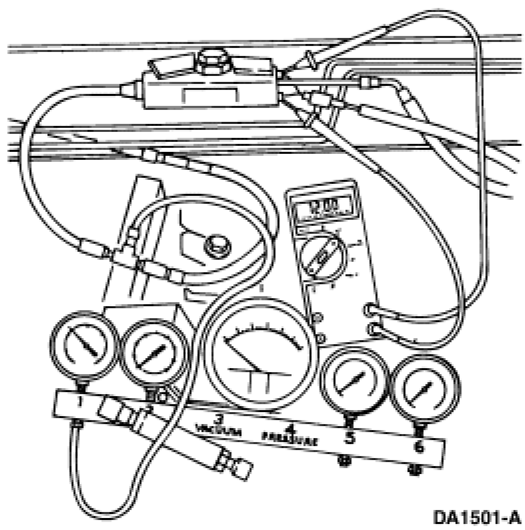
Recommended Procedure:

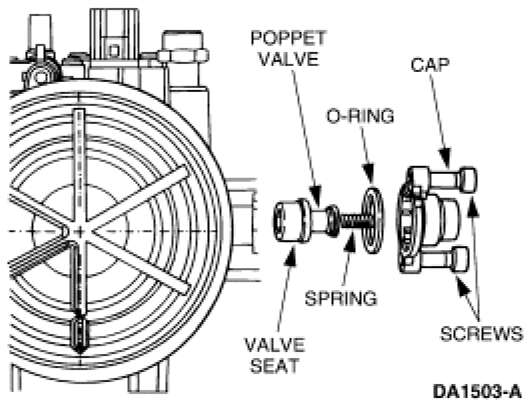
After verifying that there is fuel in the tank, the pump is being powered and there is not a restriction.

Remove the fuel line to the outlet side of the fuel pump. Install Low Fuel Pump Adapter 014-00931-2 or equivalent between the fuel outlet line and the electric fuel pump. Connect test adapter to gauge (160 psi). Run engine at idle and check for leaks from the line to the gauge. Measure pressure with a full load on the engine. If pressure measures below specification (30-80 psi), check fuel regulator valve for debris. If OK, replace the electric fuel pump. After replacing fuel pump, re-check fuel pressure to verify that there is not a restriction downstream of the pump causing high fuel pressure, which will cause the pump to fail again.

A stuck-open regulator valve will cause low fuel pressure.

A stuck-closed regulator valve (possibly caused by debris) will cause high fuel pressure for a short time until the pump fails.





Possible Causes:

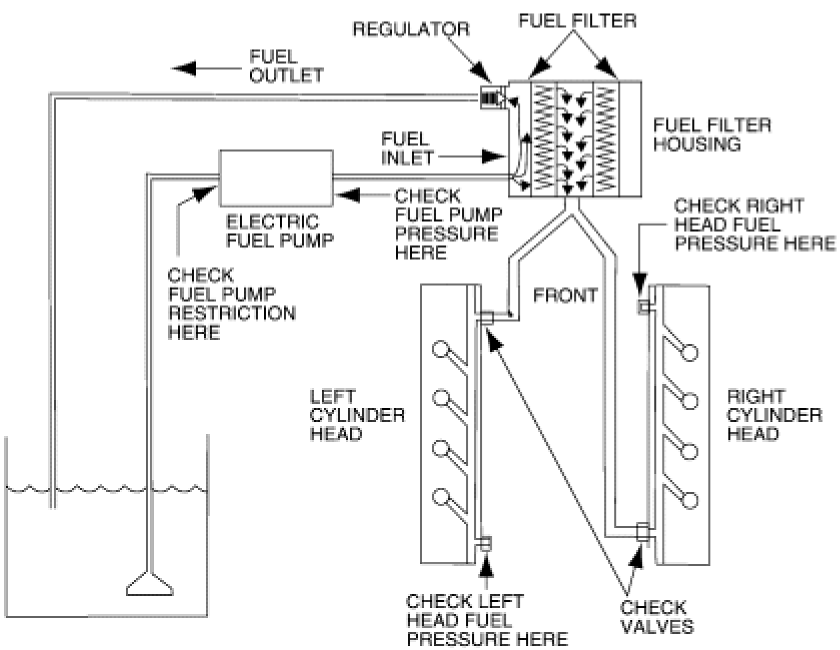
- A stuck-open regulator valve will cause low fuel pressure.
- A stuck-closed regulator valve (possibly caused by debris) will cause high fuel pressure for a short time until the pump fails.
- A loose fuel line on the suction side of the fuel system can cause air to be ingested into the system and cause low fuel pressure.
- Electric fuel pump.
- Fuel pump fuse.
- Fuel pump relay.
- Inertia switch.
- Fuel pump circuit faults.

8d. Electric Fuel Pump Inlet Restriction
Purpose:

To determine if there is a restriction in the fuel pump inlet.

Remove the fuel line to the inlet side of the fuel pump. Install Low Fuel Pump Adapter 014-00931-2 or equivalent between the fuel inlet line and the electric fuel pump. Connect test adapter to gauge (0-30 in-Hg vacuum). Measure restriction at WOT (maximum engine speed out of gear with the brakes set and the wheels blocked). If restriction measures above specification (6 in-Hg), there is a blockage between the fuel pump and the fuel tank.

Fuel is drawn from the fuel tank through the primary filter (the screen on the fuel tank sending unit) by the electric fuel pump. Pressurized fuel (approximately 30-80 psi) is supplied to the secondary filter (the fuel filter housing is located in the V on top of engine) by means of electric pump and regulator valve. The regulator relieves the pressure, sending fuel back to the fuel tank. Only the filtered fuel going through fuel filter will go to the heads. A check valve is located on both heads to prevent fuel pressure spikes in fuel rail.



DA1521-B

8d. Electric Fuel Pump Inlet Restriction

- Measure WOT at fuel inlet to Electric fuel pump for restriction.

Instrument	Spec.	Measurement
0-30" Hg vacuum G	6" Hg MAX	

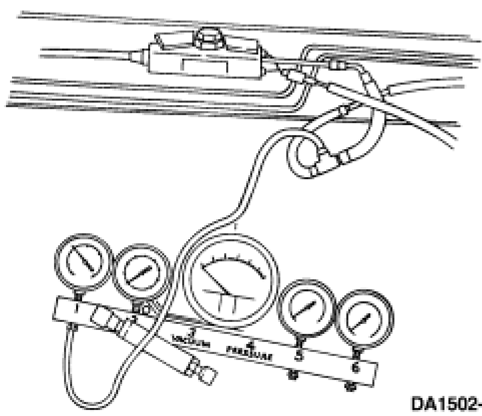
- ***If fuel line is restricted above 6" Hg, check for blockage between pump and fuel tank.***
- ***If fuel line is not restricted, inspect regulator valve condition and for debris. If OK, replace pump.***

DA1489-B

Recommended Procedure:

First verify that there is fuel in the tank and battery voltage going to the fuel pump, using a digital multimeter connected between the two circuits going to the pump. Battery voltage will be present for approximately 20 seconds when the ignition key is turned on. If no voltage is present, go to Pinpoint Test FK .

Remove the fuel line to the inlet side of the fuel pump. Install Rotunda Low Fuel Pump Adapter 014-00931-2 or equivalent between the fuel inlet line and the electric fuel pump. Connect test adapter to gauge (0-30 in-Hg vacuum). Measure restriction at WOT (maximum engine speed out of gear with the brakes set and the wheels blocked). If restriction measures above specification (6 in-Hg), there is a blockage between the fuel pump and the fuel tank.



DA1502-B

9. Perform KOER On-Demand Self Test
Purpose:

To determine if the PCM has detected any fault conditions that would cause a performance problem while the engine is running. This will perform step tests on the injection control pressure system and the exhaust back pressure system.

Step tests are PCM-controlled tests where the PCM commands a specific exhaust back pressure or injection control pressure and then measures the result. If a predetermined threshold is not reached, a fault code will be generated. This test can be performed at any engine temperature.

9. Perform KOER On Demand Test

• This will test both ICP and EBP systems for fault.

KOER DTC	

DA1490-B

Recommended Procedure:

Connect the NGS Tester to the DLC under the dash. Turn off accessories. Turn A/C off. If vehicle is equipped with an auxiliary powertrain control (rpm control), it must be turned off to perform self tests.

Note: Engine will run rough during this test.

- Perform the necessary vehicle preparation and visual inspection. Refer to Quick Test Operation .
- SELECT CORRECT VEHICLE, YEAR and MODEL.
- Select DIAGNOSTIC DATA LINK.
- Select PCM — POWERTRAIN CONTROL MODULE.
- Select DIAGNOSTIC TEST MODE.
- Select KOEO ON DEMAND SELF TEST.
- Start vehicle.
- Follow operating instructions from the menu.
- Record DTCs and follow appropriate pinpoint test.
- After test, cycle key to off before running other tests or driving vehicle.

Tools Required:

New Generation Star (NGS) Tester 007-00500 or equivalent

10a. Injection Control Pressure Tests (Oil Aeration — Poor Idle Quality)
Purpose:

To determine if the engine lube oil is aerated and causing poor idle quality.

10a. Injection Control Pressure Tests (Oil Aeration - Poor idle quality)

- All acc. off, Monitor ICP and RPM with NGS Tester.
- Hold engine speed at 3400 RPM for 3 minutes.

Parameter	High RPM	Measurement
ICP	1250 PSI MAX @ 3400 RPM	

- ***If ICP signal increases above 1250 PSI after 3 minutes, anti-foam oil additives may have become depleted from oil; change oil and re-test.***

DA1491-B

Recommended Procedure:

Install NGS Tester. Turn A/C off. Access ICP PID on NGS Tester and monitor ICP pressure. Operate the engine at 3400 rpm for 3 minutes. This test should be performed with engine at normal operating temperature.

Possible Causes:

- Extended oil drain intervals — the anti-foam additives in the oil may be depleted either from severe use or extended intervals.

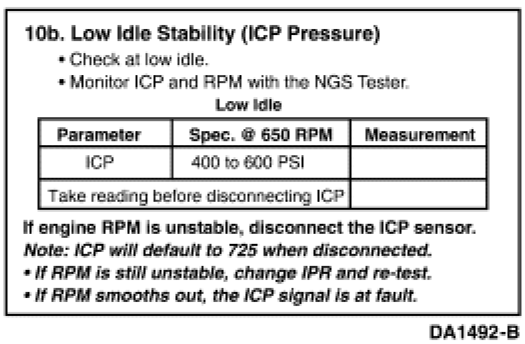
- Air may be present due to recent engine repair on injection control pressure system. It may be necessary to run the vehicle aggressively for 24-32 kilometers (15-20 miles) to remove air.
- Wrong type or grade of oil.

Tools Required:

New Generation Star (NGS) Tester 007-00500 or equivalent

10b. Low Idle Stability (ICP Pressure)
Purpose:

To determine if idle stability or low power is caused by a stuck or dirty IPR or faulty ICP signal.



10b. Low Idle Stability (ICP Pressure)

- Check at low idle.
- Monitor ICP and RPM with the NGS Tester.

Low Idle

Parameter	Spec. @ 650 RPM	Measurement
ICP	400 to 600 PSI	
Take reading before disconnecting ICP		

If engine RPM is unstable, disconnect the ICP sensor.
Note: ICP will default to 725 when disconnected.
- ***If RPM is still unstable, change IPR and re-test.***
- ***If RPM smooths out, the ICP signal is at fault.***

DA1492-B

Recommended Procedure:

Install NGS Tester. Turn A/C off. Access ICP PID on NGS Tester and monitor ICP pressure. Operate the engine at low idle. If engine does not stabilize, disconnect the ICP sensor. If low idle speed stabilizes with the ICP sensor disconnected, the problem is most likely in the ICP sensor circuit. Refer to Pinpoint Test DC . If rpm does not stabilize, change the IPR and retest. This test should be performed with engine at normal operating temperature.

Possible Causes:

- Debris stuck in the IPR
- In-range ICP sensor or circuit failure

Tools Required:

New Generation Star (NGS) Tester 007-00500 or equivalent

11. Crankcase Pressure Test
Purpose:

This test will measure crankcase pressure. Crankcase pressure is a measure of how well the cylinders are sealing.

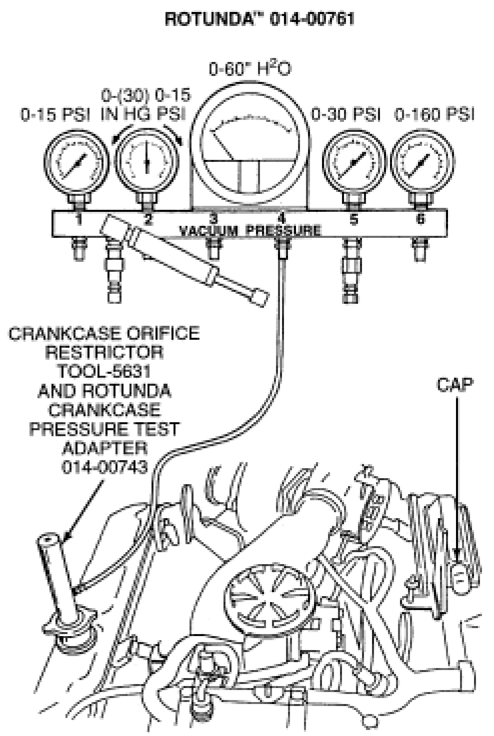
11. Crankcase Pressure Test

- Assure engine is at normal operating temp.
- Measure at oil fill with adapter and orifice tool P.N. 5631 & 014-00743 installed.
- Block breather tube on left valve cover.
- Measure at WOT under no load.

Instrument	Spec.	Measurement
Magnehelic 0 to 60" H_2O	less than 4" H_2O	

If more than 4" H_2O, refer base engine in Shop Manual.

DA1493-C



CRANKCASE PRESSURE A24026-B

Recommended Procedure:

Note: Do not plug hole on Crankcase Orifice Restrictor Tool 014-00743.

Make sure the engine is up to operating temperature. A cold engine will give higher readings. Remove the ducting to the turbocharger inlet pipe and remove the inlet pipe and elbow that connects to the breather box. Block the outlet at the breather box with the cap provided in Pressure Test Adapter Kit 014-00761 or equivalent. Install a protective screen over the turbocharger inlet.

Screw the Crankcase Orifice Restrictor Tool 014-00743 and Crankcase Pressure Test Adapter or equivalent in the oil fill cap hole. Plumb to the Magnehelic® gauge in the gauge block. Make sure the Magnehelic® gauge has been zeroed.

Start the engine and operate at 3400 rpm. Hold for 30 seconds minimum and take a stabilized reading. Do not block the hole at the top of the restrictor tool.

Possible Causes:

- Broken or worn compression rings
- Polished cylinder bores
- Leaking or bent valves

Inspect air induction system. If the air induction system allows dirt to enter the cylinders, it will quickly "dust" the engine causing high crankcase pressure.

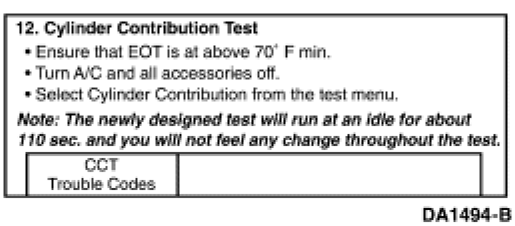
Tools Required:

- Crankcase Orifice Restrictor Tool 014-00743 (part of Pressure Test Adapter Kit 014-00761)
- Magnehelic® gauge (part of Pressure Test Kit 014-00761)
- Protective screen
- Crankcase Pressure Test Adapter 014-00743 or equivalent

12. Cylinder Contribution Tests
Purpose:

To test individual cylinders and injectors to determine if all are contributing equally to engine performance.

Note: Only California vehicles will set a Continuous Misfire DTC. Both 49-state and California vehicles will set a KOER Cylinder Contribution Self Test code for a low or non-contributing cylinder. If any CCT or misfire DTCs are set, go to Pinpoint Test NA to diagnose the fault.



Recommended Procedure:

The A/C must be off and engine oil temperature above 21° C (68°F) to run Cylinder Contribution Self Test. This test will determine if all cylinders are contributing equally to engine performance. The PCM will test all eight cylinders continuously during the test; there is no change in engine speed or operation that can be detected by the technician. The test checks for cylinder-to-cylinder decrease in speed and sets a code if the decrease is too high. A fault must be present at the time of testing for the KOER Cylinder Contribution Self Test to detect a fault, so the engine operating condition at which the idle is worst will produce the best test results. If a fault is detected, a Diagnostic Trouble Code (DTC) will be output on the data link at the end of the test when requested by a scan tool. Only a hard fault code (DTC) will be displayed.

Possible Causes:

Failing this test could indicate mechanical engine problems such as:

- broken compression rings
- leaking or bent valves
- bent push rods
- bent connecting rods
- damaged rocker arms
- faulty injector assembly

Go to the workshop manual for base engine diagnostic procedures.

If the base engine condition meets specifications, the injector may not be functioning correctly and will need replacement. The solenoid and wiring should have been checked in earlier tests. Verify KOEO Injector Electrical Self Test passed.

Tools Required:

New Generation Star (NGS) Tester 007-00500 or equivalent

13. Exhaust Restriction
Purpose:

To determine if the exhaust system is sufficiently restricted to cause a performance problem.

13. Exhaust Restriction
- Visually inspect exhaust system for damage.
- Verify EBP device is open at WOT in park or neutral.
- Monitor EBP with the NGS Tester with the engine temperature at 170°F minimum at 3400 RPM.

Parameter	Spec.	Measurement
EBP	34 PSI MAX @ 3400 RPM	

DA1495-A

Recommend Procedure:

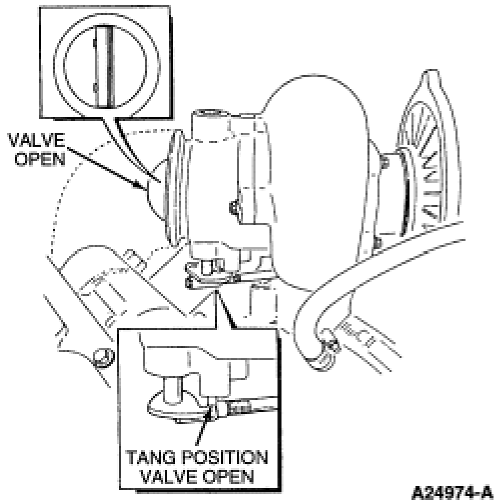
Use NGS Tester PID EBP. An EBP reading above 234 kPa (34 psia) indicates a restricted exhaust condition.

Possible Causes:

- Collapsed tail pipe
- Clogged tail pipe
- Closed exhaust back pressure device
- Clogged catalytic converter
- Damaged muffler

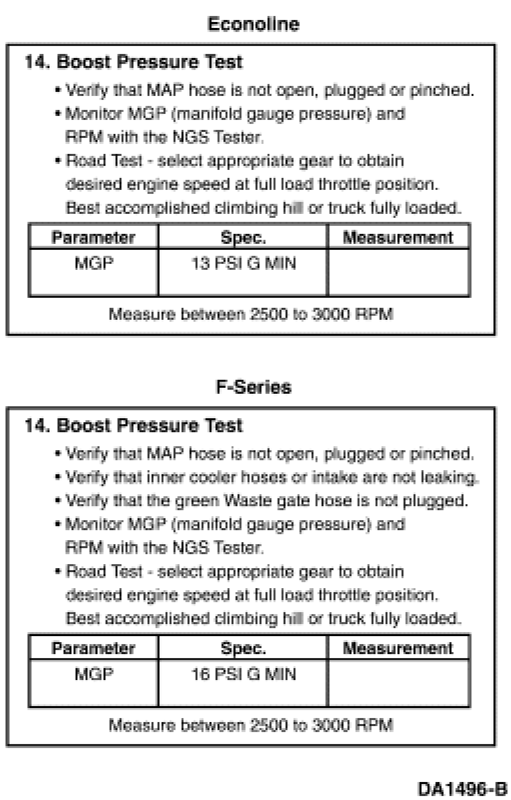
Tools Required:

- New Generation Star (NGS) Tester 007-00500 or equivalent



14. Boost Pressure Test
Purpose:

To determine if the engine can develop sufficient boost to obtain specific power.


Econoline

14. Boost Pressure Test

- Verify that MAP hose is not open, plugged or pinched.
- Monitor MGP (manifold gauge pressure) and RPM with the NGS Tester.
- Road Test - select appropriate gear to obtain desired engine speed at full load throttle position. Best accomplished climbing hill or truck fully loaded.

Parameter	Spec.	Measurement
MGP	13 PSI G MIN	

Measure between 2500 to 3000 RPM

F-Series

14. Boost Pressure Test

- Verify that MAP hose is not open, plugged or pinched.
- Verify that inner cooler hoses or intake are not leaking.
- Verify that the green Waste gate hose is not plugged.
- Monitor MGP (manifold gauge pressure) and RPM with the NGS Tester.
- Road Test - select appropriate gear to obtain desired engine speed at full load throttle position. Best accomplished climbing hill or truck fully loaded.

Parameter	Spec.	Measurement
MGP	16 PSI G MIN	

Measure between 2500 to 3000 RPM

DA1496-B

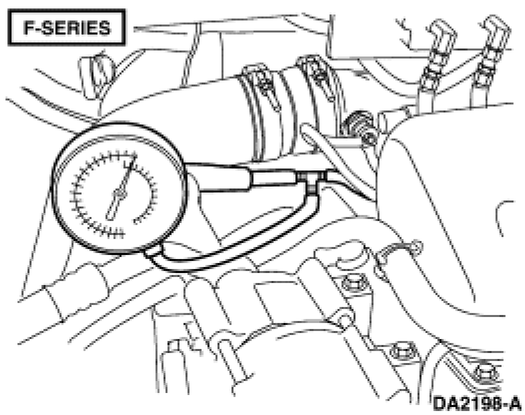
Recommended Procedure:

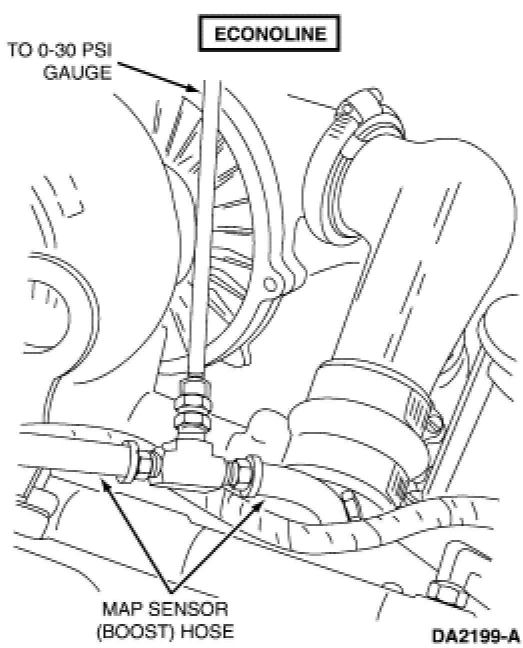
Monitor NGS Tester PID MGP and RPM. After the engine is up to operating temperature, find an open section of road and select the best gear to achieve a 2500-3000 rpm acceleration. With the accelerator at WOT, note the highest boost reading while accelerating through the 2500-3000 rpm range. Boost will level out after 3000 rpm. This is best accomplished either climbing a hill or with the vehicle fully loaded.

Alternate Procedure:

Install a T (manufactured locally out of common fittings) into the manifold absolute pressure (MAP) sensor line that comes from the intake manifold. Make sure the MAP sensor is hooked up for this test.

Connect a T to a 0-30 psi gauge that is temporarily installed in the cab. Route the hose so that it is not crimped and does not come in contact with any hot surface.





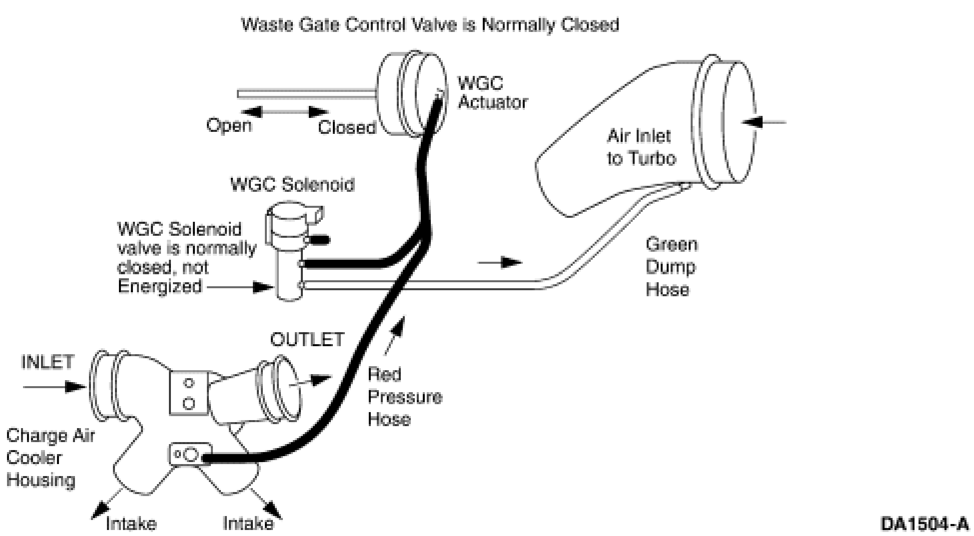
Possible Causes:

- MAP hose pinched or open
- Leaking intake, hoses or fittings
- Defective turbocharger
- Base engine failure

Added Causes for F-Series

- Plugged green wastegate hose or port in the charge air intake to the turbo
- Wastegate control solenoid not electrically but mechanically inoperative
- Wastegate actuator
- Wastegate valve
- Wastegate turbo
- Intercooler hoses leaking

A wastegated turbo is designed to reach maximum boost sooner then a conventional turbo, but overboosting will cause damage to the turbo. The PCM will control the boost pressure by duty cycle to the solenoid to maximize boosting performance. When pressure is supplied on the red hose going to the actuator (solenoid NOT energized) the valve will open, dumping boost. When low or no pressure is on the red hose going to the actuator (solenoid is being energized) the valve will stay closed.



Diagnostic Trouble Code Description

4 Digit	Description	Pinpoint Test Step Go To Direction		
		KOEO	KOER	Continuous
—	System Pass (No DTCs Available) — California and all Econoline	—	—	—
P0107(a)	BARO Circuit Low Input	DG1	—	DG3
P0108(a)	BARO Circuit High Input	DG	—	DG4
P0112(a)	IAT Sensor Circuit Low Input	DA5	—	DA8
P0113(a)	IAT Sensor Circuit High Input	DA1	—	DA8
P0122(a)(b)	Accelerator Pedal Sensor Circuit Low Input	DD5	—	DD5
P0123(a)(b)	Accelerator Pedal Sensor Circuit High Input	DD1	—	DD1
P0197(a)(b)	EOT Sensor Circuit Low Input	DB4	—	DB6
P0198(a)(b)	EOT Sensor Circuit High Input	DB1	—	DB6
P0220	Throttle Switch B Circuit Malfunction	—	FE1	—
P0221(a)(b)	Throttle Switch B Circuit Performance	—	—	FE1
P0230	Fuel Pump Relay Driver Fail	FK1	—	FK16
P0231(a)	Fuel Pump Relay Driver Circuit Failure	FK5	—	FK18
P0232	Fuel Pump Relay Driver Failed Off	FK11	—	FK20
P0236(a)	Turbo Boost Sensor A Circuit Performance	DH1	—	DH1
P0237(a)(b)	Turbo Boost Sensor A Circuit Low Input	DH5	—	DH13
P0238(a)(b)	Turbo Boost Sensor A Circuit High Input	DH11	—	DH15
P0261	Injector Circuit Low — Cylinder 1	NA1	—	NA1
P0262	Injector Circuit High — Cylinder 1	NA6	—	NA6
P0263	Cylinder 1 Contribution/Balance Fault	—	NA25	—
P0264	Injector Circuit Low — Cylinder 2	NA1	—	NA1
P0265	Injector Circuit High — Cylinder 2	NA6	—	NA6
P0266	Cylinder 2 Contribution/Balance Fault	—	NA25	—
P0267	Injector Circuit Low — Cylinder 3	NA1	—	NA1
P0268	Injector Circuit High — Cylinder 3	NA6	—	NA6
P0269	Cylinder 3 Contribution/Balance Fault	—	NA25	—
P0270	Injector Circuit Low — Cylinder 4	NA1	—	NA1
P0271	Injector Circuit High — Cylinder 4	NA6	—	NA6
P0272	Cylinder 4 Contribution/Balance Fault	—	NA25	—

P0273	Injector Circuit Low — Cylinder 5	NA1	—	NA1
P0274	Injector Circuit High — Cylinder 5	NA6	—	NA6
P0275	Cylinder 5 Contribution/Balance Fault	—	NA25	—
P0276	Injector Circuit Low — Cylinder 6	NA1	—	NA1
P0277	Injector Circuit High — Cylinder 6	NA6	—	NA6
P0278	Cylinder 6 Contribution/Balance Fault	—	NA25	—
P0279	Injector Circuit Low — Cylinder 7	NA1	—	NA1
P0280	Injector Circuit High — Cylinder 7	NA6	—	NA6
P0281	Cylinder 7 Contribution/Balance Fault	—	NA25	—
P0282	Injector Circuit Low — Cylinder 8	NA1	—	NA1
P0283	Injector Circuit High — Cylinder 8	NA6	—	NA6
P0284	Cylinder 8 Contribution/Balance Fault	—	NA25	—
P0301(a)	Fault Cylinder A-Misfire Detected (CYL 1)	—	—	NA25
P0302(a)	Fault Cylinder B-Misfire Detected (CYL 2)	—	—	NA25
P0303(a)	Fault Cylinder D-Misfire Detected (CYL 3)	—	—	NA25
P0304(a)	Fault Cylinder E-Misfire Detected (CYL 4)	—	—	NA25
P0305(a)	Fault Cylinder F-Misfire Detected (CYL 5)	—	—	NA25
P0306(a)	Fault Cylinder G-Misfire Detected (CYL 6)	—	—	NA25
P0307(a)	Fault Cylinder C-Misfire Detected (CYL 7)	—	—	NA25
P0308(a)	Fault Cylinder H-Misfire Detected (CYL 8)	—	—	NA25
P0340	CMP Sensor Circuit Malfunction	DF1	—	DF1
P0341(a)	CMP Sensor Circuit Performance	—	DF1	DF1
P0344(a)(b)	CMP Sensor Circuit Intermittent	DF1	—	DF1
P0380(a)	Glow Plug Circuit Malfunction	KC3	—	KC3
P0381(a)	Glow Plug Indicator Circuit Malfunction	KD1	—	KD3
P0460	Fuel Tank Level Indicator Circuit Malfunction	—	—	—
P0470	Exhaust Back Pressure Sensor Circuit Malfunction	DE1	—	DE3
P0471(a)	Exhaust Back Pressure Sensor Circuit Performance	—	—	DE5
P0472(a)	Exhaust Back Pressure Sensor Circuit Low Input	DE9	—	DE9
P0473(a)	Exhaust Back Pressure Sensor Circuit High Input	DE15	—	DE15
P0475(a)	Exhaust Pressure Control Valve Malfunction	KB1	—	—
P0476	Exhaust Pressure Control Valve Performance	—	KB7	KB7
P0478(a)	Exhaust Pressure Control Valve High Input	—	—	DE17
P0500(a)	Vehicle Speed Sensor	—	—	DL1
P0501	Vehicle Speed Sensor (VSS) Range/Performance	—	—	DL1

P0502	Vehicle Speed Sensor	—	—	DL1
P0503	Vehicle Speed Sensor Noisy	—	—	DL11
P0541	Manifold Intake Air Heater......	—	—	—
P0542	Manifold Intake Air Heater......	—	—	—
P0560	System Voltage Malfunction	—	A1	—
P0562(a)	System Voltage Low	A1	—	A1
P0563	System Voltage High	A1	—	A1
P0565	Cruise "On" Signal Malfunction	—	FG1	—
P0566	Cruise "Off" Signal Malfunction	—	FG1	—
P0567	Cruise "Resume" Signal Malfunction	—	FG1	—
P0568	Cruise "Set" Signal Malfunction	—	FG1	—
P0569	Cruise "Coast" Signal Malfunction	—	FG1	—
P0571	Brake Switch A Circuit Malfunction	—	FB1	—
P0603	Internal Control Module KAM Error	MA1	—	MA1
P0605	Internal Control Module ROM Error	MD1	—	MD1
P0606	PCM Processor Fault	MC1	—	—
P0640	Manifold Intake Air Heater......	KL1	KL1	KL1
P0703	Brake Switch B Circuit Malfunction	—	FD1	—
P0704	Clutch Pedal Position Switch Input Circuit Malfunction	—	FC1	—
P0705(d)	TR Sensor Circuit Malfunction	(c)	(c)	(c)
P0708(d)	TR Sensor Circuit High Input	(c)	(c)	(c)
P0712	Transmission Fluid Temp. Sensor CKT Low Input	(c)	(c)	(c)
P0713	Transmission Fluid Temp. Sensor CKT High Input	(c)	(c)	(c)
P0715	TSS Sensor Circuit Malfunction Fault	(c)	(c)	(c)
P0717	TSS Intermittent Failure	(c)	(c)	(c)
P0718	Noisy TSS	(c)	(c)	(c)
P0720	OSS Sensor Circuit Malfunction	(c)	(c)	(c)
P0721	Noisy OSS	(c)	(c)	(c)
P0722	OSS Intermittent Failure	(c)	(c)	(c)
P0732	Gear Two Ratio Error	(c)	(c)	(c)
P0733	Gear Three Ratio Error	(c)	(c)	(c)
P0741	TCC Circuit Performance	(c)	(c)	(c)
P0743	Torque Converter Clutch System Electrical Failure	(c)	(c)	(c)

P0750	Shift Solenoid 1 Malfunction	(c)	(c)	(c)
P0755	Shift Solenoid B Malfunction	(c)	(c)	(c)
P0781	1-2 Shift Malfunction	(c)	(c)	(c)
P0782(d)	2-3 Shift Malfunction	(c)	(c)	(c)
P0783(d)	3-4 Shift Malfunction	(c)	(c)	(c)
P1000	OBD II Monitor Checks Not Complete, More Driving Required	—	—	MB
P1105	Dual Alternator Upper Fault (Monitor)	(c)	(c)	(c)
P1106	Dual Alternator Lower Fault (Control)	(c)	(c)	(c)
P1107	Dual Alternator Lower Circuit Malfunction (Control)	(c)	(c)	(c)
P1108	Dual Alternator BATT Lamp Circuit Malfunction	(c)	(c)	(c)
P1118(a)	Manifold Air Temperature Sensor Low Input	DI4	—	DI4
P1119(a)	Manifold Air Temperature Sensor High Input	DI1	—	DI1
P1139	Water in Fuel Indicator Circuit Malfunction	DK1	—	DK1
P1140	Water in Fuel Condition	—	—	DJ1
P1184	Engine Oil Temp Sensor Circuit Performance	—	DB10	—
P1209(a)	Injection Control System Pressure Peak Fault	—	—	KE15
P1210(a)	Injection Control Pressure Above Expected Level	DC11	—	DC22
P1211(a)(b)	ICP Not Controllable — Pressure Above/Below Desired	KE15	KE7	KE15
P1212	ICP Voltage Not at Expected Level	—	—	DC14
P1218	CID Stuck High	KA9	—	KA9
P1219	CID Stuck Low	KA12	—	KA12
P1247(a)	Turbo Boost Pressure Low	—	—	DC1
P1248(a)	Turbo Boost Pressure Not Detected	—	—	DH1
P1249(a)	Wastegate Fail Steady State Test	—	—	KH5
P1261	High to Low Side Short — Cylinder 1	NA6	—	NA6
P1262	High to Low Side Short — Cylinder 2	NA6	—	NA6
P1263	High to Low Side Short — Cylinder 3	NA6	—	NA6
P1264	High to Low Side Short — Cylinder 4	NA6	—	NA6
P1265	High to Low Side Short — Cylinder 5	NA6	—	NA6
P1266	High to Low Side Short — Cylinder 6	NA6	—	NA6
P1267	High to Low Side Short — Cylinder 7	NA6	—	NA6
P1268	High to Low Side Short — Cylinder 8	NA6	—	NA6
P1271	High to Low Side Open — Cylinder 1	NA11	—	NA11
P1272	High to Low Side Open — Cylinder 2	NA11	—	NA11

P1273	High to Low Side Open — Cylinder 3	NA11	—	NA11
P1274	High to Low Side Open — Cylinder 4	NA11	—	NA11
P1275	High to Low Side Open — Cylinder 5	NA11	—	NA11
P1276	High to Low Side Open — Cylinder 6	NA11	—	NA11
P1277	High to Low Side Open — Cylinder 7	NA11	—	NA11
P1278	High to Low Side Open — Cylinder 8	NA11	—	NA11
P1280(a)(b)	ICP Circuit Out of Range Low	DC1	—	DH1
P1281(a)(b)	ICP Circuit Out of Range High	DC8	—	DH8
P1282(a)(b)	Excessive ICP	—	KE5	KE5
P1283	IPR Circuit Failure	KE1	—	—
P1284	ICP Failure — Aborts KOER or CCT Test	—	DC21	—
P1291	High Side No. 1 (Right) Short to GND or B+	NA16	—	NA16
P1292	High Side No. 2 (Left) Short to GND or B+	NA16	—	NA16
P1293	High Side Open Bank No. 1 (Right)	NA20	—	NA20
P1294	High Side Open Bank No. 2 (Left)	NA20	—	NA20
P1295(b)	Multiple Faults on Bank No. 1 (Right)	NA29	—	NA29
P1296(b)	Multiple Faults on Bank No. 2 (Left)	NA29	—	NA29
P1297	High Sides Shorted Together	NA27	—	NA27
P1298	IDM Failure	KA1	—	KA1
P1316(a)(b)	Injector Circuit/IDM Codes Detected	FJ9	—	FJ9
P1391(a)	Glow Plug Circuit Low Input Bank No. 1 (Right)	—	KC1	KC1
P1393(a)	Glow Plug Circuit Low Input Bank No. 2 (Left)	—	KC1	KC1
P1395(a)	Glow Plug Monitor Fault Bank No. 1	—	KC1	KC1
P1396(a)	Glow Plug Monitor Fault Bank No. 2	—	KC1	KC1
P1397	System Voltage Out of Self Test Range	—	KC15	KC15
P1464	A/C On During KOER or CCT Test	—	FA1	—
P1501	VSS Out of Self Test Range	—	DL10	—
P1502	Invalid Self Test — APCM Functioning	QA	QA	QA
P1531	Invalid Test — Accelerator Pedal Movement	—	Repeat Test	—
P1536	Parking Brake Applied Failure	—	FF1	—
P1662	IDM__EN Circuit Failure	NC1	—	—
P1663	FDCS Circuit Failure	KF1	—	—
P1667	CID Circuit Failure	KA1	—	—
P1668	PCM — IDM Diagnostic Communication Error	FJ1	—	FJ1
P1670	EF Feedback Signal Not Detected	—	—	FJ1

P1690	Wastegate Control Valve Malfunction	KH1	—	KH1
P1702	TRS Sensor Intermittent Circuit Malfunction	(c)	(c)	(c)
P1704	Digital TRS Failed to Transition State	—	—	—
P1705	TR Sensor out of Self Test Range	(c)	(c)	(c)
P1711	TFT Sensor Out of Self Test Range	(c)	(c)	(c)
P1713	TFT Stuck in Range Low-Below 50°F	(c)	(c)	(c)
P1714	Shift Solenoid A Inductive Signature Malfunction	(c)	(c)	(c)
P1715	Shift Solenoid B Inductive Signature Malfunction	(c)	(c)	(c)
P1718	TFT Stuck in Range High-Above 250°F	(c)	(c)	(c)
P1729	4x4L Switch Error	(c)	(c)	(c)
P1744	Torque Converter Clutch System Performance	(c)	(c)	(c)
P1746	EPC Solenoid Open Circuit	(c)	(c)	(c)
P1747	EPC Solenoid Short Circuit	(c)	(c)	(c)
P1754	CCS (Solenoid) Circuit Malfunction	(c)	(c)	(c)
P1760	EPC Solenoid Short Intermittent	(c)	(c)	(c)
P1780	TCS Circuit Out of Self Test Range	(c)	(c)	(c)
P1781	4x4L Circuit Out of Self Test Range	(c)	(c)	(c)
P1783(d)	Transmission Overtemperature Condition	(c)	(c)	(c)
No Code	No Communication	QA1	QA1	QA1
No Code	Auxiliary Powertrain Control System	H1	H1	H1
No Code	Tachometer	KG1	KG1	KG1

(a)Check Engine light illuminates when fault is detected in second drive cycle (California, OBDII calibration).

(b)Check Engine light illuminates when fault is present. (Federal)

(c)Refer to the Powertrain Group in the Workshop Manual for diagnostic procedures.

(d)Transmission Control Indicator Light (TCIL) flashes when fault is present.

Note: Speed control DTCs will be set during KOER Switch Test if the vehicle is not equipped with speed control. This is a normal condition. On these vehicles ignore the following DTCs: P0565-P0566-P0567-P0568-P0569-P0571.

Powertrain Control/Emissions Diagnosis

1999

On Board Diagnostics II Diesel

SECTION 5: Pinpoint Tests

SECTION 5: Pinpoint Tests

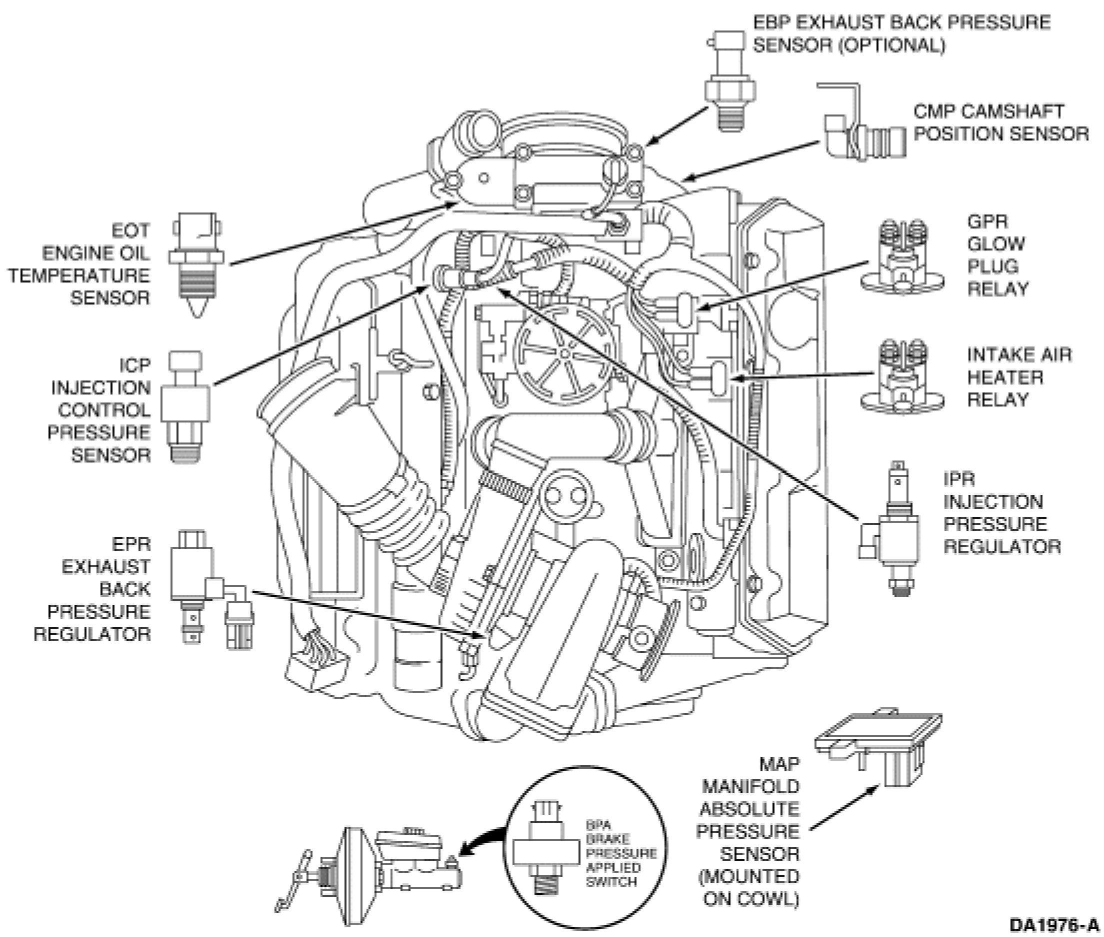
Sensor and Actuator Diagnostic Procedures

Operational Signal Checks

These checks are made with the breakout box installed and normally measure a signal voltage or frequency. They are useful for determining an in-range type concern, or an intermittent connection.

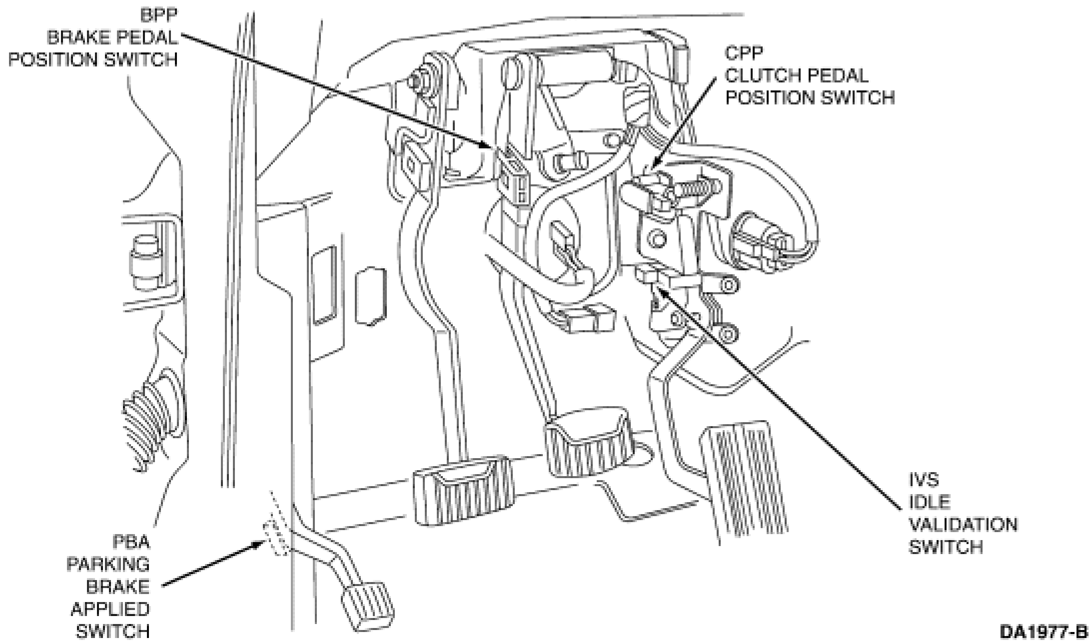
In the case of an intermittent concern, monitoring a suspected circuit and recreating the environmental or physical conditions that caused the complaint will help verify if a problem is in a particular circuit.

It is critical when measuring the signal level of a circuit to understand the function and whether it is an analog voltage, digital frequency, sine wave or digital communication signal. A standard digital multimeter has certain limitations in measuring any circuit that has a frequency.



WARNING: RED-STRIPED WIRES CARRY 115 V DC. SEVERE ELECTRICAL SHOCK MAY BE RECEIVED. DO NOT PIERCE.

CAUTION: Do not pierce engine electrical wires or damage to the harness may occur.



General Procedures for Pinpoint Testing

Inspection

The basic diagnostic procedure recommended for most sensor and actuator circuits is to disconnect the harness at the connector and inspect for corrosion, bent pins, spread pins or any condition that could cause a loose or intermittent connection.

Connector Checks to Ground (B-)

Measure the resistance of all wiring harness connectors to ground (preferably the negative battery cable) to determine if a short to ground condition is present. **It is important that during this test all accessories, including the dome light, be turned off. Current flow in the system will affect resistance readings. If the reading is fluctuating greatly, disconnect the battery and measure to the negative battery cable.**

- Signal return (marked A on all sensor circuits except IAT) should measure less than 5 ohms.
- The VREF and signal lines, with the processor connected, will normally measure greater than 50 k ohms.
- Power ground on an actuator circuit should measure less than 5 ohms. The control side of an actuator circuit will also normally measure greater than 50 k ohms.

Connector Voltage Checks

The next step is to turn the ignition key to the ON position and measure if the expected voltages are present at the connector. On circuits with expected voltages this test will verify the integrity of that circuit. On circuits without an expected voltage this test will determine if that circuit is shorted or miswired to a voltage source.

- Signal return (marked A on all sensor circuits except IAT) should measure less than 2.5 volts.
- VREF should measure 4.5-5.5 volts. If this is higher or lower than expected, disconnect sensors one at a time to determine if a sensor is biasing the circuit and refer to VREF pinpoint procedures.
- Signal lines will measure either 0-.25v if the circuit is designed to pull down when disconnected or a higher voltage (normally 4.6-5, or 12v) if it is designed as a pull up circuit. A pull up signal circuit that measures the expected value normally indicates a good circuit.
- Actuator circuits may be either on/off type circuits (normally 12 volts) or pulse width modulated circuits (12 volts controlled by a % duty cycle).

- Communication circuits are similar to sensor circuits when disconnected in that they will be designed to either pull up or pull down when disconnected. Measuring the expected voltage of a communication circuit when disconnected will often discern its condition.

Harness Resistance Tests

Harness resistance tests are performed when a circuit is suspected of having high resistance or being open. These tests are performed with the breakout box connected and ignition off. Measure resistance from the sensor connector end to the processor connector. If an open circuit or high resistance is encountered, the problem is most easily isolated by separating the circuit at the interim connectors (normally the 42-way connector) and measuring resistance through both halves of the circuit.

A: Pinpoint Tests

Note

Enter this pinpoint test only when directed here from the symptom flowcharts.

