ENGINE—7.3L DIESEL—GLOW PLUG CONTROL MODULE—VEHICLES WITH CALIFORNIA EMISSIONS—SERVICE TIP	Article No. 99-25-10

FORD: 2000 ECONOLINE, EXCURSION, SUPER DUTY F SERIES

ISSUE

California emissions vehicles built after 10/24/1999 have a new Glow Plug Monitor system which incorporates a solid state Glow Plug Control Module (GPCM). This system replaces the relay and shunt assembly previously used.

ACTION

Refer to the following Diagnostic Procedure for new GPCM system pinpoint test.

DIAGNOSTIC PROCEDURE

The GPCM supplies power to the glow plugs through solid state drivers and performs diagnostics internally to detect and report system failures. The Powertrain Control Module (PCM) still controls glow plug on-time through a control circuit between the two modules. On-time is a function of engine oil temperature, barometric pressure, and battery voltage. This is the same as the previous system.

There are two circuits connecting the PCM and the GPCM. PCM Pin 101 is still used as the control circuit which activates the GPCM to enable glow plugs. PCM Pin 8 is used as the serial communication circuit which is used for the GPCM to report failures to the PCM. The PCM monitors these circuits for failures. The GPCM internally performs diagnostics for individual glow plug/glow plug circuit failures. When a failure is detected, the GPCM will transmit that failure to the GPCM over the communication circuit. If a fault is detected, it will be stored in PCM continuous memory. New fault codes have been added and descriptions are as follows:

- P0670 - Glow plug (GP) control circuit malfunction
- P0671 - Glow plug #1 circuit failure (circuit/GP)
- P0672 - Glow plug #2 circuit failure (circuit/GP)
- P0673 - Glow plug #3 circuit failure (circuit/GP)
- P0674 - Glow plug #4 circuit failure (circuit/GP)
- P0675 - Glow plug #5 circuit failure (circuit/GP)
- P0676 - Glow plug #6 circuit failure (circuit/GP)
- P0677 - Glow plug #7 circuit failure (circuit/GP)
- P0678 - Glow plug #8 circuit failure (circuit/GP)
- P0683 - Glow plug diagnostic signal communication fault

When servicing this system for fault codes, carefully inspect all connections for damaged or pushed out pins and fully engaged connectors. The green engine harness connector must be connected to the green glow plug monitor connector and the black engine harness connector must be connected to the black glow plug monitor connector. After any repair or removal of the GPCM components, it is very important to re-run the KOER Glow Plug Monitor self test to verify no system faults are present before releasing the vehicle. For diagnostic procedures, refer to the new pinpoint test for the GPCM system (Figures 1-6).

NOTE

WHEN SERVICING OR DIAGNOSING THE GLOW PLUG SYSTEM OR WHEN DISCONNECTING THE GREEN AND BLACK CONNECTORS ON THE

GPCM, UNBOLT THE MODULE FROM THE MOUNTING BRACKET FIRST AND THEN DISCONNECT THE GPCM GREEN AND BLACK CONNECTORS. THIS WILL ALLOW FOR EASIER DISCONNECT AND WILL HELP PREVENT DAMAGE TO THE CONNECTOR TERMINALS DURING DISASSEMBLY/ASSEMBLY.

OTHER APPLICABLE ARTICLES: NONE
WARRANTY STATUS: INFORMATION ONLY
OASIS CODES: 602300, 603300, 690000

GLOW PLUG SYSTEM (California)	QB

DESCRIPTION

The California glow plug system is composed of solid state Glow Plug Control Module (GPCM), glow plugs and the associated wiring harness. The glow plug on-time is controlled by the Power Control Module (PCM) and is a function of oil temperature, barometric pressure and battery voltage. The PCM enables the GPCM which drives the individual glow plugs. Glow plug on-time normally varies between 1 to 120 seconds. In addition to PCM control, the GPCM internally limits the glow plug operation to 180 seconds regardless of PCM commanded on-time. The power to the glow plugs is provided through the GPCM solid state drivers directly from the vehicle battery. The GPCM monitors and detects individual glow plug functionality and the control and communication links to the PCM. The failures detected by the GPCM are passed to the PCM using a serial communication signal on the diagnostic line.

NOTE: Wait-to-start lamp on-time is independent from GPCM on-time.

REMEMBER

This pinpoint test is intended to diagnose the following:

- Glow Plugs
- Glow Plug Control Module
- UVC Gasket and Harness
- Engine Harness
- Chassis Harness
- Powertrain Control Module

CAUTION

- Connectors are not interchangeable; the system will generate trouble codes if connectors are mismatched. Make sure the green connector is plugged into the module green connector, and the black connector into the black connector. There is a black stripe on the GPCM housing for visual verification. The stripe should line up with the black connector.
- Do not perform any voltage checks with the engine running; 115V DC at 10 amps are present in the injector circuits.

