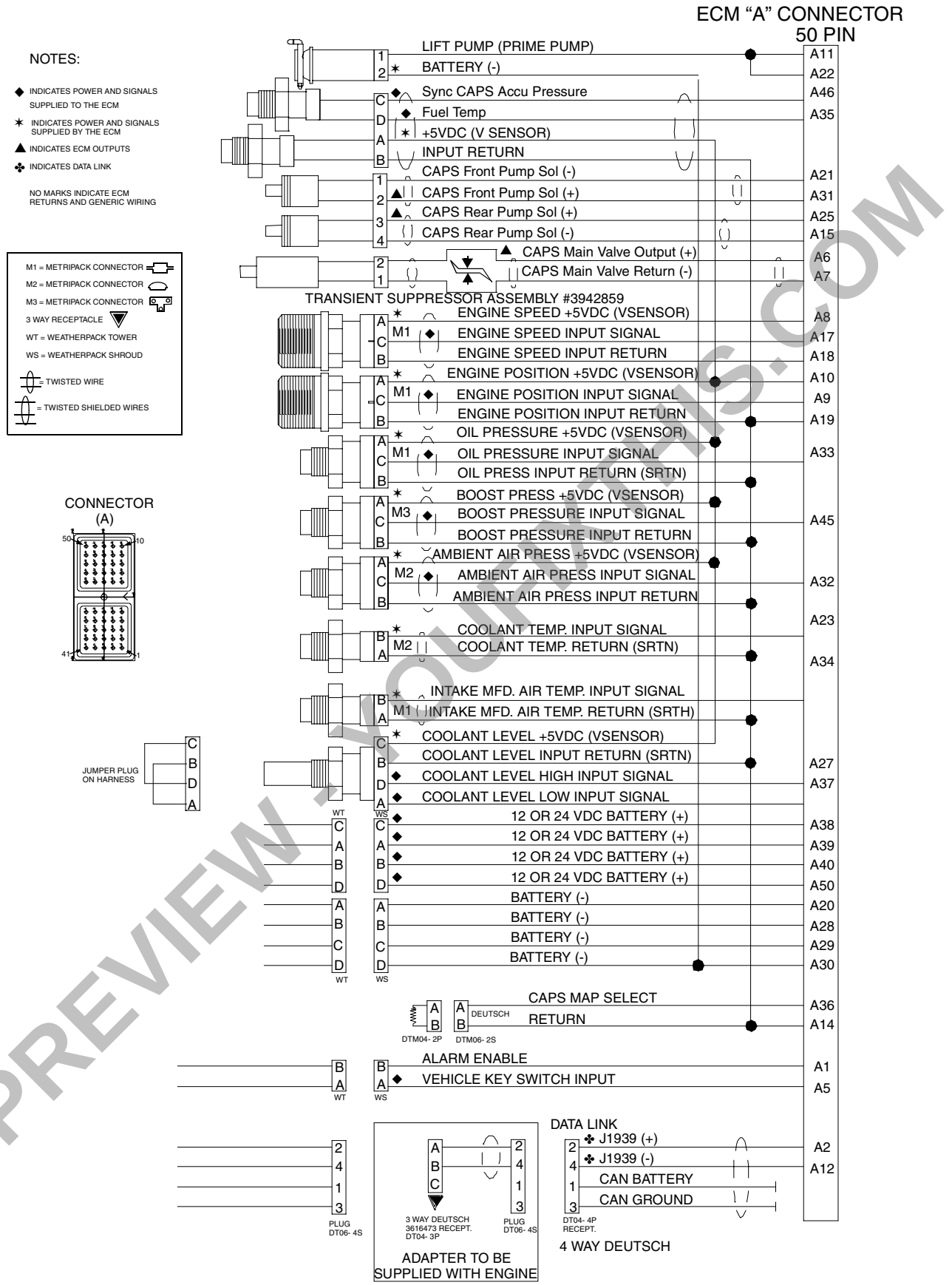
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Cummins Accumulator Pump System (CAPS) Service and Troubleshooting Guide		6-12680

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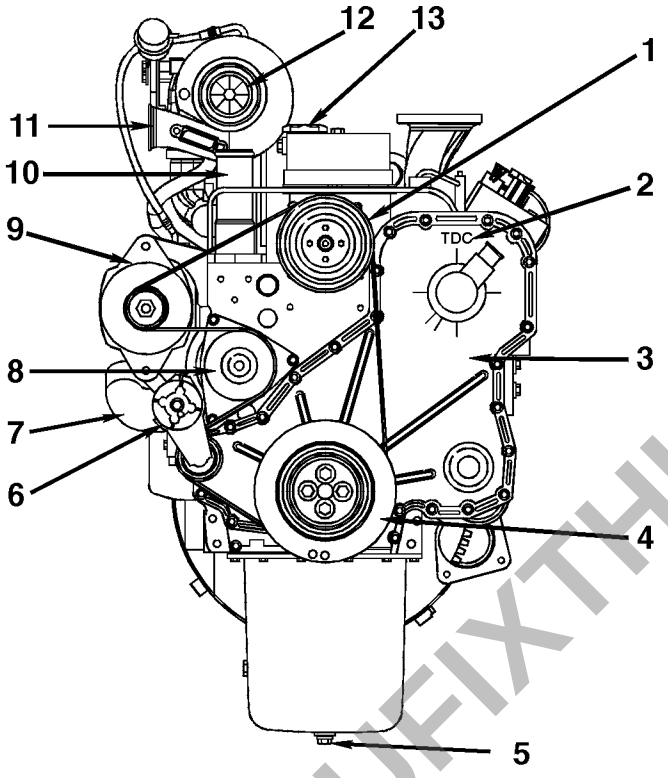
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Engine Views



00900121

Front View

1. Fan Pulley
2. Top Dead Center Mark
3. Front Gear Cover
4. Vibration Damper
5. Engine Oil Pan Drain Plug
6. Automatic Belt Tensioner
7. Water Inlet
8. Water Pump
9. Alternator
10. Water Outlet
11. Turbocharger Air Outlet
12. Turbocharger Air Inlet
13. Engine Rocker Housing Oil Fill