Remember

To prevent the replacement of good components, be aware that the following areas may be at fault:

- ignition switch
- battery cables
- generator
- voltage regulator
- ground straps

This pinpoint test is intended to diagnose only the following:

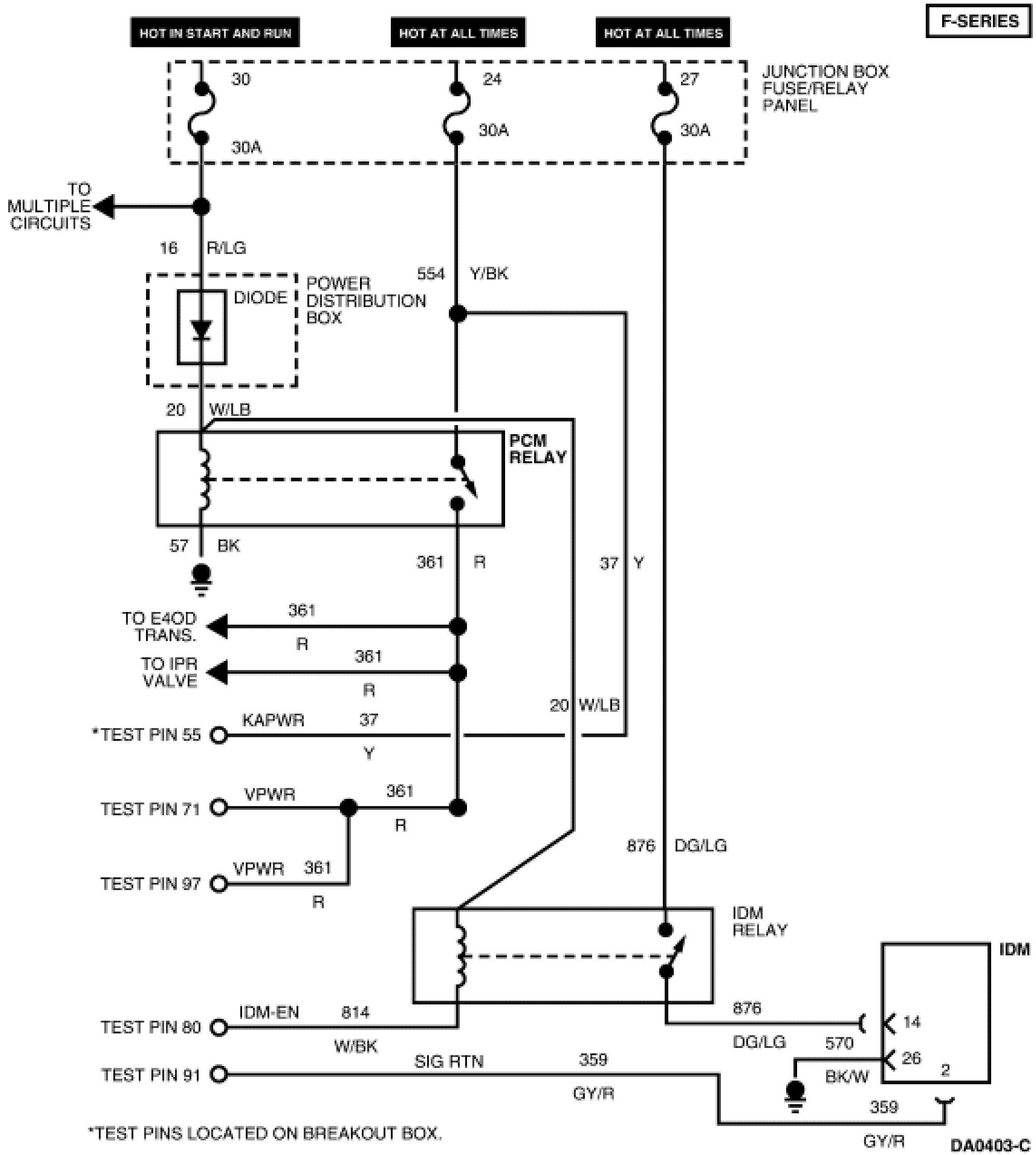
- powertrain control module (PCM) (12A650)
- harness circuits: SIG RTN, PWR GND, VPWR, KAPWR, IGNITION SWITCH, VREF
- battery positive voltage (B+)
- closed loop power relay

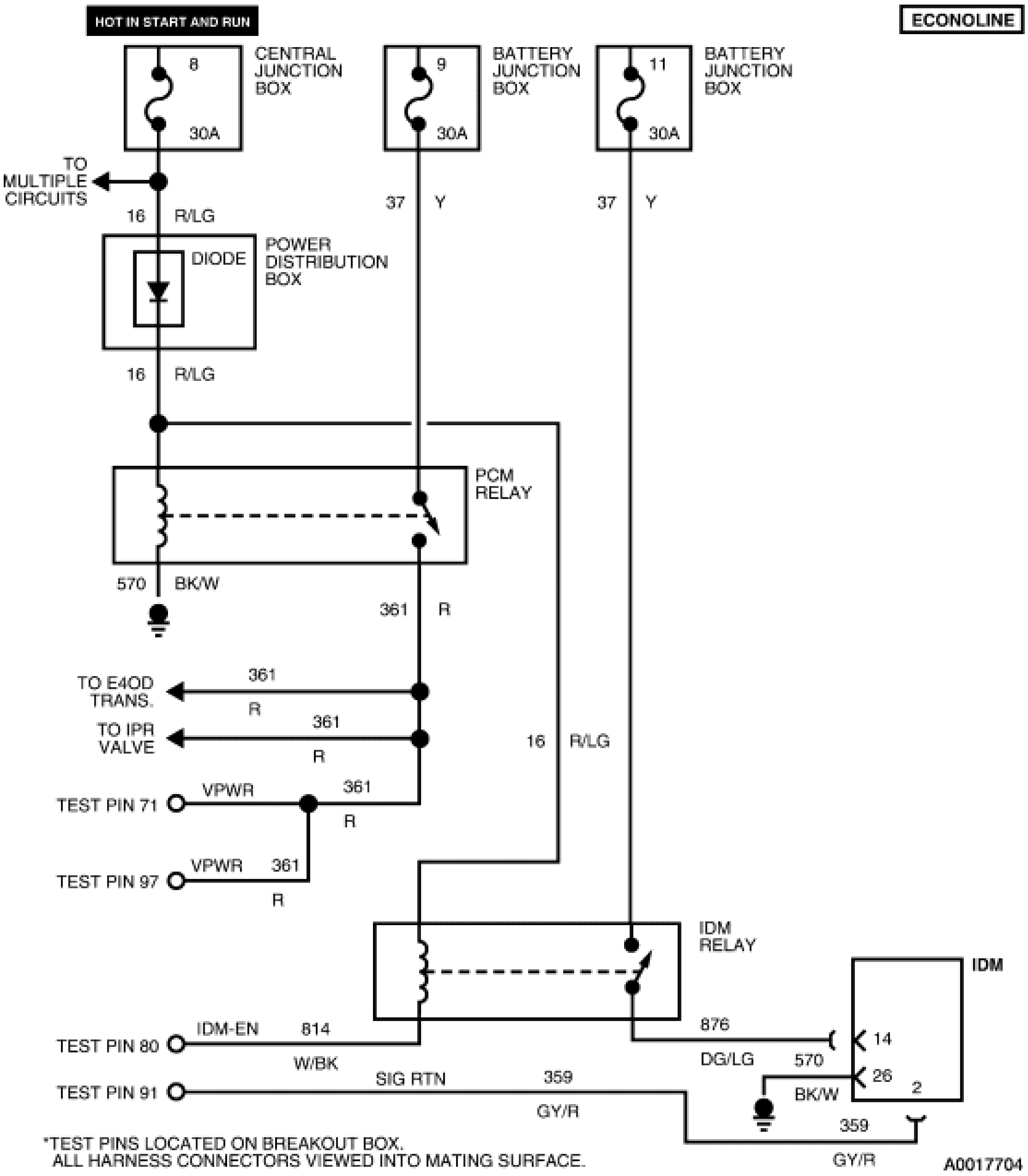
DTC Description

P0560 = System Voltage Malfunction

P0562 = System Voltage Low

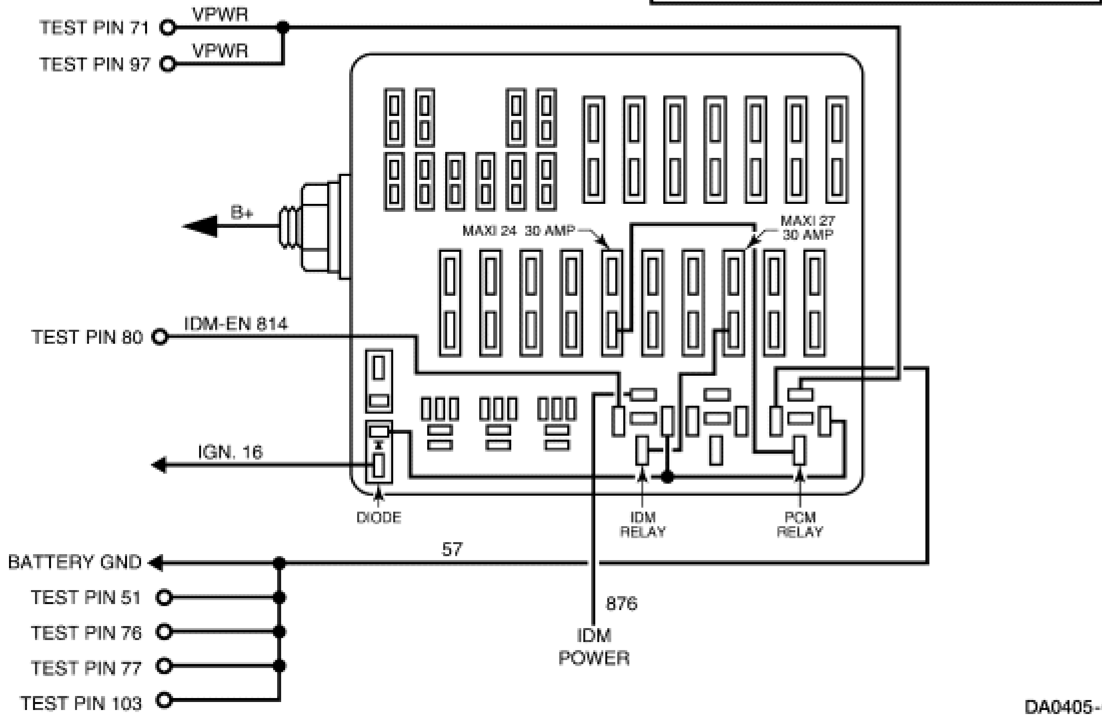
P0563 = System Voltage High


F-SERIES
HOT IN START AND RUN
HOT AT ALL TIMES
HOT AT ALL TIMES
30
30A
24
30A
27
30A
JUNCTION BOX FUSE/RELAY PANEL
TO MULTIPLE CIRCUITS
16 R/LG
554 Y/BK
DIODE
POWER DISTRIBUTION BOX
20 W/LB
PCM RELAY
57 BK
361 R
37 Y
TO E4OD TRANS.
361 R
TO IPR VALVE
361 R
20 W/LB
*TEST PIN 55
KAPWR 37 Y
TEST PIN 71
VPWR 361 R
TEST PIN 97
VPWR 361 R
876 DG/LG
IDM RELAY
IDM
TEST PIN 80
IDM-EN 814 W/BK
876 DG/LG
14
570 BK/W
26
2
TEST PIN 91
SIG RTN 359 GY/R
359 GY/R
*TEST PINS LOCATED ON BREAKOUT BOX.
DA0403-C


HOT IN START AND RUN
ECONOLINE
CENTRAL JUNCTION BOX
8
30A
BATTERY JUNCTION BOX
9
30A
BATTERY JUNCTION BOX
11
30A
TO MULTIPLE CIRCUITS
16 R/LG
37 Y
37 Y
DIODE
POWER DISTRIBUTION BOX
16 R/LG
PCM RELAY
570 BK/W
361 R
TO E4OD TRANS.
361 R
TO IPR VALVE
361 R
16 R/LG
TEST PIN 71
VPWR
361 R
TEST PIN 97
VPWR
361 R
IDM RELAY
IDM
TEST PIN 80
IDM-EN
814 W/BK
876 DG/LG
14
570
26
BK/W
2
TEST PIN 91
SIG RTN
359 GY/R
359 GY/R
*TEST PINS LOCATED ON BREAKOUT BOX.
ALL HARNESS CONNECTORS VIEWED INTO MATING SURFACE.
A0017704

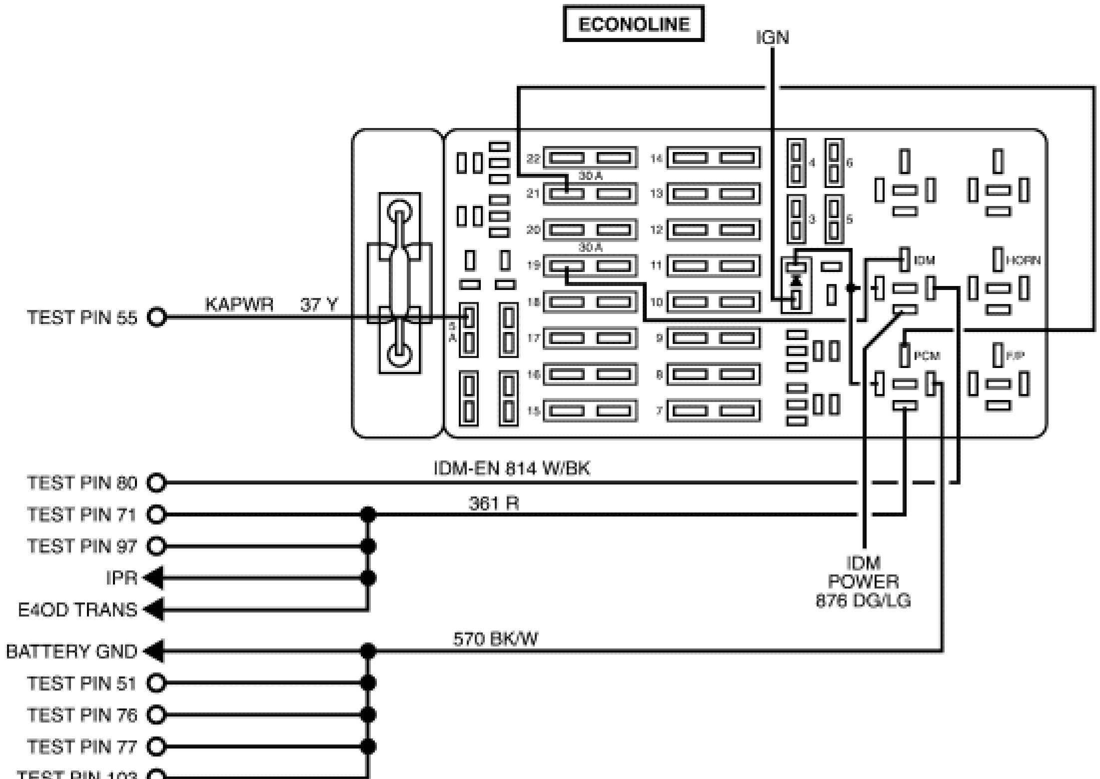
F-SERIES

DTCS: 0560 SYSTEM VOLTAGE MALFUNCTION
0562 SYSTEM VOLTAGE LOW
0563 SYSTEM VOLTAGE HIGH



DA0405-C

ECONOLINE



DA1505-C

A1 DIAGNOSTIC TROUBLE CODES (DTCs) P0563/P0562/P0560

- Key on, engine off.
- Measure voltage across battery terminals.

Is voltage greater than 10.5 volts?

Note: DTC P0563 may be a temporary condition with a 24-volt jump start. DTC P0562 may be a temporary condition at crank only.

P0563 — System voltage high
P0562 — System voltage low
P0560 — System voltage malfunction, below 11.5 volts during KOER tests

Yes	No
F-Series, GO to A2 . Econoline, GO to A12 .	REPAIR discharged battery. REFER to the Electrical Group in the Workshop Manual.

A2 CHECK VOLTAGE AT MAXI FUSE 24

- Measure voltage between power distribution box Maxi Fuse 24 and battery negative post.
- Key off.

Is voltage greater than 10.5 volts?

Yes	No
GO to A3 .	REPAIR open in Circuit 554 (Y/BK) between the power distribution box and the starter relay. RESTORE vehicle.

A3 CHECK MAXI FUSE 24

- Check power distribution box Maxi Fuse 24.

Is fuse blown?

Yes	No
REPAIR short to ground. REPLACE Maxi Fuse 24. RESTORE vehicle.	GO to A4 .

A4 CHECK CIRCUIT 554 (Y/BK) TO RELAY

- Remove PCM relay and Maxi Fuse 24.
- Measure resistance of Circuit 554 (Y/BK) between the nonpower side of Maxi Fuse 24 and the PCM relay connector.

Is resistance less than 5 ohms?

Yes	No
GO to A5 .	REPAIR open in Circuit 554 (Y/BK). RESTORE vehicle.

A5 CHECK IGNITION FEED TO DIODE

- Key off.
- Remove diode from power distribution box.
- Key on, engine off.
- Measure voltage between battery ground and ignition feed side of diode connector.
- Key off.

Was voltage greater than 10.5 volts?

Yes	No
GO to A6 .	REPAIR open in ignition feed Circuit 16 (R/LG) or ignition switch. RESTORE vehicle.

A6 CHECK DIODE

- Disconnect diode and inspect.

Does diode check OK?

Yes	No
F-Series, GO to A7 . Econoline, GO to A13 .	REPLACE diode. RESTORE vehicle.

A7 CHECK CIRCUIT 20 (W/LB)

- Measure resistance of Circuit 20 (W/LB) between the nonpower side of diode connector and the PCM relay connector.

Is resistance less than 5 ohms?

Yes	No
GO to A8 .	REPAIR open in Circuit 20 (W/LB). RESTORE vehicle.

A8 CHECK GROUND CIRCUIT 57 (BK) AT RELAY

- Measure resistance between battery ground and Circuit 57 (BK) at PCM relay connector.

Is resistance less than 5 ohms?

Yes	No
GO to A9 .	REPAIR open in Circuit 57 (BK). RESTORE vehicle.

A9 CHECK CIRCUIT 361 (R) FROM RELAY TO PCM

- Install breakout box, leave PCM disconnected.
- Measure resistance of Circuit 361 (R) between the PCM relay connector and PCM Test Pins 71 and 97.

Is resistance less than 5 ohms?

Yes	No
GO to A10 .	REPAIR open in Circuit 361 (R). RESTORE vehicle.

A10 CHECK PWR GND CIRCUIT CONTINUITY

- Measure resistance between battery negative post and PCM Test Pins 25, 51, 76, 77 and 103.

Is each resistance less than 5.0 ohms?

Yes	No
F-Series, GO to A11 . Econoline, GO to A14 .	REPAIR open in PWR GND circuit. RESTORE vehicle. CLEAR DTCs and RETEST.

A11 CHECK PCM RELAY

- Remove Maxi Fuse 24.
- Install PCM relay.
- Key on, engine off.

- Measure resistance between the nonpower side of Maxi Fuse 24 and PCM Test Pins 71 and 97.

Is resistance less than 5 ohms?

Yes	No
If fault is still present, REPLACE PCM. RESTORE vehicle.	REPLACE PCM relay. RESTORE vehicle.

A12 CHECK VOLTAGE AT PCM RELAY

- Key off.
- Remove PCM relay.
- Key on, engine off.
- Measure voltage of Circuit 37 (Y) between the PCM relay connector and battery ground.

Is voltage greater than 10.5 volts?

Yes	No
GO to A5 .	REPAIR open in Circuit 37 (Y) between PCM relay and starter relay. RESTORE vehicle.

A13 CHECK CIRCUIT 16

- Measure resistance of Circuit 16 (R/LG) between the nonpower side of the diode connector and the PCM relay connector.

Is resistance less than 5 ohms?

Yes	No
GO to A8 .	REPAIR open in Circuit 16 (R/LG). RESTORE vehicle.

A14 PCM RELAY CHECK

- Install PCM relay.
- Key on, engine off.
- Measure voltage between battery negative post and PCM Test Pins 71 and 97.

Is voltage greater than 10.5 volts?

Yes	No
If fault is still present, REPLACE PCM. RESTORE vehicle.	REPLACE PCM relay. RESTORE vehicle.

C: Reference Voltage
Introduction

C: Pinpoint Tests

Note

Enter this pinpoint test only when a check for VREF has failed in the sensor pinpoint tests for the AP, MAP, BARO, ICP, EBP or CMP 3-wire sensors.

Remember

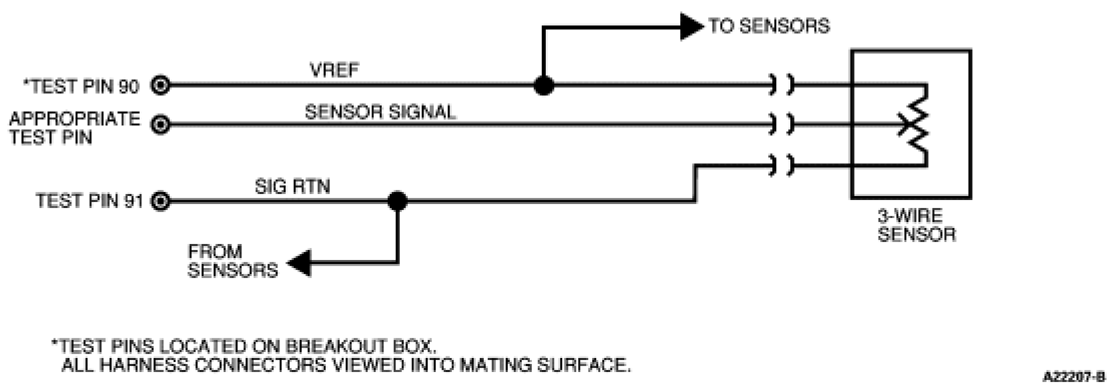
This pinpoint test is intended to diagnose only the following:

- sensor harness circuits: SIG RTN, VREF
- 3-wire sensors: AP, MAP, BARO, ICP, EBP, CMP
- powertrain control module (PCM) (12A650)

Description

Reference Voltage (VREF) is a positive voltage (approximately 5.0 volts ± 3%) that is output by the PCM. This consistent voltage is used by all 3-wire sensors.

Signal Return (SIG RTN) is a dedicated ground used by most sensors and some other inputs.



C: Pinpoint Tests

C: Reference Voltage

C: Introduction

C1 CHECK VEHICLE BATTERY POWER CIRCUIT

- Install breakout box; connect PCM to breakout box.
- Key on, engine off.
- Measure voltage between PCM Power Test Pins 55, 71 and 97 and PCM Ground Test Pins 25, 51, 76, 77 and 103. Note voltage.
- Measure voltage across battery terminals. Note voltage.

Are both voltages greater than 10.5 volts, and are both voltages within 1.0 volt of each other?

Yes	No
GO to C2 .	GO to A1 .

C2 CHECK VREF VOLTAGE

- Measure voltage between PCM Test Pins 90 and 91.
- Key off.

Was voltage between 4.0 volts and 6.0 volts?

Yes	No
GO to C3 .	Less than 4.0 volts, GO to C10 . Greater than 6.0 volts, GO to C4 .

C3 CHECK VREF AND SIG RTN CIRCUITS FOR CONTINUITY

- Disconnect faulty sensor.
- Disconnect PCM from breakout box.
- Measure resistance between PCM Test Pin 90 and VREF circuit at harness connector of the sensor that sent you here.
- Measure resistance between PCM Test Pin 91 and SIG RTN circuit at harness connector of the sensor that sent you here.

Is each resistance less than 5.0 ohms?

Yes	No
RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR open in VREF or SIG RTN circuits. RESTORE vehicle. CLEAR DTCs and RETEST.

C4 CHECK FOR EXCESS VOLTAGE ON VREF CIRCUIT

- Disconnect PCM from breakout box.
- Key on, engine off.
- Measure voltage between PCM Test Pin 90 and battery ground.

Is voltage less than 0.5 volts?

Yes	No
REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR short to power in harness. RESTORE vehicle. CLEAR DTCs and RETEST.

C5 CHECK FOR SHORTED ACCELERATOR PEDAL (AP) SENSOR

- Disconnect AP sensor harness connector.
- Key on, engine off.
- Measure voltage between PCM Test Pins 90 and 91.
- Key off.

Was voltage less than 4.0 volts?

Yes	No
GO to C6 .	REPLACE AP sensor. RESTORE vehicle. CLEAR DTCs and RETEST.

C6 CHECK FOR SHORTED CAMSHAFT POSITION (CMP) SENSOR

- Disconnect CMP sensor harness connector.
- Key on, engine off.
- Measure voltage between PCM Test Pins 90 and 91.
- Key off.

Was voltage less than 4.0 volts?

Yes	No
GO to C7 .	REPLACE CMP sensor. RESTORE vehicle.

C7 CHECK FOR SHORTED INJECTION CONTROL PRESSURE (ICP) SENSOR

- Disconnect ICP sensor harness connector.
- Key on, engine off.
- Measure voltage between PCM Test Pins 90 and 91.
- Key off.

Was voltage less than 4.0 volts?

Yes	No

GO to C8 .	REPLACE ICP sensor. RESTORE vehicle.

C8 CHECK FOR SHORTED EXHAUST BACK PRESSURE (EBP) SENSOR

- Disconnect EBP sensor harness connector.
- Key on, engine off.
- Measure voltage between PCM Test Pins 90 and 91.
- Key off.

Was voltage less than 4.0 volts?

Yes	No
GO to C9 .	REPLACE EBP sensor. RESTORE vehicle.

C9 CHECK FOR SHORTED MANIFOLD ABSOLUTE PRESSURE MAP SENSOR

- Disconnect MAP sensor harness connector.
- Key on, engine off.
- Measure voltage between PCM Test Pin 90 and 91.
- Key off.

Was voltage less than 4.0 volts?

Yes	No
Leave MAP sensor disconnected. GO to C10 .	REPLACE MAP sensor. RESTORE vehicle.

C10 SIG RTN CIRCUIT CHECK

- Measure resistance between PCM Test Pin 91 and PCM Test Pins 25, 51, 76, 77 and 103.

Is each resistance less than 5 ohms?

Yes	No
GO to C11 .	REPLACE PCM. RESTORE vehicle.

C11 CHECK VREF CIRCUIT FOR SHORT TO GROUND

- Disconnect PCM from breakout box.
- AP, CMP, ICP, EBP, MAP and BARO disconnected.
- Measure resistance between PCM Test Pin 90 and PCM Test Pins 25, 51, 76, 77, 91 and 103.

Are all resistances greater than 10,000 ohms?

Yes	No

REPLACE PCM. RESTORE vehicle. RERUN Scan Tool Diagnostic Test.	REPAIR short to ground. RESTORE vehicle. CLEAR DTCs and RETEST.

DA: Intake Air Temperature (IAT) Sensor Introduction

DA: Pinpoint Tests

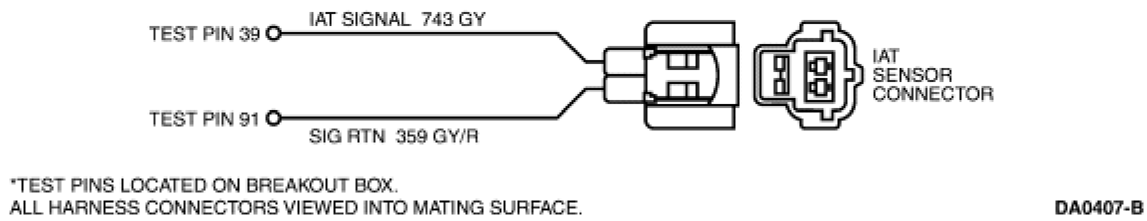
Signal Functions

The intake air temperature (IAT) sensor is a thermistor-type sensor with a variable resistance that changes when exposed to different temperatures. When interfaced with the powertrain control module (PCM), it produces a 0-5 volt analog signal that will measure temperature.

The IAT sensor's primary function is to measure ambient air temperature in order to determine when the exhaust back pressure device is needed.

Detection/Management

An IAT signal that is detected out of range high or low by the PCM will cause the engine to ignore the IAT signal, disable exhaust back pressure operation and assume an ambient temperature of 15°C (59° F).



Note

After removing connectors, always check for damaged pins, corrosion, loose terminals, etc.

kohms	IAT (Volts)	Degrees C	Degrees F
1.19	0.28	120	248
1.56	0.36	110	230
2.08	0.47	100	212
2.80	0.61	90	194
3.84	0.80	80	176
5.34	1.04	70	158
7.55	1.34	60	140
10.93	1.72	50	122
16.11	2.15	40	104

24.25	2.63	30	86
37.34	3.09	20	68
58.99	3.52	10	50

DTC Descriptions

P0113 = Intake Air Temperature Sensor Circuit High Input.

P0112 = Intake Air Temperature Sensor Circuit Low Input.

DA: Pinpoint Tests

DA1 DIAGNOSTIC TROUBLE CODE (DTC) P0113

- DTC P0113 indicates that the corresponding sensor signal circuit is out of range high.
- Possible causes:
  - open in harness
  - worn or damaged connection
  - worn or damaged sensor
  - damaged PCM
- Key on, engine off.
- Access IATV PID.

Is voltage reading 4.95 V or above?

Yes	No
GO to DA2 .	GO to DA8 .

DA2 INDUCE OPPOSITE FAILURE

- Disconnect IAT sensor harness connector.
- Jumper signal circuit Pin 2 on the IAT sensor connector to battery ground.
- Key off.

Did voltage reading on NGS Tester read 0 V?

Yes	No
GO to DA3 .	GO to DA4 .

DA3 CHECK SIGNAL RETURN

- Measure resistance between signal return Pin 1 on the IAT sensor connector and ground.

Is resistance less than 5 ohms?

Yes	No
REPLACE IAT sensor. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR open in Signal Return Circuit 359 (GY/R). RESTORE vehicle. CLEAR DTCs and RETEST.

DA4 CHECK CONTINUITY OF SENSOR SIGNAL AND SIG RTN CIRCUITS

- Install breakout box; leave PCM disconnected.
- Measure resistance between sensor signal Pin 2 on the IAT sensor connector and PCM Test Pin 39.

Is resistance less than 5 ohms?

Yes	No
REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR open in Circuit 743 (G/Y). RESTORE vehicle. CLEAR DTCs and RETEST.

DA5 DIAGNOSTIC TROUBLE CODE (DTC) P0112

- DTC P0112 indicates that the corresponding sensor signal circuit is out of range low.
- Possible causes:
  - grounded circuit in harness
  - worn or damaged sensor
  - damaged PCM
  - worn or damaged connection
- Key on, engine off.
- Access IATV PID.

Is voltage reading 0.13 V or below?

Yes	No
GO to DA6 .	GO to DA8 .

DA6 INDUCE FAILURE

- Disconnect IAT sensor harness connector.
- Key off.

Did reading go to 4.59 V or above?

Yes	No
REPLACE IAT sensor. RESTORES vehicle. CLEAR DTCs and RETEST.	GO to DA7 .

DA7 CHECK TEMPERATURE SENSOR SIGNAL CIRCUIT FOR SHORT TO GROUND

- Install breakout box; leave PCM disconnected.
- Measure resistance between PCM Test Pin 39 and PCM Test Pins 51, 76, 77, 91 and 103.

Is each resistance greater than 10,000 ohms?

Yes	No
REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR short to ground Circuit 743 (G/Y). RESTORE vehicle. CLEAR DTCs and RETEST.

DA8 CONTINUOUS MEMORY DIAGNOSTIC TROUBLE CODE (DTC) P0113 OR P0112

- Continuous Memory DTC P0113 indicates that the sensor signal circuit was out of range high. The DTC was generated under normal driving conditions.
- Continuous Memory DTC P0112 indicates that the sensor signal circuit was out of range low. The DTC was generated under normal driving conditions.
- Possible causes:
  - worn or damaged sensor
  - open circuit in harness
  - grounded circuit in harness
  - damaged PCM
- Access IATV PID.
- Tap on sensor while observing scan tool reading.

Does voltage reading fluctuate?

Yes	No
REPLACE IAT sensor. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DA9 .

DA9 CHECK EEC VEHICLE HARNESS

- Observe IAT value on scan tool while performing the following:
  - Grasp the harness close to the sensor connector.
  - Wiggle and shake harness while working toward the PCM.
- Key off.

Did value fluctuate?

Yes	No
REPAIR circuits as required. RESTORE vehicle.	GO to DA10 .

DA10 CHECK PCM AND VEHICLE HARNESS CONNECTORS

- Disconnect PCM. Disconnect sensor connector. Inspect for damage, loose or pushed-out pins, loose or poorly crimped wires.

Are connectors and terminals OK?

Yes	No
Unable to duplicate or identify concern at this time. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR as necessary. RESTORE vehicle. CLEAR DTCs and RETEST.

DB: Engine Oil Temperature (EOT) Sensor
Introduction

DB: Pinpoint Tests

Signal Functions

The engine oil temperature (EOT) sensor is a thermistor type sensor that has a variable resistance that changes when exposed to different temperatures. When interfaced with the powertrain control module (PCM), it produces a 0 to 5 volt analog signal that will deduce temperature.

Cranking Fuel Quantity/Timing Control — The EOT sensor signal is used to determine the timing and quantity of fuel required to optimize starting over all temperature conditions.

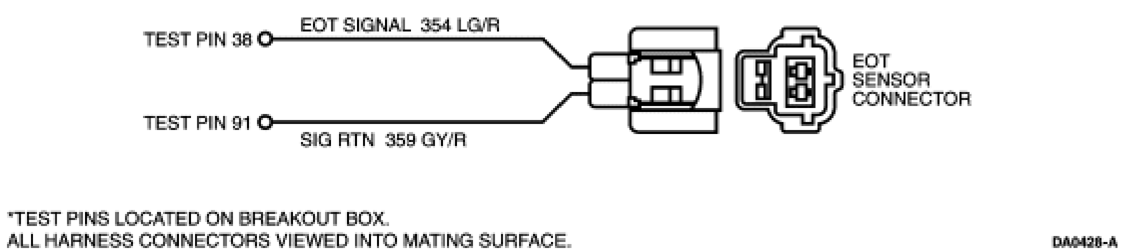
Idle Speed — At oil temperatures below 70° C (158°F) low idle is incrementally increased to a maximum of 950 rpm.

Temperature Compensation — Fuel quantity and timing is controlled throughout the total operating range to ensure adequate torque and power is available.

Glow Plug Control — The glow plug relay and lamp ON times are controlled by engine oil temperature.

Detection/Management

An EOT sensor signal that is detected out of range (high or low) by the PCM will cause the PCM to ignore the EOT sensor signal and assume an engine oil temperature of -20°C (-4°F) for starting and a temperature of 100°C (212°F) for engine-running conditions. The CHECK ENGINE light will also be illuminated as long as the condition exists (Federal calibration only).



Note

After removing connectors, always check for damaged pins, corrosion, loose terminals, etc.

CONNECTOR CHECKS TO GROUND (B-)

(CHECK WITH SENSOR CONNECTOR DISCONNECTED AND IGNITION KEY OFF, ALL ACCESSORIES OFF)		
Test Points	**Spec.**	**Comments**
Pin 91	<5 ohms	Resistance to ground. If greater than 5 ohms the harness is open
Pin 38	>5 ohms	Resistance less than 5 ohms indicates a short to ground

CONNECTOR VOLTAGE CHECKS (CHECK WITH SENSOR CONNECTOR DISCONNECTED AND IGNITION KEY ON)		
Test Points	**Spec.**	**Comments**
Pin 91	0-.25 volts	If greater than.25 volts signal wire is shorted to VREF or battery
Pin 38	4.6-4.9 volts	Pull up voltage, if no or low voltage circuit has open or high resistance

DTC Descriptions

Circuit Faults:

P0197 = EOT sensor circuit low input

P0198 = EOT sensor circuit high input

System Faults

P1184 (California and all Econoline) = Engine oil temperature less than 20°C (68°F) or above 117°C (242°F) during KOER Cylinder Contribution Self Test (self test access denied).

kohms	EOT (Volts)	°C	°F
1.19	0.53	120	248
1.56	0.67	110	230
2.08	0.86	100	212
2.80	1.09	90	194
3.84	1.37	80	176
5.34	1.72	70	158

kohms	EOT (Volts)	°C	°F
7.55	2.11	60	140
10.93	2.56	50	122
16.11	3.01	40	104

24.25	3.44	30	86
37.34	3.82	20	68
58.99	4.13	10	50

DB: Pinpoint Tests

DB: Engine Oil Temperature (EOT) Sensor

DB: Introduction

DB1 DIAGNOSTIC TROUBLE CODE (DTC) P0198

- DTC P0198 indicates EOT sensor circuit out of range high.
- Possible causes:
  - open in harness
  - damaged connection
  - damaged EOT sensor
  - damaged PCM
- Disconnect EOT sensor harness connector.
- Measure resistance between Pin 1 on the EOT connector and ground.

Is resistance less than 5 ohms?

Yes	No
GO to DB2 .	REPAIR open in signal return circuit. RESTORE vehicle. CLEAR DTCs and RETEST.

DB2 INDUCE OPPOSITE FAILURE

- Key on, engine off.
- Jumper Pin 1 to Pin 2 on the EOT connector at harness connector.
- Key off.

Was DTC P0197 present?

Yes	No
REPLACE EOT sensor. RESTORE vehicle.	GO to DB3 .

CLEAR DTCs and RETEST.	

DB3 CHECK CONTINUITY OF SENSOR SIGNAL AND SIG RTN CIRCUITS

- Install breakout box; leave PCM disconnected.
- Measure resistance between EOT connector Pin 2 and PCM Test Pin 38.

Is each resistance less than 5 ohms?

Yes	No
REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR open in signal circuit. RESTORE vehicle. CLEAR DTCs and RETEST.

DB4 DIAGNOSTIC TROUBLE CODE (DTC) P0197

- DTC P0197 indicates EOT sensor circuit out of range low.
- Possible causes:
  - grounded circuit in harness
  - damaged EOT sensor
  - damaged PCM
  - damaged connection
- Disconnect EOT sensor harness connector.
- Run KOEO Self Test.

Is DTC P0198 present?

Yes	No
REPLACE EOT sensor. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DB5 .

DB5 CHECK TEMPERATURE SENSOR SIGNAL CIRCUIT FOR SHORT TO GROUND

- Install breakout box; leave PCM disconnected.
- Measure resistance between PCM Test Pin 38 and PCM Test Pins 25, 51, 76, 77, 91 and 103.

Is each resistance greater than 10,000 ohms?

Yes	No
REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR short to ground circuit. RESTORE vehicle. CLEAR DTCs and RETEST.

DB6 CONTINUOUS MEMORY DIAGNOSTIC TROUBLE CODE (DTC) P0198, OR P0197

- Continuous Memory DTC P0198 indicates EOT sensor circuit out of range high. The DTC was generated under normal driving conditions.

- Continuous Memory DTC P0197 indicates EOT sensor circuit out of range low. The DTC was generated under normal driving conditions.
- Possible causes:
    - worn or damaged EOT sensor
    - open circuit in harness
    - grounded circuit in harness
    - worn or damaged PCM
- Key on, engine off.
- Access EOT PID.
- Tap on EOT sensor to simulate road shock, wiggle harness connector while observing NGS Tester value.

Does EOT sensor value default to 100°C (212° F)?

Yes	No
GO to DB9 .	GO to DB7 .

DB7 CHECK VEHICLE HARNESS

- Access EOT PID.
- Grasp the vehicle harness close to the EOT sensor connector. Wiggle and shake harness while working toward the PCM.
- Key off.

Did EOT sensor value default to 100°C (212° F)?

Yes	No
REPAIR circuit as required. RESTORE vehicle.	GO to DB8 .

DB8 CHECK PCM AND VEHICLE HARNESS CONNECTORS

- Disconnect PCM. Inspect for damage, loose or pushed-out pins, loose or poorly crimped wires.

Are connectors and terminals OK?

Yes	No
Unable to duplicate or identify concern at this time. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR as necessary. RESTORE vehicle. CLEAR DTCs and RETEST.

DB9 INSPECT CONNECTOR PINS

- Disconnect EOT harness connector.
- Inspect pins.

Is a fault detected?

Yes	No
REPAIR damaged pins as required. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE EOT sensor. RESTORE vehicle. CLEAR DTCs and RETEST.

DB10 DIAGNOSTIC TROUBLE CODE (DTC) OR P1184

- DTC P0196 or P1184 indicates that the engine oil temperature is not warm enough to perform a KOER Cylinder Contribution Self Test. The engine oil temperature must be greater than 20°C or 68° F (3.82 volts).
- Possible causes:
  - engine not fully warmed up
  - low oil level
  - cooling system failure
  - worn or damaged EOT sensor
  - faulty thermostat
  - EOT sensor circuit failure
- Verify no KOEO DTCs are present.
- Drive vehicle until thermostat opens.
- Fully warm engine.
- Check that upper radiator hose is hot and pressured.
- Rerun KOER Cylinder Contribution Self Test

Is DTC P1184 present?

Yes	No
GO to DB11 .	REPAIR other DTCs as necessary. RESTORE vehicle.

DB11 EOT SENSOR CHECK

- Key on, engine off.
- Engine at normal operating temperature.
- Access EOT PID.
- Observe EOT PID while tapping on EOT sensor.

Does EOT valve fluctuate or go below 20°C ([68°F) (3.82 volts)]?

Yes	No
REPLACE EOT sensor. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DB12 .

DB12 VEHICLE HARNESS CHECK

- Observe EOT PID while performing the following:

- Grasp the vehicle harness close to the EOT sensor connector.
- Wiggle and shake vehicle harness while working toward PCM.
- Key off.

Did value fluctuate?

Yes	No
REPAIR circuits as required. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DB13 .

DB13 CHECK PCM AND VEHICLE HARNESS CONNECTOR

- Disconnect EOT sensor and PCM harness connectors.
- Inspect for damage, loose or pushed-out pins.

Are connectors and terminals OK?

Yes	No
Unable to duplicate or identify concern at this time. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR as required. RESTORE vehicle. CLEAR DTCs and RETEST.

DC: Injection Control Pressure (ICP) Sensor Introduction

DC: Pinpoint Tests

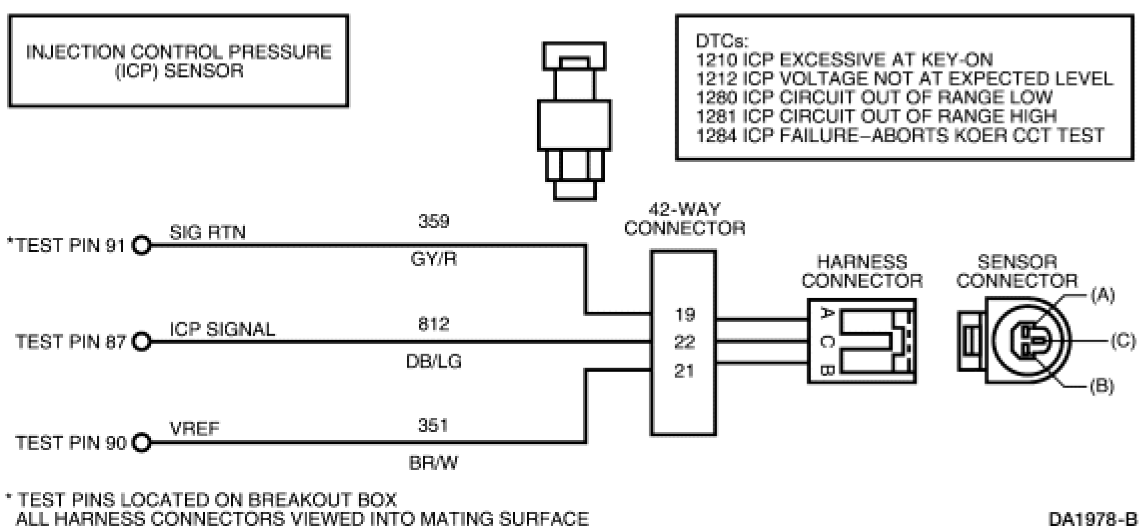
Signal Functions

The injection control pressure (ICP) sensor is a variable capacitance sensor that, when supplied with a 5-volt reference signal from the powertrain control module (PCM), produces a linear analog voltage signal that indicates pressure.

The ICP sensor's primary function is to provide a feedback signal to indicate rail pressure so that the PCM can command the correct injector timing and pulse width and the correct injection control pressure for proper fuel delivery at all speed and load conditions.

Detection/Management

If the PCM detects a malfunctioning ICP sensor the CHECK ENGINE light is illuminated and the PCM will go to open loop control of injection control pressure. (Operate from an estimated injection control pressure.)



Note

After removing connector, check for damaged pins, corrosion, loose terminals, etc.

DT Descriptions

P1210 ICP excessive at key on

P1212 = ICP voltage not at expected level

P1280 = ICP circuit out of range low

P1281 = ICP circuit out of range high

P1284 = ICP failure — aborts KOER Cylinder Contribution Self Test

Pressure (PSI)	Pressure (MPA)	Sensor Voltage
0	0	.02v
200	1.5	.4v
400	3	0.73v
600	4	.96v
800	5.5	1.2v
1000	7	1.4v
1200	8	1.6v
1400	9.7	1.9v
1600	11	2.1v
1800	12.4	2.3v
2000	13.8	2.6v
2200	15.2	2.8v
2400	16.5	3v
2600	18	3.3v
2800	19.3	3.5v
3000	20.6	3.8v

DC: Pinpoint Tests

DC1 DIAGNOSTIC TROUBLE CODE (DTC) P1280

- DTC P1280 indicates injector control signal circuit out of range low was detected during KOEO Self Test or during continuous diagnostic monitoring.

- Possible causes:
  - biased ICP sensor/PCM
  - open ICP sensor circuit
  - short to SIG RTN or PWR GND on ICP sensor circuit
  - open in VREF circuit
- Disconnect ICP sensor harness connector.
- Key on, engine off.
- Measure voltage between VREF Pin B and battery ground.

Is voltage between 4.5 and 5.5 volts?

Yes	No
GO to DC2 .	REPAIR open in VREF Circuit 351 (BR/W). RESTORE vehicle. CLEAR DTCs and RETEST.

DC2 SIGNAL RETURN CIRCUIT CHECK

- Measure voltage between VREF Pin B and signal return Pin A.
- Key off.

Was voltage between 4.5 and 5.5 volts?

Yes	No
GO to DC3 .	REPAIR open in signal return Circuit 359 (GY/R). RESTORE vehicle. CLEAR DTCs and RETEST.

DC3 ICP SIGNAL CIRCUIT CHECK

- Install breakout box; leave PCM disconnected.
- Measure resistance between PCM Test Pin 87 and Pin C at ICP sensor harness connector.

Is resistance less than 5 ohms?

Yes	No
GO to DC4 .	REPAIR open in signal Circuit 812 (DB/LG) for F-Series or 535 (LB/R) for Econoline. RESTORE vehicle. CLEAR DTCs and RETEST.

DC4 VREF CIRCUIT CHECK

- Measure resistance between PCM Test Pin 90 and Pin B at ICP sensor harness connector.

Is resistance less than 5 ohms?

Yes	No

GO to DC5 .	REPAIR open in VREF Circuit 351 (BR/W). RESTORE vehicle. CLEAR DTCs and RETEST.

DC5 SIGRTN CIRCUIT CHECK

- Measure resistance between PCM Test Pin 91 and Pin A at ICP sensor harness connector.

Is resistance less than 5 ohms?

Yes	No
GO to DC6 .	REPAIR open in SIG RTN Circuit 359 (GY/R). RESTORE vehicle. CLEAR DTCs and RETEST.

DC6 SENSOR SIGNAL CIRCUIT SHORT TO GROUND

- Measure resistance between PCM Test Pin 87 and PCM Test Pins 25, 51, 76, 77, 91 and 103.

Is resistance greater than 10,000 ohms?

Yes	No
GO to DC7 .	REPAIR short to ground in signal wire Circuit 812 (DB/LG). RESTORE vehicle. CLEAR DTCs and RETEST.

DC7 CHECK FOR SHORT ON PIN 87

- Connect breakout box to PCM.
- Measure resistance between PCM Test Pin 87 and PCM Test Pins 25, 91, 51, 76, 77 and 103.

Is resistance greater than 10,000 ohms?

Yes	No
REPLACE ICP sensor. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.

DC8 DIAGNOSTIC TROUBLE CODE (DTC) P1281

- DTC P1281 indicates injector control pressure circuit out of range high during KOEO Self Test or during continuous diagnostic monitoring.
- Possible causes:
    - biased ICP sensor/PCM
    - ICP circuit shorted to VREF

- Key on, engine off.
- Disconnect ICP harness connector.
- Check DTCs.
- Key off.

Did DTC P1280 appear?

Yes	No
REPLACE ICP sensor. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DC9 .

DC9 CHECK FOR SHORT TO POWER

- Install breakout box; leave PCM disconnected.
- Measure resistance between PCM Test Pin 87 and PCM Test Pins 55, 71, 90 and 97.

Is resistance greater than 10,000 ohms?

Yes	No
GO to DC10 .	REPAIR short to power in signal Circuit 812 (DB/LG). RESTORE vehicle. CLEAR DTCs and RETEST.

DC10 CHECK FOR SHORT ON PIN 87

- Connect PCM to breakout box.
- Measure resistance between PCM Test Pin 87 and PCM Test Pins 55, 71, 90 and 97.

Is resistance greater than 10,000 ohms?

Yes	No
REPLACE ICP sensor. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.

DC11 KOEO DIAGNOSTIC TROUBLE CODE (DTC) P1210

- DTC P1210 indicates ICP signal voltage was greater than expected during KOEO On-Demand Self Test.
- Possible causes:
  - biased ICP sensor
  - open ICP signal return
  - signal circuit shorted to power
  - damaged PCM
- Disconnect ICP sensor harness connector.
- Measure resistance between signal return Circuit 359 (GY/R) Pin A and ground.

Is resistance less than 5 ohms?

Yes	No
GO to DC12 .	REPAIR open in signal return Circuit 359 (GY/R). RESTORE vehicle. CLEAR DTCs and RETEST.

DC12 CHECK SIGNAL CIRCUIT SHORT TO POWER

- Key on, engine off.
- Measure voltage between ICP signal circuit Pin C and ground.
- Key off.

Was voltage less than 0.25 volts?

Yes	No
GO to DC13 .	REPAIR short to power in ICP signal circuit. RESTORE vehicle. CLEAR DTCs and RETEST.

DC13 ICP SENSOR CHECK

- Connect ICP sensor harness connector.
- Key on, engine off.
- Access ICP PID.

Is ICP reading 0 kPa (0 psi)?

Yes	No
REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE ICP sensor. RESTORE vehicle. CLEAR DTCs and RETEST.

DC14 CONTINUOUS DIAGNOSTIC TROUBLE CODE (DTC) P1212

> **Note:** This code may set after a high-pressure oil system repair (i.e., injector change). Drive vehicle to clear air from system after repair, and clear code.

- Continuous DTC P1212 indicates that there was no ICP detected during crank (long crank time).
- Possible causes:
  - high-pressure oil system repair
  - empty/low oil reservoir at crank
  - low engine oil level or incorrect viscosity
  - IPR circuit fault
  - damaged low-pressure oil pump
  - damaged IPR valve
  - damaged ICP sensor
  - damaged high-pressure oil pump

- Check engine oil level.
- Perform KOEO On-Demand Self Test to verify ICP/IPR circuit faults are not present at this time.

Are KOEO DTCs present?

Yes	No
REPAIR KOEO DTCs before continuing. If DTC P1212 returns. GO to DC15 .	GO to DC15 .

DC15 CHECK OIL RESERVOIR LEVEL

> **Note:** If vehicle stalls after start and reservoir empties, oil is not being supplied from low pressure oil system.

- Verify correct oil level, quality and viscosity.
- Check oil level in oil reservoir.
- Verify Steps 5 and 9 on the Hard Start/No Start Diagnostic Guide have been performed.
- Clear DTCs.
- Monitor ICP__ V PID while cranking.

Is ICP__ V reading at least 0.85 V within 5 seconds at crank?

Yes	No
DTC is intermittent. GO to DC19 . If other DTCs are set, SERVICE them first.	GO to DC16 .

DC16 CHECK ICP SENSOR

- Disconnect ICP sensor harness connector.

Does vehicle start?

Yes	No
REPLACE ICP sensor. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DC17 .

DC17 HIGH-PRESSURE LEAKAGE TEST

- Connect ICP sensor harness connector.
- Clear ICP DTCs.
- Perform the Injection Control Pressure Tests per the procedures in Section 4 , Hard Start/No Start.

Is a leak fault indicated?

Yes	No

REPAIR condition causing the leak as necessary. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DC18 .

DC18 IPR VALVE CHECK

- Connect all hoses and ICP sensor harness connector.
- Replace IPR valve.
- Refill oil reservoir.

Does vehicle start?

Yes	No
IPR valve was faulty. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE the high pressure pump. RESTORE vehicle. CLEAR DTCs and RETEST.

DC19 CHECK FOR INTERMITTENT CIRCUIT FAULTS

- Key on, engine off.
- Access ICP PID.
- Grasp the vehicle harness close to the sensor connector. Wiggle, shake vehicle harness while working towards the PCM.

Does ICP reading fluctuate?

Yes	No
REPAIR circuit as required. CLEAR DTCs and RETEST.	GO to DC20 .

DC20 INSPECT IPR CIRCUIT

- Inspect IPR circuit from IPR valve through 42-way connector to the PCM.

Are any faults indicated?

Yes	No
REPAIR circuit as required. RESTORE vehicle. CLEAR DTCs and RETEST.	Unable to verify concern at this time. RESTORE vehicle. CLEAR DTCs and RETEST.

DC21 DIAGNOSTIC TROUBLE CODE (DTC) P1284

- DTC P1284 indicates that a ICP circuit failure was present while trying to perform KOER Cylinder Contribution Self Test.
- Perform KOEO On-Demand Self Test.

Is a ICP circuit fault indicated?

Yes	No
REFER to appropriate Pinpoint Test for ICP DTC retrieved.	REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.

DC22 CONTINUOUS DIAGNOSTIC TROUBLE CODE P1210

- Continuous DTC P1210 indicates ICP signal voltage was greater than expected with key on during normal driving conditions.
- Possible causes:
  - biased ICP sensor
  - open ICP signal return circuit
  - ICP signal circuit shorted to power
- Perform KOEO On-Demand Self Test.

Are KOEO ICP codes present?

Yes	No
REPAIR KOEO codes before continuing. If DTC P1210 is still present, GO to DC23 .	DTC is intermittent. GO to DC23 .

DC23 ICP SIGNAL GROUND CIRCUIT CHECK

- Key off.
- Disconnect ICP sensor harness connector.
- Install breakout box; leave PCM disconnected.
- Measure resistance between signal return Circuit 359 (GY/R) Pin A and PCM Test Pin 91.
- Observe resistance while performing the following.
  - Grasp the harness close to the sensor connector. Wiggle and shake vehicle harness while working toward the PCM.
- Key off.

Does resistance value stay below 5 ohms?

Yes	No
GO to DC24 .	REPAIR intermittent open in Circuit 359 (GY/R). RESTORE vehicle. CLEAR DTCs and RETEST.

DC24 ICP CIRCUIT SHORT TO POWER CHECK

- Key on, engine off.
- Measure voltage between PCM Test Pin 87 and ground.
- Observe voltage while performing the following:
  - Grasp the harness close to the sensor connector. Wiggle and shake harness while working toward PCM.

Is voltage ever present?

Yes	No
REPAIR intermittent short to power on SIG RETURN circuit. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DC25 .

DC25 ICP SENSOR CIRCUIT CHECK

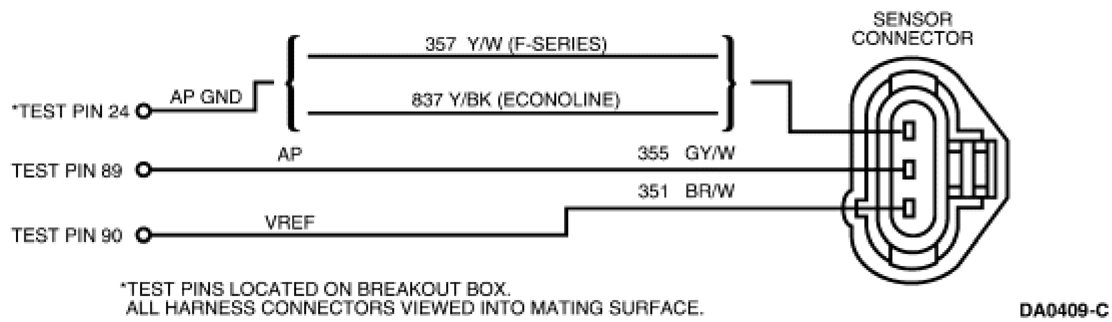
- Reconnect ICP sensor harness connector.
- Remove breakout box; reconnect PCM.
- Clear ICP DTC.
- Key on, engine off.
- Lightly tap ICP sensor.

Does code P1210 reappear?

Yes	No
REPLACE ICP sensor. RESTORE vehicle. CLEAR DTCs and RETEST.	DTC is intermittent. Cannot duplicate failure at this time. RESTORE vehicle. CLEAR DTCs and RETEST.

DD: Accelerator Pedal (AP) Sensor
Introduction

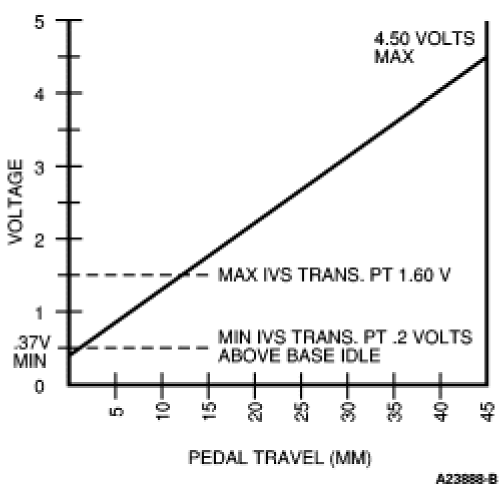
DD: Pinpoint Tests



Signal Functions

The accelerator pedal (AP) sensor provides the powertrain control module (PCM) with the driver's demand for power.

The AP signal is used in calculating desired fuel quantity, injection timing and injection control pressure.



Note: Base idle should be no lower than 0.5 volts.

DTC Descriptions

P0122 = AP sensor circuit low input

P0123 = AP sensor circuit high input

P0220 = Throttle Switch B circuit malfunction

P0221 = Throttle Switch B circuit performance

Fault Detection/Management

Any detected malfunction of the AP sensor will illuminate the CHECK ENGINE light (Federal calibration only).

An AP signal that is detected out of range high or low by the PCM will cause the engine to ignore the AP signal and will only allow the engine to operate at low idle.

If a disagreement in the state of idle validation switch (IVS) and AP sensor is detected by the PCM, the engine will only be allowed to operate at low idle.

DD: Pinpoint Tests

DD1 DIAGNOSTIC TROUBLE CODE (DTC) P0123

- DTC P0123 indicates AP sensor circuit high input.
- Possible causes are:
  - damaged accelerator pedal assembly
  - AP sensor may not be seated properly (tightened down)
  - damaged AP sensor
  - short to power in harness
  - damaged PCM
- Key on, engine off.
- Access AP PID.
- Slowly depress accelerator pedal while observing voltage reading on scan tool.

Does reading go above 4.5 V?

Yes	No
GO to DD2 .	CLEAR DTCs and RETEST.

DD2 INDUCE OPPOSITE FAILURE

- Disconnect AP sensor harness connector.

Does AP voltage read 0 V?

Yes	No
Circuit OK. REPLACE accelerator pedal assembly. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DD3 .

DD3 CHECK AP SENSOR SIGNAL WIRE

- AP sensor disconnected.
- Key on, engine off.
- Measure voltage between AP signal wire at harness connector and ground.
- Key off.

Was voltage above 4.5 V?

Yes	No
GO to DD4 .	REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.

DD4 CHECK AP CIRCUIT FOR SHORTS TO POWER

- Install breakout box; leave PCM disconnected.
- Key on, engine off.
- Measure voltage between PCM Test Pin 89 and ground.