NOTE

- Enter this pinpoint test only when directed here from the symptom flowcharts.
- Make sure the vehicle batteries are fully charged prior to performing the glow plug diagnostic tests.
- The glow plug diagnostic pinpoint test requires a New Generation Star (NGS) Tester.

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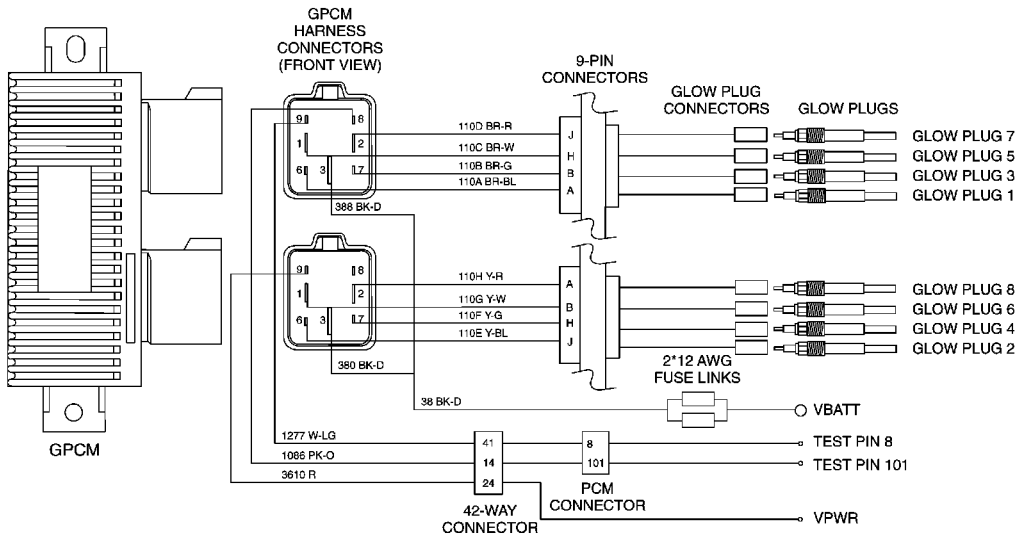
Figure 1 - Article 99-25-10

GLOW PLUG SYSTEM



GPCM Pin Number	Signal Name	
	GREEN Connector/Header	BLACK Connector/Header
1	Glow Plug #5 Output	Glow Plug #6 Output
2	Glow Plug #7 Output	Glow Plug #8 Output
3	VBatt, B+ Power Input	VBatt, B+ Power Input
6	Glow Plug #1 Output	Glow Plug #2 Output
7	Glow Plug #3 Output	Glow Plug #4 Output
8	Glow Plug Control Circuit	Glow Plug Control Circuit (no external connection)
9	Diagnostic Communication Output	VPWR, Relay Power Input

Diagnostic Trouble Codes (DTCs) Description

P0670 = [Control line failure] – Fault code will be set when control circuit is open or shorted to ground or power.

P0671-P0678 = [Glow plug failure(s)] – Fault code will be set upon detection of a failed glow plug #1 to #8 respectively, or its circuit is open.

P0683 = [Diagnostic line failure] – Fault code will be set when diagnostic line is open or shorted to ground or power.

Glow Plug Test Setup and Procedure

The Key On Engine Off (KOEO) test is performed in order to test and retrieve DTCs stored in the PCM memory; glow plugs are not operated during the test.

The Glow Plug Monitor Self Test is a functional KOER test of the Powertrain Control Module performed on demand with the engine running and the A/C off. The PCM will activate the GPCM which monitors the glow plugs. The pedal may be used to increase the engine speed to increase voltage if needed. A fault must be present at the time of testing for the test to detect a fault. The trouble codes will be sent to the PCM on the diagnostic line and outputted to the NGS.

NOTE: When disconnecting the green and black connectors at the GPCM, it is suggested that the module be unbolted from the mounting bracket first and then the connectors disconnected. This will allow for easier disconnect and will help prevent damage to the connector terminals.