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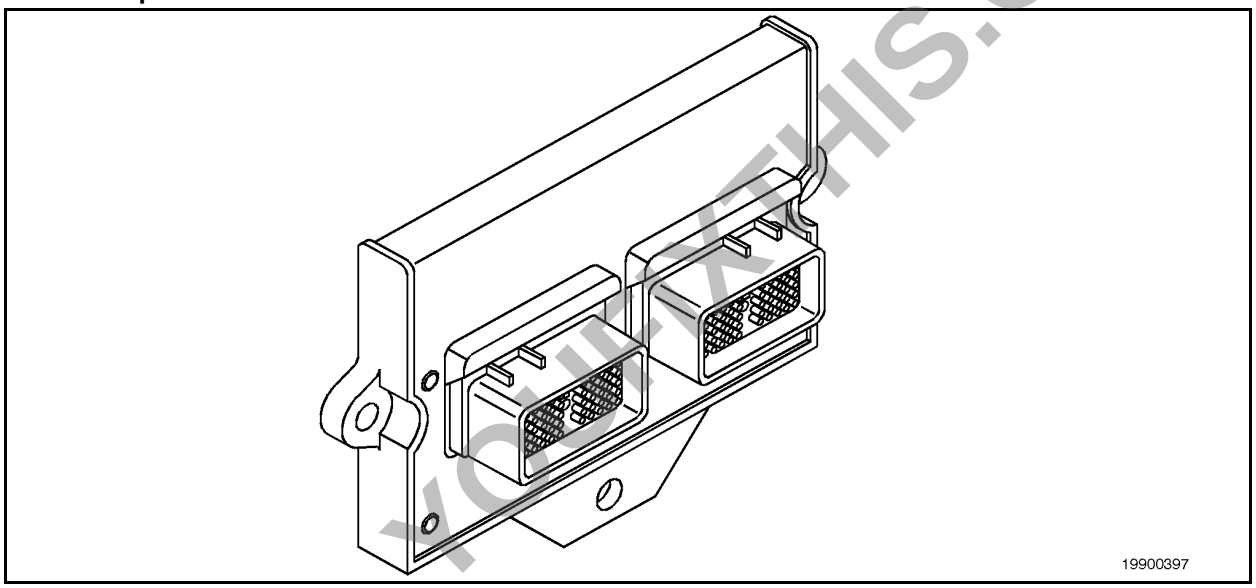
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Fault Code 111

Electronic Control Module (ECM) Microprocessor

CODES	REASON	EFFECT
Fault Code: 111 PID(P), SID (S): S254 SPN:FMI: 12 Lamp: Yellow	ECM internal hardware error.	Possible no effect or engine may run rough or not start.

ECM Microprocessor



Circuit Description:
The ECM is a computer that is responsible for engine control, diagnostics and user features.

Component Location:
The ECM is located on the left side of the engine block, behind the fuel filter.

Shop Talk:
This fault code can be caused only by an internal ECM problem. Repairs are not possible for the ECM.

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TROUBLESHOOTING SUMMARY

∆ CAUTION ∆

To avoid damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check the fault codes.		
STEP 1A: Read the fault codes.	**Fault Code 111 inactive.**	
STEP 1B: Check the inactive counts of Fault Code 111.	**Fault is inactive and no performance related complaints are associated with this fault**	
STEP 2: Clear the fault codes.		
STEP 2A: Disable the fault code.	**Fault Code 111 inactive**	
STEP 2B: Clear the inactive fault codes.	**All faults cleared**	

TROUBLESHOOTING STEP

STEP 1: Check the fault codes.

STEP 1A: Read the fault codes.

∆ CAUTION ∆ **To avoid damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**		
Condition: • Key switch in the "ON" position.		
Action	**Specification/Repair**	**Next Step**
Read the fault codes. • Read the fault codes using an electronic service tool	**OK** **Fault Code 111 Inactive**	1B
	NOT OK **Replace the ECM** Refer to Procedure 019-031.	2A

STEP 1B: Check the inactive counts of Fault Code 111.

∆ CAUTION ∆ **To avoid damaging a new ECM, all other active fault codes must be investigated prior to replacing the ECM.**		
Condition: • Key switch in the "ON" position.		
Action	**Specifications/Repair**	**Next Step**
Check the inactive counts of Fault Code 111. • Read the inactive counts of Fault Code 111 using an electronic service tool	**OK** **Less than 3 counts**	2A
	NOT OK **Replace the ECM** Refer to Procedure 019-031.	2A

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SENSOR SPECIFICATIONS

OIL PRESSURE SENSOR

Torque (Threaded style) = 40 N·m [30 ft-lb]

Pressure (kPa)	Pressure [psi]	Voltage (V)
0	0	0.42 to 0.58
172.37	25	1.42 to 1.58
344.74	50	2.42 to 2.58
517.11	75	3.42 to 3.58
689.48	100	4.42 to 4.58

ALL TEMPERATURE SENSORS

Torque = 14 N·m [10 ft-lb]

Temperature (ºC)	Temperature [ºF]	Resistance (Ω)
0	32	30k to 36k
25	77	9k to 11k
50	122	3k to 4k
75	167	1350 to 1500
100	212	600 to 675

CAPS FUEL PRESSURE SENSOR

Torque (Threaded style) = 81 N·m [60 ft-lb]

Pressure (MPa)	Pressure [psi]	Voltage (V)
0	0	0.31 to 0.69
35.84	5000	1.19 to 1.47
57.34	8000	1.69 to 1.97
78.84	11000	2.19 to 2.47
107.51	15000	2.92 to 3.08

BOOST PRESSURE SENSOR

Torque (Threaded style) = 40 N·m [30 in-lb]

Pressure (mmHg)	Pressure [inHg]	Voltage (V)
0	0	0.44 to 0.56
646.48	25.45	1.44 to 1.56
1292.88	50.90	2.44 to 2.56
1939.36	75.35	3.44 to 3.56
2585.76	101.80	4.44 to 4.56

ACCELERATOR PEDAL (IVS, ISS, APS)

Idle Validation Circuit Resistance:

For ON and OFF-IDLE states

ISS - MAX Closed Circuit Resistance 125

ISS - MIN Open Circuit Resistance > 100 k

Accelerator Position Sensor coil Resistance:

Between supply and return wires

- 2000 to 3000 ohms

Between supply and signal wires (released pedal)

1500 to 3000 ohms

Between supply and signal wires (depressed pedal)

200 to 1500 ohms

NOTE: Released resistance minus depressed resistance **must** be 1000 ohms.

VEHICLE SPEED SENSOR

Torque = 7 N·m [35 ft-lb]

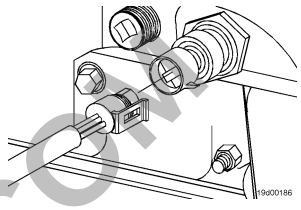
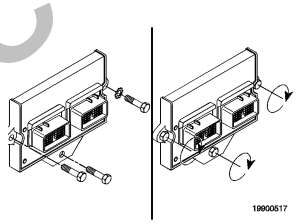
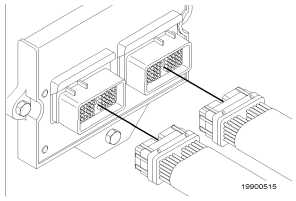
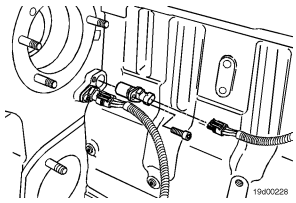
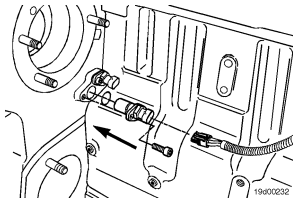
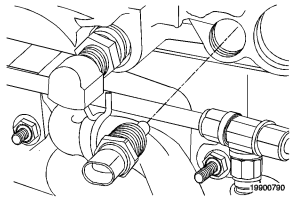
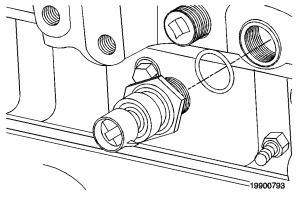
Coil Resistance:

First Coil Resistance = 750 to 1100 Ω

Second Coil Resistance = 1100 to 1500 Ω

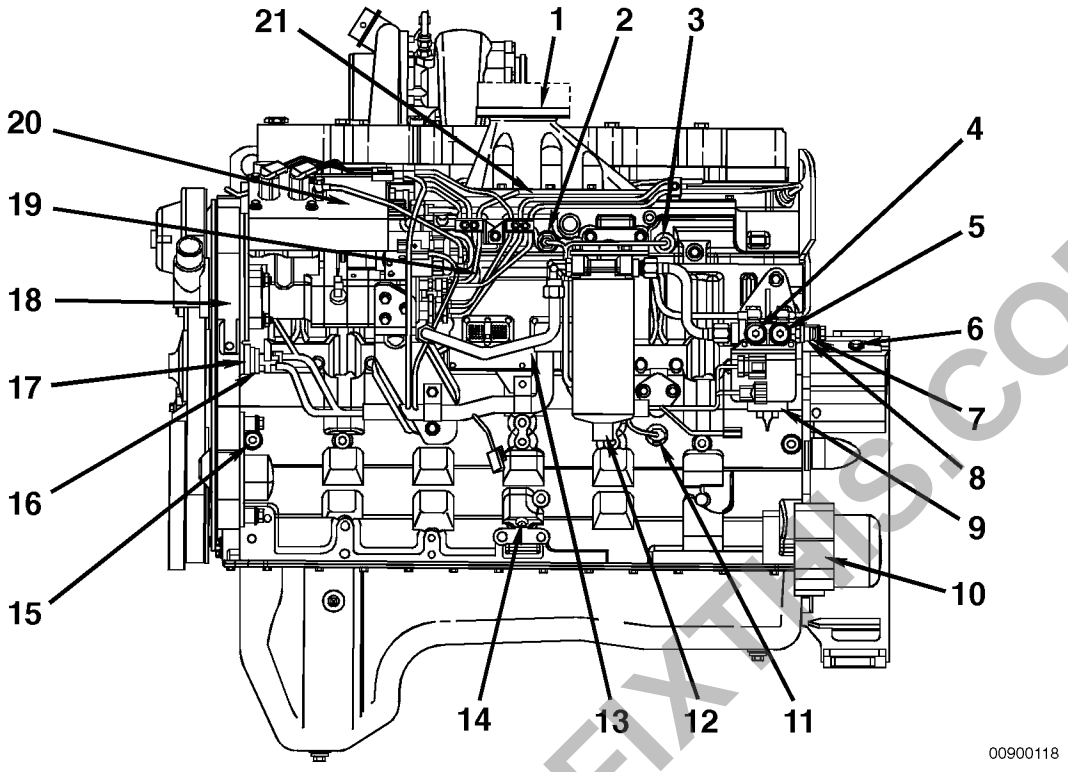
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Component or Assembly (Procedure)	Ref.No./Steps	Metric	U.S.	
Electronic Engine Controls - Torque Values				
Coolant Temperature Sensor (019-019)				
Coolant Temperature Sensor		14 N·m	10 ft-lb	
Electronic Control Module (ECM) (019-031)				
Electronic Control module (ECM)		24 N·m	18 ft-lb	
Deutsch Connectors		2.8 N·m	25 in-lb	
Engine Position Sensor (EPS) (019-038)				
Engine Position Sensor		8 N·m	71 in-lb	
Engine Speed Sensor (019-042)				
Engine Speed Sensor		8 N·m	71 in -lb	
Intake Manifold Temperature Sensor (019-059)				
Intake Manifold Temperature Sensor		14 N·m	10 ft-lb	
Intake Manifold Pressure Sensor (019-061)				
Intake Manifold Pressure Sensor		40 N·m	30 ft-lb	

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Fuel Pump Side View

1. Engine Air Inlet
2. Intake Manifold Pressure Sensor
3. Intake Manifold Temperature Sensor
4. M10 (STOR) Fuel Pressure After Lift Pump
5. M10 (STOR) Fuel Pressure Before Lift Pump
6. Magnetic Pickup Location 3/4-16 UNF
7. Fuel Return Connection
8. Fuel Inlet Connection
9. Fuel Lift Pump
10. Starter
11. Engine oil pressure sender
12. Fuel filter water seperator
13. Electronic Control Module (ECM)
14. Dipstick Location
15. M10 (STOR) Oil Pressure Port
16. Engine Position Sensor - Inboard (EPS - Inboard))
17. Engine Speed Sensor - Outboard (ESS - Outboard)
18. Engine Dataplate
19. High Pressure Fuel Lines
20. CAPS Injection Pump
21. Intake Air Preheater

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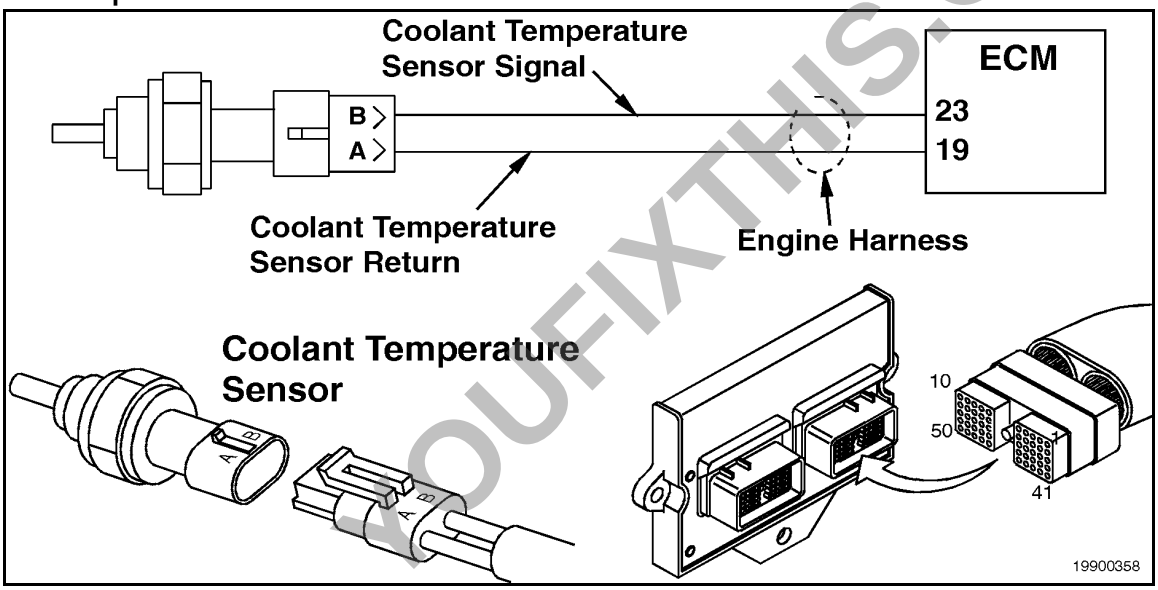
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Fault Code 144 or 145

Coolant Temperature Sensor Circuit

CODES	REASON	EFFECT
Fault Code: 144 or 145 PID(P), SID (S): P110 SPN: 110 FMI: 3 or 4 Lamp: Yellow	FC144: High voltage detected at the coolant temperature signal pin 23 of the engine harness. FC145: Low voltage detected at the coolant temperature signal pin 23 of the engine harness.	Default value used for engine coolant temperature. No engine protection for coolant temperature.