Is voltage present?

Yes	No
REPAIR short to power in Circuit 355 (GY/W). RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.

DD5 DIAGNOSTIC TROUBLE CODE (DTC) P0122

- DTC P0122 indicates the AP sensor circuit low input.
- Possible causes:
  - AP sensor may not be seated properly (tightened down)
  - damaged AP sensor
  - open harness
  - grounded harness
  - damaged PCM
- Key on, engine off.

- Access AP PID.
- Depress accelerator pedal while observing voltage reading on scan tool.
- Key off.

Did voltage drop below 0.37 V?

Yes	No
GO to DD6 .	Unable to duplicate and/or identify concern at this time. RESTORE vehicle. CLEAR DTCs and RETEST.

DD6 INDUCE OPPOSITE FAILURE

- Disconnect AP sensor harness connector.
- Jumper VREF pin to AP signal wire.
- Key on, engine off.

Does scan tool display stay on and read over 4.5 V?

Yes	No
REPLACE accelerator pedal assembly. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DD7 .

DD7 CHECK VREF CIRCUIT VOLTAGE

- Measure voltage between VREF circuit and ground.
- Key off.

Was voltage 5 V ± 0.5?

Yes	No
GO to DD8 .	REPAIR open in VREF Circuit 351 (BR/W). RESTORE vehicle. CLEAR DTCs and RETEST.

DD8 CHECK AP GROUND CIRCUIT

- Measure resistance between AP ground circuit and ground.

Is resistance less than 5 ohms?

Yes	No
GO to DD9 .	REPAIR open in AP ground Circuit 837 (Y/BK) if Econoline or Circuit 357 (Y/W) if F-Series. RESTORE vehicle. CLEAR DTCs and RETEST.

DD9 CHECK AP CIRCUIT CONTINUITY

- Install breakout box; leave PCM disconnected.
- Measure resistance between AP circuit at the harness connector and PCM Test Pin 89.

Is the resistance less than 5 ohms?

Yes	No
GO to DD10 .	REPAIR open in AP signal Circuit 355 (GY/W). RESTORE vehicle. CLEAR DTCs and RETEST.

DD10 CHECK AP CIRCUIT FOR SHORTS TO GROUND

- Measure resistance between PCM Test Pin 89 and PCM Test Pins 51, 76, 77, 91 and 103.

Is each resistance greater than 10,000 ohms?

Yes	No
GO to DD11 .	REPAIR short to ground in AP sensor signal Circuit 355 (GY/W). RESTORE vehicle. CLEAR DTCs and RETEST.

DD11 VREF CIRCUIT CONTINUITY CHECK

- Measure resistance between VREF circuit at harness connector and PCM Test Pin 90.

Is resistance less than 5 ohms?

Yes	No
GO to DD12 .	REPAIR open in VREF Circuit 351 (BR/W). RESTORE vehicle. CLEAR DTCs and RETEST.

DD12 SIGNAL RETURN CIRCUIT CONTINUITY CHECK

- Measure resistance between AP ground circuit at harness connector and PCM Test Pin 24.

Is resistance less than 5 ohms?

Yes	No
REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR open in AP ground Circuit 837 (Y/BK) if Econoline or Circuit 357 (Y/W) if F-Series. CLEAR DTCs and RETEST.

DE: Exhaust Back Pressure (EBP) Sensor Introduction

DE: Pinpoint Tests

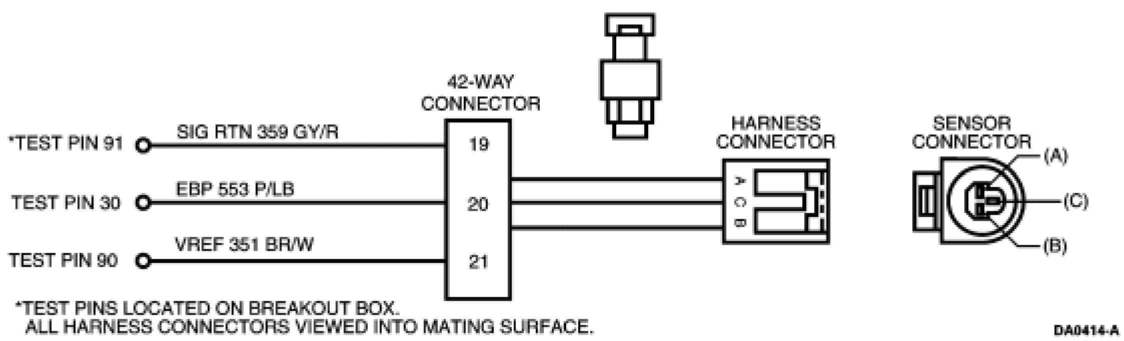
Signal Functions

The exhaust back pressure (EBP) sensor is a variable capacitance sensor that, when supplied with a 5-volt reference signal from the powertrain control module (PCM), produces a linear analog voltage signal that indicates pressure.

The EBP sensor's primary function is to measure exhaust back pressure so that the PCM can control the exhaust back pressure regulator (EPR) when needed.

Detection/Management

An EBP signal that is detected out of range (high or low) by the PCM will cause the engine to ignore the EBP signal and disable exhaust back pressure operation.



Note

After removing connectors always check for damaged pins, corrosion, loose terminals, etc.

DTC Descriptions

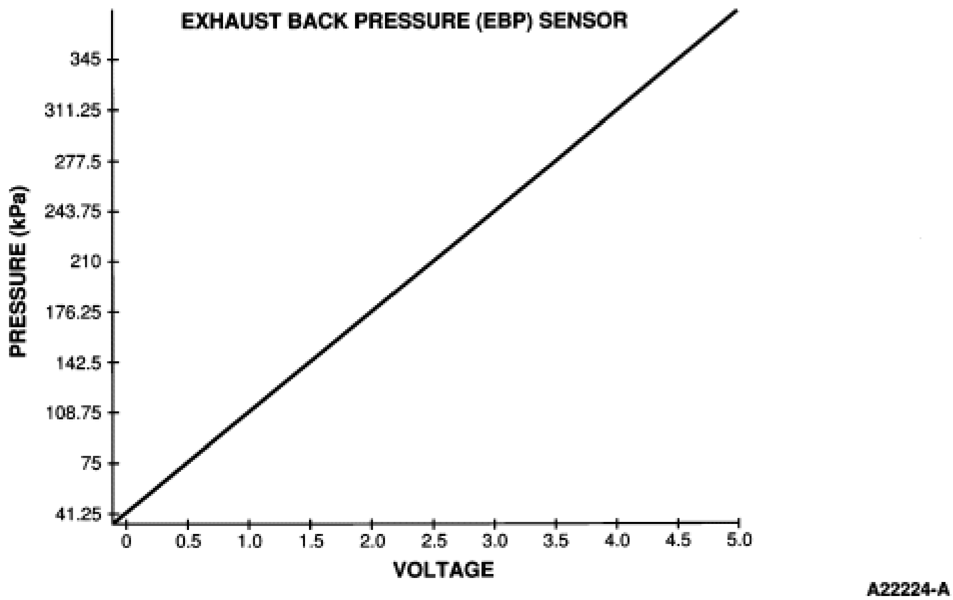
P0470 = EBP sensor circuit malfunction

P0471 = EBP sensor circuit performance

P0472 = EBP sensor circuit low input

P0473 = EBP sensor circuit high input

P0478 = EBP excessive during normal driving



kPa	EBP (Volts)
0	0
55.16	0.25
137.9	1.45
344.75	4.45
365.44	4.75
413.7	5.00

In Hg	PSI
0	0
16.38	8
40.94	20
102.36	50
108.50	53
122.83	60

DE: Pinpoint Tests

DE1 DIAGNOSTIC TROUBLE CODE (DTC) P0470

- DTC P0470 indicates an EBP sensor malfunction was detected during KOEO On-Demand Self Test.
- Possible causes:
  - damaged EBP sensor
  - open signal ground
  - damaged PCM
- Key on, engine off.
- Select EBP PID.
- Key off.

Was EBP reading below 127 kPa (18.5 psi)?

Yes	No
CLEAR DTC and RERUN KOEO On-Demand Self Test. If code is still present, REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DE2 .

DE2 SIGNAL GROUND CIRCUIT CHECK

- Disconnect EBP sensor harness connector.
- Measure resistance from Pin A Circuit 359 (GY/R) to chassis ground.

Is resistance less than 5 ohms?

Yes	No
REPLACE EBP sensor. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR open in signal return Circuit 359 (GY/R). RESTORE vehicle. CLEAR DTC and RETEST.

DE3 CONTINUOUS DIAGNOSTIC TROUBLE CODE (DTC) P0470

- Continuous DTC P0470 indicates an exhaust back pressure malfunction was detected during normal driving conditions.
- Possible causes:
  - damaged EBP sensor
  - damaged connection
  - damaged PCM

- Select EBP PID.
- Observe the PID while performing the following:
  - Grasp the vehicle harness close to the EBP sensor connector.
  - wiggle and shake the vehicle harness while working toward the PCM.
- Key off.

Does the EBP reading fluctuate?

Yes	No
ISOLATE intermittent connection problem. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DE4 .

DE4 CONNECTOR INSPECTION

- Disconnect EBP sensor harness connector.
- Inspect connector terminals and sensor terminals for signs of poor connection or corrosion.
- Inspect connections at the 42-way and PCM connectors.

Are all connections good?

Yes	No
Unable to verify problem at this time. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR connection concern as required. RESTORE vehicle. CLEAR DTCs and RETEST.

DE5 DIAGNOSTIC TROUBLE CODE (DTC) P0471

- DTC P0471 indicates an EBP range/performance problem was detected during normal driving conditions when EBP is enabled.
- Possible causes:
  - damaged EBP sensor
  - plugged or restricted sensor supply tube
  - EPR linkage or butterfly damage
  - damaged PCM
- Perform KOER On-Demand Self Test. If codes are present, repair them before continuing.
- Select EBP PID.
- Road test vehicle performing hard accelerations while monitoring the PID.

Does EBP increase and go above 25 psi with EBP device on?

Yes	No
Unable to duplicate failure. RESTORE vehicle. CLEAR DTC and RETEST.	GO to DE6 .

DE6 INSPECT FOR EXHAUST LEAKS

- Inspect turbo pipe, crossover pipes, and exhaust manifolds for leaks.

Are exhaust leaks present?

Yes	No
REPAIR exhaust leak. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DE7 .

DE7 SENSOR SUPPLY TUBE CHECK

- Inspect the EBP sensor supply tube from the exhaust manifold to the sensor bracket for damage.
- Verify tube is not plugged or restricted.

Is tube OK?

Yes	No
GO to DE8 .	REPLACE tube. RESTORE vehicle. CLEAR DTC and RETEST.

DE8 EBP SENSOR CHECK

- Disconnect EBP sensor harness connector.
- Install ICP/EBP Adapter Cable D94T-50-A or equivalent between EBP sensor and vehicle harness.
- Engine running.
- Measure voltage between signal circuit and signal ground on ICP/EBP Adapter Cable D94T-50-A or equivalent.
- Accelerate engine to WOT several times.

Is a minimum reading of 1.35 V present during acceleration?

Yes	No
RESTORE vehicle. CLEAR DTC and RETEST. If code reappears REPLACE PCM.	REPLACE EBP sensor. RESTORE vehicle. CLEAR DTC and RETEST.

DE9 DIAGNOSTIC TROUBLE CODE (DTC) P0472

- DTC P0472 indicates EBP sensor circuit low input was detected during KOEO Self Test or during continuous diagnostic monitoring.
- Possible causes:
  - open EBP sensor circuit
  - biased sensor/PCM
  - short to SIGN RTN or PWR GND on EBP sensor circuit
  - open in VREF circuit
- Disconnect EBP sensor harness connector.

- Key on, engine off.
- Measure voltage between Pin B Circuit 351 (BR/W) on harness connector and battery ground.
- Key off.

Was voltage reading 5 V ± 0.5?

Yes	No
GO to DE10 .	REPAIR open in VREF Circuit 351 (BR/W). RESTORE vehicle. CLEAR DTCs and RETEST.

DE10 SIG RTN CIRCUIT CHECK

- Measure resistance between Pin A Circuit 359 (GY/R) and ground.

Is resistance less than 5 ohms?

Yes	No
GO to DE11 .	REPAIR open in SIG RTN Circuit 359 (GY/R). RESTORE vehicle. CLEAR DTCs and RETEST.

DE11 EBP SIGNAL CIRCUIT CHECK

- Install breakout box; leave PCM disconnected.
- Measure resistance between PCM Test Pin 30 and Pin C Circuit 553 (P/LB) at EBP sensor harness connector.

Is resistance less than 5 ohms?

Yes	No
GO to DE12 .	REPAIR open in EBP signal wire Circuit 553 (P/LB). RESTORE vehicle. CLEAR DTCs and RETEST.

DE12 VREF CIRCUIT CHECK

- Measure resistance between PCM Test Pin 90 and Pin B Circuit 351 (BR/W) at EBP sensor harness connector.

Is resistance less than 5 ohms?

Yes	No
GO to DE13 .	REPAIR open in EBP VREF (Circuit 351 [BR/W]). RESTORE vehicle. CLEAR codes and RETEST.

DE13 GROUNDED EBP SIGNAL CIRCUIT CHECK

- Measure resistance between PCM Test Pin 30 and PCM Test Pins 25, 91, 51, 76, 77 and 103.

Is resistance greater than 10,000 ohms?

Yes	No
GO to DE14 .	REPAIR short to ground in EBP signal wire Circuit 533 (P/LB). RESTORE vehicle. CLEAR DTCs and RETEST.

DE14 CHECK FOR INTERNAL PCM SHORT ON PIN 30

- Connect PCM to breakout box.
- Measure resistance between PCM Test Pin 30 and PCM Test Pins 25, 91, 51, 76, 77 and 103.

Is resistance greater than 10,000 ohms?

Yes	No
REPLACE EBP sensor. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.

DE15 DIAGNOSTIC TROUBLE CODE (DTC) P0473

- DTC P0473 indicates EBP sensor circuit high input detected during KOEO On-Demand Self Test or during continuous diagnostic monitoring.
- Possible causes:
  - biased sensor/PCM
  - EBP circuit shorted to VREF
  - induce opposite DTC
- Disconnect EBP sensor harness connector.
- Key on, engine off.
- Perform KOEO On-Demand Self Test.
- Key off.

Did DTC P0472 appear?

Yes	No
REPLACE EBP sensor. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DE16 .

DE16 CHECK SHORT TO POWER ON PIN 30

- Install breakout box; leave PCM disconnected.
- Measure resistance between PCM Test Pin 30 and PCM Test Pins 90, 97, 71 and 55.

Is resistance greater than 10,000 ohms?

Yes	No
REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR short to power in EBP signal Circuit 553 (P/LB). RESTORE vehicle. CLEAR DTCs and RETEST.

DE17 CONTINUOUS DIAGNOSTIC TROUBLE CODE P0478

- DTC P0478 indicates an excessive back pressure condition existed during normal driving.
- Possible causes:
    - stuck EBP butterfly valve
    - restricted exhaust
    - plugged EBP sensor line
    - misadjusted EPR linkage
    - F-Series wastegate turbo may be overboosting
- Access PIDs MGP and RPM.
- Road test vehicle selecting the best gear to achieve a 2500-3000 rpm acceleration.
- Note the highest boost pressure. This is best accomplished either climbing a hill or with the truck fully loaded.

Does MGP read 18 psi for over 5 seconds?

Yes	No
GO to KH5 .	GO to DE18 .

DE18 INSPECT BUTTERFLY TANG

- Visually inspect butterfly tang.
- Refer to Section 4 , Diagnostic Subroutines, Performance Diagnostic Procedures, Exhaust Restriction for exhaust back pressure regulator tang position illustration.

Does tang reflect an open position?

Yes	No
GO to DE19 .	REPAIR damaged linkage or butterfly valve as required. RESTORE vehicle. CLEAR DTCs and RETEST.

DE19 EXHAUST RESTRICTION CHECK

- Select EBP PID.
- Engine running.
- Accelerate engine to WOT while observing scan tool reading.

Is EBP reading below 193 kPa (28 psi)?

Yes	No
GO to DE20 .	REPAIR restricted exhaust. RESTORE vehicle. CLEAR DTCs and RETEST.

DE20 EBP SYSTEM CHECK

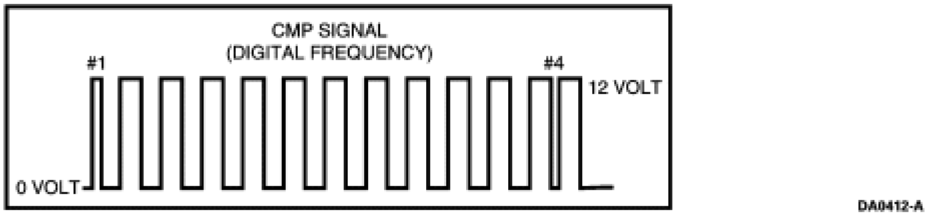
- Engine cold. EOT below 21°C (70°F) and IAT below 7°C (45°F).
- Road test vehicle while monitoring EBP reading on scan tool.
- Observe reading while back pressure device is on.

Does scan tool reading stay below 345 kPa (50 psi)?

Yes	No
REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	CHECK EPR adjustment. RESTORE vehicle.

DF: Camshaft Position (CMP) Sensor Introduction

DF: Pinpoint Tests



Signal Functions

The camshaft position (CMP) sensor is a Hall-effect type sensor that generates a digital frequency, as windows in a target wheel pass through its magnetic field. The frequency of the windows passing by the sensor as well as the width of selected windows allows the powertrain control module (PCM) to detect engine speed and position.

Engine Speed — Is determined by counting the 12 windows on the cam gear each camshaft revolution.

Fuel Timing Control — The position of cylinders No. 1 and No. 4 is determined by distinguishing a narrow or wide window on the camshaft gear.

Engine Mode Selection — Allows the PCM to discern when the engine is in the off, crank or run mode.

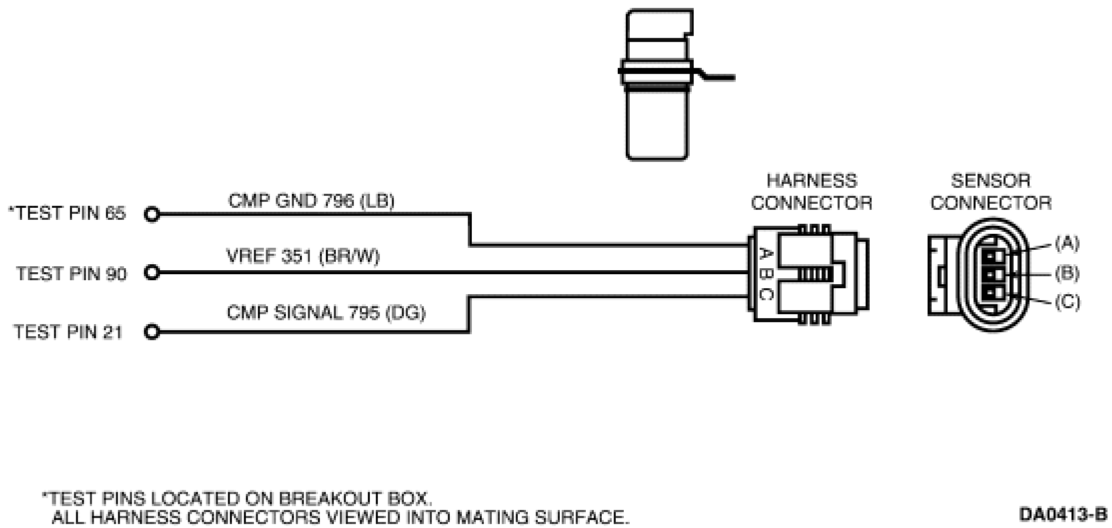
Injection Control Pressure — Engine speed is one of the controlling variables in the calculation of desired injection control pressure.

Exhaust Back Pressure — Exhaust back pressure control is a function of engine speed and load.

Fuel Quantity Control/Torque Limiting — Engine torque and fuel is controlled and is dependent on engine speed. Fuel quantity is determined by engine speed.

Detection/Management

An inactive CMP signal during cranking is detectable by the PCM. An inactive CMP signal will cause a no start condition. Electrical noise can also be detected by the PCM. If the level is sufficient to effect engine operation, a corresponding DTC will be set.



Note

After removing connectors, always check for damaged pins, corrosion, loose terminals, etc.

DTC Descriptions

P0340 = CMP sensor circuit malfunction

P0341 = CMP sensor circuit performance

P0344 = CMP sensor circuit intermittent

DF: Pinpoint Tests

DF1 CLEAR AND ATTEMPT TO REGENERATE DTC P0344, P0341 OR P0340

- Clear Continuous Memory DTCs.
- Select RPM PID.
- Crank engine while monitoring RPM PID.

Does PID indicate crank RPM?

Yes	No
GO to DF2 .	GO to DF3 .

DF2 RETRIEVE/CLEAR CONTINUOUS DTCs

- Warm up engine to normal operating temperature.
- Increase rpm to 3300 rpm for 2 minutes.
- Key on, engine off.
- Retrieve/Clear Continuous DTCs.
- Key off.

Was DTC P0344 or P0341 present?

Yes	No
GO to DF3 .	GO to DF12 .

DF3 CHECK CMP SIGNAL RETURN CIRCUIT 796 (LB)

- Disconnect CMP sensor.
- Measure resistance between Pin A on CMP connector and chassis ground.

Is resistance less than 5 ohms?

Yes	No
GO to DF4 .	GO to DF9 .

DF4 CHECK CMP CIRCUIT 351 (BR/W) FOR VREF

- Key on, engine off.
- Measure voltage between Pin B on CMP connector and chassis ground.

Is 5 volts ± 0.5 volts present?

Yes	No
GO to DF5 .	REPAIR VREF circuitry. RESTORE vehicle. GO to C1 .

DF5 CHECK CMP CIRCUIT 795 (DG) FOR B+

- Measure voltage between Pin C on CMP connector and chassis ground.
- Key off.

Was B+ present?

Yes	No

GO to DF6 .	GO to DF7 .

DF6 CHECK CMP CIRCUIT 795 (DG) FOR SHORT TO B+

- Disconnect PCM harness connector.
- Key on, engine off.
- Measure voltage between Pin C on CMP connector and chassis ground.

Is B+ present?

Yes	No
REPAIR short to B+ in Circuit 795 (DG). RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE CMP sensor. RESTORE vehicle. CLEAR DTCs and RETEST.

DF7 CHECK CIRCUIT 795 (DG) FOR SHORT TO GROUND

- Disconnect PCM harness connector.
- Measure resistance between Pin C on CMP connector and chassis ground.

Is resistance less than 5 ohms?

Yes	No
REPAIR short to ground in Circuit 795 (DG). RESTORE system. CLEAR DTCs and RETEST.	GO to DF8 .

DF8 CHECK CIRCUIT 795 (DG) FOR OPEN

- Install breakout box; leave PCM disconnected.
- Measure resistance between Pin C on CMP connector and PCM Test Pin 21.

Is resistance less than 5 ohms?

Yes	No
Open is at PCM Pin 21. SERVICE as necessary. RESTORE system. GO to DF11 .	REPAIR open in Circuit 795 (DG). RESTORE system. CLEAR DTCs and RETEST.

DF9 CHECK FOR OPEN IN CMP GROUND CIRCUIT 796 (LB)

- Disconnect PCM harness connector.
- Install breakout box; leave PCM disconnected.
- Measure resistance between PCM Test Pin 65 and Pin A on CMP connector.

Is resistance less than 5 ohms?

Yes	No
GO to DF10 .	REPAIR open in Circuit 796 (LB). RESTORE system. CLEAR DTCs and RETEST.

DF10 CHECK FOR CMP GROUND THROUGH PCM

- Connect PCM to breakout box.
- Measure resistance between PCM Test Pins 25, 51, 76, 77 and 103 and ground.

Is resistance less than 5 ohms?

Yes	No
PCM internal ground not supplied to Pin 65. RESTORE system. GO to DF11 .	REPAIR open in Circuit 570 (BK/W) and Circuit 57 (BK) as required. RESTORE system. CLEAR DTCs and RETEST.

DF11 CONFIRM PCM FAULT

- Perform Steps DF1 and DF2.

Are faults still present?

Yes	No
REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.	System is OK. RESTORE system.

DF12 FIND INTERMITTENT

- Install breakout box; connect PCM to breakout box.
- Remove IDM relay from engine compartment power distribution box.
- Key on, engine off.
- Connect digital multimeter between PCM Test Pin 21 and PCM Test Pin 65.
- Rotate engine by hand until voltage toggles from B+ to between 0.3 and 2.7 volts.

Did lower voltage toggle fall between 0.3 and 2.8 volts?

Yes	No
GO to DF13 .	GO to DF3 .

DF13 CHECK HARNESSES FOR INTERMITTENT

- Connect digital multimeter between PCM Test Pin 21 and PCM Test Pin 65.
- Rotate engine by hand until voltage stays at lower toggle of between 0.3 and 2.7 volts.
- Wiggle harnesses and watch for voltage jump to B+ or 0.0 volts.

Did voltage jump to B+ or 0.0 volts?

Yes	No
DETERMINE source of intermittent and REPAIR. RESTORE vehicle. CLEAR DTCs and RETEST.	Intermittent not found. RESTORE vehicle. CLEAR DTCs and RETEST.

DG: Barometric Pressure (BARO) Sensor Introduction

DG: Pinpoint Tests

Signal Functions

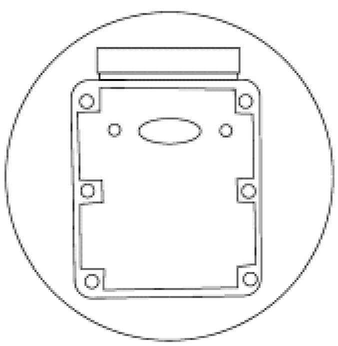
The barometric pressure (BARO) sensor is a variable capacitance sensor used to determine altitude. Prior to 99-1/2 M.Y., the BARO was remote mounted under the instrument cluster. It is now internal to the Powertrain Control Module (PCM). The BARO sensor cannot be serviced separately. PCM replacement is required if a failure is identified.

Timing Control — The BARO signal affects injection timing and fuel quantity to optimize engine operation and control smoke throughout all altitude conditions.

Glow Plug Control — The BARO signal is one of the variables used to calculate glow plug ON time. At higher altitudes glow plug on time is increased to reduce start-up smoke.

Detection/Management

A BARO signal that is detected out of range high or low by the PCM will cause the PCM to ignore the BARO signal and use the manifold absolute pressure (MAP) signal generated at low idle as an indication of barometric pressure.



DA1979-A

DTC Descriptions

Circuit Faults:

P0107 = BARO sensor low input

P0108 = BARO sensor high input

DG: Pinpoint Tests

DG: Introduction

DG1 DIAGNOSTIC TROUBLE CODE P0107 — KOEO

- KOEO diagnostic trouble code P0107 indicates barometric pressure out of range low was detected during KOEO Self Test.
- Possible cause:
  - faulty internal BARO sensor (PCM)
- Re-run KOEO On-Demand Self Test.

Is P0107 present?

Yes	No
REPLACE PCM. CLEAR DTC and RETEST.	BARO fault (PCM) is intermittent. If code reappears, REPLACE PCM.

DG2 DIAGNOSTIC TROUBLE CODE P0108 — KOEO

- KOEO diagnostic trouble code P0108 indicates barometric pressure out of range high was detected during KOEO Self Test.
- Possible cause:
  - faulty internal BARO sensor (PCM)
- Re-run KOEO On-Demand Self Test.

Is P0108 present?

Yes	No
REPLACE PCM. CLEAR DTC and RETEST.	BARO fault (PCM) is intermittent. If code reappears, REPLACE PCM.

DG3 DIAGNOSTIC TROUBLE CODE P0107 — CONTINUOUS

- Continuous diagnostic trouble code P0107 indicated barometric pressure out of range low was detected during normal operation.
- Possible cause:
  - faulty internal BARO sensor (PCM)
- Perform KOEO On-Demand Self Test.

Is P0107 present?

Yes	No
REPLACE PCM. CLEAR DTC and RETEST.	P0107 is intermittent fault. CLEAR DTC. If DTC reappears, REPLACE PCM.

DG4 DIAGNOSTIC TROUBLE CODE P0108 — CONTINUOUS

- Continuous diagnostic trouble code P0108 indicates barometric pressure out of range high was detected during normal operation.
- Possible cause:
  - faulty internal BARO sensor (PCM)
- Perform KOEO On-Demand Self Test.

Is P0108 present?

Yes	No
REPLACE PCM. CLEAR DTC and RETEST.	P0108 is intermittent fault. CLEAR DTC. If DTC reappears, REPLACE PCM.

DH: Manifold Absolute Pressure (MAP) Sensor, Analog Introduction

DH: Pinpoint Tests

Signal Functions

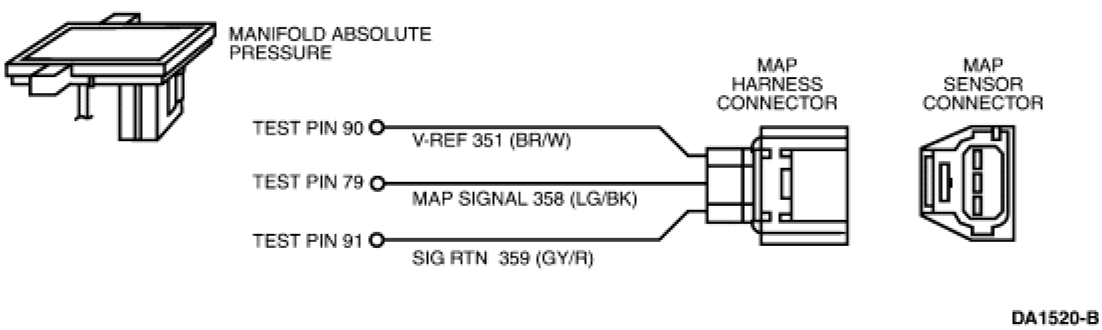
The manifold absolute pressure (MAP) sensor is a variable capacitance sensor that, when supplied with a 5-volt reference signal from the powertrain control module (PCM), produces an analog voltage signal that indicates pressure.

Smoke Control — The MAP signal is used to control smoke by limiting fuel quantity during acceleration until a specified boost pressure is obtained.

Dynamic Injection Timing — Optimizes injection timing for boost pressure measured.

Fault Detection/Management

A MAP signal that is detected by the PCM to be out of range or at an incorrect value for specific conditions will cause the PCM to ignore the MAP signal and operate the engine from an inferred boost pressure signal.



Note

After removing connectors, always check for damaged pins, corrosion, loose terminals, etc.

DTC Descriptions

P0236 = Turbo boost sensor A circuit performance

P0237 = Turbo boost sensor A circuit low input

P0238 = Turbo boost sensor A circuit high input

Volts	kPa	PSIA
1.1	80	11.5
1.5	101	14.7
2.2	138	20
2.8	172	25
3.6	206	30
4.3	242	35

Note: ± 0.3 volt from expected voltage reading is allowed.

DH: Pinpoint Tests

DH1 DIAGNOSTIC TROUBLE CODE (DTC) P0236, P1247 AND P1248

- DTC P0236 indicates a turbo boost sensor A circuit performance concern.
- DTC P1247 or P1248 indicate turbo boost pressure was low or not detected.
- Possible causes:
  - damaged MAP hose
  - low turbo boost
  - intake manifold or crossover tube hose leaks
  - damaged MAP sensor
  - damaged PCM
- Inspect MAP sensor hose and manifolds for damage, leaks, restriction and misrouting.

Are manifolds and MAP hose OK and free of damage?

Yes	No
GO to DH2 .	REPAIR leak as necessary. CLEAR DTCs and RETEST.

DH2 CHECK MAP SENSOR

Note: Refer to MAP voltage table at beginning of pinpoint test.

- Install breakout box; reconnect PCM to breakout box.
- Key on, engine off.
- Measure voltage between MAP sensor harness connector signal Pin 79 and ground.

  Note: Reading at sea level should be 1.5 volts. For each 1000 feet above sea level, add 0.05 volt.

Is voltage ± 0.5 volt for given altitude?

Yes	No
GO to DH3 .	REPLACE MAP sensor. RESTORE vehicle. CLEAR DTCs and RETEST.

DH3 MAP SENSOR VOLTAGE CHECK

- Disconnect MAP sensor harness connector.
- Connect the MAP sensor tester between the harness connector and the MAP sensor.
- Connect MAP sensor tester to a digital multimeter. Set digital multimeter to voltage scale.
- Disconnect vacuum hose from MAP sensor.
- Key on, engine off.
- Using Pressure Adapter Kit 014-00761 or equivalent (gauge bar), apply 69 kPa (10 psi) of pressure to the MAP sensor.

Is voltage reading 2.8 volts ± 0.3 volt?

Yes	No
GO to DH4 .	REPLACE MAP sensor. RESTORE vehicle. CLEAR DTCs and RETEST.

DH4 MAP PERFORMANCE TEST

- Connect vacuum hose to MAP sensor.
- Disconnect MAP sensor vacuum hose from intake manifold and install a pressure (boost) gauge.
- Road test vehicle and accelerate vehicle to achieve full boost.

Is engine boost 82 kPa (12 psi) or greater?

Yes	No
RESTORE vehicle. CLEAR DTCs and RETEST. If DTC returns, REPLACE ECM.	INSPECT intake manifolds, crossover tubes for leaks. CHECK turbo condition. REFER to the Powertrain Group in the Workshop Manual.

DH5 KOEO DIAGNOSTIC TROUBLE CODE (DTC) P0237

- DTC P0237 indicates turbo boost sensor (MAP) A circuit low input.
- Possible causes:
  - MAP signal circuit open or shorted to ground
  - open or shorted VREF circuit
  - open or shorted signal return circuit
  - damaged MAP sensor
  - damaged PCM
- Disconnect MAP sensor harness connector.
- Key on, engine off
- Measure voltage of VREF Circuit 351 (BR/W) between MAP sensor harness connector and ground.

Are 5 volts present?

Yes	No
GO to DH6 .	REPAIR VREF Circuit 351 (BR/W). RESTORE vehicle. CLEAR DTCs and RETEST.

DH6 CHECK SIGNAL RETURN

- Key off.
- Measure resistance of signal return Circuit 359 (GY/R) between MAP sensor harness connector and ground.

Is resistance less than 5 ohms?

Yes	No
GO to DH7 .	REPAIR open in signal return Circuit 359 (GY/R). RESTORE vehicle. CLEAR DTCs and RETEST.

DH7 MAP SIGNAL CONTINUITY CHECK

- Install breakout box; leave PCM disconnected.
- Measure resistance between PCM Test Pin 79 and Circuit 358 (LG/BK) at the MAP sensor harness connector.

Is resistance less than 5 ohms?

Yes	No
GO to DH8 .	REPAIR open MAP signal Circuit 358 (LG/BK). RESTORE vehicle. CLEAR DTCs and RETEST.

DH8 MAP SIGNAL SHORT TO GROUND CHECK

- Install breakout box; leave PCM disconnected.
- Measure resistance between PCM Test Pin 79 and PCM Test Pins 25, 51, 76, 77, 91, 103.

Is each resistance greater than 10,000 ohms?

Yes	No
GO to DH9	REPAIR short to ground or signal return in MAP signal Circuit 358 (LG/BK). RESTORE vehicle. CLEAR DTCs and RETEST.

DH9 MAP SIGNAL SHORT TO VOLTAGE CHECK

- Measure resistance between PCM Test Pins 79 and 90.

Is resistance greater than 10,000 ohms?

Yes	No
GO to DH10 .	REPAIR short to VREF in MAP signal Circuit 358 (LG/BK). RESTORE vehicle. CLEAR DTCs and RETEST.

DH10 PCM CHECK

- Connect PCM to breakout box.
- Key on, engine off.
- Measure voltage between MAP signal Circuit 358 (LG/BK) on MAP sensor harness connector and ground.

Is voltage reading 5 volts ± 0.5 volt?

Yes	No
REPLACE MAP sensor. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.

DH11 KOEO DIAGNOSTIC TROUBLE CODE P0238

Note: Ignore P0237 set due to sensor being disconnected.

- Refer to schematic for sensor identification.
- DTC P0238 indicates a turbo boost sensor (MAP) circuit high input.
- Possible causes:
  - damaged MAP sensor
  - MAP signal circuit shorted to power or VREF
  - faulty PCM
- Disconnect MAP sensor harness connector.
- Key on, engine off.

- Perform KOEO On-Demand Self Test.

Is DTC P0238 set?

Yes	No
GO to DH12 .	REPLACE MAP sensor. RESTORE vehicle. CLEAR DTCs and RETEST.

DH12 CHECK MAP SIGNAL CIRCUIT FOR SHORT TO POWER

- Key off.
- Install breakout box; leave PCM disconnected.
- Key on, engine off.
- Measure resistance between PCM Test Pin 79 and PCM Test Pins 55, 71, 91 and 97.

Is each resistance greater than 10,000 ohms?

Yes	No
REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR MAP signal short to power. RESTORE vehicle. CLEAR DTCs and RETEST.

DH13 CONTINUOUS DIAGNOSTIC TROUBLE CODE P0237

- Refer to schematic for sensor identification.
- Continuous DTC P0237 indicates a turbo boost sensor (MAP) A circuit low input was detected.
- Possible causes:
  - MAP signal circuit open, shorted to ground or shorted to VREF
  - open VREF circuit
  - open signal return circuit
  - damaged MAP sensor
- Perform KOEO On-Demand Test.

Is DTC P0237 present?

Yes	No
GO to DH5 .	GO to DH14 .

DH14 CHECK FOR INTERMITTENT CIRCUIT FAULT

- Clear Continuous DTCs.
- Grasp vehicle harness; wiggle and shake while working from PCM to MAP sensor.
- Retrieve Continuous DTCs.

Is DTC P0237 present?

Yes	No

REPAIR intermittent circuit fault in MAP circuitry. RESTORE vehicle. CLEAR DTCs and RETEST.	Unable to duplicate or identify failure at this time. RESTORE vehicle. CLEAR DTCs and RETEST.

DH15 CONTINUOUS DIAGNOSTIC TROUBLE CODE P0238

- Continuous DTC P0238 indicates a turbo boost sensor (MAP) circuit high input was detected during normal driving conditions.
- Grasp vehicle harness; wiggle and shake while working from PCM to MAP sensor.
- Retrieve Continuous DTCs.

Is DTC P0238 present?

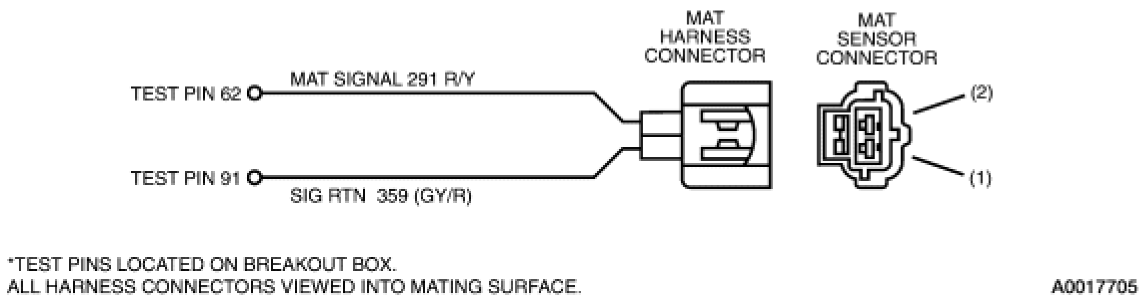
Yes	No
REPAIR intermittent circuit fault in MAP circuitry. RESTORE vehicle. CLEAR DTCs and RETEST.	Unable to duplicate or identify failure at this time. RESTORE vehicle. CLEAR DTCs and RETEST.

DI: Pinpoint Tests

Signal Functions

The manifold air temperature (MAT) sensor is a thermistor-type sensor with a variable resistance that changes when exposed to different temperatures. When interfaced with the powertrain control module (PCM), it produces a 0-5 volt analog signal that will measure temperature.

A MAT sensor is used to measure intake air temperature after being cooled through the intercooler, used to determine injection timing.



DTC Descriptions

P1118 = Manifold air temp. sensor low input

P1119 = Manifold air temp. sensor high input

DI: Pinpoint Tests

DI: Introduction

DI1 DIAGNOSTIC TROUBLE CODE (DTC) P1119

- DTC P1119 indicates that the MAT sensor circuit was out of range high.
- Possible causes:
  - open in harness
  - damaged connection
  - damaged MAT sensor
  - damaged PCM
- Disconnect MAT sensor harness connector.
- Measure resistance between Pin 1 (SIG RTN) on the MAT sensor harness connector and ground.

Is resistance less than 5 ohms?

Yes	No
GO to DI2 .	REPAIR open in (SIG RTN) Circuit 359 (GY) between MAT sensor harness connector and the PCM.

DI2 INDUCE OPPOSITE FAILURE

- Key on, engine off.
- Jumper Pin 1 to Pin 2 on the MAT sensor harness connector.
- Run KOEO Self Test.
- Key off.

Was DTC P1118 present?

Yes	No
REPLACE the MAT sensor. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DI3 .

DI3 CHECK CONTINUITY OF SIGNAL CIRCUIT

- Install breakout box; leave PCM disconnected.
- Measure resistance between MAT sensor harness connector Pin 2 and PCM Test Pin 62.

Is resistance less than 5 ohms?

Yes	No
GO to DI6 .	REPAIR open in MAT signal circuit. RESTORE vehicle. CLEAR DTCs and RETEST.

DI4 DIAGNOSTIC TROUBLE CODE (DTC) P1118 — INDUCE OPPOSITE DTC P1119

- DTC P1118 indicates that the MAT sensor circuit was out of range low.
- Possible causes:
  - grounded circuit in harness

    - damaged MAT sensor
    - damaged PCM
    - damaged connection.
- Disconnect MAT sensor harness connector.
- Run KOEO Self Test.

Is DTC P1119 present?

Yes	No
REPLACE the MAT sensor. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DI5 .

DI5 CHECK MAT SENSOR SIGNAL CIRCUIT FOR SHORT TO GROUND

- Install breakout box; leave PCM disconnected.
- Measure resistance between PCM Test Pin 62 and PCM Test Pins 51, 76, 77, 91 and 103.

Is each resistance reading greater than 10,000 ohms?

Yes	No
REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR short to ground on MAT signal circuit. RESTORE vehicle. CLEAR DTCs and RETEST.

DI6 CHECK SIG RTN FOR OPEN

- Measure resistance between MAT sensor harness connector Pin 1 and PCM Test Pin 91.

Is resistance less than 5 ohms?

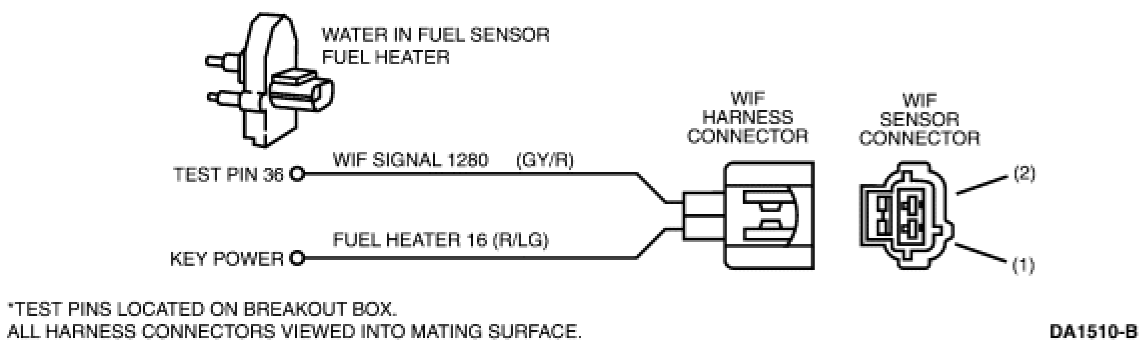
Yes	No
REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR open in SIG RTN circuit to MAT sensor. RESTORE vehicle. CLEAR DTCs and RETEST.

DJ: Water in Fuel (WIF) Sensor
Introduction

DJ: Pinpoint Tests

Input Function

The water in fuel (WIF) sensor is used to detect water in the fuel system and is located in the fuel filter housing. The WIF sensor is monitored by the PCM. If the PCM detects water for more than 5 seconds, it will set a Continuous DTC P1140 and turn on the WATER IN FUEL indicator lamp (WIFIL). Route a hose from the fuel drain line to a 1-qt clear container. Start engine and open the fuel filter housing drain valve. Close the valve when you have filled the container. Inspect fuel in the container. If no water or contaminants are in the container, you may have a circuit fault.



DTC Descriptions

P1140 = Water in fuel condition

DJ: Pinpoint Tests

DJ: Water in Fuel (WIF) Sensor

DJ: Introduction

DJ1 DIAGNOSTIC TROUBLE CODE (DTC) P1140

- DTC P1140 indicates that the PCM has detected water in the fuel filter housing or a short to ground in the monitoring circuit.

- Possible causes:
  - water in the fuel filter housing
  - shorted circuit
  - damaged connection
  - damaged sensor
  - damaged PCM
- Route a hose from the fuel drain line, located on the engine right front lower side, to a 1-qt clear container.
- Start engine.
- Open the fuel filter housing drain valve, and close when you've filled the container.

Does the container have any water or contaminants?

Yes	No
CLEAR DTCs and RETEST. If WIFIL comes back on and DTC P1140 returns, REPEAT Test Step DJ1. If water is still found in fuel sample, FLUSH and CLEAN the fuel tank and fuel system.	GO to DJ2 .

DJ2 CHECK WIF SENSOR CIRCUIT FOR SHORT TO GROUND

- Key on, engine off.
- Disconnect the WIF/FUEL HEATER harness connector.
- Clear Continuous DTCs.
- Cycle ignition key.
- Retrieve Continuous DTCs.
- Key off.

Did DTC P1140 reset?

Yes	No
GO to DJ3 .	GO to DJ4 .

DJ3 CHECK FOR SHORT TO GROUND IN CIRCUIT 1280

- Disconnect PCM harness connector.
- Measure resistance between Pin 2 on WIF sensor harness connector and battery ground.

Is resistance greater than 10,000 ohms?

Yes	No
REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR short to ground in WIF sensor Circuit 1280 (GY/R). RESTORE vehicle. CLEAR DTCs and RETEST.

DJ4 CHECK WIF SENSOR

- Remove the fuel filter, and inspect inside of filter housing for debris.

Was debris found inside the housing?

Yes	No
CLEAN out filter housing. REMOVE WIF sensor. CLEAN and REINSTALL. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE WIF sensor. RESTORE vehicle. CLEAR DTCs and RETEST.

DK: Water in Fuel Indicator Lamp (WIFIL) Introduction

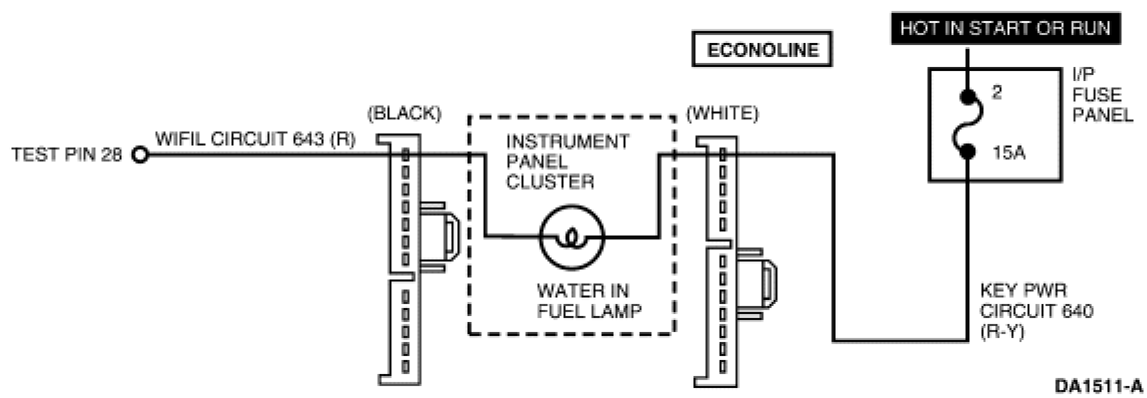
DK: Pinpoint Tests

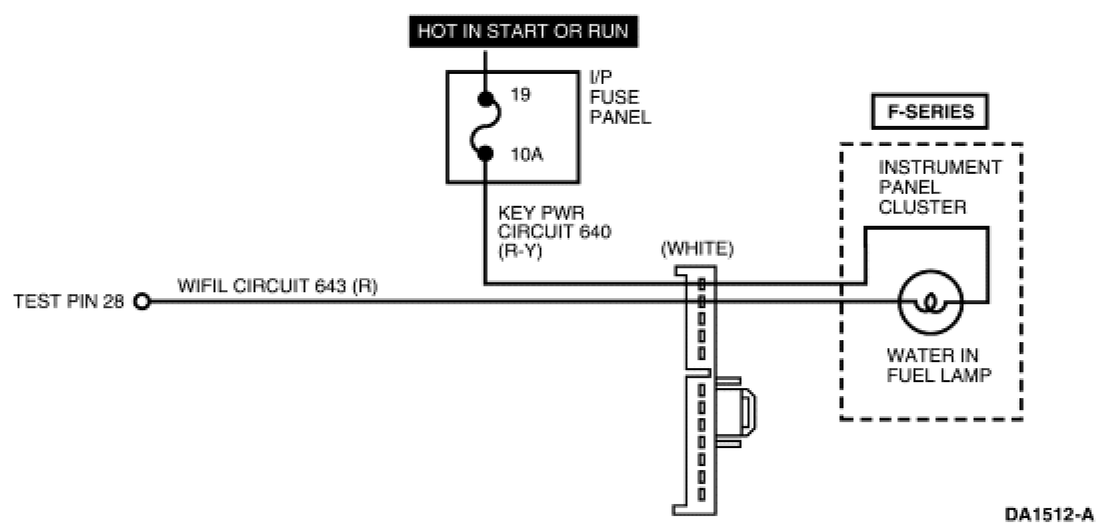
Output Function

The water in fuel indicator lamp (WIFIL) is used to alert the operator when water is present in the fuel filter housing. Drain the water into a clear container. If excessive, water or contaminants may indicate that the tank and fuel system need to be flushed and cleaned.

Detection/Management

The WIFIL is controlled and monitored by the PCM. An open or short circuit will set a P1139 in KOEO On-Demand Self Test. If WIFIL comes on without a P1139, then the cause is most likely water in the fuel filter housing.





DTC Descriptions

P1139 = Water in fuel indicator circuit malfunction

DK: Pinpoint Tests

DK1 DIAGNOSTIC TROUBLE CODE (DTC) P1139

- DTC P1139 indicates that the PCM has detected a failure on the WIFIL circuit.

  Note: If only the light comes on with a DTC P1140, GO to Pinpoint Test (DJ).

- Possible causes:
  - shorted circuit
  - open in harness
  - damaged connection
  - open in lamp
  - damaged PCM
- Key on, engine off.

Does the WIFIL come on for approximately 2 seconds, then turn off?

Yes	No
CLEAR DTC and RETEST. If DTC P1139 returns, CHECK for an intermittent open or short in Circuit 643 (R).	GO to DK2 .

DK2 LAMP STATE

- Key off.

Did the WIFIL stay on in Step DK1?

Yes	No
GO to DK3 .	GO to DK4 .

DK3 CHECK FOR SHORT TO GROUND IN CIRCUIT 643

- Disconnect the PCM harness connector.
- Key on, engine off.

Does the WIFIL stay off?

Yes	No
REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR short to ground in WIFIL control Circuit 643 (R). RESTORE vehicle. CLEAR DTCs and RETEST.

DK4 CHECK FOR BLOWN FUSE

- Check fuse for Circuit 640 (R/Y).

Is fuse blown?

Yes	No
REPLACE fuse. CHECK for short to ground. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DK5 .

DK5 CHECK POWER TO CLUSTER

- Key off.
- Disconnect instrument cluster harness connector(s).
- Key on, engine off.
- Measure voltage between instrument cluster connector(s) Circuit 640 and ground.
- Key off.

Was voltage greater than 10.5 volts?

Yes	No
GO to DK6 .	REPAIR open in PWR Circuit 640 (R/Y). RESTORE vehicle. CLEAR DTCs and RETEST.

DK6 CHECK FOR OPEN IN WIFIL CIRCUIT 643

- Install breakout box; leave PCM disconnected.
- Measure resistance between instrument cluster harness connector Circuit 643 (R) and PCM Test Pin 28.

Is resistance less than 5 ohms?

Yes	No

REPLACE the PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR open in WIFIL control Circuit 643 (R). RESTORE vehicle. CLEAR DTCs and RETEST.

DL: Vehicle Speed Sensor (VSS) Introduction

DL: Pinpoint Tests

Remember

This Pinpoint Test is intended to diagnose only the following:

- VSS Harness Circuits
- Vehicle Speed Sensor (Econoline)
- Powertrain Control Module (PCM)

Description

Econoline

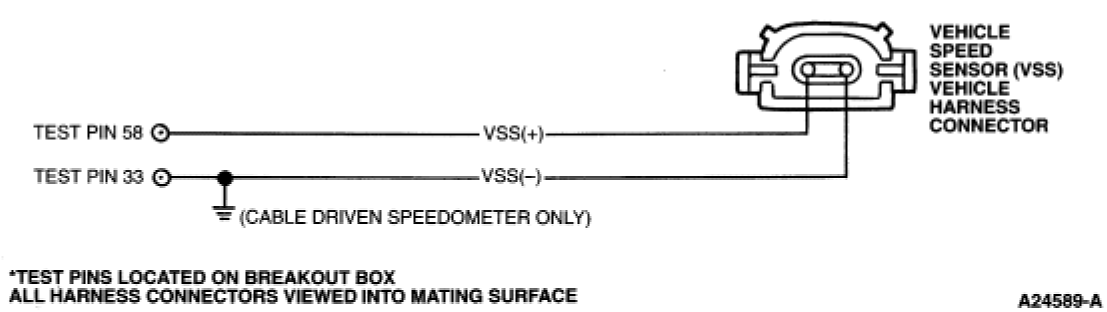
The Vehicle Speed Sensor (VSS) is a variable reluctance sensor that generates a waveform with frequency that is proportional to vehicle speed. When the vehicle is moving slowly, the sensor produces a low frequency signal. As the vehicle speed increases, the sensor produces a higher frequency signal. The sensor is located on the left side of the transmission extension housing.