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Figure 2 - Article 99-25-10

GLOW PLUG SYSTEM (California) PINPOINT TEST

Test Step		Result ▶	Action to Take
QB1	CHECK FOR DTC P0671-DTC P0678		
	• DTC P0671-DTC P0678 are set when the PCM receives a corresponding glow plug #1 to #8 fault from the glow plug control module (GPCM). Possible causes: – Open glow plug circuit – Damaged connector – Shorted glow plug circuit – Faulty GPCM – Failed glow plug • Perform KOER on-demand self test and retreive/clear continuous DTCs. • **Is one or more of the following codes present?** **DTC P0671, DTC P0672, DTC P0673, DTC P0674, DTC P0675, DTC P0676, DTC P0677, DTC P0678**	Yes ▶ No ▶	GO to **QB2**. GO to **QB6**.
QB2	CHECK FOR OPEN/SHORTED GLOW PLUG CIRCUIT		
	• Key OFF. • Disconnect wiring at GPCM. Check for loose, damaged, or backed-out terminals. **NOTE: Glow plugs are numbered front to rear with even numbers on the left side of engine.** • Measure resistance between GPCM harness connector pin(s) and battery negative post. Use wiring diagram to match connector pin(s) with DTC(s). • **Is resistance greater than 5 ohms?** (Typical resistance value of a good glow plug and wiring is 1 ohm.)	Yes ▶ No ▶	GO to **QB3**. REPLACE glow plug indicated by DTC. Refer to Glow Plug System in Workshop Manual. RESTORE system. CLEAR DTCs and RETEST.
QB3	CHECK FOR OPEN GLOW PLUG CIRCUIT – GPCM TO VALVE COVER CONNECTOR		
	• Disconnect wiring at valve cover corresponding to DTC. Check for loose, damaged, or backed-out terminals. • Measure resistance between GPCM harness connector pin(s) and valve cover harness connector pin(s). Use wiring diagram to match pin(s) at connectors with DTC(s). • **Is resistance greater than 5 ohms?** (Typical resistance value is less than 1 ohm.)	Yes ▶ No ▶	REPAIR open circuit between GPCM connector and valve cover connector. RESTORE system. CLEAR DTCs and RETEST. GO to **QB4**.

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Figure 3 - Article 99-25-10

GLOW PLUG SYSTEM (California) PINPOINT TEST

Test Step		Result ▶	Action to Take
QB4	CHECK FOR OPEN GLOW PLUG CIRCUIT – UNDER VALVE COVER (UVC) HARNESS		
	• Remove valve cover corresponding to DTC. Refer to 7.3L Diesel Engine in Workshop Manual. • Measure resistance between valve cover harness connector pin(s) and glow plug wiring terminal(s) corresponding to DTC. • **Is resistance greater than 5 ohms?** (Typical resistance value is less than 1 ohm.)	Yes ▶ No ▶	Open is in valve cover gasket or under valve cover (UVC) harness. REPLACE as necessary. RESTORE system. CLEAR DTCs and RETEST. GO to **QB5**.
QB5	CHECK FOR OPEN GLOW PLUG		
	• Measure resistance between glow plug wiring terminal and engine ground. • **Is resistance greater than 5 ohms?** (Typical cold glow plug resistance is less than 1 ohm.)	Yes ▶ No ▶	REPLACE failed glow plug. RESTORE system. CLEAR DTCs and RETEST. REPLACE GPCM. RESTORE system. CLEAR DTCs and RETEST.
QB6	CHECK FOR DTC P0670		
	• DTC P0670 is set when the PCM detects a malfunction in the GPCM control circuit. Possible causes: – Open control line – Control line shorted to ground or power – Faulty PCM circuit – Faulty GPCM circuit • Perform KOEO on-demand self test and retrieve/clear continuous DTCs. • **Is DTC P0670 present?**	Yes ▶ No ▶	GO to **QB7**. GO to **QB11**.
QB7	CHECK FOR OPEN IN CONTROL LINE		
	• Key OFF. • Disconnect wiring at PCM and GPCM. Check both connectors for loose, damaged or backed-out terminals. • Install breakout box; leave PCM disconnected. • Measure resistance between PCM Test Pin 101 and GPCM Connector Pin 8 at GREEN connector, Circuit 1086 (PK/O). • **Is resistance greater than 5 ohms?** (Typical resistance value is less than 1 ohm.)	Yes ▶ No ▶	REPAIR open in Circuit 1086 (PK/O). RESTORE system. CLEAR DTCs and RETEST. GO to **QB8**.
QB8	CHECK FOR SHORT TO POWER IN CONTROL CIRCUIT		
	• Key ON, engine OFF. • Measure voltage between PCM Test Pin 101 and ground, Circuit 1086 (PK/O). • **Is voltage greater than 5 volts?** (Typical voltage should be 0 volts.)	Yes ▶ No ▶	REPAIR short to power in Circuit 1086 (PK/O). RESTORE system. CLEAR DTCs and RETEST. GO to **QB9**.