Coolant Temperature Sensor Circuit



Circuit Description:
The coolant temperature sensor is used by the electronic control module (ECM) to monitor the temperature of the engine coolant. The coolant temperature is used by the ECM for the engine protection system, timing, and fueling control.

Component Location:
The coolant temperature sensor is located below the thermostat housing.

Shop Talk:
The resistance of the sensor varies with the temperature. Use a volt-ohm meter and read the fuel temperature using an electronic service tool. Compare the resistance value measured with the following table to verify that the sensor is functioning properly.

Temperature (°C)	Temperature [°F]	Resistance (ohms)
0	32	30k to 36k
25	77	9k to 11k
50	122	3k to 4k
75	167	1350 to 1500
100	212	600 to 675

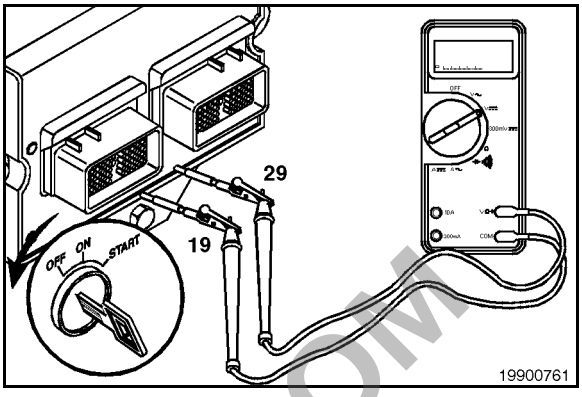
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Using jumper wires, connect pins 38, 39, 40, and 50 (battery supply) from the engine harness to the ECM.

Using jumper wires, connect pins 20, 28, 29, and 30 (battery return) from the engine harness to the ECM.

Connect a test lead to pin 10 of the ECM engine connector and the positive probe of the multimeter.

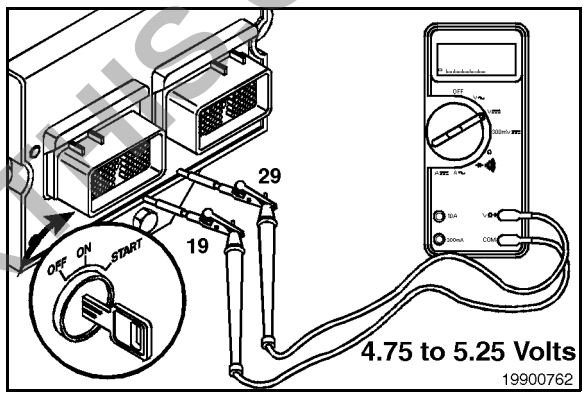
Connect the other lead to pin 19 of the ECM engine connector and the negative probe of the multimeter.



Turn the key switch to the “ON” position.

Measure the voltage from pin 10 to pin 19 of the ECM engine connector. The voltage **must** be 4.75 to 5.25 volts.

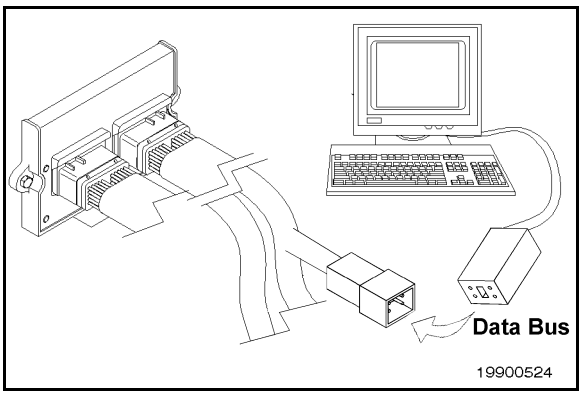
If the voltage is **not** 4.75 to 5.25 volts, replace the ECM.



ECM Calibration (019-032)

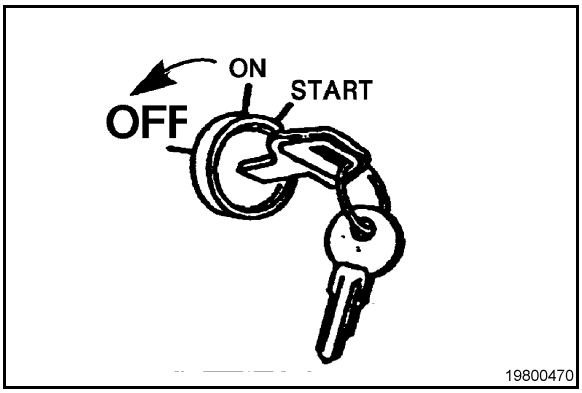
General Information

ECM calibrations can be performed with an electronic service tool.



The ECM calibration process for Case 24 Valve, 8.3 Liter engines occurs with the key switch in the “ON” position most of the time. **Always** follow the instructions on the service tool screens.

NOTE: If the tool will **not** communicate with the key switch in the “ON” position, turn the key switch to the “OFF” position and try again.



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6.2 CAPS Part Reuse Policy

When servicing a CAPS pump, certain parts should **not** be reused. The following list provides direction on what to do.

- Rate shape snubber assemblies (Part No. J**800351 & J800764**) - Installation stresses in the fitting and valve seat render them **unfit** for reinstallation. If either of these snubbers are removed, the entire assembly **must be replaced**.
- A new reusable rate shape snubber (Part No. J4**010544**) has been designed to eliminate fuel leaks caused by rate shape snubbers (released into production May 1st, 2000). This new snubber can be reused by replacing just the seal disk (Part No. J4**010545**).
- Distributor outlet snubbers (Part No. Standardized: J**800350** & Equalizer/: **J800909**) - Installation stresses in the fitting render it **unfit** for reuse. When an outlet assembly is removed for any reason, replace the entire assembly. Do **not** reuse the sealing washer.
- Distributor inlet fitting and seal disk (Part No. J4**009971 & J4009898**) - Installation stress on the fitting and the crush on the seal disk render them both **unfit** for reuse. **Replace** them both whenever a fitting is removed for any reason.
- O-rings between modules should **not** be reused any time a modular repair is performed.

6.3 CAPS & Electronics Serviceable Parts

6.3.1 CAPS Injection Pump Part Numbers

Pump Type	Old Pump P/N	Current Pump P/N & Service for Previous
Original	J417160	J4076442 plus A78006 plus calibration #
Standardized	J4010491	J4076442 plus A78008 plus calibration #
Equalizer	J4010173	J4076442 plus A78008
6TAA-9004	- - - - - - -	J4076443

Reference Service Bulletin NEN SB 002 01 for proper calibration code.

6.3.2 Engine Wiring Harness Part Numbers

Fuel Pressure/Temperature Sensor Type	MX & STX @ Wiring Harness P/N	Tyler & CX160 @ Wiring Harness P/N
Combo Fuel Pressure/Temperature Sensor – Hi-Stat	J944123 *	- - - - - -
Original ISS Pressure Sensor – Separate Temperature Sensor	J945966 *	J948165 *
ISS Pressure Sensor With Pigtail (Current)	J938746	J938747

Individual connectors for the wiring harnesses are being released for service.