F-Series

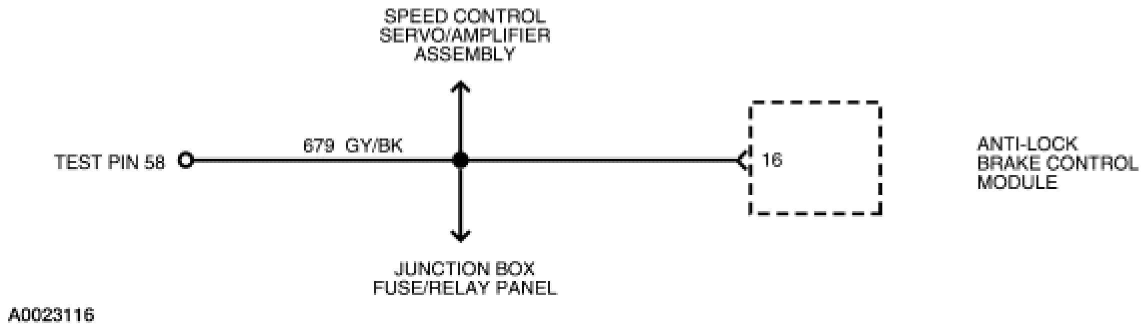
The vehicle speed signal is provided by the anti-lock brake control module.

Pinpoint Test Schematic

Econoline



F-Series



DTC Descriptions

- P0500 = Vehicle Speed Sensor (VSS)
- P0501 = Vehicle SPeed Sensor (VSS) Range/Performance
- P0502 = Vehicle Speed Sensor (VSS) Intermittent

DL: Pinpoint Tests

DL1 DTC P0500: CHECK CONTINUITY OF VSS HARNESS CIRCUITS

Diagnostic Trouble Code (DTC) P0500 indicates that a VSS malfunction has been detected.

Note: Delayed engagement or no vehicle movement may be caused by a transmission concern. Harsh shifts and/or erratic speedometer may be caused by a failed speedometer or an open or intermittent ground within the instrument panel on vehicles with electronic readout.

- Possible causes:
  - Open in VSS (+)/VSS (-) harness circuit.
  - Short to GND or SIG RTN in VSS (+)/VSS (-) harness circuit.
  - Short to PWR in VSS (+)/VSS (-) harness circuit.
  - Damaged VSS.
  - Damaged PCM.

- Key off.
- Disconnect PCM. Inspect for damaged or pushed out pins, corrosion, loose wires, etc. Service as necessary.
- Install breakout box, PCM disconnected.
- Disconnect VSS.
- Measure resistance between Test Pin 58 [VSS (+)] at the breakout box and VSS (+) circuit at the VSS vehicle harness connector.
- Measure resistance between Test Pin 33 [VSS (-)] at the breakout box and VSS (-) circuit at the VSS vehicle harness connector.

Is each resistance less than 5.0 ohms?

Yes	No
GO to DL2 .	SERVICE open in harness circuit. REMOVE breakout box. RECONNECT all components. RESTORE vehicle. CLEAR DTCs and RETEST.

DL2 CHECK VSS HARNESS CIRCUITS FOR SHORTS TO GROUND, SIG RTN AND POWER

- Key off.
- VSS disconnected.
- Breakout box installed, PCM disconnected.
- Measure resistance between Test Pin 58 [VSS (+)] and Test Pins 24, 61, 76, and 103 (PWR GND).
- Measure resistance between Test Pin 58 [VSS (+)] and Test Pin 33 [VSS (-)].
- Measure resistance between Test Pin 58 [VSS (+)] and Test Pins 91 (SIG RTN).
- Measure resistance between Test Pin 58 [VSS (+)] and Test Pin 71 (VPWR).
- Measure resistance between Test Pins 33 [VSS (-)] and 71 (VPWR) at the breakout box.

Is each resistance greater than 500 ohms?

Yes	No
GO to DL3	SERVICE short circuit. REMOVE the breakout box. RECONNECT all components. RESTORE vehicle. CLEAR DTCs and RETEST.

DL3 CHECK VSS RESISTANCE

- Key off.
- VSS disconnected.
- Measure the resistance of the VSS.

Is resistance between 190 and 250 ohms?

Yes	No

REMOVE the breakout box. REPLACE the PCM. RECONNECT the VSS. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE the VSS. REMOVE breakout box. RECONNECT the PCM. RESTORE vehicle. CLEAR DTCs and RETEST.

DL4 DTC P0500: CHECK VSS SIGNAL OUTPUT TO POWERTRAIN CONTROL MODULE (PCM)

Diagnostic Trouble Code (DTC) P0500 indicates that a VSS malfunction has been detected.

Note: Delayed engagement or no vehicle movement may be caused by a transmission concern. Harsh shifts and/or erratic speedometer may be caused by a failed speedometer or an open or intermittent ground within the instrument panel on vehicles with electronic readout.

- Possible causes:
  - Open in VSS, VPWR, PWR GND harness circuit.
  - Short to GND in VSS harness circuit.
  - Short to PWR in VSS harness circuit.
  - Damaged VSS.
  - Damaged PCM.
- Key off.
- Disconnect Powertrain Control Module (PCM). Inspect for damaged or pushed out pins, corrosion, loose wires, etc. Service as necessary.
- Install scan tool and set to frequency count with an amplitude of 2 volts.
- From a stop, accelerate to 48 km/h (30 mph).
- The frequency reading should increase to a reading between 45-85 HTZ.

Is the VSS output within specification?

Yes	No
GO to DL5 .	REPLACE the VSS. RESTORE vehicle. CLEAR DTCs and RETEST.

DL5 CHECK THE BATTERY VOLTAGE TO VSS

- Key off.
- Disconnect VSS.
- Key on.
- Measure voltage at VPWR pin to GND pin at the VSS vehicle harness connector.

Is the voltage greater than 10.5 volts?

Yes	No
GO to DL6 .	GO to DL9 .

DL6 CHECK VSS CIRCUIT SHORT TO POWER

- VSS disconnected.
- Key on, PCM disconnected.
- Measure voltage between Test Pin 58 and Test Pin 103 at the breakout box.

Is the voltage less than 1.0 volt?

Yes	No
GO to DL7 .	SERVICE short to power. REMOVE breakout box. RECONNECT all components. RESTORE vehicle. CLEAR DTCs and RETEST.

DL7 CHECK VSS CIRCUIT SHORT TO GROUND

- Key off.
- VSS disconnected.
- Measure resistance between Test Pin 58 and Test Pin 103 at breakout box.

Is resistance greater than 3,000 ohms?

Yes	No
GO to DL8 .	SERVICE short to ground. REMOVE breakout box. RECONNECT all components. RESTORE vehicle. CLEAR DTCs and RETEST.

DL8 CHECK CONTINUITY OF VSS HARNESS CIRCUIT

- Key off, VSS disconnected.
- PCM disconnected.
- Measure resistance between Test Pin 58 at the breakout box and the VSS circuit at the VSS vehicle harness connector.

Is resistance less than 5.0 ohms?

Yes	No
REPLACE VSS. REMOVE the breakout box. RECONNECT all components. RESTORE vehicle. CLEAR DTCs and RETEST.	SERVICE open circuit. REMOVE the breakout box. RECONNECT all components. RESTORE vehicle. CLEAR DTCs and RETEST.

DL9 CHECK CONTINUITY OF VSS GROUND HARNESS CIRCUIT

- Key off, VSS disconnected.
- PCM disconnected.

- Measure resistance between GND Pin at the VSS vehicle harness connector and chassis ground.

Is resistance less than 5.0 ohms?

Yes	No
SERVICE open VPWR to VSS. REMOVE breakout box. RECONNECT all components. RESTORE vehicle. CLEAR DTCs and RETEST.	SERVICE open VSS GND circuit. REMOVE breakout box. RECONNECT all components. RESTORE vehicle. CLEAR DTCs and RETEST.

DL10 KOER DTC P1501: CHECK PCM VSS PID FOR INPUT SIGNAL

Diagnostic Trouble Code (DTC) P1501 indicates the VSS input signal is out of Self Test range.

Note: When the PCM detects a VSS input signal any time during KOER testing, a DTC P1501 will be set and the testing will abort.

- Possible causes:
  - Noisy VSS input signal from RFI/EMI external sources such as ignition wires or charging circuit as examples.
- Start the engine and idle in neutral.
- Access the VSS PID with a scan tool and observe for vehicle speed input to the PCM.
- Increase the engine speed, not greater than 2000 rpm, several times while observing the VSS PID.

Is the reading on the VSS PID less than 3 mph (5 km/h)?

Yes	No
Unable to duplicate or identify a fault at this time. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DL13 .

DL11 DTC P0503: INSPECT VSS AND CIRCUIT FOR AN INTERMITTENT

Continuous Memory DTC P0503 indicates poor VSS performance.

- Possible causes:
  - Noisy VSS input signal from RFI/EMI external sources such as ignition wires or charging circuit as examples.
  - Damaged VSS or driven gears.
  - Damaged wiring harness or connectors.
- Check for harness intermittents.
  - Pins properly seated in connector shell; wiring properly crimped; no corrosion; sensor securely mounted.

Are there any indications of harness intermittents?

Yes	No
SERVICE as necessary. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to DL12 .

DL12 CHECK PCM VSS PID FOR INPUT SIGNAL

- Access the VSS PID with a scan tool.
- Drive the vehicle at several steady state speeds above and below 50 km/h (30 mph).
- During each steady state speed observe the VSS PID for variations of (+) or (-) 8 km/h (5 mph) for greater than 10 seconds.

  Note: For scan tools which have Data Record feature, recording data for playback may help in identifying variations easier.

Were there any indications of a noisy or intermittent signal with the VSS PID?

Yes	No
GO to DL13 .	Unable to duplicate or identify a fault at this time. DTC P0503 may have been set from sources external to the vehicle. SERVICE any other DTCs. RESTORE vehicle. CLEAR DTCs and RETEST.

DL13 CHECK VSS HARNESS ROUTING

- Check VSS harness routing.
  - Verify that the harness is not routed adjacent to high current wires, i.e. ignition wires or alternator wiring.
  - Verify VSS harness is shielded and grounded, if applicable.
  - Check continuity of the VSS harness; GO to DL1 .

Are any problems evident?

Yes	No
SERVICE as necessary. RESTORE vehicle. CLEAR DTCs and RETEST.	Unable to duplicate or identify a fault at this time. RERUN Quick Test.

FA: Pinpoint Tests

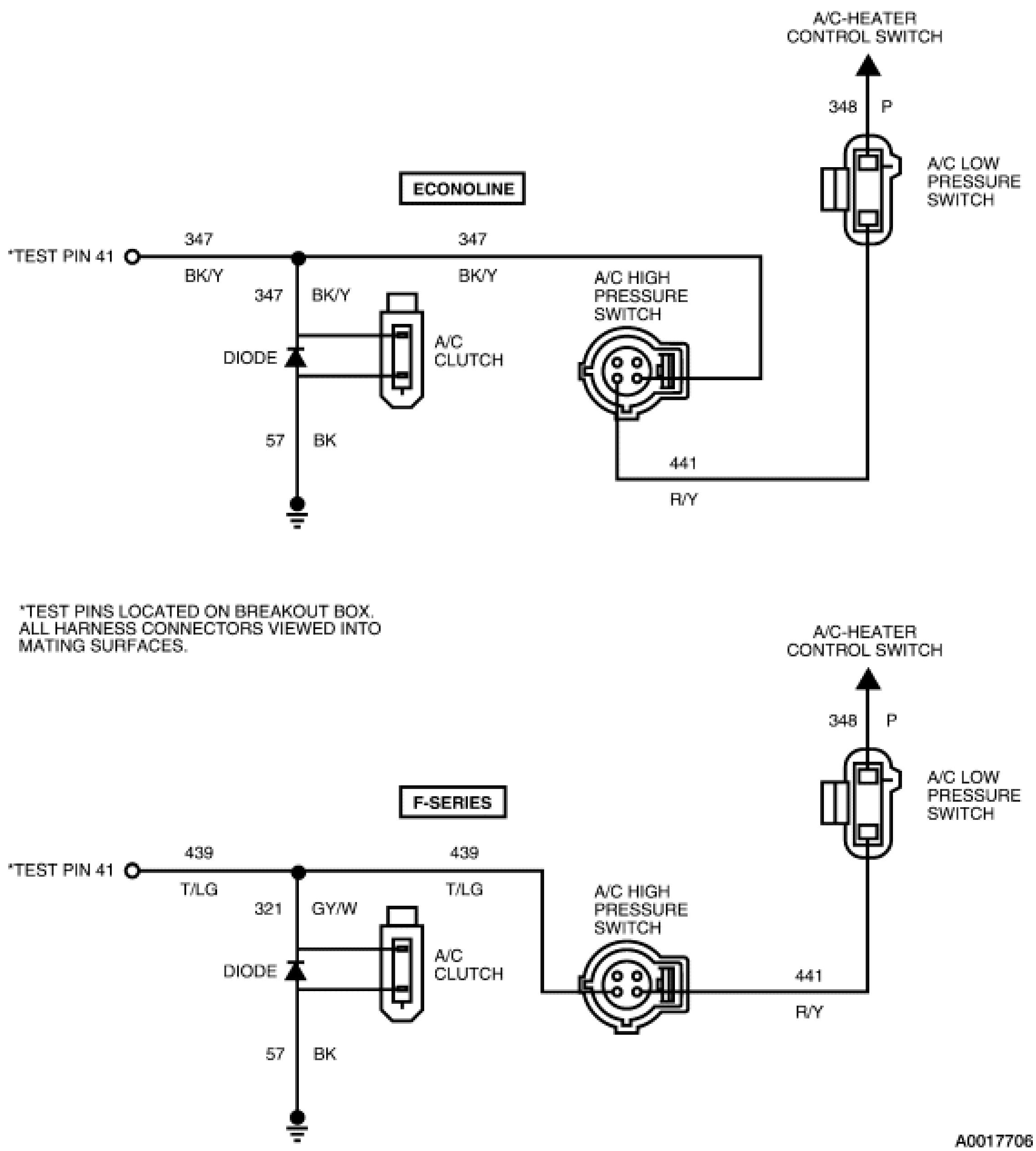
Note

Enter this pinpoint test only when directed here.

Remember

This pinpoint test is intended to diagnose the following:

- harness circuits for air conditioning
- powertrain control module (PCM) (12A650)
- A/C clutch



DTC Description

P1464 = A/C on during KOER Cylinder Contribution Self Test

FA: Pinpoint Tests

FA1 DIAGNOSTIC TROUBLE CODE (DTC) P1464

- Turn A/C-heater control switch to OFF position.
- Perform KOER Cylinder Contribution Self Test.
- Key off.

Did DTC P1464 set?

Yes	No
GO to FA2 .	Problem may be intermittent. GO to FA4 .

FA2 CHECK A/C POWER CIRCUIT FOR SHORT

- Key on, engine off.
- A/C-heater control switch off.
- Disconnect A/C clutch connector.
- Measure voltage between A/C clutch connector Circuit 321 [(GY/W) (F-Series)], or Circuit 347 [(BK/Y) (Econoline)] and battery ground.
- Key off.

Was B+ present?

Yes	No
REPAIR short to B+. RESTORE system. CLEAR DTCs and RETEST.	GO to FA3 .

FA3 CHECK TEST PIN 41 SHORTED TO POWER

- Install breakout box; leave PCM disconnected.
- Key on, engine off.
- A/C-heater control switch off.
- Measure voltage between PCM Test Pin 41 and ground.

Is B+ present?

Yes	No
REPAIR short to B+. RESTORE system. CLEAR DTCs and RETEST.	REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.

FA4 CHECK FOR INTERMITTENT SHORT TO POWER

- Install breakout box; leave PCM disconnected.
- Key on, engine off.
- A/C-heater control switch off.
- Measure voltage between PCM Test Pin 41 and ground.
- Grasp the harness. Wiggle and shake harness while working toward the PCM.

Is voltage ever present?

Yes	No
REPLACE short to B+. RESTORE system. CLEAR DTCs and RETEST.	No problem found at this time. RESTORE system. CLEAR DTCs and RETEST.

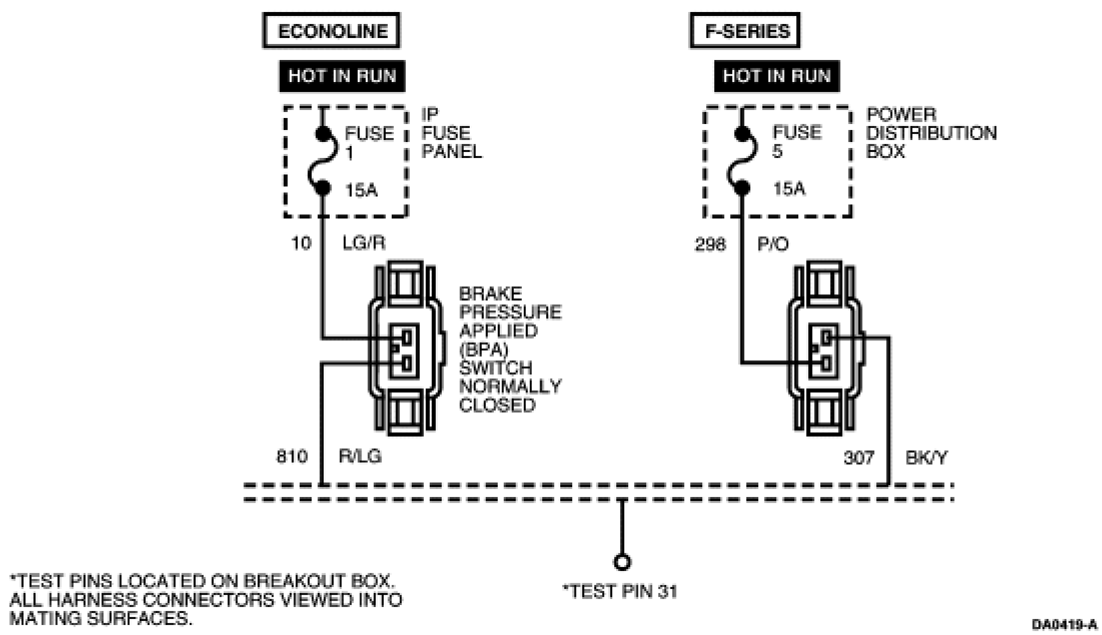
FB: Pinpoint Tests

Note

Enter this pinpoint test only when directed here from symptom flowcharts.

Description

The brake pressure applied (BPA) switch is a pressure switch that senses brake pressure and is redundant with the brake on/off (BOO) switch to provide a backup to deactivate speed control.



DTC Description

P0571 = Brake switch A circuit malfunction

FB: Pinpoint Tests

FB1 DIAGNOSTIC TROUBLE CODE (DTC) P0571

Note: When performing KOER switch test, wait five seconds after pressing the trigger to start the test before running through the driver operated controls. The test may also take up to five minutes to complete.

Note: No PID transition indicates a BPA circuit failure.

- Key on, engine off.
- Access BPA PID.
- Cycle brake pedal firmly.

Does PID read ON only?

Yes	No
GO to FB2 .	GO to FB5 .

FB2 CHECK FOR BPA SWITCH FAILED CLOSED

- Disconnect BPA switch.
- Key off.

Did PID go to OFF?

Yes	No
REPLACE BPA switch. RESTORE system. CLEAR DTCs and RETEST.	F-Series, GO to FB3 . Econoline, GO to FB4 .

FB3 CHECK FOR SHORT TO B+ IN CIRCUIT 307 (BK/Y)

- Disconnect PCM.
- Key on, engine off.
- Measure voltage between Circuit 307 (BK/Y) on BPA harness connector and chassis ground.
- Key off.

Was B+ present?

Yes	No
REPAIR short to B+ in Circuit 307 (BK/Y). RESTORE system. CLEAR DTCs and	Short to B+ is at Pin 31 in PCM. SERVICE as necessary. GO to FB11 .

RETEST.	

FB4 CHECK FOR SHORT TO B+ IN CIRCUIT 810 (R/LG)

- Disconnect PCM.
- Key on, engine off.
- Measure voltage between Circuit 810 (R/LG) on BPA harness connector and chassis ground.

Is B+ present?

Yes	No
REPAIR short to B+ in Circuit 810 (R/LG). RESTORE system. CLEAR DTCs and RETEST.	REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.

FB5 CHECK BPA PID

- Cycle brake pedal firmly.
- Key off.

Did PID read OFF only?

Yes	No
F-Series GO to FB6 , Econoline GO to FB7 .	Fault may be intermittent. GO to FB14 .

FB6 CHECK FUSE 5 (15 AMP)

- Check Fuse 5 (15 amp) in power distribution box.

Is Fuse 5 blown?

Yes	No
REPLACE fuse. If fuse blows again, GO to FB8 .	LOOK for open circuit. GO to FB10 .

FB7 CHECK FUSE 1 (15 AMP)

- Check Fuse 1 (15 amp) in power distribution box.

Is Fuse 1 blown?

Yes	No
REPLACE fuse. If fuse blows again, GO to FB19 .	GO to FB16 .

FB8 CHECK CIRCUIT 298 (P/O) FOR SHORT TO GROUND

- Disconnect BPA switch.
- Measure resistance between Circuit 298 (P/O) on BPA harness connector and chassis ground.

Is resistance greater than 10,000 ohms?

Yes	No
GO to FB9 .	REPAIR short to ground in Circuit 298 (P/O). REPLACE fuse. RESTORE system. CLEAR DTCs and RETEST.

FB9 CHECK CIRCUIT 307 (BK/Y) FOR SHORT TO GROUND

- Disconnect PCM.
- Key on, engine off.
- Measure resistance between Circuit 307 (BK/Y) on BPA harness connector and chassis ground.

Is resistance greater than 10,000 ohms?

Yes	No
GO to FB21 .	REPAIR short to ground in Circuit 307 (BK/Y). RESTORE system. CLEAR DTCs and RETEST.

FB10 CHECK BPA SWITCH FOR OPEN

- Disconnect BPA switch.
- Key on, engine off.
- Install jumper between BPA harness connector for Circuits 307 (BK/Y) and 298 (P/O) (two middle pins).
- Key off.

Did PID read ON?

Yes	No
REPLACE BPA switch. RESTORE system. CLEAR DTCs and RETEST.	GO to FB11 .

FB11 CHECK CIRCUIT 298 (P/O) FOR OPEN

- Measure resistance of Circuit 298 (P/O) between BPA harness connector and contact for Fuse 5.
- Key off.

Is the resistance less than 5 ohms?

Yes	No
Circuit 298 (P/O) is OK. GO to FB12 .	REPAIR open in Circuit 298 (P/O). RESTORE system. CLEAR DTCs and RETEST.

FB12 CHECK CIRCUIT 307 (BK/Y) FOR OPEN

- Remove jumper.
- Disconnect PCM.
- Install breakout box; leave PCM disconnected.
- Measure resistance between PCM Test Pin 31 and BPA harness connector Circuit 307 (BK/Y).

Is resistance less than 5 ohms?

Yes	No
Circuit 307 (BK/Y) is OK. Open is at PCM Pin 31. REPAIR as required. GO to FB13 .	REPAIR open in Circuit 307 (BK/Y). RESTORE system. CLEAR DTCs and RETEST.

FB13 CONFIRM PCM FAULT

- Key on, engine off.
- Cycle brake pedal.

Does PID switch between ON and OFF?

Yes	No
System is OK.	REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.

FB14 CHECK FOR INTERMITTENT OPEN OR SHORT

- Disconnect BPA switch.
- Key on, engine off.
- Install Jumper between BPA connector Circuits 307 (BK/Y) and 298 (P/O) (two middle pins).
- Confirm BPA PID reads ON.
- Wiggle connectors and wires while observing BPA PID.

Does PID switch between ON and OFF?

Yes	No
REPAIR circuitry at point of intermittent. RESTORE system. CLEAR DTCs and	GO to FB15 .

RETEST.	

FB15 CHECK FOR INTERMITTENT SHORT TO B+

- Remove Fuse 5 (15 amp).
- Confirm BPA PID reads OFF.
- Wiggle connector and wires while watching BPA PID.

Does PID switch between OFF and ON?

Yes	No
REPAIR circuitry at point of intermittent contact with B+ source. INSTALL fuse. RESTORE system. CLEAR DTCs and RETEST.	Intermittent not detected. RESTORE system. CLEAR DTCs and RETEST.

FB16 CHECK CIRCUIT 10 (LG/R) FOR OPEN

- Disconnect BPA switch.
- Measure resistance between Circuit 10 (LG/R) on BPA harness connector and non-power side of Fuse 1.

Is resistance less than 5 ohms?

Yes	No
GO to FB17 .	REPAIR open in Circuit 10 (LG/R). RESTORE system. CLEAR DTCs and RETEST.

FB17 CHECK FOR OPEN IN BPA SWITCH

- Install Fuse 1.
- Key on, engine off.
- Install Jumper between BPA harness connector Circuits 10 (LG/R) and 810 (R/LG).
- Key off.

Did PID read ON?

Yes	No
REPLACE faulty BPA switch. RESTORE system. CLEAR DTCs and RETEST.	GO to FB18 .

FB18 CHECK CIRCUIT 810 (R/LG) FOR OPEN

- Remove jumper.
- Install breakout box; leave PCM disconnected.

- Measure resistance between PCM Test Pin 31 and Circuit 810 (R/LG) on BPA harness connector.

Is resistance less than 5 ohms?

Yes	No
REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.	REPAIR open in Circuit 810 (R/LG). RESTORE system. CLEAR DTCs and RETEST.

FB19 CHECK CIRCUIT 10 (LG/R) FOR SHORT TO GROUND

- Disconnect BPA switch
- Remove Fuse 1.
- Measure resistance between Circuit 10 (LG/R) on BPA harness connector and ground.

Is resistance greater than 10,000 ohms?

Yes	No
GO to FB20 .	REPAIR short to ground in Circuit 10 (LG/R). REPLACE fuse. RESTORE system. CLEAR DTCs and RETEST.

FB20 CHECK CIRCUIT 810 (R/LG) FOR SHORT TO GROUND

- Disconnect PCM.
- Measure resistance between Circuit 810 (R/LG) on BPA harness connector and ground.

Is resistance greater than 10,000 ohms?

Yes	No
GO to FB21 .	REPAIR short to ground in Circuit 810 (R/LG). RESTORE system. CLEAR DTCs and RETEST.

FB21 PCM INTERNAL SHORT CHECK

- Install breakout box; connect PCM to breakout box.
- Measure resistance from PCM Test Pin 31 to PCM Test Pins 25, 76, 77 and 103.

Is resistance greater than 10,000 ohms?

Yes	No
Unable to identify short condition. REPLACE fuse. RESTORE system. CLEAR DTCs and RETEST.	REPLACE shorted PCM. RESTORE system. CLEAR DTCs and RETEST.

Note

Enter this pinpoint test only when directed here from symptom flowcharts.

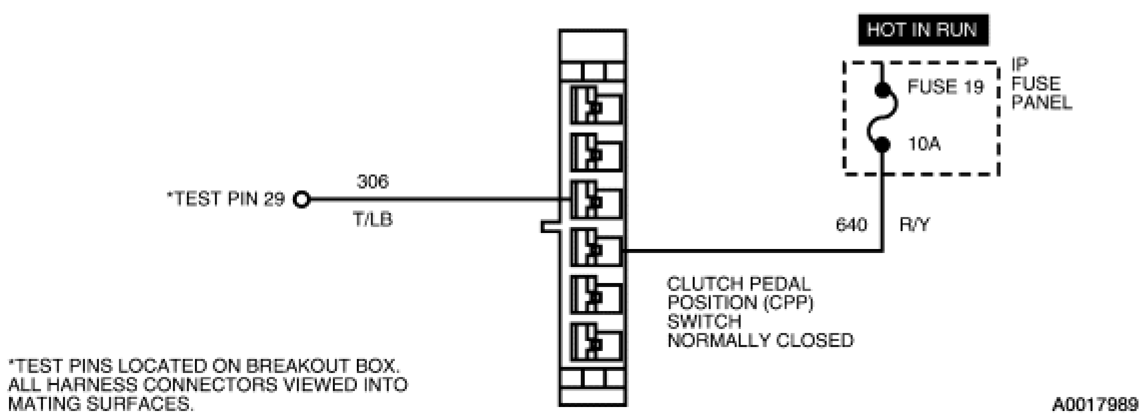
Remember

This pinpoint test is intended to diagnose only the following:

- clutch pedal position switch (CPP) (11A152)
- powertrain control module (PCM) (12A650)
- harness circuits: CPP and SIG RTN

Description

The clutch pedal position switch detects when the clutch pedal is depressed (manual transmissions) to disable the speed control system and PTO/raised-idle mode. Switch actuation occurs as the clutch is initially depressed prior to disengaging the transmission at the top of travel.



DTC Description

P0704 = Clutch switch input circuit malfunction

FC1 DIAGNOSTIC TROUBLE CODE (DTC) P0704

Note: When performing KOER switch test, wait five seconds after pressing the trigger to start the test before running through the driver operated controls. The test may also take up to five minutes to complete.

Note: No PID transition indicates a CPP circuit failure.

- Key on, engine off.
- Foot off clutch pedal.
- Access CPP PID.

Does PID read ON only?

Yes	No
GO to FC2 .	GO to FC4 .

FC2 CHECK FOR CPP SWITCH FAILED CLOSED

- Disconnect CPP switch.
- Key off.

Did PID go to OFF?

Yes	No
REPLACE CPP switch. RESTORE system. CLEAR DTCs and RETEST.	GO to FC3 .

FC3 CHECK FOR SHORT TO B+ IN CIRCUIT 306 (T/LB)

- Disconnect PCM.
- Key on, engine off.
- Measure voltage between Circuit 306 (T/LB) on CPP harness connector and chassis ground.

Is B+ present?

Yes	No
REPAIR short to B+ in Circuit 306 (T/LB). RESTORE system. CLEAR DTCs and RETEST.	Short to B+ is at Pin 29 in PCM. SERVICE as necessary. GO to FC11 .

FC4 CHECK PID CPP

- Hold clutch pedal to the floor.
- Key off.

Did PID read OFF only?

Yes	No
GO to FC5 .	Fault may be intermittent. GO to FC12 .

FC5 CHECK FUSE 19 (10 AMP)

- Check Fuse 19 (10 amp) in IP fuse panel.

Is Fuse 19 blown?

Yes	No
THROW away fuse. LOOK for short to ground. GO to FC6 .	LOOK for open circuit. GO to FC8 .

FC6 CHECK CIRCUIT 640 (W/P) FOR SHORT TO GROUND

- Disconnect CPP switch.
- Measure resistance between Circuit 640 (W/P) on CPP harness connector and chassis ground.

Is resistance less than 5 ohms?

Yes	No
REPAIR short to ground in Circuit 640 (W/P). REPLACE fuse. RESTORE system. CLEAR DTCs and RETEST.	GO to FC7 .

FC7 CHECK CIRCUIT 306 (T/LB) FOR SHORT TO GROUND

- Disconnect PCM.
- Key on, engine off.
- Measure resistance between Circuit 306 (T/LB) on CPP harness connector and chassis ground.

Is resistance less than 10,000 ohms?

Yes	No
REPAIR short to ground in Circuit 306 (T/LB). RESTORE system. CLEAR DTCs	Short to ground is at PCM Pin 29. SERVICE as necessary. GO to FC11 .

and RETEST.	

FC8 CHECK CIRCUIT 640 (W/P) FOR OPEN

- Disconnect CPP switch.
- Measure resistance between Circuit 640 (W/P) on CPP harness connector and output side of Fuse 19.

Is resistance less than 5 ohms?

Yes	No
Circuit 640 (W/P) is OK. GO to FC9 .	SERVICE open in Circuit 296 (W/P). RESTORE system. CLEAR DTCs and RETEST.

FC9 CHECK CPP SWITCH FOR OPEN

- Key on, engine off.
- Install Jumper between CPP connector Circuits 306 (T/LB) and 640 (W/P) (two middle pins).
- Key off.

Did PID read ON?

Yes	No
REPLACE CPP switch. RESTORE system. CLEAR DTCs and RETEST.	GO to FC10 .

FC10 CHECK CIRCUIT 306 (T/LB) FOR OPEN

- Remove jumper.
- Disconnect PCM.
- Install breakout box; leave PCM disconnected.
- Measure resistance between PCM Test Pin 29 and Circuit 306 (T/LB) on CPP harness connector.

Is resistance less than 5 ohms?

Yes	No
Circuit 306 (T/LB) is OK. Open is at PCM Pin 29. REPAIR as required. GO to FC11 .	REPAIR open in Circuit 306 (T/LB). RESTORE system. CLEAR DTCs and RETEST.

FC11 CONFIRM PCM FAULT

- Cycle clutch pedal.

Does PID switch between ON and OFF?

Yes	No
System is OK. RESTORE system. CLEAR DTCs and RETEST.	REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.

FC12 CHECKS FOR INTERMITTENT OPEN OR SHORT

- CPP switch unplugged.
- Key on.
- Jumper between CPP connector contacts for Circuits 306 (T/LB) and 640 (W/P) (two middle pins).
- Confirm that NGS Tester PID CPP shows ON.
- Wiggle connectors and wires while watching CPP on NGS Tester.

Does PID switch between ON and OFF?

Yes	No
REPAIR circuitry at point of intermittent. RESTORE system. CLEAR DTCs and RETEST.	GO to FC13 .

FC13 CHECK FOR INTERMITTENT SHORT TO B+

- CPP switch unplugged.
- Remove fuse.
- Jumper between CPP connector contacts for Circuits 306 (T/LB) and 640 (W/P) (two middle pins).
- Confirm that NGS Tester PID CPP shows OFF.
- Wiggle connector and wires while watching CPP on NGS Tester.

Does PID switch between OFF and ON?

Yes	No
REPAIR circuitry at point of intermittent contact with B+ source. INSTALL fuse. RESTORE system. CLEAR DTCs and RETEST.	Intermittent not detected. RESTORE system. CLEAR DTCs and RETEST.

FD: Brake Lamp Switch
Introduction

FD: Pinpoint Tests

Note

Enter this pinpoint test only when directed here from symptom flowcharts.

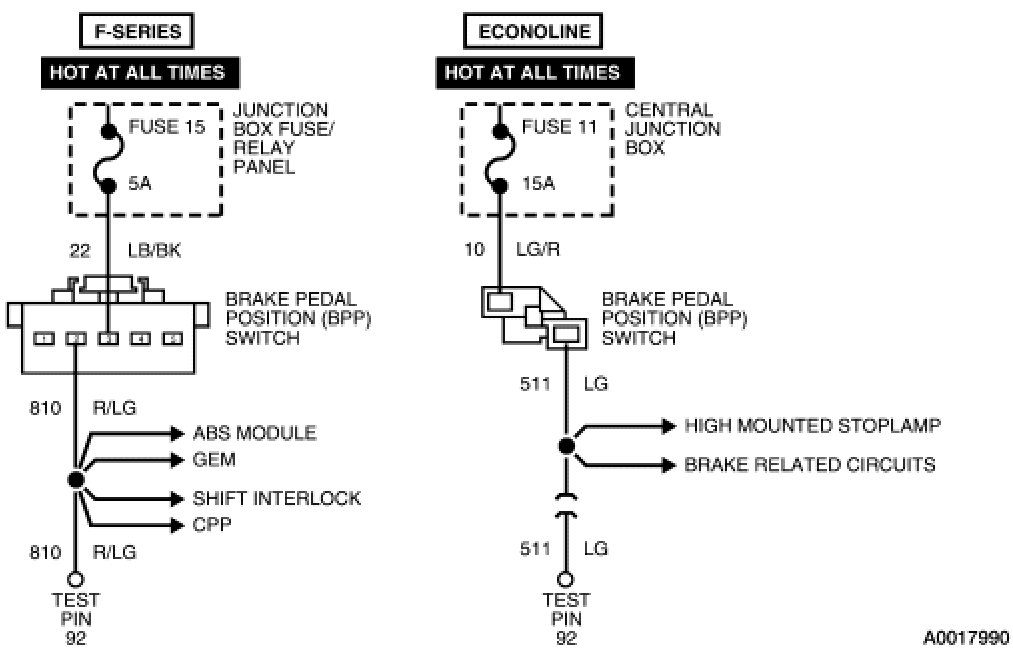
Remember

This pinpoint test is intended to diagnose only the following:

- brake on/off (BPP) circuit
- powertrain control module (PCM) (12A650)

Description

The brake lamp switch (BPP) input is wired to the stoplamp circuit and informs the PCM when the brake is applied. The BPP input is used to disengage the speed control system.



DTC Description

P0703 = Brake Switch B circuit malfunction

FD1 DIAGNOSTIC TROUBLE CODE (DTC) P0703

Note: When performing KOER switch test, wait five seconds after pressing the trigger to start the test before running through the driver operated controls. The test may also take up to five minutes to complete.

Note: No PID transition indicates a BPP circuit failure.

- Key on, engine off.
- Firmly cycle brake pedal.
- Access BPP PID.

Does PID read ON only?

Yes	No
GO to FD2 .	GO to FD4 .

FD2 CHECK FOR BPP SWITCH FAILED CLOSED

- Disconnect brake lamp switch.
- Key off.

Did PID go to OFF?

Yes	No
REPLACE brake lamp switch.	GO to FD3 .

FD3 CHECK FOR SHORT TO B+ IN SWITCH OUTPUT CIRCUIT

- Disconnect PCM.
- Key on, engine off.
- Check voltage between Circuit 511 (LG) for Econoline or 810 (R/LG) for F-Series brake lamp switch harness connector and chassis ground.
- Key off.

Was B+ present?

Yes	No
REPAIR short to B+ in Circuits 511 (LG) or 810 (R/LG).	Short to B+ is at Pin 92 in PCM. SERVICE as necessary. GO to FD12 .

FD4 CHECK PID BPP

Does PID read OFF only?

Yes	No
F-Series, GO to FD5 . Econoline, GO to FD6 .	Fault may be intermittent. GO to FD13 .

FD5 CHECK FUSE 15 (15 AMP)

- Check Fuse 15 (15 amp) in IP fuse panel.

Is Fuse 15 OK?

Yes	No
LOOK for open circuit. GO to FD9 .	THROW away fuse. TEST for short to ground. GO to FD7 .

FD6 CHECK FUSE 11 (15 AMP)

- Check Fuse 11 (15 amp) in IP fuse panel.

Is Fuse 1 OK?

Yes	No
GO to FD9 .	THROW away fuse. TEST for possible short to ground. GO to FD7 .

FD7 CHECK BATTERY INPUT CIRCUIT TO BPP SWITCH

- Key off.
- Disconnect wiring at BPP brake lamp switch.
- Check resistance between Circuit 10 (LG/R) for Econoline or 22 (LB/BK) for F-Series, and chassis ground.

Is resistance less than 10,000 ohms?

Yes	No
REPAIR short to ground in Circuits 22 (LB/BK) or 10 (LG/R). REPLACE Fuse 15	GO to FD8 .

(15A). RESTORE system. CLEAR DTCs and RETEST.	

FD8 CHECK FOR SHORT TO GROUND IN BPP SWITCH OUTPUT CIRCUIT

- Disconnect PCM.
- Key on, engine off.
- Check resistance between Circuit 511 (LG) for Econoline or 810 (R/LG) for F-Series at brake lamp switch harness connector, and chassis ground.

Is resistance less than 10,000 ohms?

Yes	No
REPAIR short to ground in Circuits 511 (LG) or 810 (R/LG). RESTORE system. CLEAR DTCs and RETEST.	Short to ground is at PCM Pin 92. SERVICE as necessary. GO to FD12 .

FD9 CHECK BATTERY INPUT CIRCUIT TO BPP SWITCH FOR OPEN

- Key off.
- Disconnect brake lamp switch.
- Check resistance between Circuit 10 (LG/R) for Econoline or 22 (LB/BK) for F-Series, and fuse contact.

Is resistance less than 5 ohms?

Yes	No
Circuit 10 (LG/R) is OK. GO to FD10 .	REPAIR open in Circuits 22 (LB/BK) or 10 (LG/R). RESTORE system. CLEAR DTCs and RETEST.

FD10 CHECK BPP SWITCH FOR OPEN

- Key on, engine off.
- Install jumper between brake lamp switch Circuits 511 (LG) and 10 (LG/R) for Econoline, or 810 (R/LG) and 22 (LB/BK) for F-Series.
- Key off.

Did PID read ON?

Yes	No
REPLACE brake lamp switch. RESTORE system. CLEAR DTCs and RETEST.	GO to FD11 .

FD11 CHECK SWITCH OUTPUT CIRCUIT FOR OPEN

- Remove jumper.
- Disconnect PCM.
- Install breakout box; leave PCM disconnected.
- Key on, engine off.
- Check resistance between PCM Test Pin 92 and BPP switch Circuit 511 (LG) for Econoline, or 810 (R/LG) for F-Series.

Is resistance less than 5 ohms?

Yes	No
Circuits 511 (LG) for Econoline or 810 (R/LG) for F-Series are OK. Open is at PCM Pin 92. REPAIR as required. GO to FD12 .	REPAIR open in Circuits 511 (LG) for Econoline or 810 (R/LG) for F-Series. RESTORE system. CLEAR DTCs and RETEST.

FD12 CONFIRM PCM FAULT

Does PID switch between ON and OFF?

Yes	No
System is OK. RESTORE system. CLEAR DTCs and RETEST.	REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.

FD13 CHECKS FOR INTERMITTENT OPEN OR SHORT

- Key off.
- Disconnect wiring at BPP.
- Key on, engine off.
- Install jumper between switch connector Circuits 511 (LG) and 10 (LG/R) for Econoline, or 22 (LB/BK) and 810 (R/LG) for F-Series.
- Confirm BPP PID reads ON and that stoplamps are on.
- Wiggle connectors and wires while observing BPP PID and stoplamps.

Does PID switch between ON and OFF?

Yes	No
REPAIR circuitry at point of intermittent. RESTORE system. CLEAR DTCs and RETEST.	GO to FD14 .

FD14 CHECK FOR INTERMITTENT SHORT TO B+

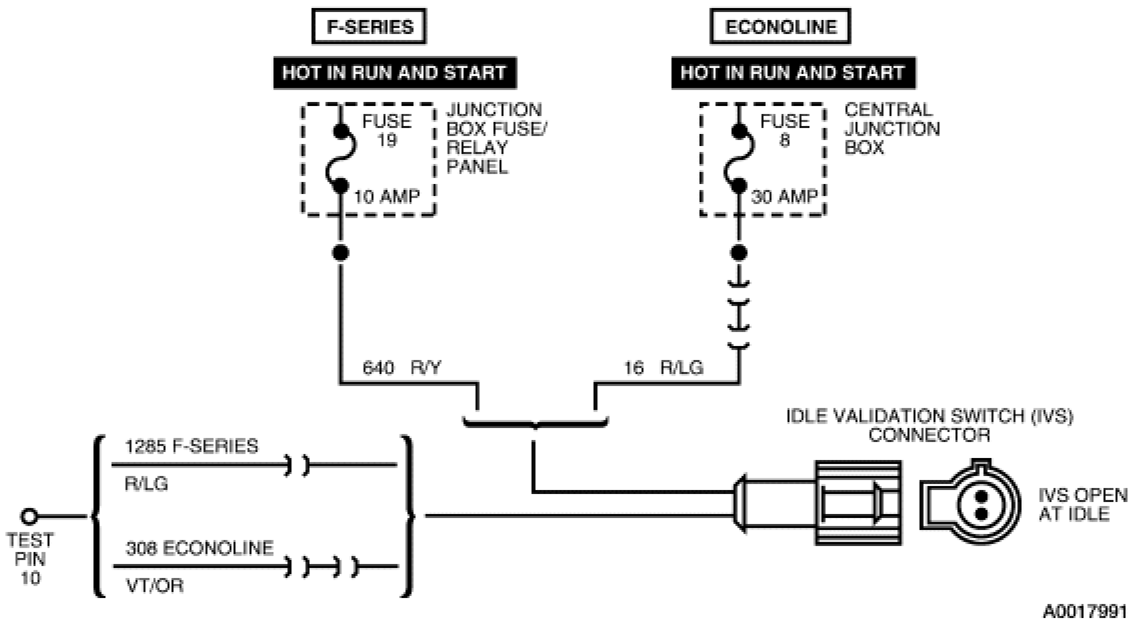
- Remove fuse.
- Confirm BPP PID reads OFF and that stoplamps are off.
- Wiggle connector and wires while watching BPP PID and stoplamps.

Does PID switch between OFF and ON?

Yes	No
REPAIR circuitry at point of intermittent contact with B+ source. INSTALL fuse. RESTORE system. CLEAR DTCs and RETEST.	Intermittent not detected. RESTORE system. CLEAR DTCs and RETEST.

FE: Idle Validation Switch (IVS)
Introduction

FE: Pinpoint Tests



Signal Functions

The idle validation switch (IVS) provides the powertrain control module (PCM) with a signal to verify when the accelerator pedal is in the idle position.

Detection/Management

Any detected malfunction of the IVS will illuminate the CHECK ENGINE light.

DTC Description

P0220 = Throttle switch B circuit malfunction

P0221 = Throttle switch B circuit performance

FE: Pinpoint Tests

FE1 DIAGNOSTIC TROUBLE CODE (DTC) P0221, P0220

Note: When performing KOER switch test, wait five seconds after pressing the trigger to start the test before running through the driver-operated controls. The test may take up to five minutes to complete.

- Possible Causes:
  - blown fuse
  - open in powering circuit to IVS switch
  - open in IVS circuit
  - IVS switch
  - IVS transition out of range
- Key on, engine off.
- Access AP and IVS PID.
- Foot off accelerator pedal.

Does the IVS PID read ON?

Yes	No
GO to FE7 .	GO to FE2 .

FE2 IVS TRANSITION VOLTAGE CHECK

- Depress accelerator pedal slowly while observing IVS state and AP voltage.

Does the IVS switch ON between 0.40 V and 1.6 V?

Yes	No
CLEAR DTCs and RETEST. If code is still present, REPLACE PCM.	GO to FE3 .

FE3 IVS CHECK

- Fully depress accelerator pedal while observing IVS.

Does IVS PID go ON at any pedal travel?

Yes	No
REPLACE accelerator pedal. CLEAR DTCs and RETEST.	GO to FE4 .

FE4 IVS RESISTANCE CHECK

- Key off.
- Disconnect IVS connector.
- Measure resistance across IVS on accelerator pedal with accelerator pedal depressed.

Is resistance less than 5 ohms?

Yes	No
GO to FE5 .	REPLACE accelerator pedal assembly. RESTORE system. CLEAR DTCs and RETEST.

FE5 CHECK IVS POWER CIRCUIT

- Key on, engine off.
- Measure voltage on powering circuit going to IVS between connector and ground.

Is B+ present?

Yes	No
GO to FE6 .	REPLACE fuse or REPAIR open in powering circuit to IVS switch. RESTORE system. CLEAR DTCs and RETEST.

FE6 CHECK SIGNAL RETURN CIRCUIT FOR OPEN

- Install breakout box; leave PCM disconnected.
- Measure resistance between Circuit 1285 (R/LG) for Econoline or 308 (R/DG) for F-Series at IVS connector and PCM Test Pin 10.

Is resistance less then 5 ohms?

Yes	No
REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.	REPAIR open in Circuit 1285 (R/LG) or 308 (R/DG). RESTORE system. CLEAR DTCs and RETEST.

FE7 CHECK SIGNAL RETURN CIRCUIT SHORT TO POWER

- Disconnect IVS connector.

Does IVS PID read OFF?

Yes	No
REPLACE accelerator pedal. RESTORE system. CLEAR DTCs and RETEST.	REPAIR short to power in IVS Circuit 1285 (R/LG) for Econoline or 308 (VT/OR) for F-

	Series. RESTORE system. CLEAR DTCs and RETEST.

FF: Parking Brake Applied (PBA) Switch Introduction

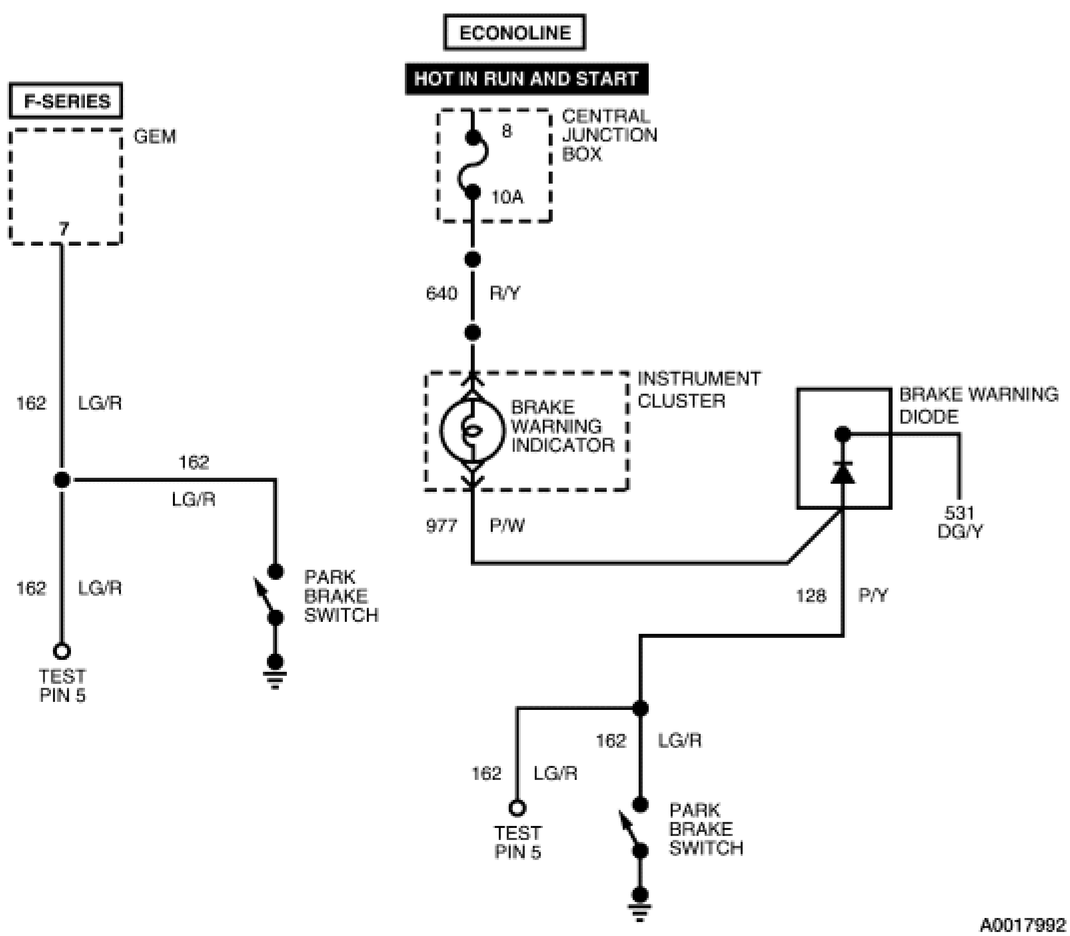
FF: Pinpoint Tests

Note

Enter this pinpoint test only when directed here from symptom flowcharts.

Description

The parking brake applied (PBA) switch detects when the parking brake is applied to enable the PTO/raised-Idle mode.



DTC Description

P1536 = Parking brake applied fail

FF: Pinpoint Tests

FF1 DIAGNOSTIC TROUBLE CODE (DTC) P1536

Note: When performing KOER switch test, wait five seconds after pressing the trigger to start the test before running through the driver operated controls. The test may also take up to five minutes to complete.

- DTC P1536 is set when the PCM does not see a PBA state change during KOER.
- Possible causes:
  - low brake fluid
  - short to ground
  - short to B+
  - open circuit
- Confirm BRAKE WARNING and RABS light are working during engine start mode (bulb check).

Are bulbs working?

Yes	No
GO to FF2 .	REPAIR bulbs circuitry: Circuit 977 (P/W) (possible short to B+) and Circuit 640 (R/Y). CONFIRM fix with Bulb Check during start mode.

FF2 CHECK FOR BRAKE SYSTEM PROBLEM

- Key on, engine off.
- Parking brake fully off.

Are both BRAKE WARNING and RABS lights on?

Yes	No
REPAIR brake system. CLEAR DTCs and	GO to FF3 .

RETEST.	

FF3 CHECK PID PBA

Note: No PID transition indicates a PBA circuit failure.

- Access PBA PID.
- Cycle parking brake.

Does PID read ON only?

Yes	No
GO to FF4 .	GO to FF6 .

FF4 CHECK FOR PBA SWITCH FAILED CLOSED

- Parking brake fully up.
- Disconnect PBA switch.

Does PID go to OFF?

Yes	No
REPLACE PBA switch. RESTORE system. CLEAR DTCs and RETEST.	GO to FF5 .

FF5 CHECK PARKING BRAKE SWITCH SIDE OF CIRCUIT FOR SHORT TO GROUND

- Key off.
- Disconnect PCM.
- Measure resistance between Circuit 977 (P/W) for Econoline or 162 (LG/R) for F-Series on PBA harness connector, and chassis ground.

Is resistance less than 10,000 ohms?

Yes	No
REPAIR short to ground in Circuits 977 (P/W) for Econoline or 162 (LG/R) for F-Series. RESTORE system. CLEAR DTCs and RETEST.	Short to ground is at PCM Pin 4 (49 State except Econoline) or Pin 5 (California and all Econoline). REPAIR as necessary. GO to FF9 .

FF6 CHECK PID PBA

- Cycle parking brake.

Does PID read OFF only?

Yes	No
Open circuit. GO to FF7 .	Fault may be intermittent. GO to FF10 .

FF7 CHECK PBA SWITCH AND CIRCUIT LEAD FOR OPEN

- Disconnect PBA switch.
- Install jumper between PBA Circuit 977 (P/W) for F-Series or 162 (LG/R) for Econoline and ground.

Does PID read ON?

Yes	No
REPLACE PBA switch. RESTORE system. CLEAR DTCs and RETEST.	GO to FF8 .

FF8 CHECK PARKING BRAKE SWITCH SIDE OF CIRCUIT LEAD FOR OPEN

- Key off.
- Install breakout box; leave PCM disconnected.
- Key on, engine off.
- Measure voltage between PCM Pin 5 and chassis ground.

Is B+ present?

Yes	No
Circuits 977 (P/W) of Econoline or 162 (LG/R) for F-Series are OK. Open is at PCM Pin. RESTORE system. CLEAR DTCs and RETEST. REPAIR as required. GO to FF9 .	REPAIR open in Circuit 162 (LG/R), DRL jumper, or Circuit 977 (P/W) PBA switch lead. RESTORE system. CLEAR DTCs and RETEST.

FF9 CONFIRM PCM FAULT

- Cycle parking brake.

Does PID switch between ON and OFF?

Yes	No
System is OK.	REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.

FF10 CHECK FOR INTERMITTENT SHORT TO GROUND

- Disconnect PBA switch.
- Confirm PBA PID reads OFF.
- Wiggle connectors and wires while watching PBA PID.

Does PID switch between OFF and ON?

Yes	No
REPAIR circuitry at point of intermittent. RESTORE system. CLEAR DTCs and RETEST.	GO to FF11 .

FF11 CHECK FOR INTERMITTENT OPEN

- Engage parking brake.
- Confirm PBA PID reads ON.
- Wiggle connector and wires while watching PBA PID.

Does PID switch between ON and OFF?

Yes	No
REPAIR circuitry at point of intermittent open. RESTORE system. CLEAR DTCs and RETEST.	Intermittent not detected. RESTORE system. CLEAR DTCs and RETEST.