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Figure 4 - Article 99-25-10

GLOW PLUG SYSTEM (California) PINPOINT TEST

Test Step		Result ▶	Action to Take
QB9	CHECK FOR SHORT TO GROUND IN CONTROL CIRCUIT		
	• Key OFF. • Connect PCM to breakout box; leave PCM disconnected. • Key ON, engine OFF. • Measure resistance between PCM Test Pin 101 and ground. • **Is resistance less than 1 ohm?**	Yes ▶ No ▶	Repair short to ground in Circuit 1086 (PK/O). RESTORE system. CLEAR DTCs and RETEST. GO to **QB10**.
QB10	CHECK MODULE FUNCTION		
	• Connect both GPCM and PCM properly. • Disconnect wiring at engine oil temperature (EOT) sensor (this will maximize the glow plug on-time). • Connect a voltmeter across battery terminals. **NOTE: Take voltage measurements within first minute of turning key to ON position.** • Key ON, engine OFF. • Check voltmeter. If battery voltage drops below 11 volts, recharge and test battery before continuing this test. • Measure voltage between PCM Test Pin 101 and ground while ignition key in in ON position. • Wait until glow plug system times out (glow plug on-time will be 2 minutes after key ON). • Measure voltage at PCM Test Pin 101 after glow plug system times out. • **Is voltage low (less than 1 volt) when glow plugs are on and high (greater than 10 volts) when glow plugs are off?**	Yes ▶ No ▶	REPLACE GPCM. RESTORE system. CLEAR DTCs and RETEST. REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST.
QB11	CHECK FOR DTC P0683		
	• DTC P0683 is set when the PCM detects an open or short to ground or power diagnostic line. Possible causes: – Open diagnostic line – Diagnostic line shorted to ground or power – Faulty PCM circuit – Faulty GPCM circuit • Perform KOER on-demand self test and retrieve/clear continuous DTCs. • **Is DTC P0683 present?** Clear DTCs and retest, making sure there is no DTC P0670 present. If DTC P0670 is present, perform DTC P0670 pinpoint test sequence and fix problem before performing DTC P0683 pinpoint tests.	Yes ▶ No ▶	GO to **QB12**. END TEST if no further glow plug DTC is detected.

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Figure 5 - Article 99-25-10

GLOW PLUG SYSTEM (California) PINPOINT TEST

Test Step		Result ▶	Action to Take
QB12	CHECK FOR OPEN IN DIAGNOSTIC LINE		
	• Key OFF. • Disconnect wiring at PCM and GPCM. • Connect breakout box; leave PCM harness disconnected. • Check resistance between PCM Test Pin 8 and GPCM Test Pin 9 at green connector. • **Is resistance greater than 5 ohms?** (Typical resistance value is less than 1 ohm.)	Yes ▶ No ▶	Repair open in Circuit 1277 (W/LG). RESTORE system. CLEAR DTCs and RETEST. GO to **QB13**.
QB13	CHECK FOR SHORT TO POWER IN DIAGNOSTIC LINE		
	• Key ON, engine OFF. • Measure voltage between PCM Test Pin 8 and ground. • **Is voltage greater than 5 volts?** (Typical voltage should be 0 volts.)	Yes ▶ No ▶	REPAIR short to power in Circuit 1277 (W/LG). RESTORE system. CLEAR DTCs and RETEST. GO to **QB14**.
QB14	CHECK FOR SHORT TO GROUND IN DIAGNOSTIC LINE		
	• Key OFF. • Connect PCM and GPCM. • Key ON, engine OFF. • Measure resistance between PCM Test Pin 8 and ground. • **Is voltage constant 0 volts?** (Diagnostic signal that is not shorted to ground is a pulse train; 0-12 volts.)	Yes ▶ No ▶	REPAIR short to ground in Circuit 1277 (W/LG). RESTORE system and RETEST. GO to **QB15**.
QB15	CHECK GPCM CIRCUIT		
	• Install breakout box; leave PCM disconnected. • Make sure PCM and GPCM are connected. • Set up NGS scan tool as follows: – Choose digital measurement system – Choose frequency meter – Choose level and change to 6-volt scale – Connect only the scan tool signal to PCM breakout Pin 8 (GPCM diagnostic input). • Disconnect EOT sensor connector (this will maximize glow plug on-time). • Key ON, engine OFF. • Measure frequency at PCM breakout box Pin 8 (take measurement when frequency stabilizes; approximately 5 seconds). • **Is frequency in the range of 5 to 20 Hz?** (Typical frequency for diagnostic signal with all plugs functioning is maximum 7 Hz. Typical frequency for signal with one or more glow plugs failed is maximum 15 Hz.)	Yes ▶ No ▶	REPLACE PCM. RESTORE system. CLEAR DTCs and RETEST. REPLACE GPCM. RESTORE system. CLEAR DTCs and RETEST.

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Figure 6 - Article 99-25-10