* No longer available for service.

@ STX & CX160 machines used only latest .

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STEP 1C: Check for a short circuit to ground.

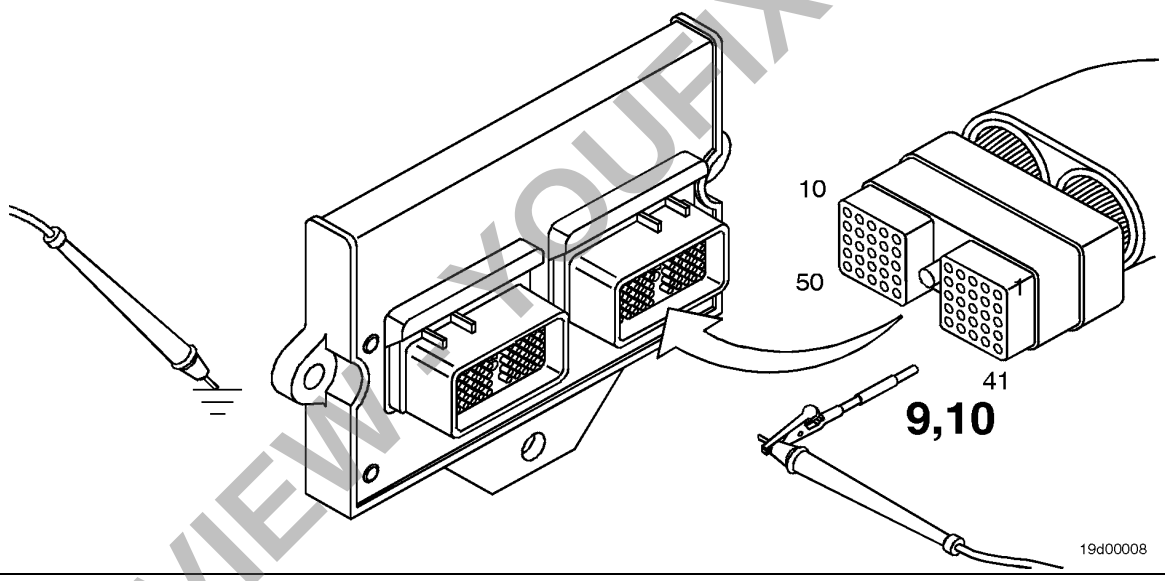
∆ CAUTION ∆

To avoid pin and harness damage, use the following test lead when taking a measurement:
Tool No. 3822758 - male Deutsch/Cannon/Metri-Pack test lead.

Conditions:

- Key switch in the "OFF" position.
- Disconnect the engine harness from the ECM.
- Disconnect the engine harness from the EPS.

Action	Specifications/Repair	Next Step
Check for a short circuit to ground in the +5 VDC supply wire and the signal wire. • Measure the resistance from pin 9 of the engine harness connector to engine block ground. • Measure the resistance from pin 10 of the engine harness connector to engine block ground.	**OK** **More than 100k ohms**	1D
	NOT OK **Replace the engine harness** Refer to Procedure 019-043.	3A



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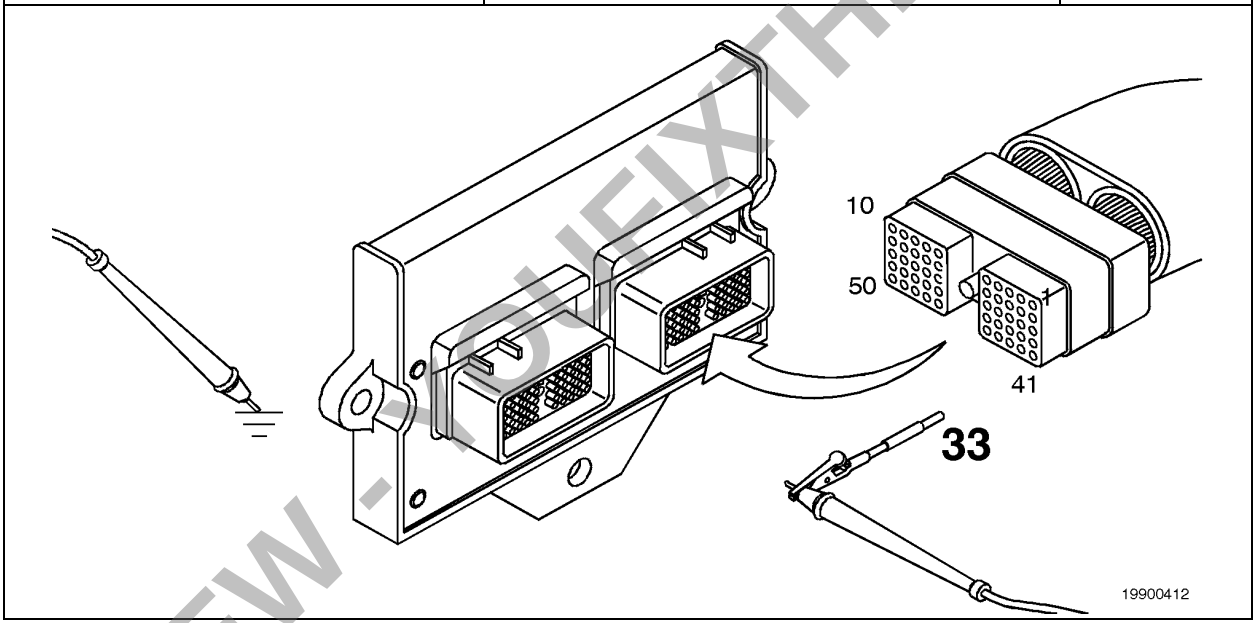
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STEP 3C: Check for a short circuit to ground.

∆ CAUTION ∆
To avoid pin and harness damage, use the following test lead when taking a measurement:
Tool No. 3822758 - male AMP/Metri-Pack/Deutsch test lead.

Condition:
- Key switch in the "OFF" position.
- Disconnect the engine harness from the oil pressure sensor.
- Disconnect the engine harness from the ECM.

Action	Specifications/Repair	Next Step
Check for a short circuit to ground. • Measure the resistance from pin 33 of the engine harness connector to engine block ground.	**OK** **More than 100k ohms**	3D
	NOT OK **Replace the engine harness** Refer to Procedure 019-043.	4A



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STEP 3C: Check for a short circuit to ground.