FG: Speed Control Command Switch (SCCS) Introduction

FG: Pinpoint Tests

Note

Enter this pinpoint test only when directed here from the symptom flowcharts.

Remember

If the SCCS fails the switch test or vehicle speed is not being received by the PCM, the speed control will not operate.

This pinpoint test is intended to diagnose only the following:

- harness circuits: speed control command switch (SCCS)
- speed control switches
- powertrain control module (PCM) (12A650)

Description

The speed control function is integrated in the PCM. The speed control command switches are momentary switches which are located on the face of the steering wheel. They consist of one ON-OFF toggle switch and one three-position SET/ACCEL-COAST-RESUME switch. These switches, when depressed, select one of several resistance values to the PCM to select speed control functions. After pressing trigger, wait at least five seconds to depress accelerator pedal.

DTC Descriptions

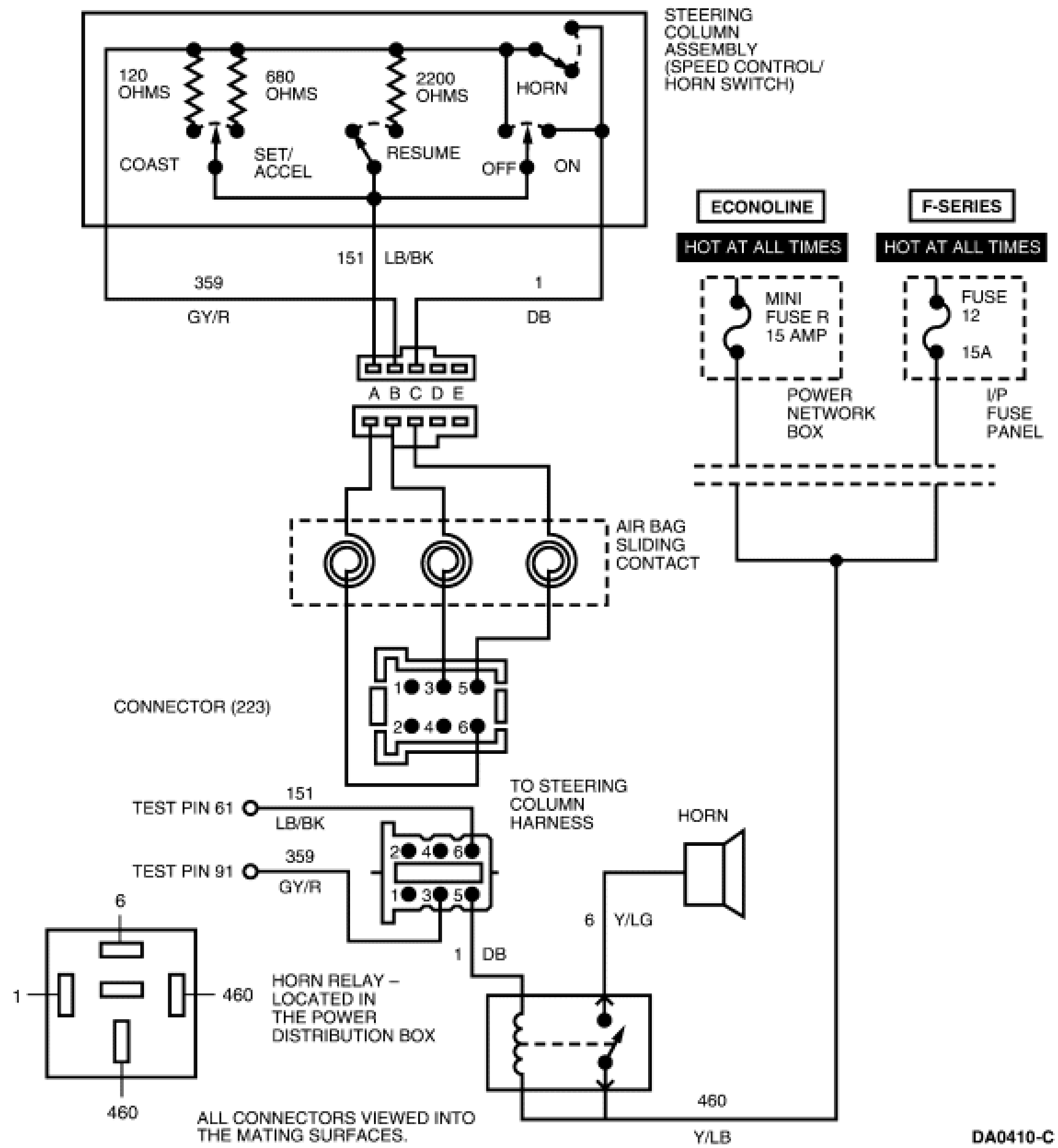
P0565 = Speed control ON. Not pressed — KOER Switch Test.

P0566 = Speed control OFF. Not pressed — KOER Switch Test.

P0567 = Speed control RESUME. Not pressed — KOER Switch Test.

P0568 = Speed control SET. Not pressed — KOER Switch Test.

P0569 = Speed control COAST. Not pressed — KOER Switch Test.



FG: Pinpoint Tests

FG1 DIAGNOSTIC TROUBLE CODES (DTCs) P0565/P0566/P0567/P0568/P0569

Note: When performing KOER switch test, wait five seconds after pressing the trigger to start the test before running through the driver operated controls. The test may also take up to five minutes to complete.

- DTCs P0565, P0566, P0567, P0568 and P0569 are set if the PCM does not detect when a switch has been pressed during the KOER switch test.
- Possible causes:
  - switch not depressed during test
  - worn or damaged speed control switch
  - open, grounded, or short to power in SCCS circuit
  - open or short in SC GND circuit
  - open in power supply circuit
- Access SCCS PID.
- Key on, engine off.
- No switches depressed.

Is voltage reading 6.68 V ± 0.1?

Yes	No
GO to FG2 .	If voltage reading is 10 V, GO to FG5 . If voltage reading is 0 V, GO to FG8 .

FG2 SWITCH ON FUNCTION CHECK

- Press ON switch.

Does scan tool read 10 V?

Yes	No
GO to FG3 .	GO to FG11 .

FG3 SWITCH OFF FUNCTION CHECK

- Press OFF switch.

Does scan tool read 0 V?

Yes	No
GO to FG4 .	GO to FG17 .

FG4 COMMAND SWITCHES FUNCTION

- Press RESUME, COAST, SET/ACCEL switches.
- Observe voltage reading as each switch is depressed.
- Refer to Section 2 , Diagnostic Methods, Parameter Identification (PID), Driver Operated Controls Check Chart for voltage specifications supplied for SCCS M PID.

Do voltage readings agree with voltage values in driver operated controls check chart ± 0.2 V?

Yes	No
RERUN KOER switch test. If code is still present, REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.	REPLACE speed control switch assembly. RESTORE system. CLEAR DTCs and RETEST.

FG5 SHORTED COMMAND SWITCH CHECK

- Remove horn pad.
- Disconnect 3-way (F-Series) or 5-way (Econoline) speed control switch harness connector.

Is voltage reading 6.68 V ± 0.1?

Yes	No
REPLACE speed control switch assembly. RESTORE system. CLEAR DTCs and RETEST.	GO to FG6 .

FG6 AIR BAG SLIDING CONTACT CHECK

- Disconnect air bag sliding contact connector C219 (F-Series) or C223 (Econoline).

Is voltage reading 6.68 V ± 0.1?

Yes	No
REPLACE air bag sliding contact. RESTORE system. CLEAR DTCs and RETEST.	GO to FG7 .

FG7 SIGNAL CIRCUIT CHECK

- Key off.
- Install breakout box; leave PCM disconnected.
- Key on, engine off.
- Measure voltage between PCM Test Pin 61 and ground.

Is voltage reading 0 V?

Yes	No
REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.	REPAIR short to power in Circuit 151 (LB/BK). RESTORE system. CLEAR DTCs and RETEST.

FG8 CHECK SHORTED COMMAND SWITCH

- Remove horn pad.
- Disconnect 3-way (F-Series) or 5-way (Econoline) speed control switch harness connector.

Is voltage reading 6.68 V ± 0.1?

Yes	No
REPLACE speed control switch assembly. RESTORE system. CLEAR DTCs and RETEST.	GO to FG9 .

FG9 CHECK AIR BAG SLIDING CONTACT

- Disconnect air bag sliding contact connector C219 (F-Series) or C223 (Econoline).

Is voltage reading 6.68 V ± 0.1?

Yes	No
REPLACE air bag sliding contact. RESTORE system. CLEAR DTCs and RETEST.	GO to FG10 .

FG10 CHECK SIGNAL CIRCUIT

- Key off.
- Install breakout box; leave PCM disconnected.
- Measure resistance between PCM Test Pin 61 and PCM Test Pins 25, 51, 76, 77 and 103.

Is each resistance reading greater than 10,000 ohms?

Yes	No
REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.	REPAIR short to ground in Circuit 151 (LB/BK). RESTORE system. CLEAR DTCs and RETEST.

FG11 CHECK FUSE

- Key off.

- Remove Fuse 27 (15 amp) for Econoline or Fuse 12 (15 amp) for F-Series from power distribution box.

Is Fuse R OK?

Yes	No
GO to FG12 .	REPLACE Fuse R. RESTORE system. CLEAR DTCs and RETEST.

FG12 CHECK CONTINUITY FROM FUSE TO HORN PAD

- Remove horn pad.
- Disconnect 5-way speed control switch harness connector.
- Measure resistance between non-power side of Fuse 27 for Econoline or Fuse 12 for F-Series, and Pin C of air bag sliding contact in column (refer to schematic at beginning of this pinpoint test for pin orientation).

Is resistance less than 75 ohms?

Yes	No
GO to FG13 .	GO to FG16 .

FG13 CHECK SPEED CONTROL SWITCH

- Measure resistance between Pin A and Pin C on horn assembly harness.
- Press ON switch.

Is resistance less than 5 ohms?

Yes	No
GO to FG14 .	REPLACE speed control switch assembly. RESTORE system. CLEAR DTCs and RETEST.

FG14 CHECK CIRCUIT 151 (LB/BK) FOR OPEN

- Disconnect air bag sliding contact connector C223.
- Measure resistance between Pin 61 and Circuit 151 (LB/BK) Pin 6 at vehicle harness side of connector C223.

Is resistance less than 5 ohms?

Yes	No
GO to FG15 .	REPAIR open in Circuit 151 (LB/BK). RESTORE system. CLEAR DTCs and RETEST.

FG15 CHECK AIR BAG SLIDING CONTACT CIRCUIT

- Measure resistance between Pin C and Pin 5 of air bag sliding contact side of connector C223 (refer to schematic at beginning of this pinpoint test for pin orientation).

Is resistance less than 5 ohms?

Yes	No
REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.	REPLACE air bag sliding contact. RESTORE system. CLEAR DTCs and RETEST.

FG16 RESISTANCE CHECK ACROSS AIR BAG SLIDING CONTACT

- Disconnect air bag sliding contact connector C223.
- Measure resistance between Pin B and Pin 5 on air bag sliding contact connector C223 column side.

Is resistance less than 5 ohms?

Yes	No
REPAIR open in Circuit 1 (DB), 460 (Y/LB), or the horn relay. RESTORE system. CLEAR DTCs and RETEST.	REPLACE air bag sliding contact. RESTORE system. CLEAR DTCs and RETEST.

FG17 GROUND CHECK AT SWITCH

- Remove horn pad.
- Disconnect 5-way speed control switch harness connector.
- Measure voltage between Pin B and Pin C of the air bag sliding contact connector C223 in column.

Does voltage reading indicate B+?

Yes	No
REPLACE speed control switch assembly. RESTORE system. CLEAR DTCs and RETEST.	GO to FG18 .

FG18 CHECK AIR BAG SLIDING CONTACT FOR OPEN

- Key off.
- Disconnect air bag sliding contact connector C223.
- Measure resistance between Pin B and Pin 3 on air bag sliding contact side of connector C223 (refer to schematic at beginning of this pinpoint test for pin orientation).

Is resistance less than 5 ohms?

Yes	No
GO to FG19 .	REPLACE air bag sliding contact. RESTORE system. CLEAR DTCs and RETEST.

FG19 CHECK FOR OPEN IN CIRCUIT 563 (O/Y)

- Install breakout box; leave PCM disconnected.
- Measure resistance between Circuit 848 (G/O) Pin 3 at vehicle harness side of connector C223 and PCM Test Pin 40.

Is resistance less than 5 ohms?

Yes	No
REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.	REPAIR open in Circuit 848 (G/O) between PCM and connector C223. RESTORE system. CLEAR DTCs and RETEST.

FH: 4x4 Low
Introduction

FH: Pinpoint Tests

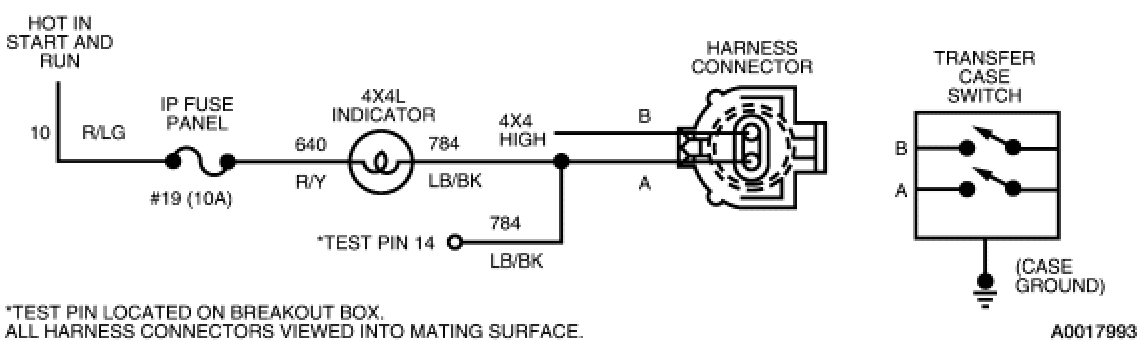
Note

Enter this pinpoint test only when directed here.

Remember

This pinpoint test is intended to diagnose the following:

- harness circuits and fuse for 4x4 low
- powertrain control module (PCM) (12A650)
- 4x4 low switch



DTC Description

P1729 = 4x4 low switch error

P1781 = 4x4L circuit out of self test range

FH: Pinpoint Tests

FH1 DIAGNOSTIC TROUBLE CODES (DTCs) P1729 AND P1781: PERFORM SWITCH FUNCTIONAL CHECK

- Key on, engine off.
- Switch to and from 4x4L while monitoring the 4x4L indicator.

Does the indicator agree with the lever position?

Yes	No
GO to FH2 .	GO to FH4 .

FH2 CHECK 4X4 LOW

- Key on, engine off.
- Access 4x4L PID.
- Switch to and from 4x4L while monitoring the PID.

Does PID agree with the lever position?

Yes	No
GO to FH3 .	GO to FH11 .

FH3 INTERMITTENT PROBLEM

- Key on, engine off.
- Wiggle all circuits for 4x4L while monitoring the PID.

Does the PID change states during the wiggle test?

Yes	No
REPAIR failure in circuitry. CLEAR DTCs and RETEST.	Unable to duplicate error at this time. CLEAR DTCs and RETEST.

FH4 VOLTAGE CHECK AT SWITCH

- Key on, engine off.
- Disconnect 2-way to 4x4L switch.
- Measure voltage at 4x4L switch Pin A.

Is voltage greater than 10.5 volts?

Yes	No
REPLACE 4x4L switch. RESTORE system. CLEAR DTCs and RETEST.	GO to FH5 .

FH5 LIGHT ALWAYS ON?

- Disconnect 4x4L harness.
- Shift to and from 4x4L.

Does the light remain ON regardless of lever position?

Yes	No
REPAIR short to ground between indicator light and switch connector. RESTORE system. CLEAR DTCs and RETEST.	GO to FH6 .

FH6 CHECK VOLTAGE AT FUSE

- Measure voltage to ground at both sides of the fuse.

Is voltage greater than 10.5 volts?

Yes	No
GO to FH9 .	GO to FH7 .

FH7 MAIN POWER FEED TO FUSE

- Measure voltage to ground at the battery side of the fuse.

Is voltage greater than 10.5 volts?

Yes	No
GO to FH8 .	REPAIR voltage source. RESTORE system. CLEAR DTCs and RETEST.

FH8 CHECK SHORT TO GROUND

- 4x4 lever not in LOW position.
- Key off.
- Measure resistance to ground on Circuit 640 (R/Y).

Is the resistance greater than 10,000 ohms?

Yes	No
REPLACE fuse. RESTORE system.	REPAIR short circuit to ground. REPLACE

CLEAR DTCs and RETEST.	fuse. RESTORE system. CLEAR DTCs and RETEST.

FH9 CHECK 4X4L BULB

- Key off.
- Remove the 4x4L indicator light.

Is the indicator bulb OK?

Yes	No
GO to FH10 .	REPLACE bulb. RESTORE system. CLEAR DTCs and RETEST.

FH10 CHECK VOLTAGE AT INDICATOR LAMP

- Key on, engine off.
- Shift out of 4x4 low.
- Measure voltage between input Circuit 640 (R/Y) and indicator lamp

Is voltage greater than 10.5 volts?

Yes	No
REPAIR open in Circuit 784 (LB/BK) to switch connector. RESTORE system. CLEAR DTCs and RETEST.	REPAIR open in Circuit 640 (R/Y) to lamp. RESTORE system. CLEAR DTCs and RETEST.

FH11 CHECK CIRCUIT 784 (LB/BK) FOR CONTINUITY

- Key off.
- Install breakout box; leave PCM disconnected.
- Measure resistance between PCM Test Pin 14 and Pin A.

Is the resistance less than 5 ohms?

Yes	No
GO to FH12 .	REPAIR open in Circuit 784 (LB/BK). RESTORE system. CLEAR DTCs and RETEST.

FH12 CHECK SHORT TO GROUND IN CIRCUIT 784 (LB/BK)

- Measure resistance to ground from Circuit 784 (LB/BK) at Pin A.

Is resistance less than 10,000 ohms?

Yes	No
REPAIR short to ground in circuit. RESTORE system. CLEAR DTCs and RETEST.	REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.

FJ: IDM Electronic Feedback (EF)
Introduction

FJ: Pinpoint Tests

Note

Enter this pinpoint test only when directed here from the symptom flowcharts.

Remember

This pinpoint test is intended to diagnose only the following:

- powertrain control module (PCM) (12A650)
- injector driver module (IDM)
- harness circuits: EF

Description The IDM provides the EF output signal to the PCM to confirm that proper timing/duration of fuel delivery command signal (FDCS) was received. Additionally, the EF signal is used to send diagnostics of the IDM and injectors (electrical) to the PCM.

DTC Description

P1668 = PCM-IDM diagnostic communication error

P1670 = Electronic feedback signal not detected

P1316 = Indicates that IDM DTCs are stored within the IDM

FJ: Pinpoint Tests

FJ1 DIAGNOSTIC TROUBLE CODE (DTC) P1670 and P1668

- DTC P1668 and P1670 indicates that a communication error has occurred between the PCM and the IDM.
- Possible causes:
  - Open fuse
  - IDM relay
  - Open or shorted IDM enable circuit
  - Open/short in EF circuit
  - Open/short in FDCS circuit
  - IDM powering circuits
  - PCM
- Check for other codes.
- Key on, engine off.
- Perform KOEO On-Demand Self Test and retrieve Continuous DTCs.

Was DTC P1668 present?

Yes	No
If DTC P1668 is present, GO to FJ2 .	If DTCs P1667 and P1663 are set together with or without DTC P1668, GO to FJ6 . If DTC P1298 is also present, REPLACE the IDM. If DTC P1667 is also present, GO to KA1 . If DTC P1663 is also present, GO to KF1 . If DTC P1662 is also present, GO to NC1 . If P1670 was set without any other DTC, GO to FJ10 .

FJ2 CHECK CIRCUIT 818 (GY/W) FOR OPEN

- Install breakout box; leave PCM disconnected.
- Disconnect the IDM harness connector.
- Measure resistance on Circuit 818 (GY/W) between PCM Test Pin 48 and IDM harness connector Pin 4.

Is resistance less than 5 ohms?

Yes	No
GO to FJ3 .	REPAIR open in Circuit 818 (GY/W). RESTORE system. CLEAR DTCs and RETEST.

FJ3 CHECK CIRCUIT 818 (GY/W) FOR SHORT TO GROUND

- Measure resistance between IDM relay Circuit 818 (GY/W) and battery ground.

Is resistance greater than 10,000 ohms?

Yes	No
GO to FJ4 .	REPAIR ground short in Circuit 818 (GY/W). RESTORE system. CLEAR DTCs and RETEST.

FJ4 CHECK CIRCUIT 818 (GY/W) FOR SHORT TO POWER

- Key on, engine off.
- Measure for voltage on Circuit 818 (GY/W) between PCM Test Pin 48 and battery ground.

Is voltage present?

Yes	No
REPAIR short to power on Circuit 818 (GY/W). RESTORE system. CLEAR DTCs and RETEST.	GO to FJ5 .

FJ5 CHECK SIGNAL RETURN CIRCUIT 359 (GY/R)

- Turn ignition switch to OFF.
- Measure resistance on Circuit 359 (GY/R) between PCM Test Pin 91 and IDM connector Pin 2.

Is resistance less than 5 ohms?

Yes	No
GO to FJ6 .	REPAIR open in signal return Circuit 359 (GY/R). RESTORE system. CLEAR DTCs and RETEST.

FJ6 CHECK IDM POWER

- PCM connected, IDM disconnected.

- Key on, engine off.
- Measure voltage between IDM connector Pin 14 and battery ground.

Is B+ present?

Yes	No
GO to FJ7 .	GO to NC6 .

FJ7 CHECK IDM GROUND

- Key off.
- Measure resistance between IDM connector Pin 26 and battery ground.

Is resistance less than 5 ohms?

Yes	No
GO to FJ8 .	REPAIR open in IDM ground Circuit 574 (BK/PK). RESTORE system. CLEAR DTCs and RETEST.

FJ8 MEASURE FREQUENCY ON THE EF LINE

- Connect PCM to breakout box.
- IDM connected to harness.
- Set up NGS Scan tool as follows:
  - Connect NGS Tester to the DLC
  - Connect test probe between NGS common and breakout box Pin 77 (ground).
  - Connect second test probe between NGS signal and breakout box Pin 48 (EF line).
  - Select VEHICLE and ENGINE
  - Select DIGITAL MEASUREMENT SYSTEM
  - Change level to 4 VOLT DC
  - Press the link button to choose a PID
  - Select PID/DATA MONITOR
  - Select RPM PID
  - Press START
- Key on, engine running.
- Measure frequency at 3 different RPMs.

rpm	Frequency (Hz)
1000	66
2000	133
3000	200

-

For each rpm value, does the corresponding frequency match closely to the table?

Yes	No
REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.	REPLACE IDM. RESTORE system. CLEAR DTCs and RETEST.

FJ9 DIAGNOSTIC TROUBLE CODE (DTC) P1316 INDICATES THAT CODES ARE STORED IN THE IDM

- Possible causes:
  - Injector(s) or circuit(s)
  - Open or shorted IDM enable circuit
  - Open/short in EF circuit
  - Open/short in FDCS circuit
  - IDM relay
  - IDM powering circuits
  - IDM
  - PCM
- Check for other codes.
- Key on, engine off.
- Perform KOEO On-Demand Self Test.

Are IDM or any other codes stored?

Yes	No
GO to the appropriate pinpoint test.	GO to FJ10 .

FJ10 DTC P1316 OR P1670, CHECK FOR AN INTERMITTENT OPEN CIRCUIT

- Key off.
- Install breakout box, leave PCM disconnected.
- Disconnect IDM.
- Check for intermittent open in the following circuits:
  - Measure resistance on (FDCS) Circuit 821 (BR/O) between IDM connector Pin 17 and PCM Test Pin 95.
  - Measure resistance on (EF) Circuit 818 (GY/W) between IDM connector Pin 4 and PCM Test Pin 48.
- Grasp the harness close to the IDM connector. Wiggle, shake the harness while working your way back to the PCM, while looking for a spike on the DVOM.

Do all readings remain below 5 ohms throughout procedure?

Yes	No
GO to FJ11 .	REPAIR open in the suspect circuit. RESTORE vehicle. CLEAR DTCs and RETEST.

FJ11 CHECK FOR AN INTERMITTENT SHORT TO GROUND

- Check for intermittent short to ground on the following circuits:
  - Measure resistance on (FDCS) Circuit 821 (BR/O) between battery ground and PCM Test Pin 95.
  - Measure resistance on (EF) Circuit 818 (GY/W) between battery ground and PCM Test Pin 48.
- Grasp the harness close to the IDM connector. Wiggle, shake the harness while working your way back to the PCM, while looking for a spike on the DVOM.

Do all readings remain above 10,000 ohms throughout procedure?

Yes	No
GO to FJ12 .	REPAIR short to ground on the suspect circuit. RESTORE vehicle. CLEAR DTCs and RETEST.

FJ12 CHECK FOR AN INTERMITTENT SHORT TO POWER

- Key on, engine off.
- Check for intermittent short to power on the following circuits:
  - Measure voltage on (FDCS) Circuit 821 (BR/O) between battery ground and PCM Test Pin 95.
  - Measure voltage on (EF) Circuit 818 (GY/W) between battery ground and PCM Test Pin 48.
- Grasp the harness close to the IDM connector. Wiggle, shake the harness while working your way back to the PCM, while looking for a spike on the DVOM.

Did voltage ever appear on any circuit throughout procedure?

Yes	No
REPAIR short to ground on the suspect circuit. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to FJ13 .

FJ13 VERIFY DTC P1316 AND/OR P1670

- Restore vehicle.
- Clear DTCs.
- Cycle key off, than start engine.
- Road test vehicle.
- Perform KOEO On-Demand Self Test and retrieve Continuous DTCs.

Was DTC P1316 and/or P1670 set in Continuous without any codes in KOEO On-Demand?

Yes	No
GO to FJ14 .	REPAIR KOEO On-Demand DTCs. RESTORE vehicle. CLEAR DTCs and RETEST.

FJ14 ATTEMPT TO GENERATE IDM DTCS

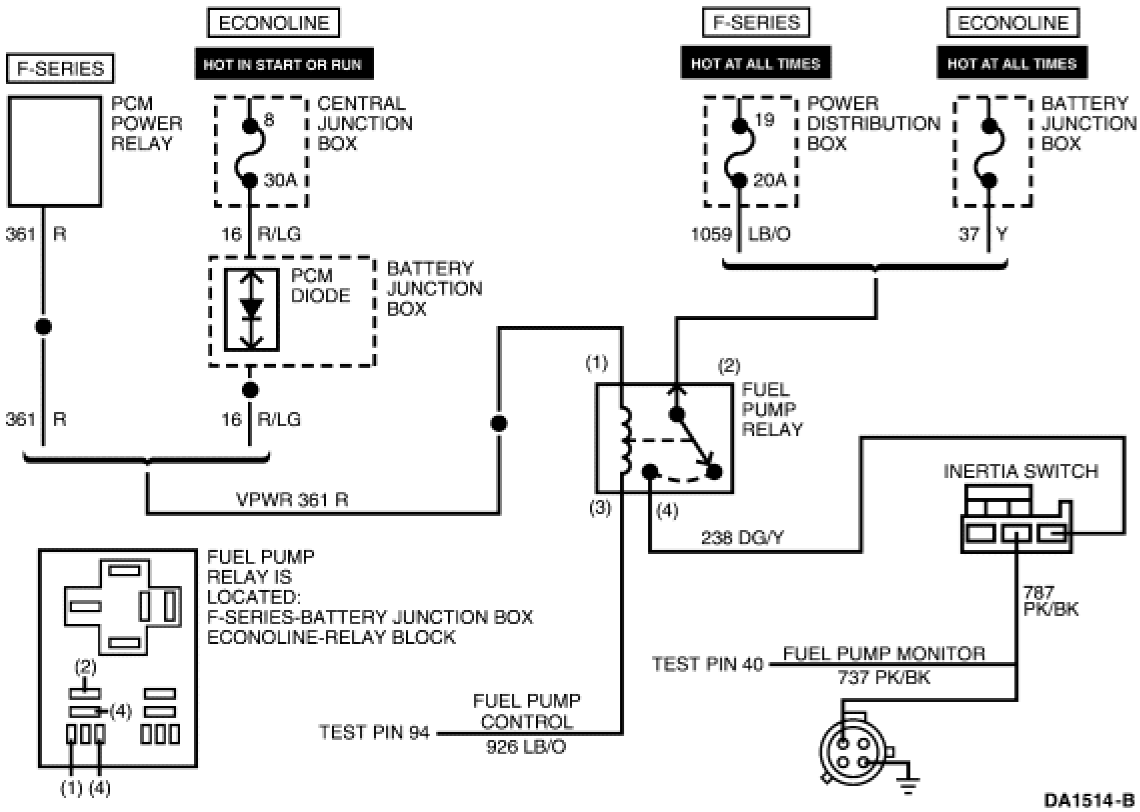
- Key off.
- Disconnect one valve cover connector.
- Start engine to generate IDM codes.
- Perform KOEO Injector Electrical Self Test and KOEO On-Demand Self Test.

Are IDM codes retrieved?

Yes	No
REPLACE PCM, RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE IDM. RESTORE vehicle. CLEAR DTCs and RETEST.

FK: Fuel Pump Monitor/Control
Introduction

FK: Pinpoint Tests



Signal Functions

The fuel pump control (FPC) is the control circuit from the PCM used to energize the fuel pump relay. At key on, the relay is energized for 20 seconds, and all the time when rpm is detected. The fuel pump monitor (FPM) circuit is downstream of the inertia switch and is used by the PCM to monitor voltage going to the fuel pump.

DTC Descriptions

P0230 = Fuel pump relay driver circuit fall

P0231 = Fuel pump relay driver failed on — was not detected on the FPM circuit when the fuel pump was commanded on

P0232 = Fuel pump relay driver failed off — voltage was detected on the FPM circuit when fuel pump was commanded off

FK1 KOEO DIAGNOSTIC TROUBLE CODE P0230

- DTC P0230 indicates that a fault was detected on the fuel pump relay control circuit.
- Possible causes:
  - blown fuse
  - failed F/P relay
  - open fuel pump control circuit
  - failed PCM
- Check fuel pump relay coil power fuse.

Is fuse OK?

Yes	No
GO to FK2 .	REPLACE fuse. CLEAR DTCs and RETEST.

FK2 CHECK RELAY COIL POWER

- Remove fuel pump relay.
- Key on, engine off.
- For F-Series, measure voltage of Circuit 361 (R) between Pin 1 of the fuel pump relay harness connector and ground.
- For Econoline, measure voltage of Circuit 16 (R/LG) between Pin 1 of the fuel pump relay harness connector and ground.
- Key off.

Was voltage greater than 10.5 volts?

Yes	No
GO to FK3 .	REPAIR open in fuel pump relay coil power supply circuit. RESTORE vehicle. CLEAR DTCs and RETEST.

FK3 CHECK RELAY TRIGGER CIRCUIT

Note: At key on, the EEC only grounds Circuit 926 (LB/O) for 20 seconds with engine not running.

- Remove the fuel pump relay.
- Measure resistance of Circuit 926 (LB/O) between Pin 3 of the fuel pump relay harness connector and ground.
- Key on.
- Key off.

Was resistance less than 100 ohms when fuel pump was commanded on?

Yes	No
REPLACE fuel pump relay. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to FK4 .

FK4 CHECK FUEL PUMP CONTROL CIRCUIT FOR OPEN

- Install breakout box; leave PCM disconnected.
- Measure resistance between Pin 3 of the fuel pump relay harness connector and PCM Test Pin 94.

Is resistance less than 5 ohms?

Yes	No
REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR open in relay control Circuit 926 (LB/O). RESTORE vehicle. CLEAR DTCs and RETEST.

FK5 KOEO DIAGNOSTIC TROUBLE CODE P0231

Note: Voltage is present for 20 seconds after key on with engine not running.

- DTC P0231 indicates voltage was not present on fuel pump monitor circuit when the fuel pump was commanded on.
- Possible causes:
  - open inertia switch
  - blown F/P fuse
  - open fuel pump monitor circuit
  - open fuel pump control circuit
  - faulty fuel pump relay
- If DTC P0230 is also present, GO to FK1 .
- Disconnect inertia switch harness connector.
- Key on, engine off.
- Measure voltage of Circuit 238 (DG/Y) between inertia switch harness connector and ground.

Is voltage greater than 10.5 volts?

Yes	No
GO to FK6 .	GO to FK8 .

FK6 CHECK INERTIA SWITCH

- Connect the inertia switch harness electrical connector.
- Measure voltage of Circuit 787 (PK/BK) between inertia switch harness connector and ground.
- Key on.

Was voltage greater than 10.5 volts?

Yes	No
GO to FK7 .	RESET or REPLACE inertia switch. RESTORE vehicle. CLEAR DTCs and RETEST.

FK7 CHECK FUEL PUMP MONITOR CIRCUIT

- Install breakout box; leave PCM disconnected.
- Disconnect inertia switch harness connector.
- Measure resistance of Circuit 787 (PK/BK) between inertia switch harness connector and PCM Test Pin 40.

Is resistance less than 5 ohms?

Yes	No
REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR open in fuel pump monitor Circuit 787 (PK/BK). RESTORE vehicle. CLEAR DTCs and RETEST.

FK8 CHECK FUEL PUMP FUSE

- Key off.
- Check fuel pump fuse (for an Econoline Fuse 17 or an F-Series Fuse 19).

Is fuse OK?

Yes	No
GO to FK9 .	REPLACE fuse. RESTORE vehicle. CLEAR DTCs and RETEST.

FK9 CHECK FOR POWER TO FUEL PUMP RELAY

- Remove fuel pump relay.

- Key on, engine off.
- For F-Series, measure voltage of Circuit 1059 (LB/O) between Pin 2 of the fuel pump relay harness connector and ground.
- For Econoline, measure voltage of Circuit 37 (Y) between Pin 2 of the fuel pump relay harness connector and ground.
- Key off.

Was voltage greater than 10.5 volts?

Yes	No
GO to FK10 .	REPAIR open in Circuit 1059 (LB/O) for F-Series or Circuit 37 (Y) for Econoline. RESTORE vehicle. CLEAR DTCs and RETEST.

FK10 CHECK INERTIA SWITCH FEED CIRCUIT

- Disconnect inertia switch harness connector.
- Measure resistance of Circuit 238 (DG/Y) between fuel pump relay harness connector Pin 4 and inertia switch harness connector.

Is resistance less than 5 ohms?

Yes	No
REPLACE fuel pump relay. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR open in Circuit 238 (DG/Y). RESTORE vehicle. CLEAR DTCs and RETEST.

FK11 KOEO DIAGNOSTIC TROUBLE CODE P0232

Note: Ignore DTC P0230 at this time.

- DTC P0232 indicates power was present on the fuel pump monitor circuit when the fuel pump was commanded off.
- Possible causes:
  - shorted fuel pump relay
  - short to power in fuel pump circuitry
- Remove fuel pump relay coil power fuse.
- Key on, engine off.
- Perform KOEO On-Demand Self Test.
- Key off.

Was DTC P0232 present?

Yes	No
GO to FK12 .	GO to FK15 .

FK12 CHECK FUEL PUMP RELAY FOR SHORT

- Reinstall fuse.
- Remove fuel pump relay.
- Perform KOEO On-Demand Self Test.

Is DTC P0232 present?

Yes	No
GO to FK13 .	REPLACE fuel pump relay. RESTORE vehicle. CLEAR DTCs and RETEST.

FK13 CHECK FOR SHORT TO INERTIA SWITCH

- Disconnect inertia switch harness connector.
- Perform KOEO On-Demand Self Test.
- Key off.

Was DTC P0232 present?

Yes	No
GO to FK14 .	REPAIR short to power in Circuit 238 (DG/Y). RESTORE vehicle. CLEAR DTCs and RETEST.

FK14 CHECK FOR FUEL PUMP MONITOR OR FUEL PUMP FEED SHORT TO POWER

- Install breakout box; leave PCM disconnected.
- Key on, engine off.
- Measure voltage between PCM Test Pin 40 and ground.

Is voltage greater than 10.5 volts?

Yes	No
REPAIR short to power in fuel pump or monitor circuit. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.

FK15 CHECK FUEL PUMP CONTROL CIRCUIT FOR SHORT TO GROUND

- Install breakout box; leave PCM disconnected.
- Measure resistance between PCM Test Pin 94 and ground.

Is resistance less than 5 ohms?

Yes	No

REPAIR short to ground in Circuit 926 (LB/O). RESTORE vehicle. CLEAR DTCs and RETEST.	GO to FK12 .

FK16 CONTINUOUS DIAGNOSTIC TROUBLE CODE P0230

- Continuous DTC P0230 indicates that a fault was detected on the fuel pump relay control circuit.
- Possible causes:
    - blown fuse
    - failed F/P relay
    - open fuel pump control circuit
    - intermittent circuit fault
- Perform KOEO On-Demand Self Test.

Is DTC P0230 present?

Yes	No
GO to FK1 .	GO to FK17 .

FK17 CHECK FOR INTERMITTENT FAILURE

- Clear DTC.
- Grasp vehicle harness; wiggle and shake while working from PCM to fuel pump relay.
- Retrieve Continuous DTCs.

Is DTC P0230 present?

Yes	No
REPAIR intermittent circuit fault. RESTORE vehicle. CLEAR DTCs and RETEST.	Unable to duplicate or identify problem at this time. RESTORE vehicle. CLEAR DTCs and RETEST.

FK18 CONTINUOUS DIAGNOSTIC TROUBLE CODE P0231

> **Note:** Voltage is present for 20 sec. (fuel pump commanded on) after key on with engine not running.

- Continuous DTC P0231 indicates voltage was not present on fuel pump monitor circuit when the fuel pump was commanded on.
- Possible causes:
    - open inertia switch
    - blown F/P fuse
    - open fuel pump monitor circuit
    - open fuel pump control circuit
    - faulty fuel pump relay

- Verify inertia was not reset without clearing codes.
- If DTC P0230 is also present, GO to FK16 .
- Perform KOEO On-Demand Self Test.

Is DTC P0231 present?

Yes	No
GO to FK5 .	GO to FK19 .

FK19 CHECK FOR INTERMITTENT CIRCUIT FAULTS

- Clear DTCs.
- Grasp vehicle harness; wiggle and shake while working from PCM to inertia switch and from the inertia switch to the fuel pump relay.
- Retrieve Continuous DTCs.

Is P0231 present?

Yes	No
REPAIR intermittent circuit fault in fuel pump circuitry. RESTORE vehicle. CLEAR DTCs and RETEST.	Unable to duplicate or identify failure at this time. RESTORE vehicle. CLEAR DTCs and RETEST.

FK20 CONTINUOUS DIAGNOSTIC TROUBLE CODE P0232

- Continuous DTC P0232 indicates that power was present on the fuel pump monitor circuit when the fuel pump was commanded off during normal driving conditions.
- Possible causes:
  - shorted fuel pump relay
  - short to power in fuel pump circuitry
- Perform KOEO On Demand Self Test.

Is P0232 present?

Yes	No
GO to FK11 .	GO to FK21 .

FK21 CHECK FOR INTERMITTENT FAILURE

- Clear DTCs.
- Grasp vehicle harness, wiggle and shake while working from PCM to the fuel pump relay.
- Retrieve continuous DTCs.

Is P0232 present?

Yes	No
REPAIR intermittent circuit fault.	Unable to duplicate or identify problem at

RESTORE vehicle. CLEAR DTCs and RETEST.	this time. RESTORE vehicle. CLEAR DTCs and RETEST.

Note

Enter this pinpoint test for PCM diagnostics.

Remember

This pinpoint test is intended to diagnose only the following:

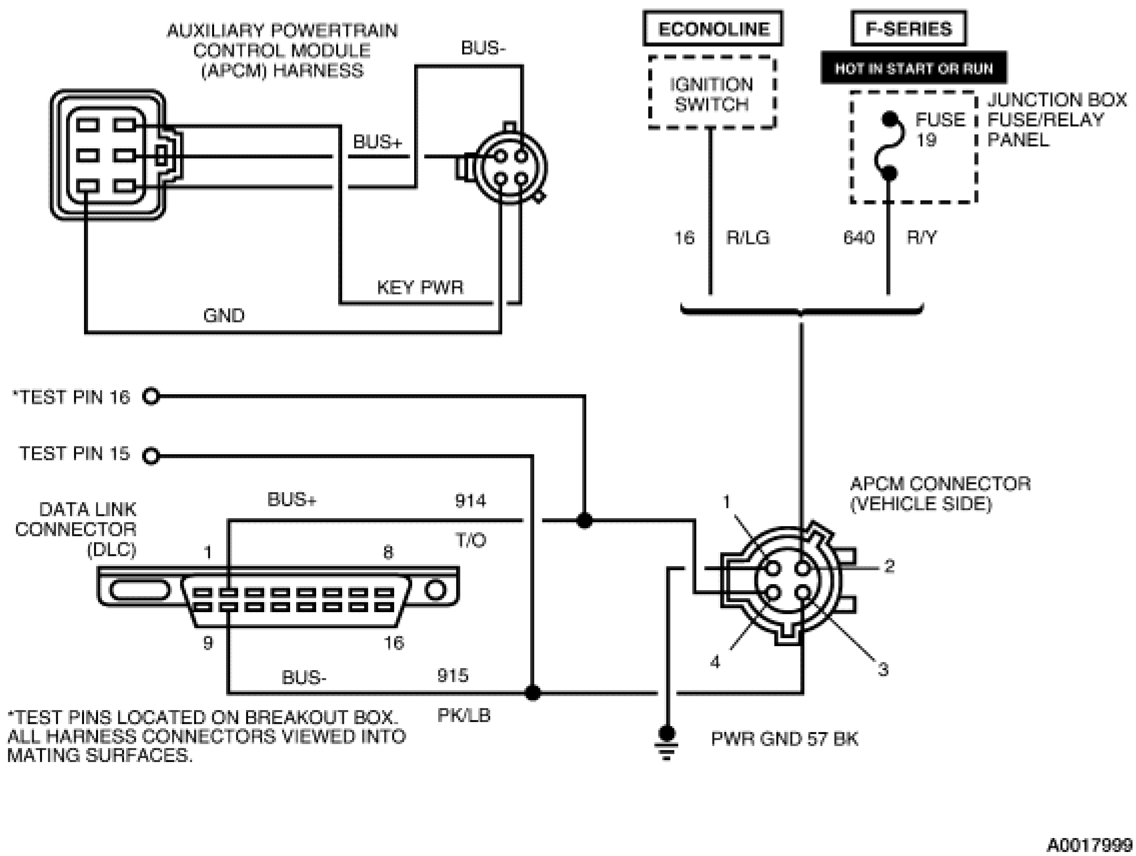
- harness circuits: KEY PWR, GND, BUS+, BUS- and hi-mount stoplight circuit 569 (DG) for F-Series or 511 (LG) for Econoline
- APCM: F-Series F5TF-12B641, Econoline F5UF-12B641 (12B641)

Description

Note: Functions may not be available if the operator has deprogrammed them.

The auxiliary powertrain control system provides an operator interface to the drive-by-wire powertrain control system to effect Charge Protection, RPM Control, and manual throttle control between 1300 and 2500 rpm.

Enabling conditions: Parking brake set, automatic transmission in park, manual transmission in neutral, foot off clutch pedal, service brake and accelerator pedal, and brake lights connected and functional. To operate system with hazard flashers, the hi-mount stoplight circuit must be complete and operational. If necessary refer to Pinpoint Test FD.



The following error codes are displayed from the APCM only:

- CErr indicates that one or both BUS circuits are open or shorted.
- CrSd indicates a fault on BUS circuits or internal APCM fault.
- EErr and AErr both indicate an internal APCM fault.

Follow the direction given below to aid in diagnosing the APCM fault condition:

- If APCM doesn't work at all, go to Pinpoint Test Step H1.
- If APCM doesn't work with hazard flashers for all vehicles except Econoline Cutaway, go to Pinpoint Test Step H7.
- If APCM doesn't work with hazard flashers on Econoline Cutaway only, go to Pinpoint Test Step H11.
- If APCM error code CErr or CrSd are displayed, go to Pinpoint Test Step H5.
- If APCM error code EErr or AErr are displayed, replace APCM.

H: Pinpoint Tests

H1 VERIFY OPERATION PROCEDURE

- Verify vehicle has correct calibration.
- Refer to the auxiliary powertrain control manual provided with the system to verify correct operating procedures and entry conditions.

Are entry conditions met and correct calibration installed?

Yes	No
GO to H2 .	CORRECT operating procedure or CORRECT calibration level as required. CLEAR DTCs and RETEST. If system still does not operate, GO to H2 .

H2 CHECK FOR DTCs

Note: When performing KOER Switch Self Test, wait five seconds after pressing the trigger to start the test before running through the driver-operated controls. The test can also take up to five minutes to complete.

- Verify auxiliary powertrain control system is off before running any self tests.
- Run KOEO On-Demand Self Test, KOER Switch Self Test and Retrieve/Clear Continuous DTCs.

Were any DTCs retrieved?

Yes	No
GO to appropriate pinpoint test.	GO to H3 .

H3 CHECK FOR KEY ON POWER

- Disconnect APCM harness connector.
- Key on, engine off.
- Measure voltage between Pin 2 of the APCM connector vehicle side and ground. Refer to circuit diagram for pin location.
- Key off.

Was battery voltage present?

Yes	No
GO to H4 .	F-Series: REPLACE Fuse 18 or REPAIR

	open in Circuit 296 (W/P). Econoline: REPAIR open in Circuit 16 (R/LG). RESTORE system. CLEAR DTCs and RETEST.

H4 CHECK GROUND CIRCUIT

- Measure resistance between Circuit 57 (BK), Pin 1 of the APCM harness connector and ground.

Is resistance less than 5.0 ohms?

Yes	No
GO to H5 .	REPAIR open in ground Circuit 57 (BK). RESTORE system. CLEAR DTCs and RETEST.

H5 CHECK FOR OPEN IN (BUS-) CIRCUIT 915 (PK/LB)

- Measure resistance of Circuit 915 (PK/LB) between the APCM harness connector Pin 3 and DLC Pin 10.

Is resistance less than 5.0 ohms?

Yes	No
GO to H6 .	REPAIR open in Circuit 915 (PK/LB). RESTORE system. CLEAR DTCs and RETEST.

H6 CHECK FOR OPEN IN (BUS+) CIRCUIT 914 (T/O)

- Measure resistance of Circuit 914 (T/O) between the APCM harness connector Pin 4 and DLC Pin 2.

Is resistance less than 5.0 ohms?

Yes	No
REPLACE APCM. RESTORE system. CLEAR DTCs and RETEST.	REPAIR open in Circuit 914 (T/O). RESTORE system. CLEAR DTCs and RETEST.

H7 APCM DOESN'T WORK WITH HAZARD FLASHERS

- Press service brake pedal.

Does hi-mount stoplight come on?

Yes	No
GO to FD1 .	GO to H8 .

H8 CHECK HI-MOUNT STOPLIGHT

- Bench test bulb by applying B+ to one side and B- to the other.

Does the bulb illuminate?

Yes	No
GO to H9 .	REPLACE bulb. RESTORE system. CLEAR DTCs and RETEST.

H9 GROUND CIRCUIT CHECK

- Measure resistance on Circuit 57 (BK) between the bulb socket and ground.

Is resistance less than 5.0 ohms?

Yes	No
GO to H10 .	REPAIR open in ground Circuit 57 (BK). RESTORE system. CLEAR DTCs and RETEST.

H10 CHECK POWER TO LIGHT

- Press service brake pedal.
- Using a test light, probe between powering Circuit 569 (DG) and ground.

Does the test light illuminate?

Yes	No
REPAIR loose connection in the bulb socket. RESTORE system. CLEAR DTCs and RETEST.	F-Series: REPAIR open in Circuit 569 (DG). Econoline: REPAIR open in Circuit 511 (LG). RESTORE system. CLEAR DTCs and RETEST.

H11 ECONOLINE CUTAWAY ONLY: APCM DOESN'T WORK WITH HAZARD FLASHERS

- Disconnect brake resistor, located on the left B-pillar.
- Measure resistance of Circuit 57 (BK) between resistor connector and ground.

Is resistance less than 5.0 ohms?

Yes	No

GO to H12 .	REPAIR open in Circuit 57 (BK). RESTORE system. CLEAR DTCs and RETEST.

H12 CHECK POWER CIRCUIT TO RESISTOR

- Press service brake pedal.
- Using a test light, probe between Circuit 511 (LG) of the resistor connector and ground.

Does the test light illuminate?

Yes	No
GO to H13 .	REPAIR open in Circuit 511 (LG). RESTORE system. CLEAR DTCs and RETEST.

H13 CHECK RESISTOR

- Measure resistance across the resistor 13A427.

Is resistance 140 ± 10 ohms?

Yes	No
RECONNECT the resistor and GO to FD1 .	REPLACE the resistor. RESTORE system. CLEAR DTCs and RETEST.

KA: Cylinder Identification (CID) Introduction

KA: Pinpoint Tests

Note

Enter this pinpoint test only when directed here from the symptom flowcharts.

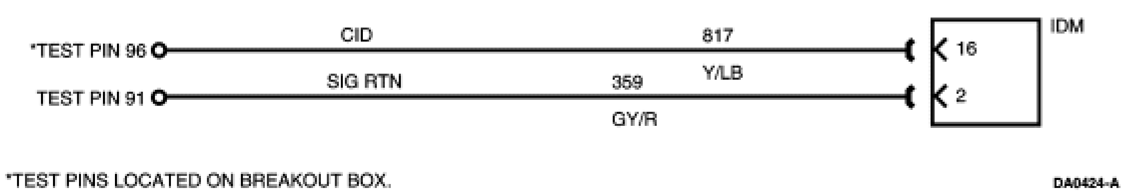
Remember

This pinpoint test is intended to diagnose only the following:

- powertrain control module (PCM) (12A650)
- injector driver module (IDM)
- harness circuits: cylinder identification (CID)

Description

The CID output provides information to the IDM so that the injector current can be applied to the correct injector.



DTC Description

P1218 = CID stuck high

P1219 = CID stuck low

P1667 = CID circuit failure

KA: Pinpoint Tests

 KA: Introduction

KA1 DIAGNOSTIC TROUBLE CODES (DTCs) P1667

- DTC P1667 indicated that the PCM has detected a failure on the CID line.
- Possible causes:
  - Open/short in CID circuit
  - IDM
  - PCM
- Check for other codes.
- Key on, engine off.
- Perform KOEO On-Demand Self Test and retrieve Continuous DTCs.

Was only DTC P1667 present?

Yes	No
If DTC P1667 was present, GO to KA2 .	If DTC P1663 and P1667 are set together, with or without DTC P1668, GO to FJ6 . If DTC P1298 is also present REPLACE the IDM. If DTC P1662 is also present, GO to NC1 .

KA2 CHECK VOLTAGE ON CID CIRCUIT 817 (Y/LB)

- Install breakout box; connect PCM to breakout box.
- Key on, engine off.
- Measure voltage on Circuit 817 (Y/LB) between PCM Test Pins 96 and ground Pins 25, 51, 76, 77, 91 and 103.

Is voltage of 0.6 ± 0.1 volt present?

Yes	No
GO to KA3 .	Voltage of less than 0.5 volt present, GO to KA4 . Above 0.7 volt is present. GO to KA5 .

KA3 PERFORM AN OUTPUT STATE CHECK

- Key on, engine off.

- Perform KOEO Output State Self Test, toggle outputs by pressing and releasing the accelerator pedal.
- Measure voltage between PCM Test Pin 96 and ground Pins 25, 51, 76, 77, 91 and 103.

Did the output voltage toggle from 0.6 ± 0.1 volt to B+ volts?

Yes	No
Intermittent failure. GO to KA8 .	REPLACE the PCM. RESTORE vehicle. CLEAR DTCs and RETEST.

KA4 CHECK FOR OPEN ON CID CIRCUIT 817 (Y/LB)

- Key off.
- Disconnect the PCM from breakout box.
- Disconnect the IDM connector.
- Measure resistance on Circuit 817 (Y/LB) between PCM Test Pin 96 and Pin 16 on the IDM harness connector.

Is resistance less than 5 ohms?

Yes	No
GO to KA6 .	REPAIR open in Circuit 817 (Y/LB). RESTORE vehicle. CLEAR DTCs and RETEST.

KA5 CHECK CID CIRCUIT 817 (Y/LB) FOR SHORT TO POWER

- PCM disconnected.
- Key on, engine off.
- Measure voltage on Circuit 817 (Y/LB) between PCM Test Pin 96 and ground Pins 25, 51, 76, 77, 91 and 103.

Is voltage present?

Yes	No
REPAIR short to power on Circuit 817 (Y/LB). RESTORE vehicle. CLEAR DTCs and RETEST.	GO to KA7 .

KA6 CHECK CID CIRCUIT 817 (Y/LB) FOR SHORT TO GROUND

- Key off.
- Measure resistance between PCM Test Pin 96 and ground Pins 25, 51, 76, 77, 91 and 103.

Is resistance greater than 10,000 ohms?

Yes	No

GO to KA7 .	REPAIR ground short on Circuit 817 (Y/LB). RESTORE vehicle. CLEAR DTCs and RETEST.

KA7 CHECK PCM OUTPUT STATE FUNCTION

- Key off.
- Connect PCM to breakout box.
- Perform KOEO Output State Test.
- Measure voltage between PCM Test Pin 96 and ground Pins 25, 51, 76, 77, 91 and 103 while pressing and releasing accelerator pedal.

Did the output voltage toggle from 0.5 ± 0.1 volt to 0.0 volt?

Yes	No
REPLACE IDM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.

KA8 INTERMITTENT

- Key off.
- Restore vehicle.
- Turn key on.
- Clear DTCs.
- Turn key off, then turn key on.
- Perform KOEO On-Demand Self Test.

Did DTC P1667 reset?

Yes	No
REPLACE the PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	Unable to duplicate failure. RESTORE vehicle. CLEAR DTCs and RETEST.

KA9 DIAGNOSTIC TROUBLE CODE (DTC) P1218

- Key on, engine off.
- Perform KOEO On-Demand Self Test.

Was DTC P1218 present?

Yes	No
If DTC P1218 present without P1667, GO to KA10 .	If DTCs P1663, P1667 and P1668 are also present with DTC P1218, GO to FJ6 . If DTC P1667 is only set with P1218, GO to KA2 .

	If DTC P1298 is also present, REPLACE the IDM. If DTC P1662 is also present, GO to NC1 .

KA10 CHECK FOR INTERMITTENT OPEN ON THE CID CIRCUIT 817 (Y/LB)

- Key off.
- Install breakout box, leave PCM disconnected.
- Disconnect IDM.
- Check for intermittent open on CID circuit.
- Measure resistance on (CID) Circuit 817 (Y/LB) between IDM connector Pin 16 and PCM Test Pin 96.
- Grasp the harness close to the IDM connector. Wiggle, shake the harness while working your way back to the PCM connector, while looking for a spike on the DVOM.

Did readings remain below 5 ohms throughout procedure?