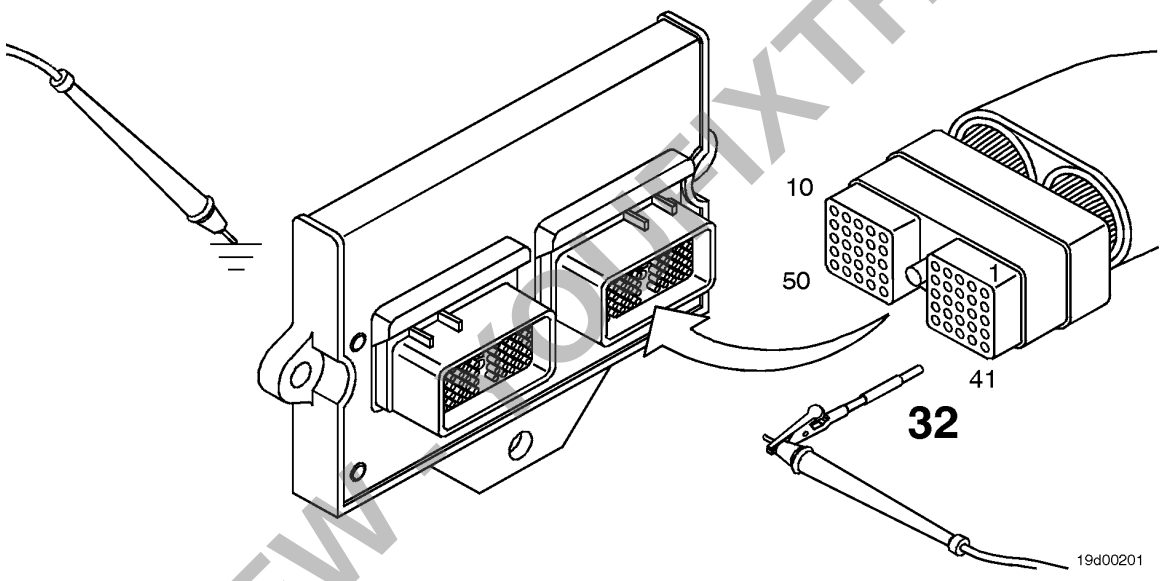
∆ CAUTION ∆

To avoid pin and harness damage, use the following test leads when taking a measurement:
Tool No. 3822758 - male Deutsch/AMP/Metri-Pack test lead.

Condition:

- Key switch in the "OFF" position.
- Disconnect the ambient air pressure sensor from the engine harness.
- Disconnect the engine harness from the ECM.

Action	Specifications/Repair	Next Step
Check for a short circuit to ground. • Measure the resistance from engine harness connector pin 32 to the chassis ground.	**OK** **More than 100k ohms**	3D
	NOT OK **Replace the engine harness** Refer to Procedure 019-043.	5A



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STEP 2: Check the engine harness.

STEP 2A: Inspect the harness, pumping control valve connector, and ECM connector pins.

Condition:
- Key switch in the “OFF“ position.
- Disconnect the engine harness from the ECM.
- Disconnect the engine harness from the pumping control valve at the four pin connector.

Action	Specifications/Repair	Next Step
Inspect the engine harness, pumping control valve connector, and ECM connector pins for: • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector • missing or damaged seals.	**OK** **No damaged pins**	2B
	NOT OK **Repair the damaged pins** Repair or replace the engine harness or ECM, whichever has damaged pins. • Repair the engine harness. • Replace the engine harness. Refer to Procedure 019-043. • Replace the ECM. Refer to Procedure 019-031.	3A

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TROUBLESHOOTING SUMMARY

STEPS	SPECIFICATIONS	SRT CODE
STEP 1: Check for fault codes.		
STEP 1A: Read fault codes.	**Fault Code 275 is not present**	
STEP 2: Check for pumping element failure.		
STEP 2A: Verify pumping valve solenoid performance.	**Solenoid clicks when activated**	
STEP 2A-1: Check fault codes.	**Fault Code 273 inactive**	
STEP 2B: Verify pumping element performance.	**Pumping elements performing equally**	
STEP 3: Clear fault codes.		
STEP 3A: Disable the fault code.	**Fault Code 328 inactive**	
STEP 3B: Clear the inactive fault codes.	**All faults cleared**	

TROUBLESHOOTING STEP

STEP 1: Check fault codes.

STEP 1A: Read the fault codes.

Condition:
- Key switch in the "ON" position.

Action	Specifications/Repair	Next Step
Read the fault codes. • Read the fault codes using an electronic service tool. • Verify that Fault Code 275 is **not** present.	**OK** **Fault Code 275 is not present**	2A
	NOT OK **Fault Code 275 is present** If present, verify that the fuel filter is not plugged. Refer to Procedure 006-011 in the Troubleshooting and Repair Manual for Case 24 Valve 8.3 Liter Engines.	3A

STEP 2: Verify pumping valve solenoid performance.

STEP 2A: Check pumping valve circuit performance.

Condition:
- Key switch in the "ON" position.

Action	Specifications/Repair	Next Step
Verify pumping valve solenoid circuit performance. • Using an electronic service tool, run the Solenoid Click Test on the rear pumping valve solenoid. Listen for an audible click when activating the test to verify that the solenoid is operating.	**OK** **Solenoid clicks when activated**	2B
	NOT OK Solenoid does not click when activated	2A-1

STEP 2A-1: Check fault codes.

Condition:
- Key switch in the "ON" position.

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STEP 2B: Clear the inactive fault codes.

Condition: • Connect all the components. • Key switch in the “ON” position.		
Action	**Specifications/Repair**	**Next Step**
Clear the inactive fault codes. • Erase the inactive fault codes using an electronic service tool.	**OK** **All faults cleared**	Repair complete
	NOT OK Troubleshoot any remaining active fault codes.	Appropriate troubleshooting chart

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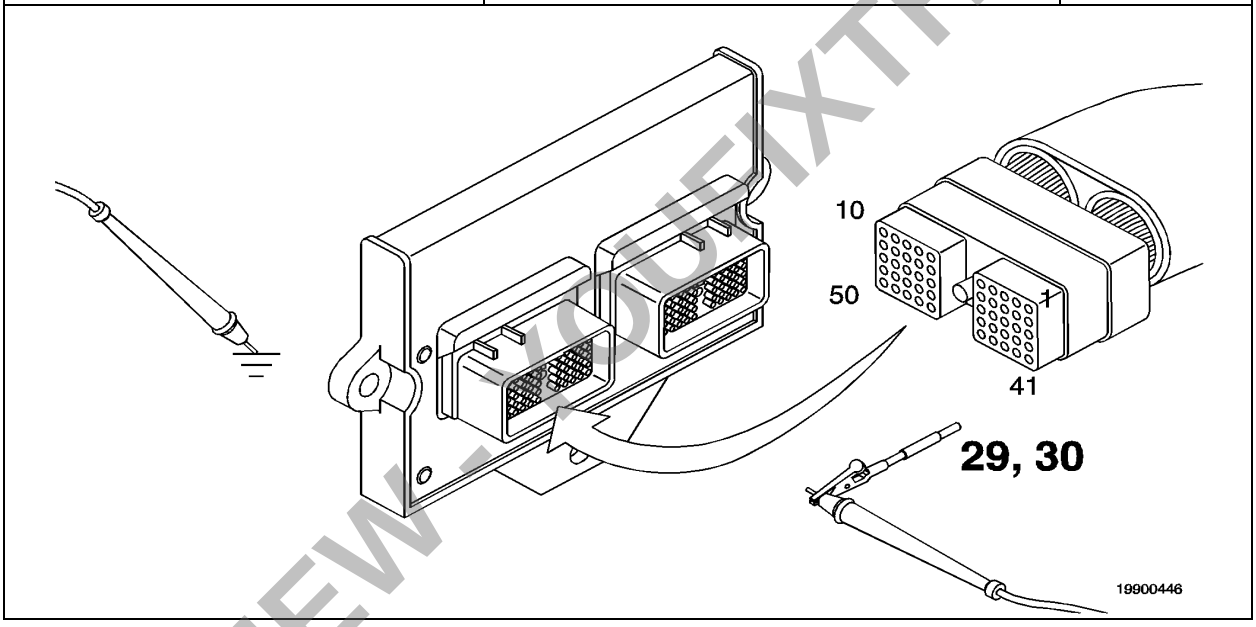
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STEP 2D-2: Check for a short circuit to ground in the vehicle harness.