Yes	No
GO to KA11 .	REPAIR open in the (CID) Circuit 817 (Y/LB). RESTORE vehicle. CLEAR DTCs and RETEST.

KA11 CHECK FOR INTERMITTENT SHORT TO POWER ON THE CID CIRCUIT 817 (Y/LB)

- Key on, engine off.
- Check for intermittent short to power on CID circuit.
- Measure voltage on (CID) Circuit 817 (Y/LB) between PCM Test Pin 96 and ground Pins 25, 51, 76, 77, 91 and 103.
- Grasp the harness close to the IDM connector. Wiggle, shake the harness while working your way back to the PCM connector, while looking for a spike on the DVOM.

Did voltage ever appear throughout procedure?

Yes	No
REPAIR short to power on the (CID) Circuit 817 (Y/LB). RESTORE vehicle. CLEAR DTCs and RETEST.	RESTORE vehicle. TEST-DRIVE. If DTC reappears, REPLACE the IDM.

KA12 DIAGNOSTIC TROUBLE CODE (DTC) P1219

- Key on, engine off.
- Perform KOEO On-Demand Self Test.

Was DTC P1219 Present?

Yes	No
If DTC P1219 was present without P1667, GO to KA13 .	If DTCs P1663, P1667 and P1668 are also present with DTC P1218, GO to FJ6 . If DTC P1667 is only set with P1219, GO to KA2 . If DTC P1298 is also present, REPLACE the IDM. RESTORE vehicle. CLEAR DTCs and RETEST. If DTC P1662 is also present, GO to NC1 .

KA13 CHECK FOR INTERMITTENT SHORT TO GROUND ON THE CID CIRCUIT 817 (Y/LB)

- Key off.
- Install breakout box, leave PCM disconnected.
- Disconnect IDM.
- Check for intermittent short to ground on CID circuit.
- Measure resistance on (CID) Circuit 817 (Y/LB) between PCM Test Pin 96 and ground Pins 25, 51, 76, 77, 91 and 103.
- Grasp the harness close to the IDM connector. Wiggle, shake the harness while working your way back to the PCM connector, while looking for a spike on the DVOM.

Did readings ever drop below 10,000 ohms throughout procedure?

Yes	No
REPAIR short to ground on the (CID) Circuit 817 (Y/LB).	RESTORE vehicle, TEST-DRIVE. If DTC reappears, REPLACE the IDM. RESTORE vehicle. CLEAR DTCs and RETEST.

KB: Pinpoint Tests

Output Functions

Exhaust Back Pressure Regulator (EPR) — Is a variable position valve that controls exhaust back pressure during cold ambient temperatures to increase cab heat and decrease the amount of time needed to defrost the windshield. The powertrain control module (PCM) uses the measured exhaust back pressure, intake air temperature and engine load to determine the desired exhaust back pressure.

Note

EPR is not used with F-Series warm weather package.

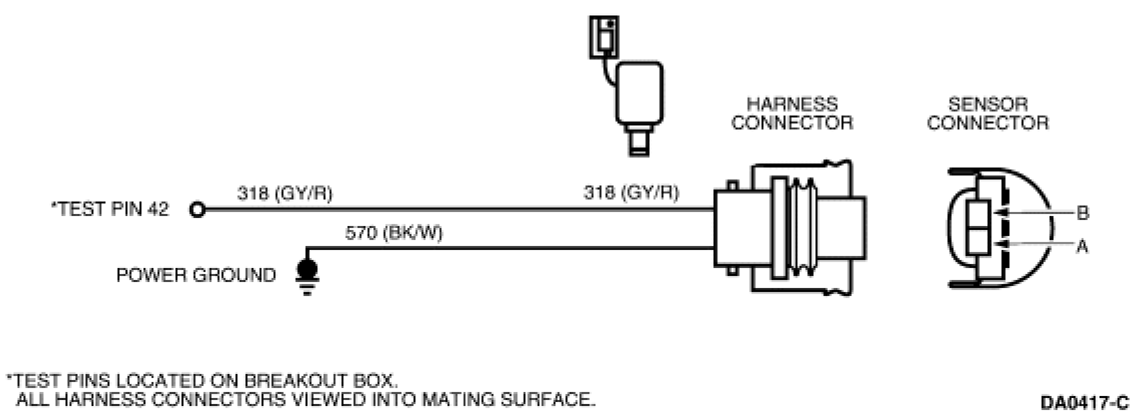
Valve position is controlled by switching the output signal circuit to 12 volts inside the PCM. On/off time is dependent upon the exhaust back pressure.

Detection/Management

An open or shorted to ground control circuit can be detected by an on-demand output circuit check performed during the KOEO test.

An exhaust back pressure step test, in which the PCM commands and then measures specific preprogrammed pressures, is performed during the KOER test.

If the PCM detects an exhaust back pressure (EBP) or intake air temperature (IAT) sensor fault it will disable the exhaust back pressure device.



Note

After removing connectors, always check for damaged pins, corrosion, loose terminals, etc.

DTC Descriptions

P0475 = Exhaust pressure control valve malfunction

P0476 = Exhaust pressure control valve performance

KB: Pinpoint Tests

KB1 DIAGNOSTIC TROUBLE CODE (DTC) P0475

- possible causes:
  - shorted to power
  - open/grounded circuit
  - damaged solenoid
  - damaged PCM
- Disconnect EPR harness connector.
- Measure resistance between Pin A and ground.

Is the resistance less than 5 ohms?

Yes	No
GO to KB2 .	REPAIR open in Circuit 570 (BK/W). RESTORE system. CLEAR DTCs and RETEST.

KB2 CHECK EPR COIL

- Measure resistance across EPR coil contacts A and B.

Is the coil resistance between 2.5 ohms and 12 ohms?

Yes	No
GO to KB3 .	REPLACE regulator. RESTORE system. CLEAR DTCs and RETEST.

KB3 CHECK FOR SHORT TO POWER IN CIRCUIT 318 (GY/R).

- Disconnect PCM harness connector.
- Measure voltage between Pin B and ground.
- Shake harness.

Is B+ ever present?

Yes	No
REPAIR short to power in Circuit 318 (GY/R). RESTORE system. CLEAR DTCs and RETEST.	GO to KB4 .

KB4 CHECK CIRCUIT 318 (GY/R) FOR SHORT TO GROUND

- Measure resistance between Pin B and ground.
- Shake harness.

Does the resistance ever drop below 10,000 ohms?

Yes	No
REPAIR short to ground in Circuit 318 (GY/R). RESTORE system. CLEAR DTCs and RETEST.	GO to KB5 .

KB5 CHECK FOR OPEN IN CIRCUIT 318 (GY/R)

- Install breakout box; leave PCM disconnected.
- Measure resistance between Pin B and Test Pin 42.
- Shake harness.

Does resistance ever go above 5 ohms?

Yes	No
REPAIR open in Circuit 318 (GY/R). RESTORE system. CLEAR DTCs and RETEST.	GO to KB6 .

KB6 PERFORM OUTPUT STATE CHECK

- Key on, engine off.
- Measure voltage between EBP connector harness side Pin B and chassis ground.
- Run KOEO Output State Self Test on NGS Tester.

Does voltage toggle between 12 V and 0 V?

Yes	No

Fault is intermittent; unable to duplicate failure. RESTORE system. CLEAR DTCs and RETEST.	REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.

KB7 KOER DIAGNOSTIC TROUBLE CODE (DTC) P0476

- DTC P0476 indicates an exhaust back pressure control valve performance malfunction was detected during KOER On-Demand Self Test.
- Possible causes:
  - stuck or damaged turbocharger wastegate valve
  - misadjusted or damaged linkage
  - restricted exhaust
  - exhaust leaks
  - damaged PCM
  - EPR valve
  - EBP sensor
- If KOEO EBP faults are present, repair them before continuing.
- Visually inspect turbocharger wastegate valve tang (refer to Section 4 , Diagnostic Subroutines, Performance Diagnostic Procedures, Exhaust Restriction for exhaust back pressure regulator tang position illustration.

Is tang in the open position?

Yes	No
GO to KB8 .	REPAIR condition causing valve to be stuck closed. RESTORE system. CLEAR DTCs and RETEST.

KB8 EXHAUST RESTRICTION CHECK

- Access EBP PID.
- Key on, engine running.
- Accelerate engine to WOT and hold for 30 seconds.

Is EBP below 28 psi?

Yes	No
GO to KB9 .	REPAIR restricted exhaust condition. RESTORE system. CLEAR DTCs and RETEST.

KB9 EBP SENSOR CHECK

- Record EBP value.
- Accelerate engine several times.

Does EBP increase at least 4 psi with acceleration?

Yes	No
GO to KB10 .	REPLACE EBP sensor. RESTORE system. CLEAR DTCs and RETEST.

KB10 INSPECT FOR EXHAUST LEAKS

- Inspect turbo pipe, crossover pipes and exhaust manifolds for leaks.

Are exhaust leaks present?

Yes	No
REPAIR exhaust leak. RESTORE system. CLEAR DTCs and RETEST.	GO to KB11 .

KB11 EBP CHECK DURING KOER

- Key off.
- Disconnect EBP sensor harness connector.
- Install ICP/EBP Adapter Cable D94T-50-A or equivalent between EBP sensor and harness connector.
- Measure voltage between signal circuit and signal ground on ICP/EBP Adapter Cable D94T-50-A or equivalent.
- Perform KOER On-Demand Self Test.

Does voltage increase 2.0 V ± 0.5 and then decrease as the test ends?

Yes	No
REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.	GO to KB12 .

KB12 EPR VISUAL INSPECTION

- Observe EPR valve linkage while performing KOER On-Demand Self Test.

Does the linkage move during the test?

Yes	No
CHECK EPR linkage adjustment. REFER to the Powertrain Group in the Workshop Manual. The adjustment procedure is part of EPR removal and installation. RESTORE system. CLEAR DTCs and RETEST.	REPLACE EPR valve. RESTORE system. CLEAR DTCs and RETEST.

KC: Pinpoint Tests

Output Functions

Glow Plug Relay — A relay that controls the current flow to the glow plugs. Glow plug relay ON time is controlled by the powertrain control module (PCM) and is a function of engine oil temperature, barometric pressure and battery voltage. Glow plug ON time normally varies between 10 to 120 seconds.

Note: WAIT TO START lamp ON time is independent from glow plug relay ON time (1 to 10 seconds).

Detection/Management

An open or shorted to ground glow plug relay or WAIT TO START lamp circuit can be detected by an on-demand output circuit check performed during the KOEO standard test.

On all 49 state vehicles, glow plug and glow plug harness concerns cannot be detected by the PCM.

Caution

Do not perform any voltage checks with the engine running; 115v DC at 10 amps present on injector circuits.

Note

Enter this pinpoint test only when directed here from the symptom flowcharts.

Remember

This pinpoint test is intended to diagnose only the following:

- powertrain control module (PCM) (12A650)
- harness circuit: GP/RELAY coil
- glow plug relay coil

Description

Glow Plug Monitoring System for California OBD II

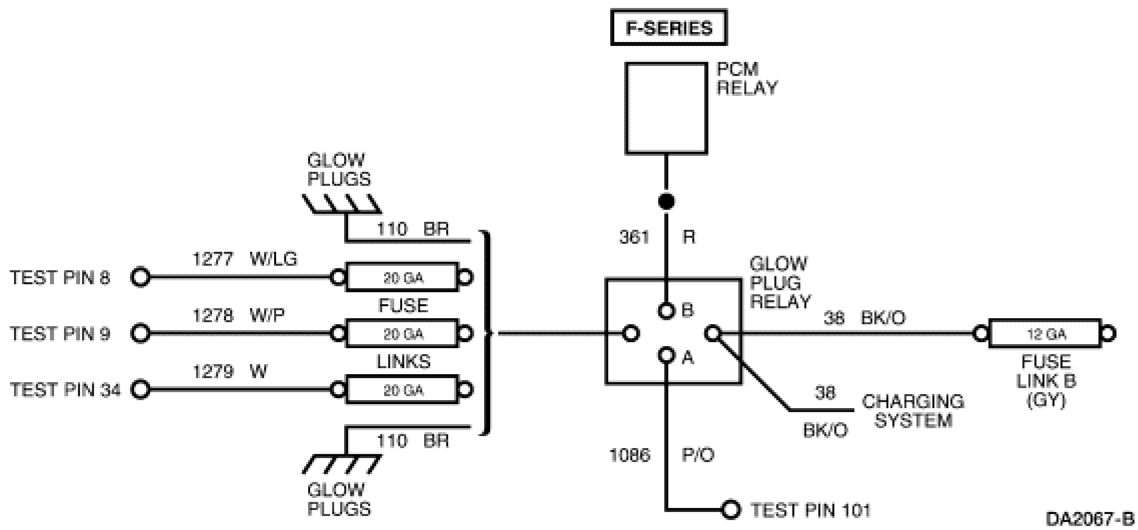
The glow plug system is monitored when the glow plugs are commanded on for more than 35 seconds. EOT needs to be below 55°C (131° F) for F-Series or 30°C (86° F) for Econoline and battery voltage must be between 11.5-14 volts.

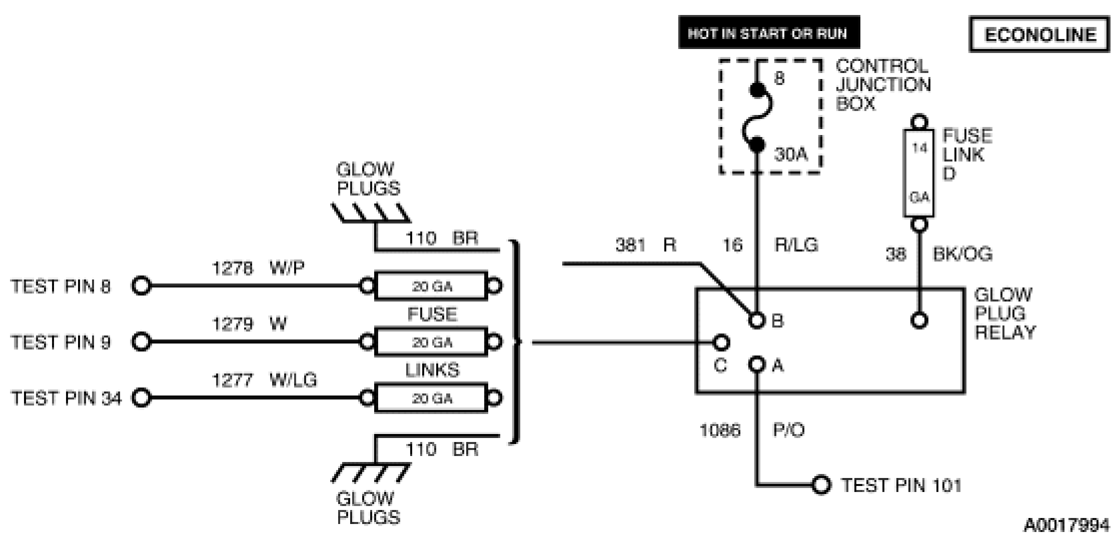
You can monitor glow plug amperage using NGS PIDs GPMR and GPML.

DTC P1395 or P1396 will set on the bank that is reading less than 39 amps. Loose fitting pins in the circuit connectors causing high resistance or high resistance glow plug(s) on that bank could be the cause. A shorted circuit or low-resistance glow plug(s) on the opposite bank could also be the cause. Each bank needs to draw more than 39 amps.

DTC P1391 or P1393 will set when the monitor indicates that all four glow plugs are not being powered on the bank. An open in the glow plug circuits, glow plug relay, glow plugs or monitoring circuit could be the possible causes.

Both DTCs P1391 and P1393 together will set when the monitor indicates that all eight glow plugs are not being powered. An open in all glow plug circuits, the glow plug relay, glow plugs, fusible links or all three monitoring circuits could be the possible causes. If KOEO On-Demand Self Test DTC P0380 is also set, a concern on the glow plug relay triggering circuit will cause all three DTCs to set.





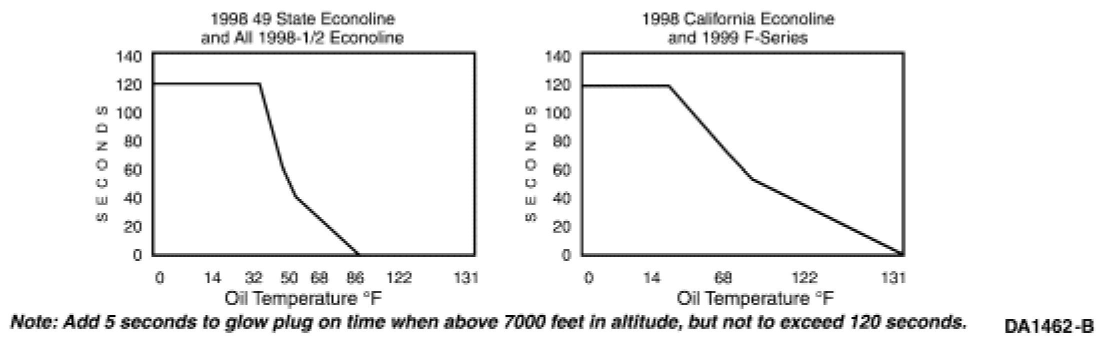
Note: Look very carefully for poor connections, burnt looking or loose fitting pins that will cause high resistance and set a code.

The Glow Plug Monitor Self Test (California only) is a functional test of the Powertrain Control Module performed on demand with the engine running and the A/C off. It may be necessary to raise engine rpm to maintain battery voltage. The test will raise engine speed to 1200 rpm to maintain a system voltage of 11.5-14 V. The PCM will activate the glow plug relay and monitor the glow plug circuits. A fault must be present at the time of testing for the test to detect a fault. If one bank is reading less than 39 amps, a fault will be detected and a Diagnostic Trouble Code (DTC) will be output on the data link at the end of the test when requested by a scan tool. Only a hard fault code (DTC) will be displayed.

Both California and 49 State

The glow plug on time is dependent on oil temperature and altitude. The glow plug relay comes on between 1-120 seconds and does not come on at all if oil temperature is above 30°C (86°F) for Econoline or 55°C (131°F) for F-Series. Using the NGS, you can run the Output State Self Test, which will cycle the glow plug relay on for 5 seconds the first time only that the accelerator pedal is pressed. This Self Test does not set any codes.

You can verify glow plug on time (and amps for California) by monitoring NGS PIDs EOT and GPCTM (California: GPMR and GPML). The Wait to Start lamp ON time (1-10 seconds) is independent from glow plug relay ON time.



DTC Description

P0380 = Glow plug circuit malfunction

P1391 = 4 glow plugs open right bank (California only)

P1393 = 4 glow plugs open left bank (California only)

P1395 = 1-3 glow plugs open right bank (California only)

P1396 = 1-3 glow plugs open left bank (California only)

P1397 = System voltage out of self-test range (California only)

P1389 = Glow plug high side out of range low (center) (California only)

KC: Pinpoint Tests

KC1 DTC P1391 AND P1395 RIGHT BANK, P1393 AND P1396 LEFT BANK AND P1994 CENTER MONITORING CIRCUIT

Note: The glow plug system is monitored when the glow plugs are commanded on for more than 35 seconds and battery voltage is between 11.5-14 volts.

DTC P1395 or P1396 will set on the bank that is reading less than 39 amps. Loose fitting pins in the circuit connectors causing high resistance or high-resistance glow plug(s) on that bank could be the cause. A shorted circuit or low-resistance glow plug(s) on the opposite bank could also be the cause. Each bank needs to draw more than 39 amps.

DTC P1391 or P1393 will set when the monitor indicates that all four glow plugs are not being powered on that bank. An open in the glow plug circuits, glow plug relay, glow plugs or monitoring circuit could be the possible causes.

Both DTCs P1391 and P1393 together will set when the monitor indicates that all eight glow plugs are not being powered. An open in all glow plug circuits, the glow plug relay, glow plugs, fusible links or all three monitoring circuits could be the possible causes.

- Possible causes:
  - glow plug relay
  - glow plug shunt
  - open in glow plug circuit(s) or monitoring circuit(s)
  - glow plugs
  - PCM
- Key on, engine off.
- Access PIDs VPWR, EOT, GPCTM, GPMR and GPML.
- Verify that EOT is below 55°C (131°F) for F-Series or 30°C (86°F) for Econoline and GPCTM is greater than 35 seconds.
- Compare GPMR to GPML, and record both readings.
- Measure voltage of Circuit 38 (BK/O) between glow plug relay and ground.

Is voltage greater than 10.5 volts?

Yes	No
GO to KC2 .	REPAIR open Circuit 38 (BK/O) or fusible links. CLEAR DTCs and RETEST.

KC2 CHECK FOR DTC P0380

- Perform KOEO On-Demand Self Test and Retrieve/Clear Continuous DTCs.

Is DTC P0380 present?

Yes	No
GO to KC3 .	GO to KC8 .

KC3 DTC P0380

- DTC P0380 is set when the PCM detects a malfunction in the glow plug relay control circuit.
- Possible causes:
  - shorted to power
  - open/grounded circuit
  - open fuse (F-Series — Fuse 30, Econoline — Fuse 8)
  - worn or damaged glow plug relay
- Key on, engine off.
- Measure voltage at glow plug relay Point B, Circuit 16 (R/LG) for Econoline or 361 (R) for F-Series, and battery ground.

Is voltage greater than 10.5 volts?

Yes	No
GO to KC4 .	REPAIR open in ignition power Circuit 16 (R/LG). If fuse is blown, CHECK for short to ground. RESTORE vehicle. CLEAR DTCs and RETEST.

KC4 RELAY COIL RESISTANCE TEST

- Key off.
- Disconnect the wire going to the glow plug relay, Circuit 1086 (P/O) Point A.
- Measure resistance through relay coil, between Point A and Point B.

Is the resistance between 1 ohm and 8 ohms?

Yes	No
GO to KC5 .	REPLACE glow plug relay. RESTORE vehicle. CLEAR DTCs and RETEST.

KC5 CHECK SHORT TO POWER

- Install breakout box; leave PCM and wire 1086 (P/O) disconnected.
- Key on, engine off.
- Measure voltage between PCM Test Pin 101 and battery ground.
- Key off.

Was voltage greater than 10.5 volts?

Yes	No
REPAIR short to power in circuit 1086 (P/O). RESTORE vehicle. CLEAR DTCs and RETEST.	GO to KC6 .

KC6 CHECK SHORT TO GROUND

- Measure resistance between PCM test pin 101 and battery ground.

Is resistance greater than 10,000 ohms?

Yes	No
GO to KC7 .	REPAIR short to ground in circuit 1086 (P/O). RESTORE vehicle. CLEAR DTCs and RETEST.

KC7 CHECK CIRCUIT FOR OPEN

- Measure resistance between PCM Test Pin 101 and Circuit 1086 (P/O) eyelet going to glow plug relay.

Is resistance less than 5 ohms?

Yes	No
REPLACE PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR open in Circuit 1086 (P/O). RESTORE vehicle. CLEAR DTCs and RETEST.

KC8 CHECK GLOW PLUG RELAY

> **Note:** The glow plug ON time is dependent on oil temperature and altitude. The glow plugs come on between 1 to 120 seconds depending on oil temperature and do not come on at all if EOT is above 55°C (131° F) for F-Series or 30°C (86° F) for Econoline. Verify glow plug control ON time using PID GPCTM.

- EOT temperature below 55°C (131°F) for F-Series or 30°C (86°F) for Econoline.
- Key on, engine off.
- Measure voltage between center terminal of glow plug shunt and battery ground.

Is voltage present for at least 30 seconds?

Yes	No
GO to KC9 .	REPLACE glow plug relay. RESTORE vehicle. CLEAR DTCs and RETEST.

KC9 CHECK GLOW PLUG

- Key off.
- On the bank with the code, disconnect connector on the valve cover gasket.
- Install Glow Plug Injector Adapter 134-00132 or equivalent to the valve cover gasket.
- Measure resistance between each of the four glow plug circuits on adapter and engine ground (clean off a spot on the high-pressure oil reservoir to ensure a good ground).

Is resistance less than 2 ohms?

Yes	No
For DTCs P1391 and P1395, GO to KC11 . For DTCs P1393 and P1396, GO to KC12 .	GO to KC10 .

KC10 CHECK UNDER VALVE COVER

- Remove valve cover and verify that the connections to the glow plugs are OK.
- If OK, disconnect the suspect glow plug connector.
- Measure resistance between the glow plug and engine ground.

Is resistance less than 2 ohms?

Yes	No
REPLACE valve cover gasket or UVC harness. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE glow plug. RESTORE vehicle. CLEAR DTCs and RETEST.

KC11 CHECK GLOW PLUG MONITORING CIRCUIT — DTCS P1391, P1395

- Disconnect connectors on both right and left banks.
- Install breakout box; leave PCM disconnected.
- Measure resistance between all four glow plug circuits on the right bank and PCM Test Pin 9.

Are all readings within 2 ohms of each other?

Yes	No
GO to KC13 .	REPAIR open between valve cover connector and PCM connector. VERIFY glow plug shunt nuts are clean and tight.

	RESTORE vehicle. CLEAR DTCs and RETEST.

KC12 CHECK GLOW PLUG MONITORING CIRCUIT — DTCs P1393, P1396

- Measure resistance between all four glow plug circuits on the left bank and PCM Test Pin 34.

Are all readings equal and less than 2 ohms?

Yes	No
GO to KC13 .	REPAIR open between valve cover connector and PCM connector. VERIFY glow plug shunt nuts are clean and tight. RESTORE system. CLEAR DTCs and RETEST.

KC13 CHECK GLOW PLUG MONITORING CENTER CIRCUIT

- Measure resistance between center terminal on glow plug shunt and PCM Test Pin 8.

Is resistance less than 2 ohms?

Yes	No
GO to KC14 .	REPAIR open in Circuit 339 (GY). RESTORE system. CLEAR DTCs and RETEST.

KC14 COMPARE RIGHT BANK TO LEFT BANK

- Record all readings. The circuits must be within 2 ohms of each other.
- Measure resistance between all four glow plug circuits on left bank and PCM Test Pins 8, 9 and 34, then all four glow plug circuits on right bank and PCM Test Pins 8, 9 and 34.

Are all readings within 2 ohms of each other?

Yes	No
REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.	REPAIR open in the higher resistance circuit. VERIFY glow plug shunt nuts are clean and tight. RESTORE system. CLEAR DTCs and RETEST.

KC15 DTC P1397 — SYSTEM VOLTAGE OUT OF SELF-TEST RANGE DURING KOER GLOW PLUG MONITOR SELF TEST

Note: DTC P1397 will set if system voltage is above 14 volts or below 11.5 volts at any time during KOER Glow Plug Self Test. It may be necessary to raise rpm to maintain voltage. If unable to maintain system voltage, service as required according to service manual direction.

- Perform KOER Glow Plug Monitor Self Test. With a digital multimeter connected to the battery. Maintain system voltage until test is complete.

Does P1397 still set?

Yes	No
GO to Pinpoint Test A1 .	No concern located at this time. RESTORE system. CLEAR DTCs and RETEST.

KD: Glow Plug Lamp (GPL)
Introduction

KD: Pinpoint Tests

Output Functions

Glow Plug WAIT TO START Lamp — A lamp to indicate to the operator when the glow plugs have been on long enough to crank the engine. It is controlled by the PCM. WAIT TO START lamp ON time is a function of engine oil temperature, barometric pressure and battery voltage. ON time normally varies between 1 to 10 seconds. Note: WAIT TO START light ON time is independent from glow plug relay ON time.

Detection/Management

An open or shorted to ground glow plug relay or WAIT TO START lamp circuit can be detected by an on-demand output circuit check performed during the KOEO standard test.

Glow plug and glow plug harness problems cannot be detected by the PCM.

Caution

Do not perform any voltage checks with the engine running; 115 V DC at 10 amps present on injector circuits.

Note

Enter this pinpoint test only when directed here from symptom flowcharts.

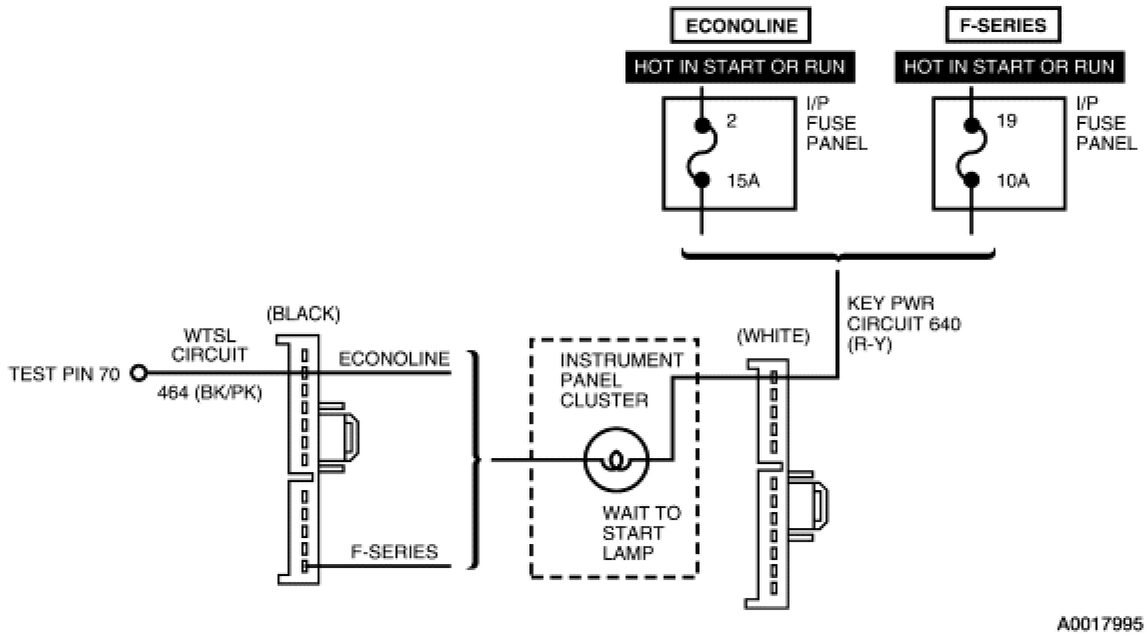
Remember

This pinpoint test is intended to diagnose only the following:

- powertrain control module (PCM) (12A650)
- harness circuits: WAIT TO START lamp
- warning lamp

Description

The glow plugs are energized during and after the WAIT TO START light is on. When the WAIT TO START light goes off, the engine is ready to be started.



DTC Description

P0381 = Glow plug indicator circuit malfunction

KD: Pinpoint Tests

KD1 DIAGNOSTIC TROUBLE CODE (DTC) P0381

- DTC P0381 is set when the PCM detects a malfunction in the glow plug indicator lamp circuit.
- Possible causes:
  - Open/grounded circuit
  - Open WAIT TO START light
  - Open fuse (F-Series — Fuse 19, Econoline — Fuse 2)
- Key on, engine running.

Does WAIT TO START light remain on?

Yes	No
GO to KD2 .	GO to KD3 .

KD2 CHECK CIRCUIT 464 (BK/PK) FOR SHORT

- Key off.
- Disconnect PCM harness connector.
- Key on, engine off.

Is WAIT TO START light on?

Yes	No
REPAIR ground short in Circuit 464 (BK/PK) between WAIT TO START light and PCM.	REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.

KD3 CHECK INTERMITTENT P0381

- A Continuous DTC P0381 is set when the PCM detects a malfunction in the WAIT TO START light circuit.
- Possible causes:
  - intermittently open/grounded circuit or fuse.
  - intermittently open WAIT TO START light
- Key off.
- Key on.

Does WAIT TO START light come on for at least 1 second?

Yes	No
Concern is intermittent. GO to KD9 .	GO to KD4 .

KD4 CHECK FUSE FOR OPEN

- Key off.
- Check fuse for continuity.

Is fuse OK?

Yes	No
GO to KD5 .	GO to KD6 .

KD5 CHECK WARNING LIGHT BULB FOR OPEN

- Disconnect WAIT TO START light.
- Check bulb for continuity.

Is bulb OK?

Yes	No
GO to KD7 .	REPLACE bulb. RESTORE system. CLEAR DTCs and RETEST.

KD6 CHECK CIRCUIT 640 (R/Y) FOR GROUND SHORT

- Disconnect WAIT TO START light.
- Measure resistance between Circuit 640 (R/Y) and chassis ground.

Is resistance greater than 10,000 ohms?

Yes	No
REPLACE fuse. RESTORE system. CLEAR DTCs and RETEST.	REPAIR ground short in Circuit 640 (R/Y). REPLACE fuse. RESTORE system. CLEAR DTCs and RETEST.

KD7 CHECK FOR OPEN CIRCUIT 640 (R/Y)

- Key off.
- Disconnect WAIT TO START light.
- Key on, engine off.
- Measure voltage on Circuit 640 (R/Y) at warning light harness connector.

Is B+ present?

Yes	No
GO to KD8 .	REPAIR open in Circuit 640 (R/Y) between fuse and WAIT TO START light. RESTORE system. CLEAR DTCs and RETEST.

KD8 CHECK FOR OPEN IN CIRCUIT 464 (BK/PK)

- Install breakout box; leave PCM disconnected.
- Measure resistance in Circuit 464 (BK/PK) between the WAIT TO START light and PCM Test Pin 70.

Is resistance less than 5 ohms?

Yes	No
REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.	REPAIR open in Circuit 464 (BK/PK). RESTORE system. CLEAR DTCs and RETEST.

KD9 CONTINUOUS P0381 CODE

- Clear Continuous DTC P0381.

Does P0381 return in Continuous after road test?

Yes	No
GO to KD10 .	Code was not cleared after a previous repair. RESTORE system. CLEAR DTCs and RETEST.

KD10 CHECK FOR CODE P0381 AFTER ROAD TEST

Did the WAIT TO START light come on or flicker on and off during road test?

Yes	No
REPAIR Circuit 464 (BK/PK) intermittently shorting to ground. RESTORE system. CLEAR DTCs and RETEST.	GO to KD11 .

KD11 CHECK FOR INTERMITTENTLY OPEN CIRCUIT

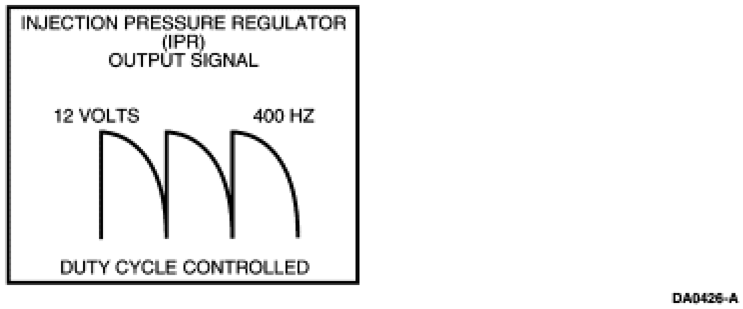
- Install breakout box; leave PCM disconnected.
- Ground PCM Test Pin 70.
- Turn key on.
- Tap on dashboard. Shake harness under dash and under hood between the 76-way connector and PCM connector.

Does the WAIT TO START light flicker on and off?

Yes	No
REPAIR an intermittently open light bulb or circuit between fuse and PCM connector. RESTORE system. CLEAR DTCs and RETEST.	If unable to find an intermittent short or open, REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.

KE: Injection Pressure Regulator (IPR) Introduction

KE: Pinpoint Tests



Output Functions

Injection Pressure Regulator (IPR) — A variable position valve that controls injection control pressure. The powertrain control module (PCM) uses many input variables to determine the desired injection control pressure.

Battery voltage is supplied to the IPR when the ignition key is in the ON position. Valve position is controlled by switching the output signal circuit to ground inside the PCM. ON/OFF time is modulated from 0 to 50% dependent upon the desired injection control pressure.

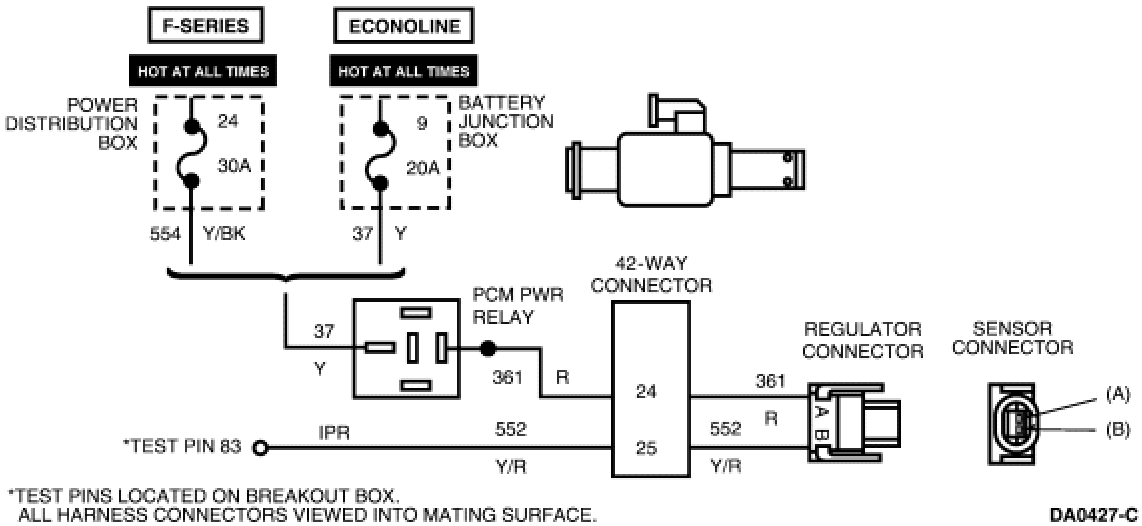
Detection/Management

An open or shorted to ground control circuit can be detected by an on demand output circuit check performed during the KOEO test.

The PCM is capable of detecting whether desired injection control pressure is equal to measured injection control pressure while the engine is running. If the measured injection control pressure does not reasonably compare to the desired injection control pressure the PCM ignores the measured ICP sensor signal and attempts to control the engine with the desired value. (If the problem was in the sensor circuit this strategy causes little performance deterioration. If the problem is in the control circuit, engine performance will probably still be unsatisfactory).

An injection control pressure step test, in which the PCM commands and then measures specific preprogrammed pressures is performed during the KOER test.

The engine will not operate with an IPR circuit that is not functioning.



Note

After removing connectors, always check for damaged pins, corrosion, loose terminals, etc.

DTC Descriptions

P1209 = ICP system fault

P1211 = If set during normal engine operation, indicates engine is operating in open loop control and injection control pressure is above or below desired pressure. If set during KOER test, indicates ICP system failed step test and could not maintain commanded pressure.

P1282 = Injection control pressure was greater than 3675 psi for 1.5 seconds (possible grounded IPR control circuit). Refer to injection control pressure diagnostics if not electronic concern.

P1283 = Output circuit check detected during KOEO test; indicates high or low resistance in circuit.

KE: Pinpoint Tests

KE1 DIAGNOSTIC TROUBLE CODE (DTC) P1283

Note: DTC P1283 indicates an IPR circuit failure was detected by the PCM.

- Disconnect IPR harness connector.
- Remove PCM relay.
- Measure resistance between IPR harness connector Pin A and PCM relay Terminal 361 (R).

Is resistance less than 5 ohms?

Yes	No
GO to KE2 .	REPAIR open Circuit 361 (R). RESTORE system. CLEAR DTCs and RETEST.

KE2 CHECK IPR COIL RESISTANCE

- Measure resistance of IPR coil.

Is resistance 5 to 20 ohms?

Yes	No
GO to KE3 .	REPLACE IPR. RESTORE system. CLEAR DTCs and RETEST.

KE3 IPR CONTROL CIRCUIT SHORT TO POWER OR GROUND

- Install breakout box; leave PCM disconnected.
- Measure resistance between PCM Test Pin 83 and PCM Test Pins 71 and 97.
- Measure resistance between PCM Test Pin 83 and PCM Test Pins 25, 51, 76, 77 and 103.

Is resistance greater than 10,000 ohms?

Yes	No
GO to KE4 .	REPAIR short in Circuit 552 (Y/R). RESTORE system. CLEAR DTCs and RETEST.

KE4 IPR HARNESS CONTROL CIRCUIT — RESISTANCE

- Measure resistance between PCM Test Pin 83 and Point B in the IPR regulator harness connector.

Is resistance less than 5 ohms?

Yes	No
REPLACE PCM. RESTORE system.	REPAIR open Circuit 552 (Y/R).

CLEAR DTCs and RETEST.	RESTORE system. CLEAR DTCs and RETEST.

KE5 DIAGNOSTIC TROUBLE CODE (DTC) P1282

- DTC P1282 indicates excessive injection control pressure was detected during continuous diagnostic monitoring.
- Possible causes:
    - intermittent IPR control circuit short to ground
    - stuck IPR
- Disconnect IPR harness connector.

Will engine start?

Yes	No
REPLACE IPR. RESTORE system. CLEAR DTCs and RETEST.	GO to KE6 .

KE6 CHECK FOR INTERMITTENT SHORT TO GROUND

- Install breakout box; leave the PCM disconnected.
- Measure resistance between PCM Test Pin 83 and ground.
- Wiggle IPR circuit connectors and wires to attempt to induce short to ground.

Is resistance greater than 10,000 ohms?

Yes	No
CLEAR codes. RERUN KOER test. If codes return, REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.	REPAIR short to ground. RESTORE system. CLEAR DTCs and RETEST.

KE7 KOER ON-DEMAND DIAGNOSTIC TROUBLE CODE (DTC) P1211

- DTC P1211 indicates that injection control pressure was above or below commanded desired pressure during self test mode.
- Possible causes:
    - incorrect oil or viscosity
    - poor oil quality
    - gel fuel/no fuel
    - low fuel pressure
    - damaged IPR valve
    - high-pressure oil system leak
    - damaged high-pressure oil pump
    - damaged PCM
- Verify correct oil quality/viscosity and correct fuel grade are being used for the temperature conditions.

Is oil and fuel quality OK?

Yes	No
GO to KE8 .	REPAIR fuel or oil condition and VERIFY DTC does not return. RESTORE system. CLEAR DTCs and RETEST.

KE8 CHECK FUEL PRESSURE

- Measure fuel pressure at regulator block.
- Measure fuel pressure at idle and on road at WOT at full load. Fuel pressure at idle should be 138 kPa (20 psi) minimum, and 206-482 kPa (30-70 psi) at WOT full load.

Is fuel pressure OK?

Yes	No
GO to KE9 .	REPAIR fuel system concern. RESTORE system. CLEAR DTCs and RETEST.

KE9 CHECK OIL RESERVOIR LEVEL

- Remove plug in top of oil reservoir and check level.

Is oil level within 25.4 mm (1 inch) of the top of the reservoir?

Yes	No
GO to KE10 .	REPAIR condition causing low oil supply to the reservoir. RESTORE system. CLEAR DTCs and RETEST.

KE10 ICP SENSOR CHECK

- Key on, engine off.
- Access ICP PID.

Is ICP reading 0 kPa (0 psi)?

Yes	No
GO to KE11 .	REPLACE faulty ICP sensor. RESTORE system. CLEAR DTCs and RETEST.

KE11 OIL AERATION CHECK

- Accelerate engine to wide-open throttle and hold for three minutes.

Does ICP reading increase above 8618 kPa (1250 psi)?

Yes	No
CHANGE engine oil and REPEAT test. RESTORE system. CLEAR DTCs and RETEST.	GO to KE12 .

KE12 CHECK ICP WHILE PERFORMING SELF TEST

Note: During KOER On-Demand Self Test, ICP will be commanded high (17 MPa), then low (5 MPa) and then EBP will be commanded high and low.

- Install ICP/EBP Adapter Cable D94T-50-A or equivalent between ICP sensor and engine harness.
- Measure the voltage between ICP signal circuit and ground.
- Perform KOER On-Demand Self Test.

Does voltage reading increase above 3 V and then decrease to approximately 1 V during the ICP portion of the KOER test?

Yes	No
If DTC 1211 was displayed, REPLACE the PCM. RESTORE system. CLEAR DTCs and RETEST.	GO to KE13 .

KE13 INJECTOR LEAK TEST

- Disconnect high pressure hose from right cylinder head.
- Using Oil High Pressure Leakage Adapter Set D94T-6600-A or equivalent, plug right high pressure hose.
- Access IPR PID.
- Start vehicle and record IPR reading.
- Key off.
- Reconnect right cylinder head high pressure hose.
- Disconnect left cylinder head high pressure hose. Install adapter and ICP into high pressure hose.
- Start vehicle and record IPR reading.

Are the two readings within 2% of each other?

Yes	No
REPLACE faulty IPR valve. If DTC 1211 is still present, GO to KE14 .	REPAIR internal oil leak on the bank with the higher IPR reading. REFER to the Powertrain Group in the Workshop Manual. RESTORE system. CLEAR DTCs and RETEST.

KE14 OIL SYSTEM PRESSURE TEST

- Go to the Powertrain Group in the Workshop Manual. Perform pressurized oil leak checks.

Is a leak condition indicated?

Yes	No
REPAIR leak as necessary. RESTORE system. CLEAR DTCs and RETEST.	REPLACE high pressure oil pump. RESTORE system. CLEAR DTCs and RETEST.

KE15 CONTINUOUS DIAGNOSTIC TROUBLE CODE (DTC) P1211, P1209

- DTC P1209 and P1211 indicates that injection control pressure was above or below desired level under normal driving conditions.
- Possible causes:
    - incorrect oil or viscosity
    - poor oil quality
    - gel fuel/no fuel
    - low fuel pressure
    - damaged IPR valve
    - high-pressure oil system leak
    - damaged high-pressure oil pump
    - damaged PCM
- Verify correct oil quality/viscosity and correct fuel grade are being used for the temperature conditions.

Is oil and fuel quality OK?

Yes	No
GO to KE16 .	REPAIR fuel or oil condition. RESTORE vehicle. CLEAR DTCs and RETEST.

KE16 RECHECK FUEL PRESSURE

- Measure fuel pressure at regulator block.
- Measure fuel pressure at idle and on road at WOT full load. Fuel pressure at idle should be 138 kPa (20 psi) minimum, and 206-482 kPa (30-70 psi) at WOT full load.

Is fuel pressure OK?

Yes	No
GO to KE17 .	REPAIR fuel system concern. RESTORE vehicle. CLEAR DTCs and RETEST.

KE17 PERFORM KOER ON-DEMAND SELF TEST

- Perform KOER On-Demand Self Test.

Is DTC P1211 set?

Yes	No
GO to KE9 .	GO to KE18 .

KE18 CHECK OIL LEVEL IN RESERVOIR

Note: If may be necessary to soak vehicle if a leakdown concern is indicated.

- Remove plug from top of oil reservoir and check level.

Is oil level within 25.4 mm (1 inch) of the top of the reservoir?

Yes	No
GO to KE19 .	REPAIR condition causing low oil supply to the reservoir. RESTORE system. CLEAR DTCs and RETEST.

KE19 CHECK ICP SENSOR

- Key on, engine off.
- Access ICP PID.

Is injection control pressure reading 0 kPa (0 psi)?

Yes	No
GO to KE20 .	REPLACE ICP sensor. RESTORE system. CLEAR DTCs and RETEST.

KE20 CHECK OIL AERATION

- Accelerate engine and hold at 3300 rpm for three minutes.

Does injection control pressure reading increase above 8618 kPa (1250 psi)?

Yes	No
CHANGE engine oil. RESTORE system. CLEAR DTCs and RETEST.	GO to KE21 .

KE21 CHECK IPR DUTY CYCLE UNDER LOAD

- Run vehicle at WOT and full load condition.

Does IPR duty increase to 65%?

Yes	No

REPLACE IPR valve. RESTORE vehicle. CLEAR DTCs and RETEST.	Unable to duplicate failure. RESTORE vehicle. CLEAR DTCs and RETEST.

KF: Fuel Delivery Command Signal (FDCS) Introduction

KF: Pinpoint Tests

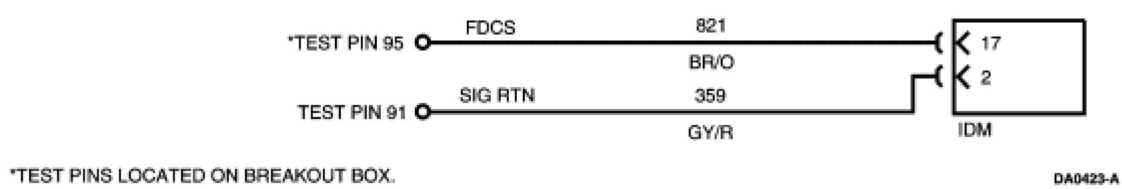
Remember

This pinpoint test is intended to diagnose only the following:

- powertrain control module (PCM) (12A650)
- injector driver module (IDM)
- harness circuits: fuel delivery command signal (FDCS)

Description

The FDCS is the output that controls the fuel injection timing and controls fuel quantity with the injection pressure regulator (IPR). This signal is sent with the cylinder identification (CID) signal to the IDM which provides power and distributes the proper signal to the appropriate injector.



DTC Description

P1663 = FDCS circuit failure

KF: Pinpoint Tests

KF: Fuel Delivery Command Signal (FDCS)

KF: Introduction

KF1 DIAGNOSTIC TROUBLE CODE (DTC) P1663 — FDCS CIRCUIT FAILURE

- DTC P1663 indicates that the PCM has detected a failure on the FDCS line.
- Possible causes:
  - Open/short in FDCS circuit
  - Non-powered IDM
  - IDM
  - PCM
- Check for other codes.
- Key on, engine off.
- Perform KOEO On-Demand Self Test and retrieve Continuous DTCs.

Was only DTC P1663 present?

Yes	No
If DTC P1663 was present, GO to KF2 .	If DTCs P1667 and P1663 are set together, with or without DTC P1668, GO to FJ6 . If DTC P1298 is also present, REPLACE the IDM. If DTC P1662 is also present, GO to NC1 .

KF2 CHECK VOLTAGE ON FDCS CIRCUIT 821 (BR/O)

- 1: Install breakout box, connect PCM to breakout box.
- 2: Key on, engine off.
- 3: Measure voltage on Circuit 821 (BR/O) between PCM Test Pins 95 and ground Pins 51, 77, 91 and 103.

Is voltage of 0.6 + 0.1 volt present?

Yes	No

GO to KF3 .	Voltage of less than 0.5 present, GO to KF4 . Above 0.7 volt is present, GO to KF5 .

KF3 PERFORM OUTPUT STATE CHECK

- Key on, engine off.
- Perform KOEO Output State Self Test, toggle outputs by pressing and releasing the accelerator pedal.
- Measure voltage between PCM Test Pin 95 and ground Pins 25, 51, 76, 77, 91 and 103.

Did the output voltage toggle from 0.6 ± 0.1 volt to B+ volts?

Yes	No
Intermittent failure. GO to KF8 .	REPLACE the PCM. RESTORE system. CLEAR DTCs and RETEST.

KF4 CHECK FOR OPEN ON FDCS CIRCUIT 821 (BR/O)

- Key off.
- Disconnect the PCM from breakout box.
- Disconnect the IDM connector.
- Measure resistance on Circuit 821 (BR/O) between PCM Test Pin 95 and Pin 17 on the IDM harness connector.

Is resistance less than 5 ohms?

Yes	No
GO to KF6 .	REPAIR open in Circuit 821 (BR/O). RESTORE system. CLEAR DTCs and RETEST.

KF5 CHECK FDCS CIRCUIT 821 (BR/O) FOR SHORT TO POWER

- PCM disconnected.
- Key on, engine off.
- Measure voltage on Circuit 821 (BR/O) between PCM Test Pin 95 and ground Pins 25, 51, 76, 77, 91 and 103.

Is voltage present?

Yes	No
REPAIR short to power on Circuit 821 (BR/O).	GO to KF7 .

KF6 CHECK FDCS CIRCUIT 821 (BR/O) FOR SHORT TO GROUND

- Key off.
- Measure resistance between PCM Test Pin 95 and ground Pins 25, 51, 76, 77, 91 and 103.

Is resistance greater than 10,000 ohms?

Yes	No
GO to KF7 .	REPAIR short to ground on Circuit 821 (BR/O). RESTORE system. CLEAR DTCs and RETEST.

KF7 CHECK PCM OUTPUT STATE FUNCTION

- Key off.
- Connect PCM to breakout box.
- Perform KOEO Output State Test.
- Measure voltage between PCM Test Pin 95 and ground Pins 25, 51, 76, 77, 91 and 103 while pressing and releasing accelerator pedal.

Did the output toggle from 0.5 ± 0.1 volt to 0 volt?

Yes	No
REPLACE the IDM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE the PCM. RESTORE vehicle. CLEAR DTCs and RETEST.

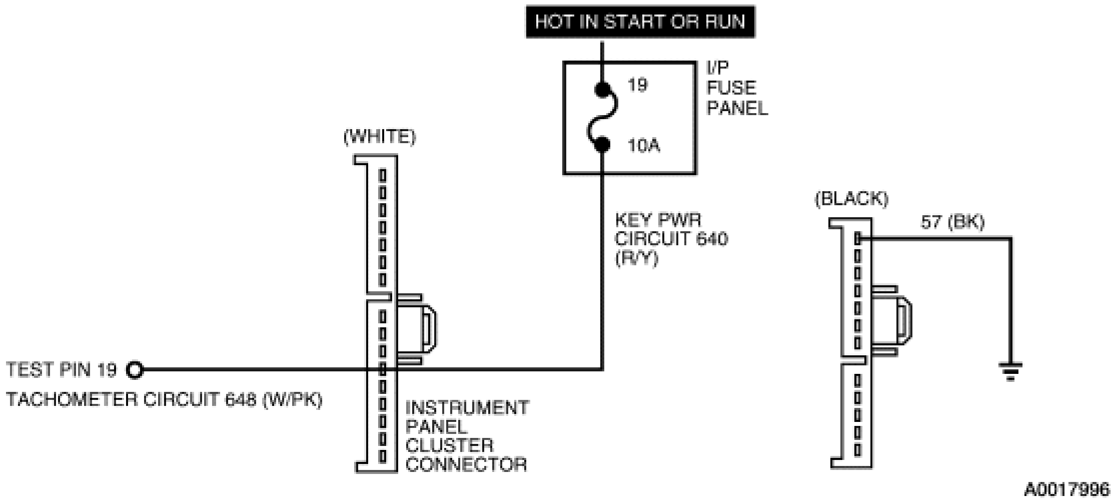
KF8 INTERMITTENT

- Key off.
- Restore vehicle.
- Clear DTCs.
- Turn key off, then turn key on.
- Perform KOEO On-Demand Self Test.

Did DTC 1663 reset?

Yes	No
REPLACE the PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	Unable to duplicate failure. System OK. RESTORE vehicle. CLEAR DTCs and RETEST.

KG: Pinpoint Tests



KG: Pinpoint Tests

KG: Introduction

KG1 TACHOMETER INOPERATIVE: CHECK FUSE

- Check I/P fuse panel Fuse 19.

Is fuse blown?

Yes	No
REPAIR short to ground. REPLACE fuse. TEST system for normal operation.	GO to KG2 .

KG2 CHECK GROUND TO TACHOMETER

- Disconnect small black instrument cluster harness connector.
- Measure resistance of Circuit 57 (BK) between Pin 1 on the small black instrument cluster harness connector and ground.