∆ CAUTION ∆
To avoid pin and harness damage, use the following test leads when taking a measurement:
Tool No. 3822758 - male Deutsch/AMP/Metri-Pack test lead.

Condition:
- Key switch in the "OFF" position.
- Disconnect the vehicle harness from the accelerator position sensor.
- Disconnect the vehicle harness from the ECM.

Action	Specifications/Repair	Next Step
Check for a short circuit to ground in the vehicle harness. • Measure the resistance from pin 29 of the vehicle harness to the engine block ground. • Measure the resistance from pin 30 of the vehicle harness to the engine block ground.	**OK** **More than 100k ohms**	2E
	NOT OK **Repair or replace the vehicle harness** Refer to the Troubleshooting and Repair Manual for Case 24 Valve, 8.3 Liter Engines.	3A



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STEP 2: Check the fuel pressure sensor.

STEP 2A: Inspect the fuel pressure sensor and engine harness.

Condition:
- Key switch in the "OFF" position.
- Disconnect the engine wiring harness from the ECM.
- Disconnect the engine wiring harness from the fuel pressure sensor.

Action	Specifications/Repair	Next Step
Inspect the engine harness, fuel pressure sensor and ECM connectors for: • bent or broken pins • pushed back or expanded pins • corroded pins • moisture in or on the connector • missing or damaged seals.	**OK** **No damaged pins**	2B
	NOT OK **Repair the damaged pins** Repair or replace the engine harness or sensor, whichever has the damaged pins. • Repair the engine harness. • Replace the engine harness. Refer to Procedure 019-043. • Replace the fuel pressure/temperature sensor. Refer to Procedure 019-153.	4A

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Engine Power Output Low

Cause	Correction
Fuel filter is plugged	Measure the fuel pressure before and after the fuel filter. Refer to Procedure 005-011 in the Troubleshooting and Repair Manual for Case 24 Valve, 8.3 Liter Engines.
OK ⇩	
Engine is operating above recommended altitude	Engine power decreases above recommended altitude. Refer to the Engine Data Sheet for specifications.
OK ⇩	
Engine duty cycle has changed	Verify the engine duty cycle with an electronic service tool. Refer to the appropriate electronic service tool user's manual.
OK ⇩	
Programmable parameters or selected features are **not** correct	Check the programmable parameters and the selected features with an electronic service tool. Set the parameters and features again if necessary. Refer to the appropriate electronic service tool user's manual.
OK ⇩	
Electronic Control Module (ECM) calibration is **not** correct	Compare the calibration stored in the ECM with the engine rating and the Control Parts List (CPL). If necessary, calibrate the ECM.
OK ⇩	
J1939 control devices are interfering with the engine controls	Alternately disconnect all other J1939 control devices from the data bus circuit until communications or functionality is restored. Refer to the vehicle service manual to locate and repair J1939 control devices.
OK ⇩	
Accelerator pedal is restricted or malfunctioning	Check the percent throttle reading on an electronic service tool. Verify that it reads 100 percent with the accelerator pedal depressed. Calibrate the accelerator if possible. Replace the accelerator pedal if necessary. Refer to the vehicle service manual.
OK ⇩	

(Continued)

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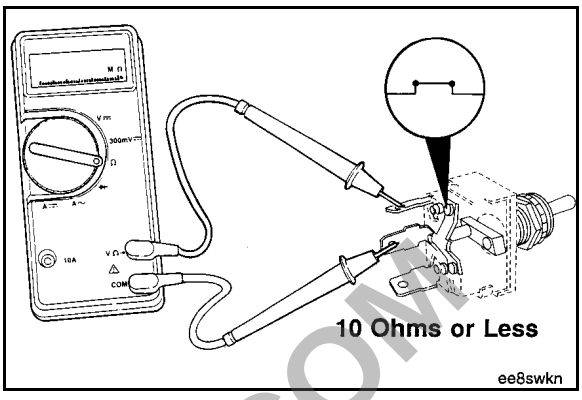
PTO Does Not Operate

Cause		Correction
J1939 control devices are interfering with the engine controls	.....	Alternately disconnect all other J1939 control devices from the data bus circuit until communications or functionality is restored. Refer to the vehicle service manual to locate and repair J1939 control devices.
OK ⇩		
Electronic Control Module (ECM) calibration is **not** correct	.....	Compare the calibration stored in the ECM with the engine rating and the Control Parts List (CPL). If necessary, calibrate the ECM.

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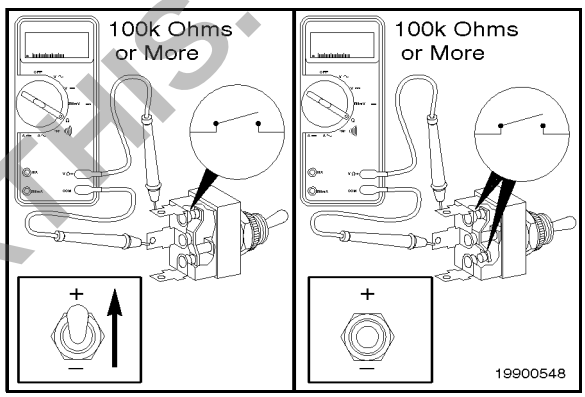
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Touch one probe of the multimeter to the center terminal of the switch. Touch the other probe to the top terminal of the switch.



Hold the idle adjust switch in the up position. The multimeter **must** show an open circuit (100k ohms or more) when the switch is held on and after it is released. If the circuit is **not** open, the switch has failed.

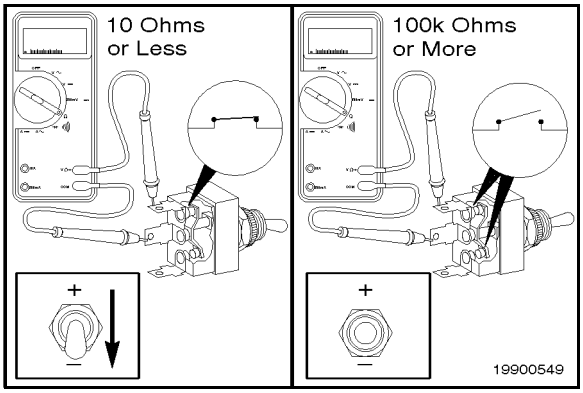
Refer to the vehicle Troubleshooting and Repair Manual for the replacement instructions.



Hold the switch in the down position. The multimeter **must** show a closed circuit (10 ohms or less) when the switch is held in the decrease position.

When the switch is released, it **must** show an open circuit (100k ohms or more). If the multimeter does **not** show the correct values, the switch has failed.

Refer to the vehicle Troubleshooting and Repair Manual for replacement instructions.

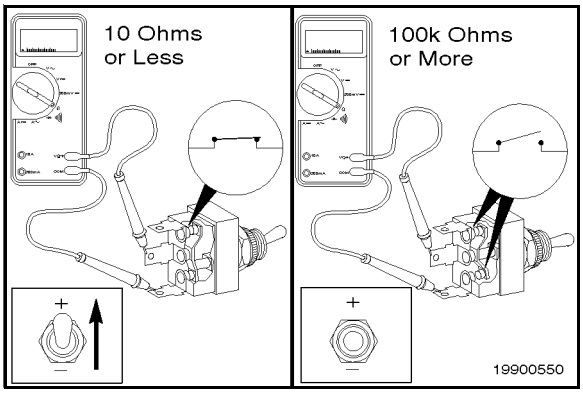


Move the electrical lead from the top to the bottom terminal.

Hold the idle adjust switch in the up position. The multimeter **must** show a closed circuit (10 ohms or less) while the switch is held in the increase position.

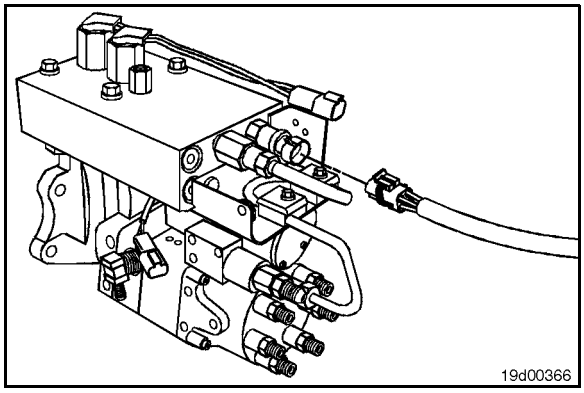
When the switch is released, the multimeter **must** show an open circuit (100k ohms or more). If the multimeter does **not** show the correct values, the switch has failed.

Refer to the vehicle Troubleshooting and Repair Manual for the replacement instructions.

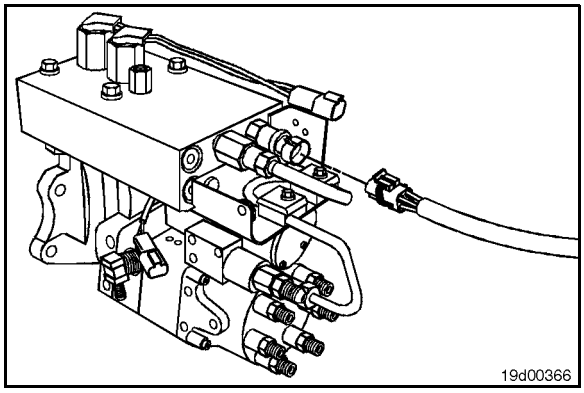


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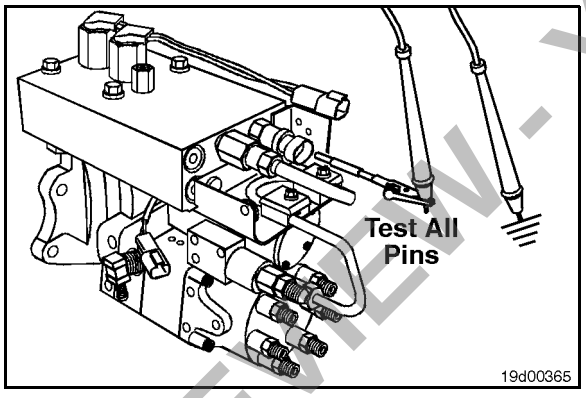
Connect the APTS connector. An audible click will be heard when the connector locks in place.



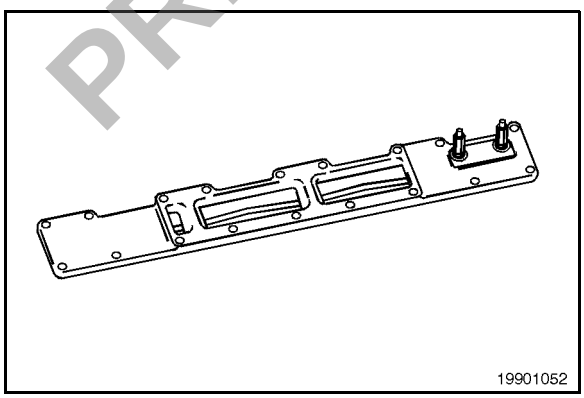
Fuel Pressure/Temperature Circuit (019-154)

Check for Short Circuit to Ground (019-154-039)

Disconnect the sensor from the sensor connector of the engine harness.



Measure the resistance from a pin of the APTS to the engine block ground. The VOM **must** show an open circuit (more than 100k ohms). If the circuit is **not** open, replace the sensor.



Cold Start Aid Circuit (019-164)

General Information

The grid heater circuit consist of the ECM, the vehicle interface harness, and the cold start relay. The ECM controls the relay which allows current to flow to the grid heater when the relay is activated.

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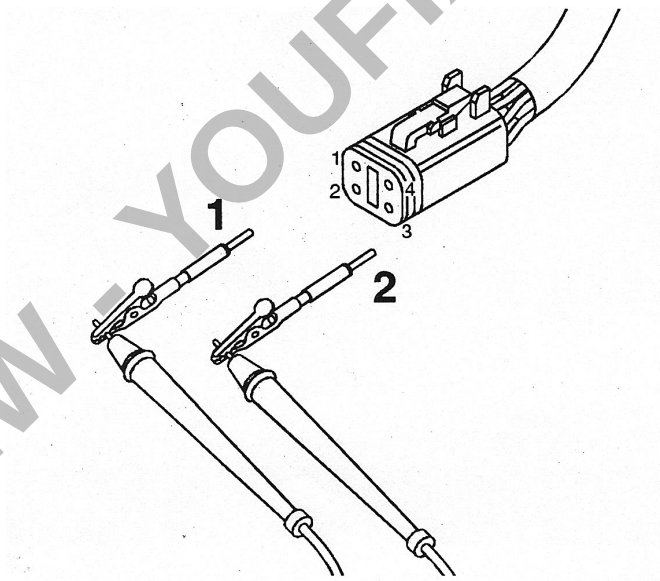
STEP 2B: Check the resistance of the injection control valve.

ΔΔ CAUTION ΔΔ

To reduce the possibility of pin and harness damage, use the following test lead when taking a measurement: Part Number 3823993 - male Deutsch/Metri-Pack test lead.

Condition:
. Turn the keyswitch OFF.
. Disconnect the engine wiring harness from the injection control valve.

Action	Specifications/Repair	Next Step
Check the resistance of the injection control valve. **. Measure the resistance between pin 1 and pin 2 of the injection control valve connector.**	**OK** **0.1 to 1.0 ohm**	**2C**
	NOT OK **Replace the fuel pump ICV-Distributor module.**	**6A**



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