Is resistance less than 5 ohms?

Yes	No
GO to KG3 .	REPAIR open in Circuit 57 (BK). RESTORE vehicle. TEST system for normal operation.

KG3 CHECK POWER TO TACHOMETER

- Disconnect large white instrument cluster harness connector.
- Key on, engine off.
- Measure voltage of Circuit 640 (R/Y) between Pin 6 on the large white instrument cluster harness connector and ground.
- Key off.

Was voltage greater than 10.5 volts?

Yes	No
GO to KG4 .	REPAIR open in Circuit 640 (R/Y). RESTORE vehicle. TEST system for normal operation.

KG4 CHECK SIGNAL CIRCUIT OUTPUT

- Use the NGS Tester plugged into the data link connector (DLC) and two jumpers, one plugged between the COM port of the NGS Tester to Pin 1 (ground) on the small black connector for the cluster, the other jumper plugged between the SIG port of the NGS Tester to Pin 12 (tach signal) on the large white connector for the cluster.
- Key to start, engine running.
  - With NGS Tester, select VEHICLE and ENGINE.
  - Select DIGITAL MEASUREMENT SYSTEM.
  - Change level to 4 VOLT DC.
  - Press the LINK button to choose a PID.
  - Select PID/DATA MONITOR.
  - Select the RPM PID.
  - Press START.
- Take three readings at 650 rpm, 1500 rpm and 3000 rpm.
- Key off.

Did the readings match the table listed below?

Step No.	Step 1	Step 2	Step 3
RPM	650	1500	3000
FREQUENCY	43 ± 10 Hz	100 ± 10 Hz	200 ± 10 Hz

Yes	No
INSPECT printed circuit board for damaged or open circuits. If damaged or open circuits are present, REPLACE printed circuit board. If OK, REPLACE tachometer. RESTORE vehicle. TEST system for normal operation.	GO to KG5 .

KG5 CHECK FOR OPEN IN TACH SIGNAL CIRCUIT

- Install breakout box; leave PCM disconnected.
- Measure resistance of Circuit 648 (W/PK) between Pin 12 on the large white instrument cluster harness and PCM Test Pin 19.

Is resistance less than 5 ohms?

Yes	No
GO to KG6 .	REPAIR open in Circuit 648 (W/PK). RESTORE vehicle. TEST system for normal operation.

KG6 CHECK FOR SHORT TO GROUND IN TACH SIGNAL

- Measure resistance of Circuit 648 (W/PK) between Pin 12 on the large white instrument cluster harness connector and ground.

Is resistance greater than 10,000 ohms?

Yes	No
GO to KG7 .	REPAIR short to ground on Circuit 648 (W/PK). RESTORE vehicle. TEST system for normal operation.

KG7 CHECK SHORT TO POWER IN TACH CIRCUIT

- Key on, engine off.
- Measure voltage of Circuit 648 (W/PK) between Pin 12 on the large white instrument cluster harness connector and ground.

Is voltage greater than 10.5 volts?

Yes	No

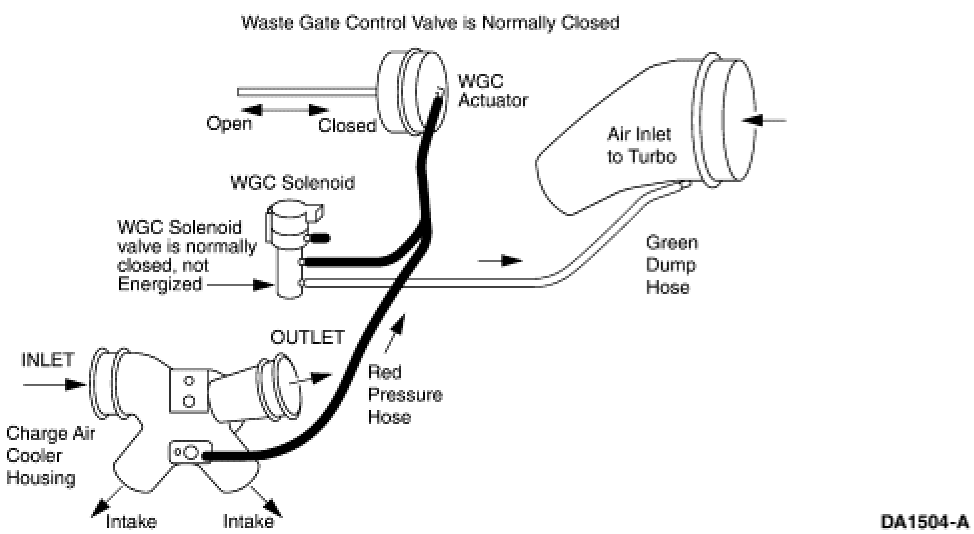
REPAIR short to power in Circuit 648 (W/PK). RESTORE vehicle. TEST system for normal operation.	REPLACE PCM. RESTORE vehicle. TEST system for normal operation.

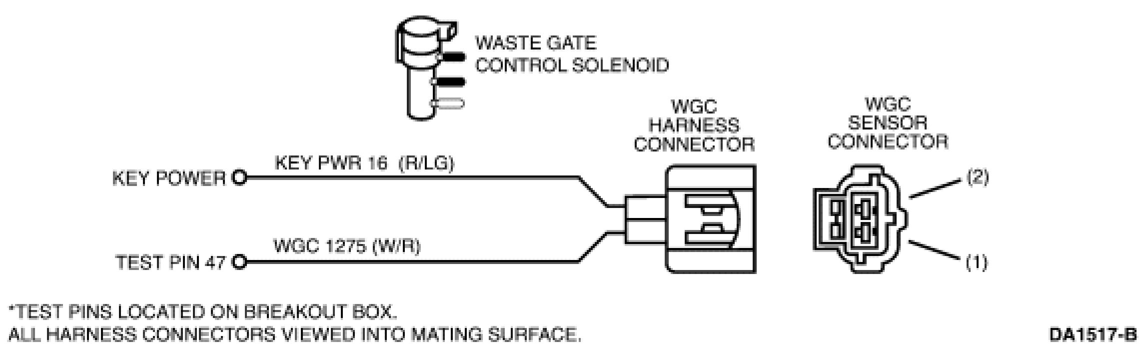
KH: Wastegate Control (WGC) Solenoid — F-Series
Introduction

KH: Pinpoint Tests

Control Functions

A wastegated turbo is designed to reach maximum boost sooner then a conventional turbo, but overboosting will cause damage to the turbo. The PCM will control the boost pressure by duty cycle to the solenoid to maximize boosting performance (no more than 16-1/2 psi). When pressure is supplied on the red hose going to the actuator (solenoid NOT energized) the valve will open, dumping boost. When low or no pressure is on the red hose going to the actuator (solenoid is being energized), the valve will stay closed.





DTC Descriptions

P1690 = Wastegate control valve malfunction

P1249 = Wastegate fall steady state test

KH: Wastegate Control (WGC) Solenoid — F-Series

KH: Introduction

KH1 DIAGNOSTIC TROUBLE CODE (DTC) P1690

- DTC P1690 indicates that the PCM has detected a failure on the WGC circuit.
- Possible causes:
  - short to ground
  - open in harness
  - damaged connection
  - damaged WGC solenoid
  - damaged PCM
  - blown fuse
- Disconnect the WGC solenoid harness connector.
- Key on, engine off.
- Measure voltage between Pin 2 (KEY PWR) on the WGC solenoid harness connector and ground.
- Key off.

Was voltage greater than 10.5 volts?

Yes	No
GO to KH2 .	REPAIR open in (KEY PWR) Circuit 16, or REPLACE blown fuse. RESTORE vehicle. CLEAR DTCs and RETEST.

KH2 CHECK FOR OPEN IN CONTROL CIRCUIT

- Install breakout box; leave PCM disconnected.

- Measure resistance between Pin 1 on the WGC solenoid harness connector and PCM Test Pin 47.

Is resistance less than 5 ohms?

Yes	No
GO to KH3 .	REPAIR open in Circuit 1275 (W/R). RESTORE vehicle. CLEAR DTCs and RETEST.

KH3 CHECK FOR SHORT TO GROUND

- Measure resistance between WGC solenoid harness connector Pin 1 and ground.

Is resistance greater than 10,000 ohms?

Yes	No
GO to KH4 .	REPAIR short to ground on Circuit 1275 (W/R). RESTORE vehicle. CLEAR DTCs and RETEST.

KH4 CHECK WGC SOLENOID

- Measure resistance between Pin 1 and Pin 2 of WGC solenoid harness connector.

Is resistance less than 50 ohms?

Yes	No
REPLACE the PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE the WGC solenoid. RESTORE vehicle. CLEAR DTCs and RETEST.

KH5 DIAGNOSTIC TROUBLE CODE P1249 — CHECK KOEO FOR P1690

- DTC P1249 indicates that the PCM detected the turbo was overboosting.
- Possible causes:
  - short to ground
  - plugged WGC hose or port
  - WGC solenoid
  - WGC actuator
  - WGC valve
  - damaged PCM
- Perform KOEO On-Demand Self Test.

Is DTC P1690 present?

Yes	No
GO to KH1 .	GO to KH6 .

KH6 CHECK WGC HOSES

- Disconnect the RED hose from the WGC actuator.
- Install Gauge Bar 014-00760 vacuum pump or equivalent to the hose.

Does the hose hold vacuum?

Yes	No
GO to KH7 .	GO to KH8 .

KH7 CHECK INTAKE PORT

- Disconnect the RED hose from the charge air cooler housing.

Does hose still hold vacuum?

Yes	No
REPLACE WGC hose. RESTORE vehicle. CLEAR DTCs and RETEST.	CLEAN out plugged charge air cooler housing hose port. RESTORE vehicle. CLEAR DTCs and RETEST.

KH8 CHECK INTERCOOLER PORT

- Disconnect the RED hose from the charge air cooler housing.
- Install vacuum gauge to the port.

Does the port hold vacuum?

Yes	No
CLEAN out the plugged port. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to KH9 .

KH9 CHECK ACTUATOR

- Install vacuum gauge on the WGC actuator.

Does actuator hold vacuum?

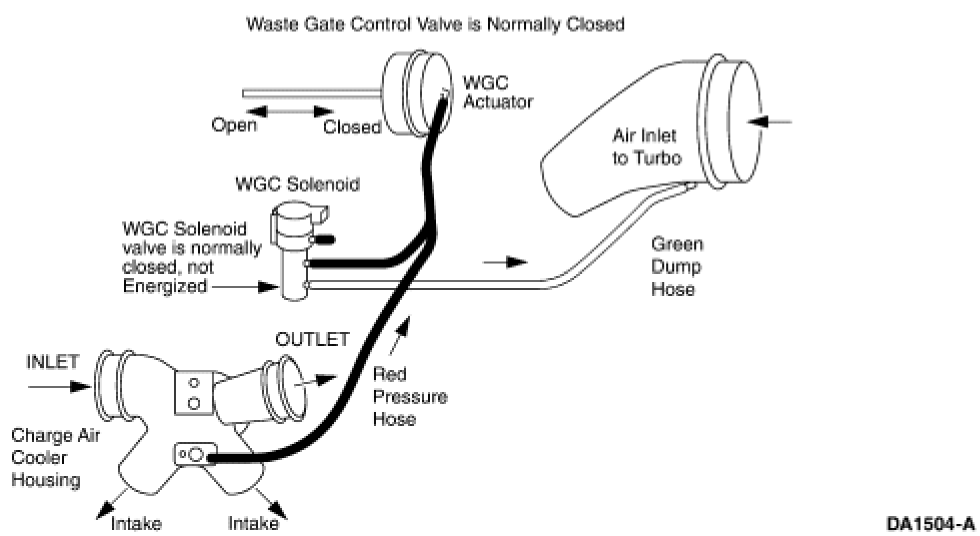
Yes	No
CHECK WGC linkage for sticking. REPLACE if necessary. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE WGC actuator. RESTORE vehicle. CLEAR DTCs and RETEST.

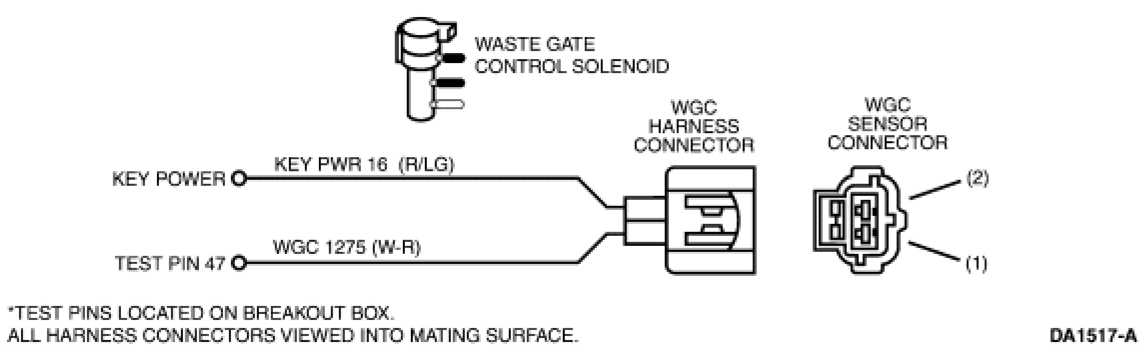
KL: Wastegate Control (WGC) Solenoid — 1999 F-Series Introduction

KL: Pinpoint Tests

Control Functions

A wastegated turbo is designed to reach maximum boost sooner then a conventional turbo, but overboosting will cause damage to the turbo. The PCM will control the boost pressure by duty cycle to the solenoid to maximize boosting performance (no more than 16-1/2 psi). When pressure is supplied on the red hose going to the actuator (solenoid NOT energized) the valve will open, dumping boost. When low or no pressure is on the red hose going to the actuator (solenoid is being energized), the valve will stay closed.





DTC Descriptions

P1690 = Wastegate control valve malfunction

P1249 = Wastegate fall steady state test

KL: Wastegate Control (WGC) Solenoid — 1999 F-Series

KL: Introduction

KL1 DIAGNOSTIC TROUBLE CODE (DTC) P1690

- DTC P1690 indicates that the PCM has detected a failure on the WGC circuit.
- Possible causes:
  - short to ground
  - open in harness
  - damaged connection
  - damaged WGC solenoid
  - damaged PCM
  - blown fuse
- Disconnect the WGC solenoid harness connector.
- Key on, engine off.
- Measure voltage between Pin 2 (KEY PWR) on the WGC solenoid harness connector and ground.
- Key off.

Was voltage greater than 10.5 volts?

Yes	No
GO to KL2 .	REPAIR open in (KEY PWR) Circuit 16, or REPLACE blown fuse. RESTORE vehicle. CLEAR DTCs and RETEST.

KL2 CHECK FOR OPEN IN CONTROL CIRCUIT

- Install breakout box; leave PCM disconnected.
- Measure resistance between Pin 1 on the WGC solenoid harness connector and PCM Test Pin 47.

Is resistance less than 5 ohms?

Yes	No
GO to KL3 .	REPAIR open in Circuit 1275 (W/R). RESTORE vehicle. CLEAR DTCs and RETEST.

KL3 CHECK FOR SHORT TO GROUND

- Measure resistance between WGC solenoid harness connector Pin 1 and ground.

Is resistance greater than 10,000 ohms?

Yes	No
GO to KL4 .	REPAIR short to ground on Circuit 1275 (W/R). RESTORE vehicle. CLEAR DTCs and RETEST.

KL4 CHECK WGC SOLENOID

- Measure resistance between Pin 1 and Pin 2 of WGC solenoid harness connector.

Is resistance less than 50 ohms?

Yes	No
REPLACE the PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE the WGC solenoid. RESTORE vehicle. CLEAR DTCs and RETEST.

KL5 DIAGNOSTIC TROUBLE CODE P1249 — CHECK KOEO FOR P1690

- DTC P1249 indicates that the PCM detected the turbo was overboosting.
- Possible causes:
  - short to ground
  - plugged WGC hose or port
  - WGC solenoid
  - WGC actuator
  - WGC valve
  - damaged PCM
- Perform KOEO On-Demand Self Test.

Is DTC P1690 present?

Yes	No
GO to KL1 .	GO to KL6 .

KL6 CHECK WGC HOSES

- Disconnect the RED hose from the WGC actuator.
- Install Gauge Bar 014-00760 vacuum pump or equivalent to the hose.

Does the hose hold vacuum?

Yes	No
GO to KL7 .	GO to KL8 .

KL7 CHECK INTAKE PORT

- Disconnect the RED hose from the charge air cooler housing.

Does hose still hold vacuum?

Yes	No
REPLACE WGC hose. RESTORE vehicle. CLEAR DTCs and RETEST.	CLEAN out plugged charge air cooler housing hose port. RESTORE vehicle. CLEAR DTCs and RETEST.

KL8 CHECK INTERCOOLER PORT

- Disconnect the RED hose from the charge air cooler housing.
- Install vacuum gauge to the port.

Does the port hold vacuum?

Yes	No
CLEAN out the plugged port. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to KL9 .

KL9 CHECK ACTUATOR

- Install vacuum gauge on the WGC actuator.

Does actuator hold vacuum?

Yes	No
CHECK WGC linkage for sticking. REPLACE if necessary. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE WGC actuator. RESTORE vehicle. CLEAR DTCs and RETEST.

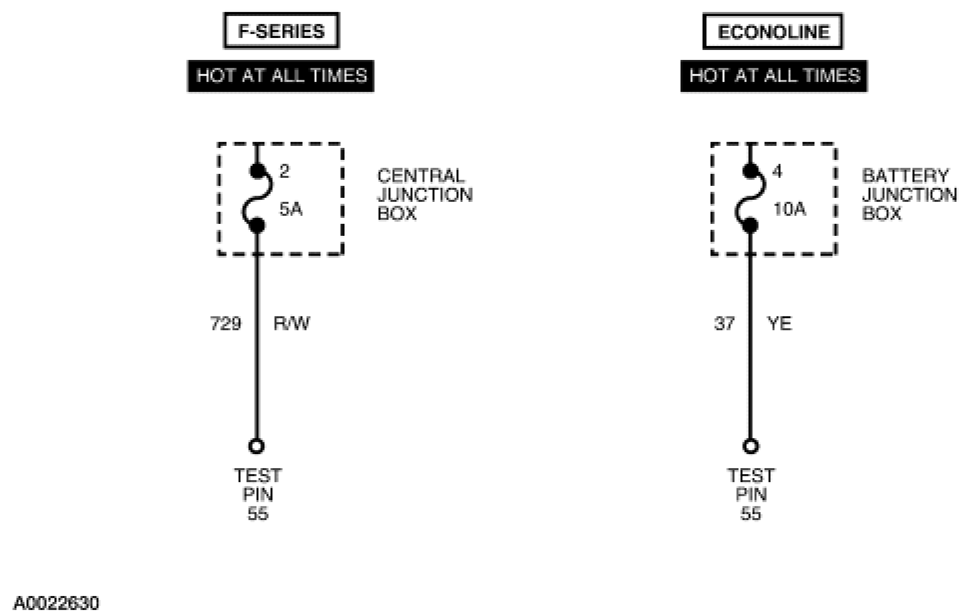
MA: Continuous Memory Failure
Introduction

MA: Pinpoint Tests

Remember

This pinpoint test is intended to diagnose only the following:

- powertrain control module (PCM) (12A650)
- harness circuit: keep alive power (KAPWR)



DTC Description

P0603 = Internal control module keep alive memory (KAM) error

MA: Pinpoint Tests

MA: Continuous Memory Failure

MA: Introduction

MA1 CONTINUOUS DTC P0603 IS SET WHEN THE PCM HAS LOST KAPWR

Note: This code may have been caused by disconnecting the PCM or the batteries.

- Possible causes:
  - Battery or PCM has been disconnected.
  - Battery cables loose or poor connection.
  - Battery discharged.
  - Open in KAPWR circuit.
  - Blown fuse.
  - PCM.
- Check for other codes.
- Key on, engine off.
- Clear DTCs.
- Cycle key off, then on.
- Perform retrieve Continuous DTCs.

Was DTC P0603 present?

Yes	No
GO to MA2 .	Intermittent failure, unable to duplicate. REPAIR other DTCs as necessary. If none, testing is complete. RESTORE vehicle. CLEAR DTCs and RETEST.

MA2 CHECK 5 AMP FUSE (#2 FOR F-SERIES) OR (#27 FOR ECONOLINE)

- Key off.
- Remove and inspect fuse 2 (F-Series) or fuse 4 (Econoline). If fuse is blown, replace it.
- Measure voltage between fuse B+ terminal and ground.

Is voltage greater than 10 volts?

Yes	No
GO to MA3 .	REPAIR open in battery feed to fuse terminal.

MA3 CHECK FOR VOLTAGE TO PCM

- Key off.
- Install breakout box, leave PCM disconnected.
- Measure voltage between PCM Test Pin 55 and ground.

Is B+ present?

Yes	No
RESTORE vehicle; CLEAR DTC, RERUN test. If code reappears, REPLACE the PCM.	REPAIR open in circuit 729 (F-Series) or circuit 37 (Econoline). RESTORE vehicle. CLEAR DTCs and RETEST.

MB: OBD II Readiness Code

MB1 DIAGNOSTIC TROUBLE CODE P1000

Note: If power to the PCM is disconnected, P1000 will be set until the OBD II monitors have run and cleared.

- Diagnostic code P1000 indicates that operating conditions have not been satisfied for all of the OBD II monitors to run.
- Possible causes:
  - drive conditions not satisfied
  - KAM cleared
  - damaged PCM
- Perform all self tests and check continuous codes.

Are DTCs other than P1000 set?

Yes	No
REPAIR other DTCs according to appropriate pinpoint test before continuing.	GO to MB2 .

MB2 PERFORM MANUFACTURER-SPECIFIED DIESEL DRIVE CYCLE

- Perform diesel drive cycle. Refer to Section 2 .

Is P1000 cleared?

Yes	No
No issue; DTC P1000 cleared.	GO to MB3 .

MB3 VERIFY CERTAIN OPERATING CONDITIONS HAVE BEEN SATISFIED

- Using NGS Scan Tool, monitor EOT, IVPWR and GPC. If vehicle is started and EOT is below 55°C (131°F) for F-Series or 30°C (86°F) for Econoline, IVPWR must be between 11.5v and 14v until the glow plug duty cycle is 0%.
- Using NGS Scan Tool, monitor MFDES and rpm at full load. MFDES must be above 37 MG/stroke for at least 12 seconds with rpm above 2300.
- Monitor MFDES at idle with vehicle warmed up. MFDES must be below 12 MG/stroke for at least 12 seconds.

With the above conditions met, is P1000 cleared?

Yes	No
No issue; DTC P1000 cleared.	COMPLETE all steps in Section 4 , Diagnostic Subroutines to determine DTC clearing issue.

MC: PCM Inactive Background Fault

MC1 DIAGNOSTIC TROUBLE CODE (DTC) P0606

- DTC P0606 exists only when there has been an internal failure of the PCM.
- Rerun Scan Tool Diagnostic Test.

  Note: If DTC P0606 is retrieved with other DTCs, service all other DTCs first.

Is DTC P0606 still present after all other DTCs have been serviced?

Yes	No
REPLACE PCM. CLEAR DTCs and RETEST.	System OK. CLEAR DTCs and RETEST.

MD: PCM-ROM Failure

MD1 DIAGNOSTIC TROUBLE CODE (DTC) P0605

- DTC P0605 exists only when there has been an internal failure of the powertrain control module (PCM).
- Rerun Scan Tool Diagnostic Test.

Is DTC P0605 retrieved?

Yes	No
REPLACE PCM. CLEAR DTCs and RETEST.	System OK. CLEAR DTCs and RETEST.

NA: Pinpoint Tests

Output Functions

High Side Drive Outputs (Right and Left Bank) — The high side driver output function is to distribute energy to the proper bank based on cylinder identification (CID) and provide regulated current to the unit injectors, based on fuel delivery command signal (FDCS) from the injector driver module (IDM) internal 115 V supply. The injection timing and duration is commanded by the powertrain control module (PCM) in the FDCS.

Low Side Drive Outputs — The low side drive outputs control the sequencing (firing order) of the engine based on the CID and FDCS inputs.

WARNING: RED-STRIPED WIRES CARRY 115 V DC. SEVERE ELECTRICAL SHOCK MAY BE RECEIVED. DO NOT PIERCE.

CAUTION: Do not pierce engine electrical wires or damage to the harness may occur.

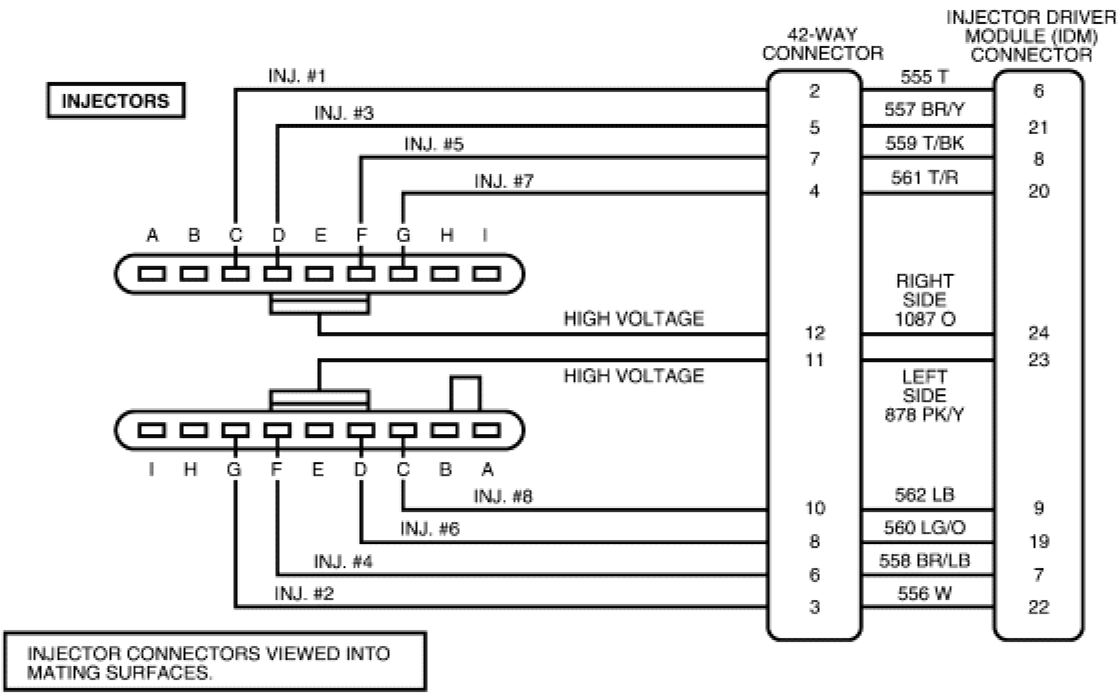
Detection/Management

Note: Special instructions required to clear IDM trouble codes (1995/1996 model year).

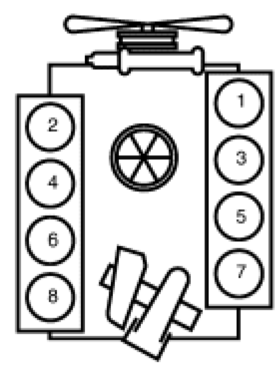
- Key on.
- Record IDM trouble codes stored in KOEO ON-DEMAND SELF TEST and KOEO INJECTOR ELECTRICAL SELF TEST modes.
- Access RETRIEVE/CLEAR CONTINUOUS DTCs from NGS Tester menu to clear IDM trouble codes from memory.
- Record any codes displayed. (P1111 may be the only code displayed.)
- Push CLEAR ALL button on NGS Tester.
- IDM trouble codes are now cleared from memory. Repeat the KOEO On-Demand Self Test and KOEO Injector Electrical Self Test. Any IDM codes that reappear are IDM hard faults. If no IDM codes reappear, then the fault is an intermittent IDM fault.

The IDM is capable of detecting individual injector open and shorts to either ground or battery while the engine is running. It is also capable of detecting right or left bank high side opens or shorts to ground. A special on-demand buzz electrical self test will also allow the operator to enable all injector solenoids while the engine is off to verify circuit operation. **IDM detected trouble codes will not be transmitted if the EF line is not functioning; however, the engine will not shut down due to a non-functional EF line.**

If a low side short to ground condition is determined by the IDM, this condition will be transmitted to the PCM via the EF signal. The PCM will enable the CHECK ENGINE light and command minimum fuel to the affected bank.



INDIVIDUAL INJECTOR DIAGNOSTIC TROUBLE CODES					
	LOW SIDE SHORT TO GROUND	LOW SIDE SHORT TO BATTERY	CYLINDER CONTRIBUTION TEST	HIGH TO LOW SIDE SHORT	HIGH TO LOW SIDE OPEN
CYL. #1	0261	0262	0263	1261	1271
CYL. #2	0264	0265	0266	1262	1272
CYL. #3	0267	0268	0269	1263	1273
CYL. #4	0270	0271	0272	1264	1274
CYL. #5	0273	0274	0275	1265	1275
CYL. #6	0276	0277	0278	1266	1276
CYL. #7	0279	0280	0281	1267	1277
CYL. #8	0282	0283	0284	1268	1278



FIRING ORDER
1-2-7-3-4-5-6-8
(CCT ORDER 1-2-3-4-5-6-7-8)

INJECTOR BANK DIAGNOSTIC TROUBLE CODES	
1291	HIGH SIDE #1 (RIGHT) SHORT TO GRD. OR B+
1292	HIGH SIDE #2 (LEFT) SHORT TO GRD. OR B+
1293	HIGH SIDE OPEN, RIGHT GROUP
1294	HIGH SIDE OPEN, LEFT GROUP
1295	MULTIPLE FAULTS ON BANK #1 (RIGHT)
1296	MULTIPLE FAULTS ON BANK #2 (LEFT)
1297	HIGH SIDES SHORTED TOGETHER

DA1980-B

NA: Pinpoint Tests

NA: Injector Driver Circuit Operation

NA: Introduction

NA1 DIAGNOSTIC TROUBLE CODES (DTCs) P0261, P0264, P0267, P0270, P0273, P0276, P0279, P0282

- DTCs below indicate a low side ground short in the circuit between the IDM and the injector. The following table lists the circuit to inspect while performing these pinpoint tests, based on the DTC retrieved during the KOEO On-Demand or Injector Electrical Self Tests.

Cyl.	DTC	Circuit	Cyl.	DTC	Circuit
1	P0261	555 (T)	5	P0273	559 (T/BK)
2	P0264	556 (W)	6	P0276	560 (LG/O)
3	P0267	557 (BR/Y)	7	P0279	561 (T/R)
4	P0270	558 (BR/LB)	8	P0282	562 (LB)

- Disconnect injector valve cover connector at the suspect injector.
- Measure resistance between suspect circuit of the engine harness connector and battery negative post.

Is resistance greater than 10,000 ohms?

Yes	No
GO to NA2 .	GO to NA4 .

NA2 CHECK SHORT IN CIRCUIT TO GROUND

- Install Glow Plug Injector Adapter 014-00935 or equivalent to the valve cover gasket.
- Measure resistance between suspect circuit and battery ground.

Is the resistance greater than 10,000 ohms?

Yes	No
Fault may be intermittent, GO to NA5 .	GO to NA3 .

NA3 UNDER VALVE COVER SHORT

- Remove valve cover and disconnect injector connector.
- Inspect under valve cover (UVC) harness for shorting to ground.

Is fault indicated?

Yes	No
REPLACE UVC harness. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE injector. RESTORE vehicle. CLEAR DTCs and RETEST.

NA4 CHECK FOR SHORT BETWEEN INJECTOR VALVE COVER CONNECTOR AND IDM

- Disconnect IDM harness connector.
- Measure resistance between respective injector circuit and all other circuits in the IDM harness connector and to chassis ground.

Is the resistance greater than 10,000 ohms?

Yes	No
REPLACE IDM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR short to ground between injector valve cover connector and IDM connector. RESTORE vehicle. CLEAR DTCs and RETEST.

NA5 CHECK FOR INTERMITTENT SHORT TO GROUND

- Key off.
- Disconnect IDM. Inspect for damaged or pushed-out pins.
- All other connectors plugged in.
- Using a digital multimeter and the flex tips supplied with the NGS Tester, measure resistance between the suspect injector low side circuit on the IDM connector and battery ground post. Refer to injector illustration at beginning of this pinpoint test for pin location.
- Grasp the harness close to the suspect injector connector. Wiggle and shake harness while working toward the IDM.

Does resistance ever drop below 10,000 ohms?

Yes	No
ISOLATE short to ground and REPAIR. RESTORE vehicle. CLEAR DTCs and RETEST.	IDM internal failure, REPLACE IDM. RESTORE vehicle. CLEAR DTCs and RETEST.

NA6 DIAGNOSTIC TROUBLE CODES (DTCs) P0262, P0265, P0268, P0271, P0274, P0277, P0280, P0283 and P1261-P1268

- DTCs P1261-P1268 indicate that the low side circuit is shorted to B+ or the high side circuit between the IDM and the injector. The following table lists the circuits to inspect while performing these pinpoint tests, based on the DTC retrieved during the KOEO On-Demand or Injector Electrical Self Tests.

Cyl.	DTC	Low Side	High Side
1	P1261-P0262	555 (T)	1087 (O)
2	P1262-P0265	556 (W)	878 (PK/Y)
3	P1263-P0268	557 (BR/Y)	1087 (O)
4	P1264-P0271	558 (BR/LB)	878 (PK/Y)
5	P1265-P0274	559 (T/BK)	1087 (O)
6	P1266-P0277	560 (LG/O)	878 (PK/Y)
7	P1267-P0280	561 (T/R)	1087 (O)
8	P1268-P0283	562 (LB)	878 (PK/Y)

-
- Key on, engine off.
- Disconnect IDM harness connector.
- Disconnect both connectors on the bank with the code.
- Measure resistance between the low side and battery positive post, then to high side at the injector valve cover connector. Refer to injector illustration at beginning of this pinpoint test for pin location.
- Key off.

Are both resistance readings less than 10,000 ohms?

Yes	No
GO to NA7 .	REPAIR short in circuits between IDM and injector valve cover connector. RESTORE system. CLEAR DTCs and RETEST.

NA7 CHECK FOR SHORT INTERNAL TO VALVE COVER

- Install Glow Plug Injector Adapter 014-00935 or equivalent to valve cover gasket.
- Measure resistance between high side and low side circuits.

Is resistance less than 2.0 ohms on a cold engine?

Yes	No
GO to NA8 .	Fault may be intermittent. GO to NA10 .

NA8 CHECK FOR SHORT UNDER VALVE COVER

- Remove valve cover.
- Disconnect injector connector.

- Measure resistance between Glow Plug Injector Adapter 014-00935 or equivalent and injector connector on both high and low side circuits.

Is resistance greater than 10,000 ohms?

Yes	No
REPLACE injector. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to NA9 .

NA9 GASKET HARNESS OR UVC SHORT LOW SIDE TO HIGH SIDE

- Remove UVC harness.
- Measure resistance between gasket harness low side and high side circuitry.

Is resistance less than 5 ohms?

Yes	No
REPLACE gasket harness. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE UVC harness. RESTORE vehicle. CLEAR DTCs and RETEST.

NA10 CHECK FOR INTERMITTENT LOW SIDE SHORT TO B+ OR HIGH SIDE

- Key on, engine off.
- All four valve cover connectors disconnected.
- Measure resistance between the suspect injector low side circuit and battery positive post, then to high side circuit on the IDM connector. Refer to injector illustration at the beginning of this pinpoint test for pin location.
- Grasp the harness close to the suspect injector connector. Wiggle and shake harness while working toward the IDM.

Do either resistance readings ever drop below 10,000 ohms?

Yes	No
ISOLATE shorted circuit and REPAIR. RESTORE vehicle. CLEAR DTCs and RETEST.	IDM internal failure. REPLACE IDM. RESTORE vehicle. CLEAR DTCs and RETEST.

NA11 DIAGNOSTIC TROUBLE CODES (DTCs) P1271-P1278

- DTCs P1271-P1278 indicate a low side-to-high side open in the circuit between the IDM and the injector. The following table lists the circuits to inspect while performing these pinpoint tests, based on the DTC retrieved during the KOEO On-Demand or Injector Electrical Self Tests.

  Note: If all of the DTCs associated with an entire bank are retrieved, the high side circuit is most likely open.

Cyl.	DTC	Low Side	High Side	Bank
1	P1271	555 (T)	1087 (O)	Right
2	P1272	556 (W)	878 (PK/Y)	Left
3	P1273	557 (BR/Y)	1087 (O)	Right
4	P1274	558 (BR/LB)	878 (PK/Y)	Left
5	P1275	559 (T/BK)	1087 (O)	Right
6	P1276	560 (LG/O)	878 (PK/Y)	Left
7	P1277	561 (T/R)	1087 (O)	Right
8	P1278	562 (LB)	878 (PK/Y)	Left

- Disconnect injector valve cover connector.
- Install Glow Plug Injector Adapter 014-00935 or equivalent to valve cover gasket.
- Measure resistance between the high side and low side on the injector. Refer to injector illustration at beginning of this pinpoint test for proper pin location.

Is the resistance less than 5 ohms?

Yes	No
GO to NA13 .	GO to NA12 .

NA12 CHECK INJECTOR FOR OPEN CIRCUIT

- Remove valve cover.
- Disconnect injector connector.
- Measure resistance between high side circuit from adapter tool and injector connector.
- Measure resistance between low side circuit from adapter tool and injector connector.

Is each resistance less than 5 ohms?

Yes	No
REPLACE injector. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to NA23 .

NA13 CHECK FOR OPEN IN LOW SIDE CIRCUIT

- Disconnect IDM harness connector.
- Measure resistance on injector low side circuit between valve cover connector and IDM.

Is resistance less than 5 ohms?

Yes	No

GO to NA14 .	REPAIR open in low side circuit. RESTORE vehicle. CLEAR DTCs and RETEST.

NA14 CHECK FOR OPEN IN HIGH SIDE CIRCUIT

- Measure resistance between suspect injector high side circuit on injector harness connector and IDM connector.

Is resistance less than 5 ohms?

Yes	No
Fault may be intermittent. GO to NA15 .	REPAIR open in high side circuit. RESTORE vehicle. CLEAR DTCs and RETEST.

NA15 CHECK FOR OPEN INJECTOR CIRCUIT

- Measure resistance between suspect low side and high side circuit at the IDM connector. Refer to injector illustration at beginning of this pinpoint test for pin location.
- Grasp the harness close to the suspect injector harness connector. Wiggle and shake harness while working your way back to the IDM.

Do resistance readings ever go above 5 ohms?

Yes	No
ISOLATE open in circuit and REPAIR. RESTORE vehicle. CLEAR DTCs and RETEST.	REPLACE IDM. RESTORE vehicle. CLEAR DTCs and RETEST.

NA16 DIAGNOSTIC TROUBLE CODES (DTCs) P1291 AND P1292

- DTCs P1291 and P1292 indicate a ground short or short to battery positive exists on the high side circuit between the IDM and the injectors. The following table list the circuits to inspect while performing these pinpoint tests, based on the DTC retrieved during the KOEO test.

DTC	High Side	Bank
P1291	1087 (O)	Right
P1292	878 (PK/Y)	Left

-
- Disconnect IDM harness connector.

- Measure resistance between the suspect high side circuit at the IDM harness connector and battery negative post. Refer to injector illustration at beginning of this pinpoint test for proper pin location.

Is resistance greater than 10,000 ohms?

Yes	No
GO to NA18 .	GO to NA17 .

NA17 CHECK SHORT TO GROUND IN HIGH SIDE CIRCUIT

- Disconnect both valve cover connectors on the bank with the code.
- Measure resistance between suspect high side circuit at IDM connector and battery negative post.

Is resistance greater than 10,000 ohms?

Yes	No
GO to NA2 .	REPAIR short to ground between IDM and injector valve cover connector. RESTORE vehicle. CLEAR DTCs and RETEST.

NA18 CHECK SHORT TO POWER IN HIGH SIDE CIRCUIT

- Key on, engine off.
- Measure resistance between the suspect high side circuit at IDM connector and battery positive post, then to other high side circuit.

Are both resistance readings greater than 10,000 ohms?

Yes	No
Fault may be intermittent. GO to NA19 .	REPAIR short to power on high side circuit. RESTORE vehicle. CLEAR DTCs and RETEST.

NA19 CHECK FOR INTERMITTENT SHORT TO POWER IN HIGH SIDE CIRCUIT

- Measure resistance between suspect high side circuit on the IDM connector and battery positive post, then to other high side circuit.
- Grasp the harness close to the suspect injector harness connector. Wiggle, shake harness while working towards the IDM.

Do both resistance readings ever drop below 10,000 ohms?

Yes	No
ISOLATE short circuit and REPAIR. RESTORE vehicle. CLEAR DTCs and	REPLACE IDM. RESTORE vehicle. CLEAR DTCs and RETEST.

RETEST.	

NA20 DIAGNOSTIC TROUBLE CODES (DTCs) P1294 AND P1293: CHECK FOR VOLTAGE ON HIGH SIDE CIRCUIT

- DTCs P1294 and P1293 indicate an open circuit exists on the high side circuit between the IDM and the injectors. The following table lists the circuits to inspect while performing these pinpoint tests, based on the DTC retrieved during the KOEO On-Demand and Injector Electrical Self Tests.

DTC	High Side	Injector Bank
P1294	878 (PK/YE)	Left
P1293	1087 (OG)	Right

-
- Key off.
- Disconnect connector on the bank with the code.
- Key on, engine off.
- Measure voltage on the suspect high side circuit Pin E on the injector vehicle harness connectors and battery ground.

Is voltage greater than one volt?

Yes	No
GO to NA21 .	GO to NA24 .

NA21 CHECK INJECTOR RESISTANCE

- Key off.
- Suspect injector valve cover connectors disconnected.
- Install Glow Plug Injector Adapter 014-00935 or equivalent.
- Measure resistance between high side and low side injector terminals on the adapter tool.

Is resistance less than 5 ohms?

Yes	No
Fault may be intermittent. GO to NA15 .	GO to NA22 .

NA22 CHECK HARNESS FOR OPEN

- Remove valve cover.
- Disconnect injector harness connector.
- Measure resistance between injector connector and exterior gasket connector.

Is resistance less than 5 ohms?

Yes	No
REPLACE injector. RESTORE system. CLEAR DTCs and RETEST.	GO to NA23 .

NA23 DETERMINE WHETHER GASKET OR UVC HARNESS HAS FAILED

- Disconnect UVC harness from gasket.
- Measure resistance across each contact in the gasket.

Is each resistance reading less than 5 ohms?

Yes	No
REPLACE UVC harness. RESTORE system. CLEAR DTCs and RETEST.	REPLACE valve cover gasket. RESTORE system. CLEAR DTCs and RETEST.

NA24 CHECK FOR OPEN IN HIGH SIDE CIRCUIT

- Key off.
- Disconnect IDM harness connector.
- Both connectors on the bank with the code disconnected.
- Measure resistance between suspect high side circuit at the IDM connector and Pin C and both suspect injector connectors.

Are both resistance readings less than 5 ohms?

Yes	No
Fault may be intermittent. GO to NA15 .	REPAIR open in high side circuit. RESTORE system. CLEAR DTCs and RETEST.

NA25 DIAGNOSTIC TROUBLE CODES (DTCs) P0263, P0266, P0269, P0272, P0275, P0278, P0281, P0284, P0301, P0302, P0303, P0304, P0305, P0306, P0307 and P0308

> **Note:** Only a California calibration will set a Continuous Misfire DTC. Both 49 state and California will set a KOER CCT DTC for a low or non-contributing cylinder. To run KOER Cylinder Contribution Test, refer to Quick Test description in Section 2 , Diagnostic Routines.

- If any of the following DTCs set in either Continuous or KOER Cylinder Contribution Test, this pinpoint test must be used to diagnose the fault.

CCT DTCs	California Continuous DTCs	Cylinder
P0263	P0301	1
P0266	P0302	2
P0269	P0303	3

P0272	P0304	4
P0275	P0305	5
P0278	P0306	6
P0281	P0307	7
P0284	P0308	8

-
- Possible causes:
  - broken compression rings
  - inoperative injector assembly
  - leaking or bent valves
  - bent push rod
  - broken rocker arm bolts
  - bent connecting rod
- Perform KOEO On-Demand Self Test, KOER Cylinder Contribution Self Test, Retrieve/Clear Continuous DTCs.

Were any DTCs retrieved?

Yes	No
REPAIR any concerns found. RESTORE system. CLEAR DTCs and RETEST.	GO to NA26 .

NA26 CYLINDER NON-CONTRIBUTING

> **Note:** A/C must be off when running KOER Cylinder Contribution Self Test.

- Go to Section 4 , Diagnostic Subroutines, and perform Steps 8a, 8b, 8c, 8d, 9, 10a, 10b, 11, 11a, 11b, and 12.

Were any problems found after running all of the above steps?

Yes	No
REPAIR any concerns found. RESTORE system. CLEAR DTCs and RETEST.	If base engine diagnostic checks pass, REPLACE injector assembly. If base engine does not pass, REPAIR concern. RESTORE system. CLEAR DTCs and RETEST.

NA27 DIAGNOSTIC TROUBLE CODE (DTC) P1297

- Disconnect IDM harness connector.
- Measure resistance between both high side circuits at the IDM connector.

Is resistance greater than 10,000 ohms?

Yes	No

GO to NA28 .	REPAIR short between both high side circuits. RESTORE system. CLEAR DTCs and RETEST.

NA28 CHECK FOR INTERMITTENT SHORT BETWEEN BOTH HIGH SIDE CIRCUITS

- Measure resistance between both high side circuits at the IDM connector, Pins 22 and 23.
- Grasp the harness close to the IDM connector. Wiggle, shake harness while working towards the injectors.

Does resistance ever drop below 10,000 ohms?

Yes	No
ISOLATE short circuit and REPAIR. RESTORE system. CLEAR DTCs and RETEST.	REPLACE IDM. RESTORE system. CLEAR DTCs and RETEST.

NA29 DIAGNOSTIC TROUBLE CODES (DTCs) P1295 AND P1296

- DTCs P1295 and P1296 indicate that more than one fault exists on the right or left bank. A short and open on both the low side and high side can exist on the bank with the DTC.

DTC	BANK
P1295	Right Bank
P1296	Left Bank

-
- Disconnect IDM harness connector.
- Measure resistance between each injector circuit one by one and battery ground from the IDM harness connector.

Are all circuits greater than 10,000 ohms?

Yes	No
GO to NA30 .	If low side short was found, GO to NA1 to find short, then RETURN to this step. If high side short was found, GO to NA16 , then RETURN to this step.

NA30 CHECK FOR SHORT TO B+

- Key on, engine off.

- Measure voltage of each injector circuit one by one between IDM harness connector and battery ground.
- Key off.

Was voltage present on any circuit?

Yes	No
If low side short was found, GO to NA6 , then RETURN to this step. If high side short was found, GO to NA16 , then RETURN to this step.	GO to NA31 .

NA31 CHECK FOR HIGH SIDE CIRCUIT SHORTED TOGETHER

- Measure resistance between high side circuits from the IDM harness connector Pins 23 and 24.

Is resistance greater than 10,000 ohms?

Yes	No
GO to NA32 .	REPAIR short between both high side circuits. RESTORE system. CLEAR DTCs and RETEST.

NA32 CHECK FOR OPEN CIRCUIT

- Disconnect all four valve cover connectors on both banks.
- Measure resistance between valve cover connector and IDM connector on all injector high side and low side circuits.

Are any circuits greater than 10,000 ohms?

Yes	No
REPAIR open in suspect circuit. RESTORE system. CLEAR DTCs and RETEST.	GO to NA33 .

NA33 CHECK FOR OPEN UNDER VALVE COVER

- Using Glow Plug Injector Adapter 418-F221 or equivalent, measure resistance between high side and low side of every injector circuit through the valve cover.

Are any injector circuits greater than 5 ohms?

Yes	No
GO to NA12 .	RECONNECT everything, CLEAR continuous DTCs and RERUN KOEO Injector Electrical Self Test and KOEO On-

	Demand Self Test. If DTC P1295 or P1296 reappears, REPLACE IDM.

NB: Pinpoint Tests

Remember

To prevent the replacement of good components, be aware that the following non-EEC areas may be at fault:

- fuse, bulb or socket

This pinpoint test is intended to diagnose only the following:

- STO/MIL circuit
- powertrain control module (PCM) (12A650)

Description

The CHECK ENGINE light is intended to alert the driver of certain concerns in the closed loop system. The CHECK ENGINE light output is turned on when the strategy detects a concern in certain input/output circuits. The light will remain on as long as the concern is present. Regulations governing this light also require that the Diagnostic Trouble Codes (DTCs) be displayed by the flashing of this light.

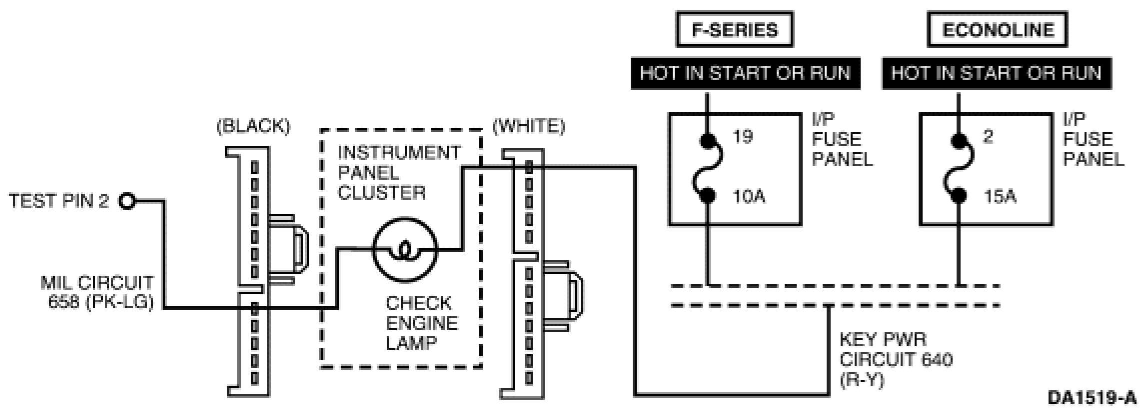
CHECK ENGINE Light Functionality

The CHECK ENGINE light is located in the instrument cluster and is amber colored. The CHECK ENGINE light functions in one of three modes.

1. Bulb check — at key-on the light is turned on for a short duration as a bulb check. If this does not occur, check the wiring, the bulb, and the associated fuse.

2. Detection of certain concerns — the CHECK ENGINE light is used to indicate that one of certain concerns has been detected by the PCM or IDM. Only those concerns which result in a change in power output available from the engine will cause the light to be turned on. Examples of such concerns are:
   a. Injector low side short to ground — the PCM will turn off four cylinders to prevent engine damage.

   b. Accelerator pedal sensor out of range — the PCM will allow the engine to idle only.



NB: Pinpoint Tests

NB: Check Engine Light

NB: Introduction

NB1 CHECK ENGINE LIGHT FAULT

- If any KOEO On-Demand or Continuous Memory Diagnostic Trouble Codes are present, service before proceeding.

Is CHECK ENGINE light always on?

Yes	No
GO to NB2 .	GO to NB3 .

NB2 CHECK ENGINE LIGHT ALWAYS ON: CHECK CIRCUIT 658 (PK/LG) FOR SHORTS TO GROUND

- Disconnect PCM harness connector.
- Key on, engine off.

Is CHECK ENGINE light on?

Yes	No
REPAIR short to ground in Circuit 658 (PK/LG). RESTORE system. CLEAR DTCs and RETEST.	REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.

NB3 CHECK ENGINE LIGHT NEVER ON

- Disconnect manifold absolute pressure (MAP) sensor.
- Key on, engine running.

Is CHECK ENGINE light on?

Yes	No
System working OK. RESTORE system. CLEAR DTCs and RETEST.	RECONNECT MAP sensor. GO to NB4 .

NB4 CHECK IGNITION FEED CIRCUIT

- Key on, engine off.
- Measure voltage between powering side of fuse in the IP fuse panel and known good ground.

Is B+ present?

Yes	No
GO to NB5 .	REPAIR open in ignition feed Circuit 640 (R/Y) or ignition switch. RESTORE system. CLEAR DTCs and RETEST.

NB5 CHECK FUSE

- Remove fuse, inspect.

Is fuse OK?

Yes	No
REINSTALL fuse. GO to NB6 .	REPAIR short to ground to Circuit 640 (R/Y). REPLACE fuse. RESTORE system. CLEAR DTCs and RETEST.

NB6 CHECK CIRCUIT 640 (R/Y) FOR OPEN

- Remove fuse.
- Remove check engine light bulb.
- Measure resistance between nonpowering side of fuse Circuit 640 (R/Y) and powering side of check engine light bulb socket.

Is resistance less than 5 ohms?

Yes	No
Circuit 640 (R/Y) OK. GO to NB7 .	REPAIR open in Circuit 640 (R/Y). REINSTALL bulb. RESTORE system. CLEAR DTCs and RETEST.

NB7 TEST CHECK ENGINE LIGHT BULB

- Bench test bulb by applying B+ to one side and B- to the other.

Does the bulb illuminate?

Yes	No
GO to NB8 .	REPLACE bulb. RESTORE system. CLEAR DTCs and RETEST.

NB8 CHECK CIRCUIT 658 (PK/LG)

- Install breakout box; leave PCM disconnected.
- Measure resistance between bulb socket Circuit 658 (PK/LG) and PCM Test Pin 2.

Is resistance less than 5 ohms?

Yes	No
Circuit 658 (PK/LG) is OK. REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.	REPAIR open in Circuit 658 (PK/LG). RESTORE system. CLEAR DTCs and RETEST.

NC: Injector Driver Module Enable (IDM-EN)
Introduction

NC: Pinpoint Tests

Note

Enter this pinpoint test only when directed here from the symptom flowcharts.

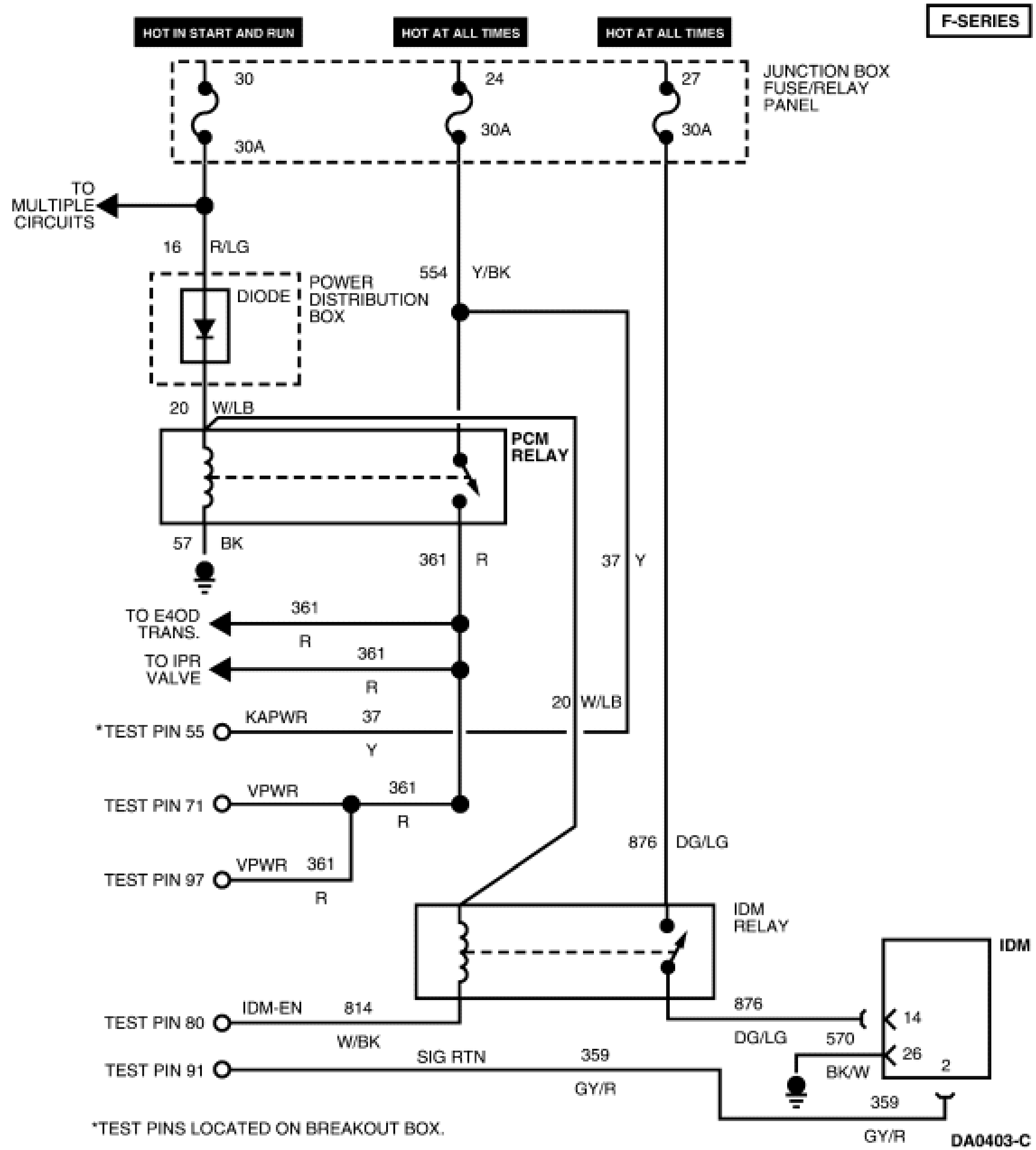
Remember

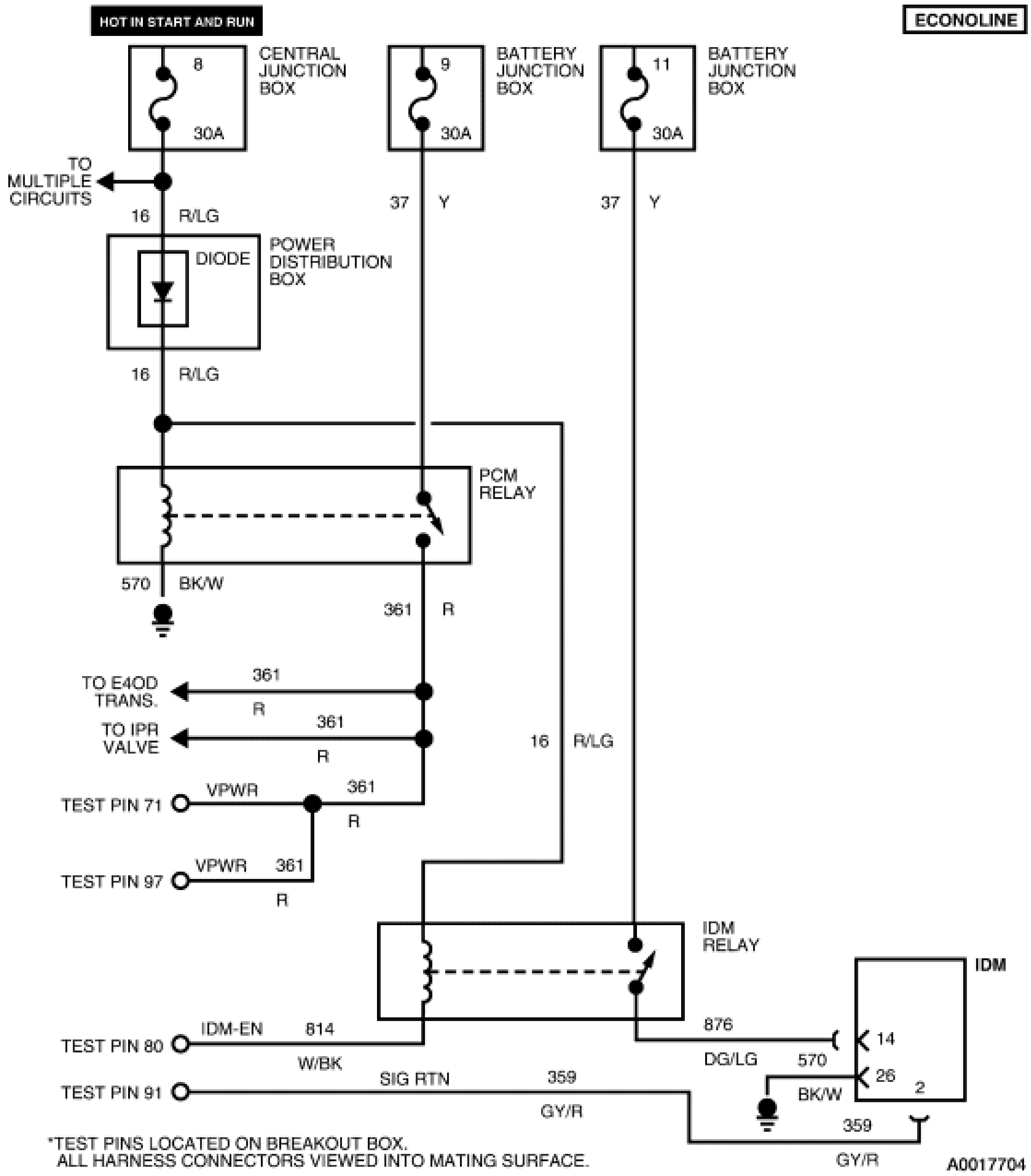
This pinpoint test is intended to diagnose only the following:

- powertrain control module (PCM) (12A650)
- harness circuits: injector driver module enable (IDM-EN)
- injector driver module (IDM) relay

Description

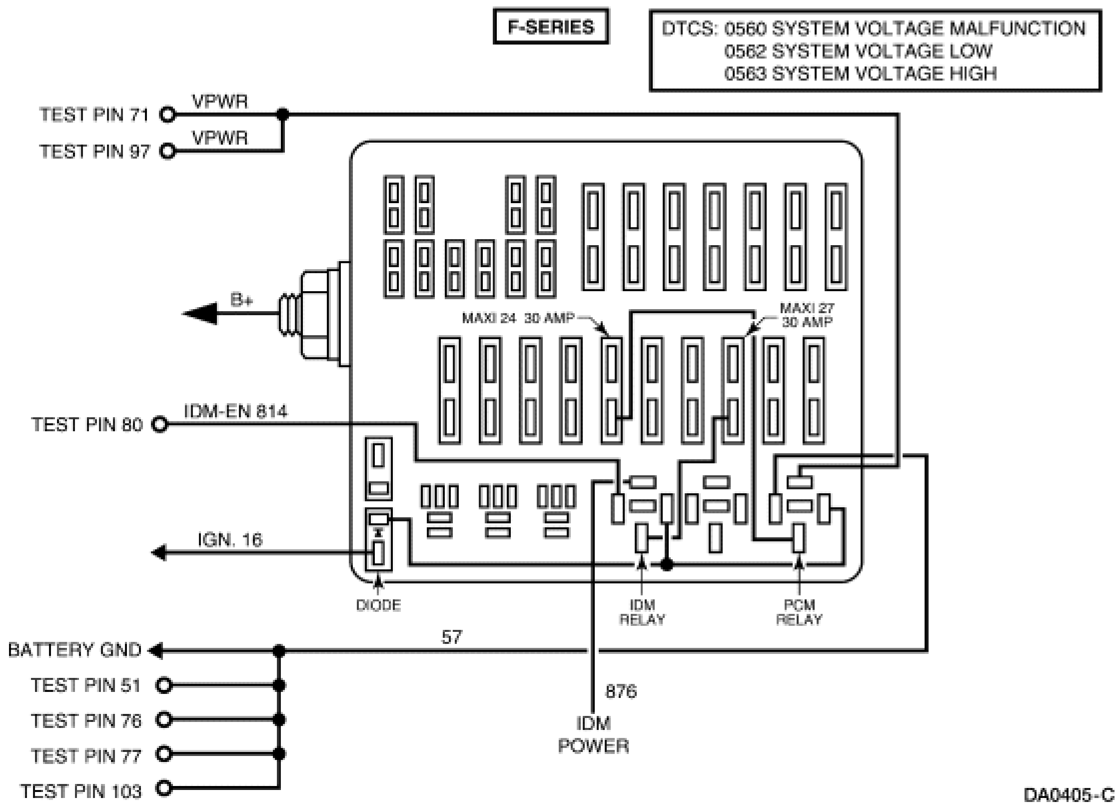
The IDM-EN output provides the shut-down control function for the fuel system by shutting off the IDM relay.

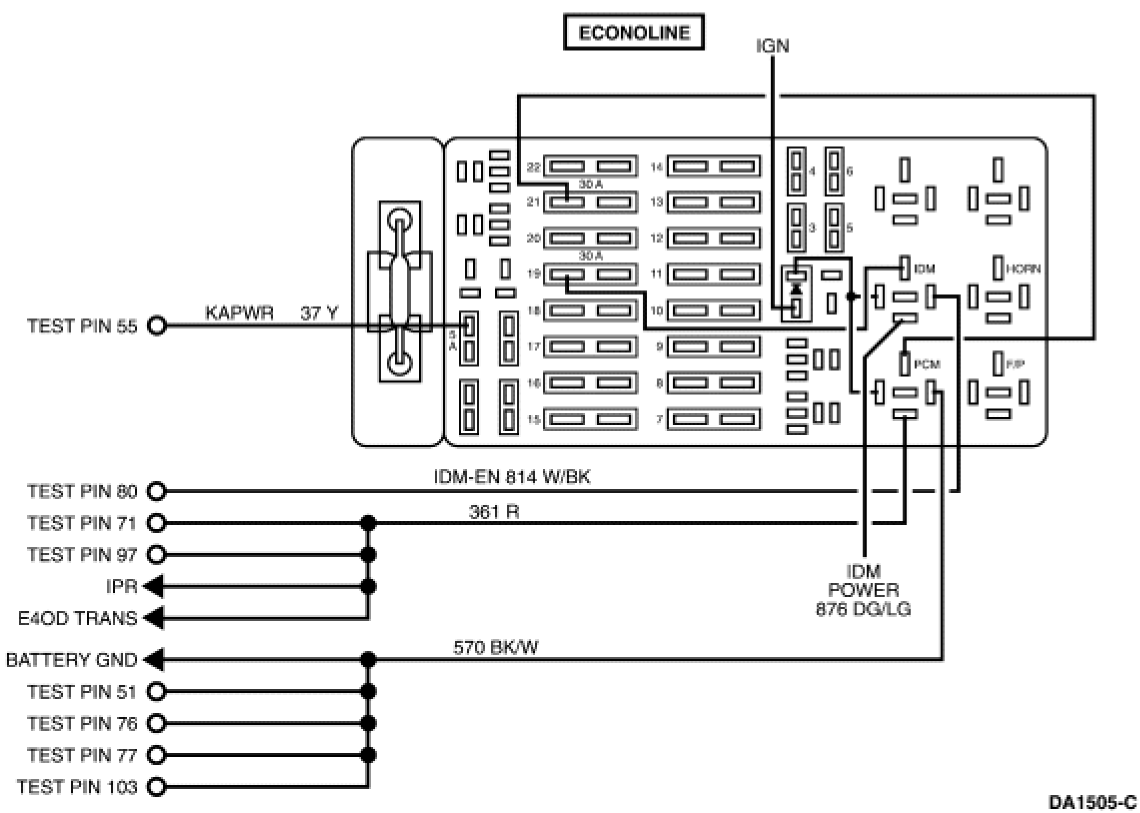

F-SERIES
HOT IN START AND RUN
HOT AT ALL TIMES
HOT AT ALL TIMES
30
30A
24
30A
27
30A
JUNCTION BOX
FUSE/RELAY
PANEL
TO
MULTIPLE
CIRCUITS
16
R/LG
554
Y/BK
DIODE
POWER
DISTRIBUTION
BOX
20
W/LB
PCM
RELAY
57
BK
361
R
37
Y
TO E4OD
TRANS.
361
R
TO IPR
VALVE
361
R
20
W/LB
*TEST PIN 55
KAPWR
37
Y
TEST PIN 71
VPWR
361
R
TEST PIN 97
VPWR
361
R
876
DG/LG
IDM
RELAY
IDM
TEST PIN 80
IDM-EN
814
W/BK
876
DG/LG
14
570
26
BK/W
2
TEST PIN 91
SIG RTN
359
GY/R
359
GY/R
*TEST PINS LOCATED ON BREAKOUT BOX.
DA0403-C



*TEST PINS LOCATED ON BREAKOUT BOX.
ALL HARNESS CONNECTORS VIEWED INTO MATING SURFACE.

A0017704





DTC Description

P1662 = IDM-EN circuit failure

NC: Pinpoint Tests

NC: Injector Driver Module Enable (IDM-EN)

NC: Introduction

NC1 DIAGNOSTIC TROUBLE CODE (DTC) P1662

- P1662 will set, if the PCM detects a fault on the IDM enable circuit.
- Possible causes:
  - Open fuse
  - Open or shorted IDM enable circuit.
  - IDM relay
  - PCM
- Verify B+ at IDM relay primary circuit.
- Disconnect the IDM relay.
- Key on, engine off.
- Measure voltage between IDM relay Circuit 16 (RD/LG) for Econoline or Circuit 20 (W/LB) for F-Series and battery ground.

Is battery voltage present?

Yes	No
GO to NC2 .	REPAIR open in Circuit 361 (W/LB). RESTORE vehicle. CLEAR DTCs and RETEST.

NC2 CHECK FOR SHORT TO GROUND

- Key off.
- Measure resistance between IDM relay Circuit 814 (W/BK) and battery ground.

Is resistance greater than 10,000 ohms?

Yes	No
Go to NC4 .	Go to NC3 .

NC3 CHECK FOR SHORT TO GROUND ON CIRCUIT 814 (W/BK)

- Key off.
- Disconnect PCM.
- Measure resistance between IDM relay Circuit 814 (W/BK) and battery ground.

Is resistance greater than 10,000 ohms?

Yes	No
REPLACE the PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR short to ground on Circuit 814 (W/BK). RESTORE vehicle. CLEAR DTCs and RETEST.

NC4 VERIFY THAT THE PCM IS ENABLING THE RELAY

- Key off.
- Measure resistance between IDM relay Circuit 814 (W/BK) and battery ground.
- Turn key on, while looking at DVOM.

Does resistance reading drop below 5 ohms?

Yes	No
REPLACE the IDM relay. RESTORE vehicle. CLEAR DTCs and RETEST.	GO to NC5 .

NC5 CHECK CONTINUITY ON CIRCUIT 814 (W/BK)

- Key off.
- Install breakout box, leave PCM disconnected.
- Measure resistance between IDM relay Circuit 814 (W/BK) and PCM Test Pin 80.

Is resistance less than 5 ohms?

Yes	No
REPLACE the PCM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR open in Circuit 814 (W/BK). RESTORE vehicle. CLEAR DTCs and RETEST.

NC6 DTC P1663 AND P1667 SET TOGETHER WITH OR WITHOUT P1668, CHECK FOR DTC P1662

- IDM and PCM connected.
- Key on, engine off.
- Perform KOEO On-Demand Self Test.

Was DTC P1662 present?

Yes	No
Go to NC1 .	Go to NC7 .

NC7 CHECK MAXI FUSE

- PCM connected.
- Key on, engine off.
- Measure voltage between IDM (MAXI Fuse 11 on F-Series) or (MAXI Fuse 19 on Econoline) and battery ground.

Is battery voltage present on both sides on the fuse?

Yes	No
GO to NC8 .	REPAIR short to ground on Circuit 876 (DG/LG) and REPLACE MAXI fuse. RESTORE vehicle. CLEAR DTCs and RETEST.

NC8 CHECK CIRCUIT 37 (Y)

- Key off.
- Disconnect MAXI fuse.
- Disconnect IDM relay.
- Measure resistance between IDM non-power side of fuse to IDM relay Circuit 37 (Y) for Econoline or Circuit 876 (DG/LG) for F-Series.

Is resistance less than 5 ohms?

Yes	No
GO to NC9 .	REPAIR open on Circuit 37 (Y). RESTORE vehicle. CLEAR DTCs and RETEST.

NC9 CHECK CONTINUITY ON CIRCUIT 876 (DG/LG)

- Disconnect IDM.
- Measure resistance on Circuit 876 (DG/LG) between IDM connector Pin 14 to IDM relay.

Is resistance less than 5 ohms?

Yes	No
GO to NC10 .	REPAIR open on Circuit 876 (DG/LG). RESTORE vehicle. CLEAR DTCs and RETEST.

NC10 IDM RELAY CHECK

- Install IDM relay, leave fuse disconnected.
- Key on, engine off.
- Measure resistance on Circuit 37 (Y) for Econoline or Circuit 876 (DG/LG) for F-Series, between the non-power side of MAXI fuse to IDM connector Pin 14.

Is resistance less than 5 ohms?

Yes	No
GO to NC11 .	REPLACE IDM relay. RESTORE vehicle. CLEAR DTCs and RETEST.

NC11 IDM GROUND CHECK

- Measure resistance on Circuit 570 (BK/W) between IDM connector Pin 26 and battery ground.

Is resistance less than 5 ohms?

Yes	No
REPLACE IDM. RESTORE vehicle. CLEAR DTCs and RETEST.	REPAIR open in IDM ground Circuit 570 (BK/W). RESTORE vehicle. CLEAR DTCs and RETEST.

QA: Unable to Activate Self Test/SCP Communication Error/DTC Not Listed
Introduction

QA: Pinpoint Tests

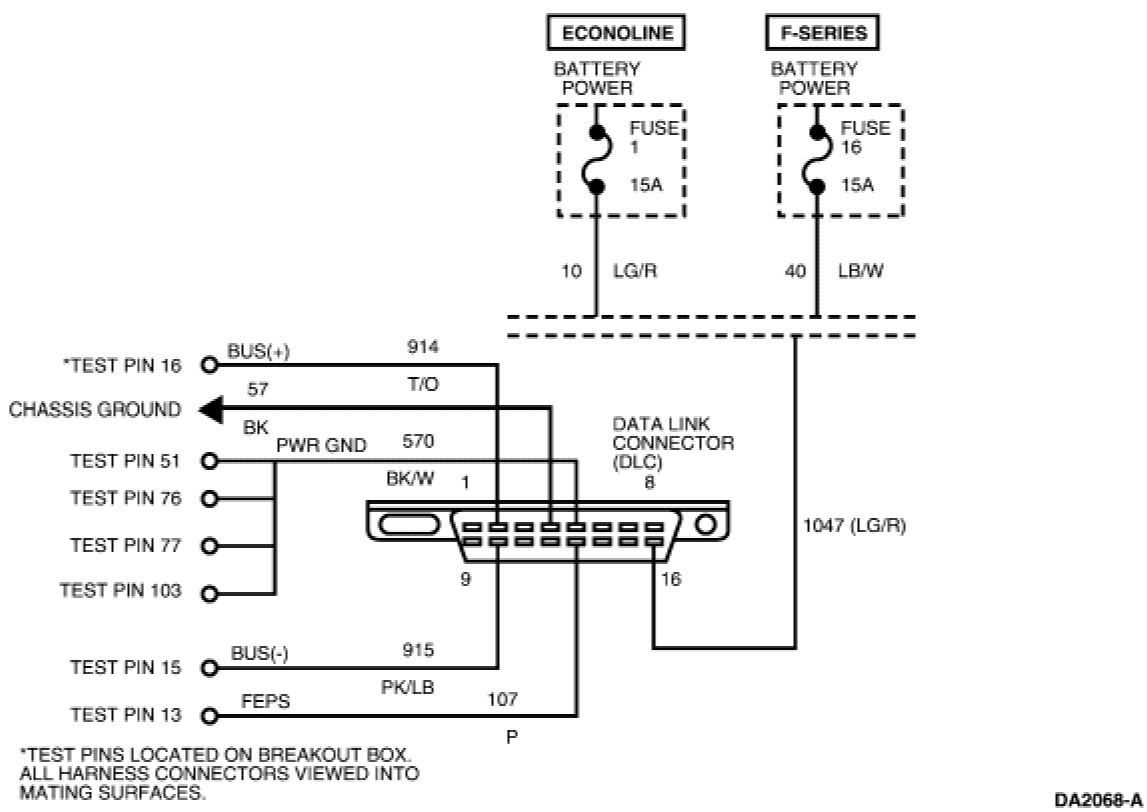
Note

Enter this pinpoint test only when directed here.

Remember

This pinpoint test is intended to diagnose only the following:

- standard corporate protocol (SCP) communication bus harness circuits: BUS (+), BUS(-)
- harness circuits: chassis ground, power ground (PWR GND), battery voltage (VBAT)
- powertrain control module (PCM) (12A650)



DTC Description

P1502 = APCM on during Self Test

QA: Unable to Activate Self Test/SCP Communication Error/DTC Not Listed

QA: Introduction

QA1 DIAGNOSTIC TROUBLE CODE (DTC) P1502

- Verify that the correct procedure was used to activate KOEO or KOER Self Test for the NGS Tester.

  Note: Verify scan tool operation on another vehicle before proceeding.

Was the correct procedure used?

Yes	No
Correct procedure for activating self test was used. GO to QA2 .	REFER to Section 2 for correct operating procedures.

QA2 CHECK PCM OUTPUT

Note: Scan tool will kick out if battery voltage drops below 9.5 volts. If performing repeated self testing, unplug glow plug relay to prevent the battery from going dead, and disregard glow plug codes while glow plug relay is unplugged. If equipped with auxiliary powertrain control system, it must be off or disconnected while trying to perform self test.

- Verify that batteries are fully charged and are not the cause of the communication error.

Does engine start?

Yes	No

GO to QA3 .	GO to C1 .

QA3 CHECK B+ AT DATA LINK CONNECTOR (DLC)

- Measure resistance between B+ circuit cavity at DLC Pin 16 and battery positive post.
- Key off.

Is resistance less than 5 ohms?

Yes	No
GO to QA4 .	REPAIR open in DLC B+ circuit. RESTORE vehicle. CLEAR DTCs and RETEST.

QA4 CHECK DLC CHASSIS GROUND CONTINUITY

- Measure resistance between chassis ground circuit cavity at DLC Pin 4 and ground.

Is resistance less than 5.0 ohms?

Yes	No
GO to QA5 .	REPAIR open in DLC chassis ground circuit. RESTORE vehicle. CLEAR DTCs and RETEST.

QA5 CHECK DLC PWR GND CIRCUIT CONTINUITY

- Install breakout box; leave PCM disconnected.
- Measure resistance between PCM Test Pins 51, 76, 77, 103 (PWR GND) and the PWR GND circuit cavity at the DLC Pin 5.

Is resistance less than 5.0 ohms?

Yes	No
GO to QA6 .	REPAIR open in DLC PWR GND circuit. RESTORE vehicle. CLEAR DTCs and RETEST.

QA6 CHECK DLC BUS(-) CIRCUIT CONTINUITY

- Measure resistance between PCM Test Pin 15 [BUS(-)] and the BUS(-) circuit at the DLC Pin 10.

Is resistance less than 5.0 ohms?

Yes	No

GO to QA7 .	REPAIR open in the DLC BUS (-) circuit. RESTORE system. CLEAR DTCs and RETEST.

QA7 CHECK BUS(-) CIRCUIT FOR SHORT TO GROUND

- Measure resistance between PCM Test Pin 15 [BUS(-)] and ground.

Is resistance greater than 10,000 ohms?

Yes	No
GO to QA8 .	REPAIR short to ground in the BUS(-) circuit. RESTORE system. CLEAR DTCs and RETEST.

QA8 CHECK BUS(-) CIRCUIT FOR SHORT TO POWER

- Key on, engine off.
- Measure voltage between PCM Test Pin 15 [BUS(-)] and PCM Test Pins 51, 76, 77 or 103 (PWR GND).

Was the voltage greater than 1.0 volt?

Yes	No
REPAIR short to power in the BUS(-) circuit. RESTORE system. CLEAR DTCs and RETEST.	GO to QA9 .

QA9 CHECK DLC BUS(+) CIRCUIT CONTINUITY

- Key off.
- Measure resistance between PCM Test Pin 16 [BUS(+)] and BUS(+) circuit at the DLC Pin 2.

Is resistance less than 5.0 ohms?

Yes	No
GO to QA10 .	REPAIR open in DLC BUS(+) circuit. RESTORE system. CLEAR DTCs and RETEST.

QA10 CHECK BUS(+) CIRCUIT FOR SHORT TO POWER

- Key on, engine off.

- Measure voltage between PCM Test Pin 16 [BUS(+)] and PCM Test Pins 51, 76, 77 or 103 (PWR GND).

Was the voltage greater than 1.0 volt?

Yes	No
REPAIR short to power in the BUS(+) circuit. RESTORE system. CLEAR DTCs and RETEST.	GO to QA11 .

QA11 CHECK BUS (+) AND BUS (-) SHORTED TOGETHER

- Key off.
- Measure resistance between PCM Test Pins 15 and 16.

Is resistance greater than 10,000 ohms?

Yes	No
CLEAR DTCs and RETEST. If DTC P1502 is still present, or if still unable to perform Self Test, REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.	REPAIR short between BUS + and BUS - circuits. RESTORE system. CLEAR DTCs and RETEST.

Powertrain Control/Emissions Diagnosis

1999

On Board Diagnostics II Diesel

SECTION 6: Reference Values

Control System Diagnostic Sheet Reference

PCM Pin Descriptions and Expected Values

Pin #	Name	Circuit #	Wire Color	Key Off	Key On	Low Idle	High Idle	Operating Range	Comments
2	Check Engine Light	658	PK-LG	0v	0v/12v	0v/12v	0v/12v	0v/12v	0v = Light On, 12v = Light Off
3	MIAHM[a]	3996	R-Y	0	0-B+	0-B+	0-B+	0-B+	Manifold Intake Air Heater Monitor
5	PBA	162	LG-R	0v	0v/12v	0v/12v	0v/12v	0v-12v	Parking Brake Applied Switch; 12v = Brake Off, 0v = Brake On
6[b]	SS1	237	O-Y	0v	0v	0v	0v	0v/12v	Shift Solenoid #1 0v = "On," 12v = "Off"
8	GPMH	339	GY	0v	0v/12v	0v/12v	0v/12v	0v/12v	Glow Plug Monitor High Side; 0v = Plugs Off, 12v = Plugs On
9	GPMR	1087	O	0v	0v/12v	0v/12v	0v/12v	0v/12v	Glow Plug Monitor Right Bank; 0v = Plugs Off, 12v = Plugs On
10	IVS	308	R-O	0v	0v	0v	12v	0v/12v	Idle Validation Switch; 0v = At

									Idle, 12v = Off Idle
11[b]	SS2	315	P-O	0v	12v	12v	12v	0v/12v	Shift Solenoid #2 0v = "On," 12v = "Off"
12[b]	TCIL	911	W-LG	0v	0v/12v	0v/12v	0v/12v	0v/12v	Trans Control Indicator Light; 0v = Light "On," 12v = Light "Off"
13	FEPS	107	P	N/A	N/A	N/A	N/A	N/A	Flash EPROM Power Supply
14[b,c]	4X4L	784	LB-BK	0v	0v/12v	0v/12v	0v/12v	0v/12v	4x4 Low Switch; 0v = "On," 12v = "Off"
15	BUS (-)	915	PK-LB	N/A	N/A	N/A	N/A	N/A	Data Link Connector
16	BUS (+)	914	T-O	N/A	N/A	N/A	N/A	N/A	Data Link Connector
17[b]	TR1	1012	O-BK	0v	Varies with gear			0v/10.7v	P = 0v, R = 0v, N = 0v, D = 10.7v, MAN2 = 10.7v, MAN1 = 10.7v
19[b]	TAC	648	W-PK	0v	12v	6.5v/ 130 Hz	6.5v/ 660 Hz	130-720 Hz	Tachometer Signal Reflected CMP signal
20[b]	CCS	924	BR-O	0v	0v	0v	0v	0v/12v	Coast Clutch Solenoid; 0v = "On," 12v = "Off"
21	CMP	795	DG	0v	0.8v	7v	7v	130-720 Hz	Camshaft Position Sensor; 650-3600 rpm
24	APGND	837	Y-BK	0v	0v	0v	0v	0v	Accelerator Pedal Sensor Ground
25	CASE GND	875	BK-LB	0v	0v	0v	0v	0v	Case Ground
28	WIFIL[d]	643 (R)	R	0	B+	B+	B+	B+	Water In Fuel Indicator Lamp
29	CPP (Manual) TCS (Auto)	306 224	T-LB T/W	0v 0v	0v/12v 0v/12v	0v/12v 0v/12v	0v/12v 0v/12v	0v/12v 0v/12v	Clutch Pedal Position Switch (Manual) Transmission Control Switch

									(Automatic)
30	EBP	553	R-LB	0v	0.9v	0.9v	1.2v	0.9v-3v	Exhaust Back Pressure Sensor
31	BPA	810	R-LG	0v/12v	0v/12v	0v/12v	0v/12v	0v/12v	Brake Pedal Applied Switch; 0v = Brake On, 12v = Brake Off
33[e]	VSS (-)	676	PK-O	0v	0v	0v	0v	0v	Vehicle Speed Sensor Ground
34	GPML	466	PK-O	0v	0v/12v	0v/12v	0v/12v	0v/12v	Glow Plug Monitor Left Bank; 0v = Plugs Off, 12v = Plugs On
35	ALTI	1183A	W-Y	0	.5-2v	6-10v	6-10v	6-10v	Alternator #1 (Top) Monitor
36	WIF [d]	1280	GY-R	0	B+	B+	B+	B+	Water In Fuel
37[b]	TFT	923	O-BK	0.2v-0.5v	0.3v-4.5v	0.3v-4.5v	0.3v-4.5v	0.3v-4.5v	Transmission Fluid Temperature; 4.5v = -40°C, 0.3v = 130° C
38	EOT	354	LG-R	0.2v-0.5v	0.3v-4.7v	0.3v-4.7v	0.3v-4.7v	0.3v-4.7v	Engine Oil Temperature; 4.7v = -40°C, 0.3v = 150° C
39	IAT	743	GY	0.2v-0.5v	0.2v-4.5v	0.2v-4.5v	0.2v-4.5v	0.2v-4.5v	Intake Air Temperature; 4.5v =.40°C, 0.2v = 130° C
40	FPM	787B	PK-BK	0	B+	B+	B+	B+	Fuel Pump Monitor
41[b]	ACC	347	BK-Y	0v	0v/12v	0v/12v	0v/12v	0v/12v	Air Conditioning Clutch; 0v = A/C Off, 12v = A/C On
42	EPR	318	GY-R	0v	0v	0v-12v	0v-12v	0v-12v	Exhaust Back Pressure Regulator; Duty cycled, 0v = "Off"
47	WGC	1275 (W-R)	W-R	0	0	0	0-B+	0-B+	Waste Gate Control
48	EF	818	GY-W	0v	3v	1v	0.9v-3v	0.9v-3v	Electronic Feedback line; Digital 12v

									frequency
49[b]	TR2	146	W-PK	0v	Varies with gear			0v/10.7v	P = 0v, R = 0v, N = 10.7v, D = 10.7v, MAN2 = 0v, MAN1 = 10.7v
50[b]	TR4	145	GY-BK	0v	Varies with gear			0v/10.7v	P = 0v, R = 10.7v, N = 0v, D = 10.7, MAN2 = 10.7v, MAN1 = 0v
51	PWR GND	570A	BK-O	0v	0v	0v	0v	0v	Power Ground
54[b]	TCC	480	P-Y	0v	12v	12v	12v	0v/12v	Torque Converter Clutch Solenoid; 0v = "On," 12v = "Off"
55	KAPWR	37E	Y	B+	B+	B+	B+	B+	Keep Alive Power; B+ = Battery voltage
58	VSS (+)	679	GY-BK	Frequency Signal — Varies with Vehicle Speed					Vehicle Speed Sensor
59	OSS [f]	136	DB-Y	0	0	0	0	0	Output Shaft Speed Sensor
60	ALT2	1185	Y	0	.5-2v	6-10v	6-10v	6-10v	Alternator #2 (Bottom) Control
61	SCCS	151	LB-BK	0v	6.6v	6.6v	6.6v	0v-12v	Cruise Control Command Switch; On = 12v, Off = 0v, Set = 2.8v, Resume = 4.7v, Coast = 0.8v, Hold = 6.6v
62	MAT[g]	1291	R-Y	0	0	0-5v	0-5v	0-5v	Manifold Air Temperature
64[b]	TR3	199	LB-Y	0v	Varies with gear			0.7v-4.5v 0v/1.6v	F-Series: P = 4.5v, R = 3.7v, N = 2.9v, D = 2.2v, MAN2 = 1.4v, MAN1 = 0.7v
65	CMP GND	796	LB	0v	0v	0v	0v	0v	Camshaft position sensor ground
66	PTO[h]	322	LB-Y	0	0-B+	0-B+	0-B+	0-B+	Power Take Off Enable
67	BATTL[j]	904A	LG-R	0	0	B+	B+	B+	Dual Alternator Battery Lamp

									Indicator
70	GPL	464	BK-PK	0v	0v/12v	12v	12v	0v/12v	Glow Plug Lamp, 0v = Light On, 12v = Light Off
71	VPWR	361B	R	0v	B+	B+	B+	B+	Ignition source power
76	PWR GND	570B	BK-O	0v	0v	0v	0v	0v	Power Ground
77	PWR GND	570C	BK-O	0v	0v	0v	0v	0v	Power Ground
79	MAP	358 (LG/BK)	LG-BK	0	1-2v	1-2v	1.5v-3v	1-3v	Manifold Absolute Pressure
80	IDM EN	814	W-BK	0v	12v->0v	0v	0v	0v-12v	IDM Relay; 0v = Relay on, 12v = Relay off
81[b]	EPC	925	W-O	0v	8v	10v	12v	8v-12v	Electronic Pressure Control Solenoid
83	IPR	552	Y-R	0v	12v	12v	12v	12v	Injection Pressure Regulator; Duty cycle controlled
84	TSS[k]	970	DG-W	0	0	0	0	0	Transmission Speed Sensor
87	ICP	535	LB-R	0v	0.2v-0.4v	0.7v-1v	1.1v-1.5v	0.6v-3.2v	Injection Control Pressure Sensor (Min 0.83v req. for starting)
89	AP	355	GY-W	0v	0.5v-4.95v	0.5v-1.6v	3.4v-4.95v	0.5v-4.95v	Accelerator Pedal Sensor
90	V REF	351	BR-W	0.2v-0.5v	5.0 ± 0.5v	5.0 ± 0.5v	5.0 ± 0.5v	5.0 ±0.5v	Voltage Reference
91	SIG GRD	359	GY-R	0v	0v	0v	0v	0v	Ground for all sensor signals
92	BOO	511	LG	0v/12v	0v/12v	0v/12v	0v/12v	0v/12v	Brake On/Off Switch; 0v = Brake Off, 12v = Brake On
94	FP[l]	926	LB-O	0	0-B+	0	0	0	Fuel Pump Control
95	FDCS	821	BR-O	0v	0v	1v/49 Hz	4v/200 Hz	40 Hz-240 Hz	Fuel Delivery Control Signal; 650-3600 rpm
96	CI	817	Y-LB	0v	0v	6v/5 Hz	7v/30 Hz	5 Hz-30 Hz	Cylinder Identification
97	VPWR	361A	R	0v	B+	B+	B+	B+	Ignition source

									power
98	MIAH[m]	462	P	0	B+	B+	B+	B+	Manifold Intake Air Heater
100	FLI[n]	29	Y-W	0	0-4v	0-4v	0-4v	0-4v	Fuel Level Indicator
101	GPC	1086	P-O	0v	0v/12v	0v/12v	0v/12v	0v/12v	Glow Plug Control, 0v = Relay on, 12v = Relay off
103	PWR GND	570D	BK-O	0v	0v	0v	0v	0v	Power Ground

[a] VBAT when heater is on; will cycle from 0 to VBAT to 0 during KOER test.
[b] E40D transmission only.
[c] Not used on Econoline.
[d] Voltage goes to 0 when water in fuel activates switch.
[e] Not used on F-series.
[f] Output is in Hz. and varies with vehicle speed; zero Hz when stopped; 450 to 750 Hz. at 50 mph.
[g] Voltage increases as manifold air temperature increases.
[h] Voltage normally 0, goes to VBAT when PTO switch is turned on and ignition is on.
[j] Will momentarily go to VBAT during lamp check.
[k] Voltage goes to VBAT if engine is not running and key is on for over 20 seconds.
[l] Output is in Hz and varies with engine speed; at low idle 300-400 Hz.; at rev. limit 1800-2200 Hz.
[m] Grounded when heater is on; will cycle from VBAT to 0 to VBAT during KOER test.
[n] Voltage increases as fuel level increases.

Fault Code	Refer to Footnote	Circuit Index	Condition Description	Probable Causes
P0107	a, b	BARO	Barometric pressure sensor circuit low input	Open/grounded circuit, PCM
P0108	a, b	BARO	Barometric pressure sensor circuit high input	Circuit shorted to 5v, biased sensor, PCM
P0112	b	IAT	Intake air temp. sensor circuit low input	Grounded circuit, biased sensor, PCM
P0113	b	IAT	Intake air temp. sensor circuit high input	Open circuit, biased sensor, PCM, short to 5v
P0122	a, b	AP	Accelerator pedal sensor circuit low input	Grounded circuit, biased sensor, PCM
P0123	a, b	AP	Accelerator pedal sensor circuit high input	Open circuit, biased sensor, PCM, short to 5v
P0197	a, b	EOT	Engine oil temp. sensor circuit low input	Grounded circuit, biased sensor, PCM
P0198	a, b	EOT	Engine oil temp. sensor	Open circuit, biased sensor, PCM, short

			circuit high input	to 5v
P0220	b	IVS	Throttle switch B circuit malfunction	Short/open circuit, switch failure, operator, PCM
P0221	a, b	AP/IVS	Throttle switch B circuit performance	Failed pedal assembly
P0230	—	FP	Fuel pump relay driver failure	Open FP relay, blown fuse, open/grounded circuit
P0231	b	FP	Fuel pump circuit failure	Fuse, relay, inertia switch, fuel pump, open/short circuit
P0232	—	FP	Fuel pump circuit failure	Relay failure, short circuit, pump failure
P0236	b	MAP	Turbo boost sensor A circuit performance	Restricted inlet/exhaust/supply hose, missing hose
P0237	a, b	MAP	Turbo boost sensor A circuit low input	Circuit open, short to ground, MAP sensor
P0238	a, b	MAP	Turbo boost sensor A circuit low high	Circuit short to power, MAP sensor
P0261	a, b	INJ	Injector circuit low — Cylinder 1	Harness short to ground
P0262	—	INJ	Injector circuit high — Cylinder 1	Miswired connector or harness
P0263	—	PCED	Cylinder 1 contribution/balance fault	Power cylinder, valve train or injector problem, circuit
P0264	a, b	INJ	Injector circuit low — Cylinder 2	Harness short to ground
P0265	—	INJ	Injector circuit high — Cylinder 2	Miswired connector or harness
P0266	—	PCED	Cylinder 2 contribution/balance fault	Power cylinder, valve train or injector problem, circuit
P0267	a, b	INJ	Injector circuit low — Cylinder 3	Harness short to ground
P0268	—	INJ	Injector circuit high — Cylinder 3	Miswired connector or harness
P0269	—	PCED	Cylinder 3 contribution/balance fault	Power cylinder, valve train or injector problem, circuit
P0270	a, b	INJ	Injector circuit low — Cylinder 4	Harness short to ground
P0271	—	INJ	Injector circuit high — Cylinder 4	Miswired connector or harness
P0272	—	PCED	Cylinder 4	Power cylinder, valve train or injector

			contribution/balance fault	problem, circuit
P0273	a, b	INJ	Injector circuit low — Cylinder 5	Harness short to ground
P0274	—	INJ	Injector circuit high — Cylinder 5	Miswired connector or harness
P0275	—	PCED	Cylinder 5 contribution/balance fault	Power cylinder, valve train or injector problem, circuit
P0276	a, b	INJ	Injector circuit low — Cylinder 6	Harness short to ground
P0277	—	INJ	Injector circuit high — Cylinder 6	Miswired connector or harness
P0278	—	PCED	Cylinder 6 contribution/balance fault	Power cylinder, valve train or injector problem, circuit
P0279	a, b	INJ	Injector circuit low — Cylinder 7	Harness short to ground
P0280	—	INJ	Injector circuit high — Cylinder 7	Miswired connector or harness
P0281	—	PCED	Cylinder 7 contribution/balance fault	Power cylinder, valve train or injector problem, circuit
P0282	a, b	INJ	Injector circuit low — Cylinder 8	Harness short to ground
P0283	—	INJ	Injector circuit high — Cylinder 8	Miswired connector or harness
P0284	—	PCED	Cylinder 8 contribution/balance fault	Power cylinder, valve train or injector problem, circuit
P0301	b	INJ	Fault cylinder 1 — Misfire detected	Mechanical engine failure
P0302	b	INJ	Fault cylinder 2 — Misfire detected	Mechanical engine failure
P0303	b	INJ	Fault cylinder 3 — Misfire detected	Mechanical engine failure
P0304	b	INJ	Fault cylinder 4 — Misfire detected	Mechanical engine failure
P0305	b	INJ	Fault cylinder 5 — Misfire detected	Mechanical engine failure
P0306	b	INJ	Fault cylinder 6 — Misfire detected	Mechanical engine failure

P0307	b	INJ	Fault cylinder 7 — Misfire detected	Mechanical engine failure
P0308	b	INJ	Fault cylinder 8 — Misfire detected	Mechanical engine failure
P0340	—	CMP	Camshaft position sensor ckt. malfunction	Open/grounded circuit, sensor fault, short to power
P0341	—	CMP	Camshaft position sensor ckt. performance	Harness routing, charging circuit, sensor
P0344	a, b	CMP	Camshaft position sensor ckt. intermittent	Harness routing, charging ckt., sensor, int. ckt., improper gap
P0380	b	GP	Glow plug circuit malfunction	Open/grounded ckt., solenoid open/shorted, failed PCM
P0381	b	GP	Glow plug indicator circuit malfunction	Open/grounded circuit, lamp open, failed PCM
P0460	—	FLI	Fuel level sensor circuit malfunction	Open/short circuit, cluster, tank unit, open case GND
P0470	—	EBP	Exhaust back pressure sensor circuit malfunction	Biased sensor, open signal return
P0471	b	EBP	Exhaust back pressure sensor circuit performance	Plugged, stuck or leaking hose
P0472	b	EBP	Exhaust back pressure sensor circuit low input	Open/grounded circuit, biased sensor, PCM
P0473	b	EBP	Exhaust back pressure sensor circuit high input	Circuit shorted to 5v, biased sensor, PCM
P0475	b	EPR	Exhaust pressure control valve malfunction	Open/grounded ckt., solenoid open/shorted, failed PCM
P0476	—	EPR	Exhaust pressure control valve performance	Failed/stuck EPR control, EBP fault, EPR circuit
P0478	b	EPR	Exhaust pressure control valve high input	Plugged sensor line, stuck butterfly, restricted exhaust
P0500	b	VSS	Vehicle speed sensor malfunction	Sensor, circuit, PCM, PSOM, TR failure, low trans. fluid
P0503	—	VSS	Vehicle speed sensor noisy	Harness routing, sensor
P0541	—	MIAH	Manifold intake air heater...	Open/short circuit
P0542	—	MIAH	Manifold intake air heater...	Grounded circuit
P0560	—	PCED	System voltage malfunction	Charging system problem/load, glow plugs still enabled

P0562	b	PCED	System voltage low	Low sys. voltage, charging sys., internal PCM failure
P0563	—	PCED	System voltage high	High sys., voltage, charging sys., internal PCM failure
P0565	—	PCED	Cruise "On" signal malfunction	Open or short circuit, switch failure, PCM failure or failed to activate switch during KOER switch test
P0566	—	PCED	Cruise "Off" signal malfunction	Open or short circuit, switch failure, PCM failure or failed to activate switch during KOER switch test
P0567	—	PCED	Cruise "Resume" signal malfunction	Open or short circuit, switch failure, PCM failure or failed to activate switch during KOER switch test
P0568	—	PCED	Cruise "Set" signal malfunction	Open or short circuit, switch failure, PCM failure or failed to activate switch during KOER switch test
P0569	—	PCED	Cruise "Coast" signal malfunction	Open or short circuit, switch failure, PCM failure or failed to activate switch during KOER switch test
P0571	—	BPA	Brake switch A circuit malfunction	Cruise control codes will be set on every switch test on vehicles not equipped with cruise control
P0603	—	PCED	Internal control module KAM error	Open PCM pin, disconnect B+, faulty PCM
P0605	—	PCED	Internal control module ROM error	Internal PCM failure
P0606	—	PCED	PCM processor fault	Internal PCM failure
P0640	—	MIAH	Manifold intake air heater...	Circuit open or shorted to ground
P0703	—	BOO	Brake switch B circuit malfunction	Open/short circuit, switch, PCM, failed to activate switch during KOER switch test
P0704	—	CPP	Clutch switch input circuit malfunction	Open/short circuit, switch, PCM, failed to activate switch during KOER switch test
P0705	b	TR	TR sensor circuit malfunction	Resistance in circuit, faulty sensor, PCM
P0707	—	TR	TR sensor circuit low input	Open in circuit, biased sensor, PCM
P0708	b	TR	TR sensor circuit high input	Open in circuit, biased sensor, PCM, short to power
P0712	c	TFT	Trans. fluid temp. sensor ckt. low input	Short to ground, biased sensor, PCM
P0713	c	TFT	Trans. fluid temp. sensor ckt. high input	Open in circuit, biased sensor, PCM, short to power

P0715	b, c	TSS	TSS sensor circuit malfunction	Short/open circuit, sensor, PCM
P0717	c	TSS	TSS intermittent failure	Short/open circuit, sensor, PCM
P0718	—	TSS	Noisy TSS	Erratic signal, sensor, intermittent circuit
P0720	b, c	OSS	OSS sensor circuit malfunction	Short/open circuit, sensor, PCM
P0721	—	OSS	Noisy OSS	Erratic signal, sensor, intermittent circuit
P0722	c	OSS	OSS intermittent failure	Short/open circuit, sensor, PCM
P0741	—	TCC	Torque converter clutch ckt. performance	Circuit failure, faulty solenoid, PCM
P0743	b, c	TCC	Torque converter clutch system electrical	Faulty solenoid, circuit, PCM
P0750	b	SS1	Shift solenoid A malfunction	Circuit failure, faulty solenoid, PCM
P0755	b, c	SS2	Shift solenoid B malfunction	Circuit failure, faulty solenoid, PCM
P0781	c	—	1-2 Shift malfunction	Circuit failure, faulty solenoid, faulty clutch, PCM
P0782	c	—	2-3 Shift malfunction	Circuit failure, faulty solenoid, faulty clutch, PCM
P0783	c	—	3-4 Shift malfunction	Circuit failure, faulty solenoid, faulty clutch, PCM
P1000	—	N/A	OBDII monitor status	OBDII monitors/drive cycle incomplete
P1105	—	ALT	Dual alternator upper fault (monitor)	Circuit failure, alternator failure, PCM
P1106	—	ALT	Dual alternator lower fault (control)	Circuit failure, alternator failure, PCM
P1107	b	ALT	Dual alternator lower circuit malf. (control)	Circuit failure, alternator failure, PCM
P1108	—	ALT	Dual alternator BATT lamp ckt. malf.	Open/short circuit, lamp, fuse, PCM
P1118	b	MAT	Manifold air temp sensor out of range low	Short to GND MAT circuit, MAT sensor
P1119	b	MAT	Manifold air temp sensor out of range high	Open/short to PWR circuit, MAT sensor
P1139	—	WIFIL	Water in fuel lamp circuit malfunction	WIF lamp, circuit failure, fuse, PCM
P1140	—	WIF	Water in fuel condition	Water in fuel, grounded circuit, shorted sensor, PCM
P1184	—	TEST	Engine oil temp out of self test range	Engine too cold/hot, leaking thermostat, ckt., sensor

P1209	b	IPR	ICP system fault	IPR valve stuck
P1210	b	ICP	ICP above expected level	ICP sensor, open signal return
P1211	a, b	IPR	ICP pressure above/below desired	IPR valve failed, stuck, or shorted to ground
P1212	a, b	ICP	ICP voltage not at expected level	Biased sensor or ckt., open signal return, low oil in reservoir
P1218	—	PCM/ IDM	CID stuck high	CID circuit open, probably intermittent
P1219	—	PCM/ IDM	CID stuck low	CID circuit short to ground, probably intermittent
P1247	b	MAP	Turbo boost pressure low	MAP hose, sensor, EBP sys, intake leaks, turbo
P1248	b	MAP	Turbo boost pressure not detected	MAP hose, sensor, EBP sys, intake leaks, turbo
P1249	b	WG	Waste gate steady state failure	GND short, plugged hose/port, solenoid, actuator
P1261-P1268	—	INJ	High to low side short cyl. # 1-8	Short circuit, shorted injector, failed IDM
P1271-P1278	—	INJ	High to low side open cyl. # 1-8	Open circuit, open injector, failed IDM
P1280	a, b	ICP	ICP circuit out of range low	Open/grounded circuit, biased sensor, PCM
P1281	a, b	ICP	ICP circuit out of range high	Circuit shorted to 5v, biased sensor, PCM
P1282	a, b	IPR	Excessive ICP pressure	Faulty IPR regulator (sticking), IPR short to ground
P1283	—	IPR	IPR circuit failure	Open/grounded circuit, stuck IPR, loose connection
P1284	—	N/A	ICP failure — aborts KOER CCT test	See codes P1280, P1281, P1282, P1283, P1211
P1291	—	INJ	High side # 1 (right) short to grd. or B+	Short circuit, faulty IDM
P1292	—	INJ	High side # 2 (left) short to grd. or B+	Short circuit, faulty IDM
P1293	—	INJ	High side open bank No. 1 (right)	Open circuit, faulty IDM
P1294	—	INJ	High side open bank No. 2 (left)	Open circuit, faulty IDM
P1295	a, b	INJ	Multiple faults on bank No. 1 (right)	Miswired connector or harness, short to ground

P1296	a, b	INJ	Multiple faults on bank No. 2 (left)	Miswired connector or harness, short to ground
P1297	—	INJ	High sides shorted together	Shorted wires, faulty IDM
P1298	—	PCED	IDM failure	Internal IDM failure
P1316	b	IDM	Injector circuit/IDM codes detected	Injector circuit failure/IDM codes detected
P1391	b	GP	Glow plug circuit low input, bank #1 (right)	Open/short/miswired circuit, faulty relay, glow plugs
P1393	b	GP	Glow plug circuit low input, bank #2 (left)	Open/short/miswired circuit, faulty relay, glow plugs
P1395	b	GP	Glow plug monitor fault, bank #1	One or more glow plugs failed or circuit fault
P1396	b	GP	Glow plug monitor fault, bank #2	One or more glow plugs failed or circuit fault
P1397	—	VPWR	System voltage out of self test range	Voltage too high or low for glow plug monitor test
P1464	—	N/A	A/C on during KOER CCT test	Operator error, A/C circuit shorted to power
P1501	—	N/A	Vehicle moved during testing	Operator error
P1502	—	TEST	Invalid test — APCM functioning	APCM active while KOER test is running
P1531	—	N/A	Invalid test — accelerator pedal movement	Accelerator moved during KOER on-demand or CCT test
P1536	—	PBA	Parking brake applied fail	Circuit, switch, PCM, failed to activate switch KOER
P1660	—	PCED	OCC signal high	High system voltage, internal PCM fault
P1661	—	PCED	OCC signal low	Low system voltage, internal PCM fault
P1662	—	PCED	IDM EN circuit failure	Open relay, blown fuse, open/grounded circuit
P1663	—	PCM/ IDM	FDCS circuit failure	Open/grounded circuit, faulty IDM
P1667	—	PCM/ IDM	CID circuit failure	Open/grounded circuit, faulty IDM
P1668	—	PCM/ IDM	PCM/IDM diag. communication error	Open/shorted EF or FDCS wire, open IDM grd.
P1690	b	WG	Waste gate failure	WGC circuit or solenoid, PCM
P1702	c	TRS	TRS sensor intermittent circuit malfunction	Sensor, wiring, PCM, mechanical alignment

P1704	—	TRS	Digital TRS failed to transition state	Sensor, wiring, PCM, mechanical alignment
P1705	—	TR	TR sensor out of self-test range	Operator error, circuit failure, faulty sensor, PCM
P1711	—	TFT	TFT sensor out of self-test range	Circuit failure, faulty sensor, PCM
P1713	c	TFT	TFT stuck in range low — below 50°F	Sensor, circuit, PCM
P1714	b	SS1	Shift solenoid 1 inductive	Circuit, solenoid, PCM
P1715	b	SS2	Shift solenoid 2 inductive	Circuit, solenoid, PCM
P1718	c	TFT	TFT stuck in range high — above 250°F	Sensor, circuit, PCM
P1729	c	4x4L	4x4L low switch error	Circuit failure, faulty switch, PCM
P1744	b	TCC	Converter not functioning	Converter solenoid/hydraulic/mechanical failure
P1746	c	EPC	EPC solenoid open circuit	Open circuit, faulty solenoid, PCM
P1747	c	EPC	EPC solenoid short circuit	Short circuit, faulty solenoid, PCM shorted to ground
P1754	—	CCS	Coast clutch solenoid ckt. malfunction	Circuit failure, faulty solenoid, PCM
P1760	c	EPC	EPC solenoid short intermittent	Switch not detected during self test, circuit, switch
P1780	—	TCS	TCS circuit of out self-test range	Circuit, switch, PCM, failed to activate switch KOER
P1781	—	4x4L	4x4L circuit out of self-test range	Operator error, short to ground, PCM
P1783	c	TFT	Transmission overtemperature condition	Internal trans. failure, circuit failure, sensor, PCM

MIL (FMEM) illuminates after first fault (Federal calibration only). a

MIL (OBDII) illuminates after second consecutive fault. b

Transmission control indicator (TCIL) flashes when fault is present. c

PCED=Powertrain Control/Emissions Diagnosis Manual.