



**IMPCO 2004 Emissions Certified
Engine Training Program**



**Certified LSI Engine with IMPCO
SPECTRUM System**

Fuel/Control System Diagnostics

Offered by Power Solutions, Inc.



**IMPCO 2004 Emissions Certified
Engine Training Program**

The Fuel System

- Computer controlled
- Closed Loop
- Adaptive Learn
- Drive By Cable
- Sequential multi port gas fuel injection for 4.3 Liter
- Single point gas fuel injected throttle body for 3.0 Liter
- LPG Fuel Options
- On Board Diagnostics



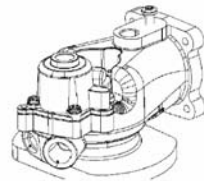


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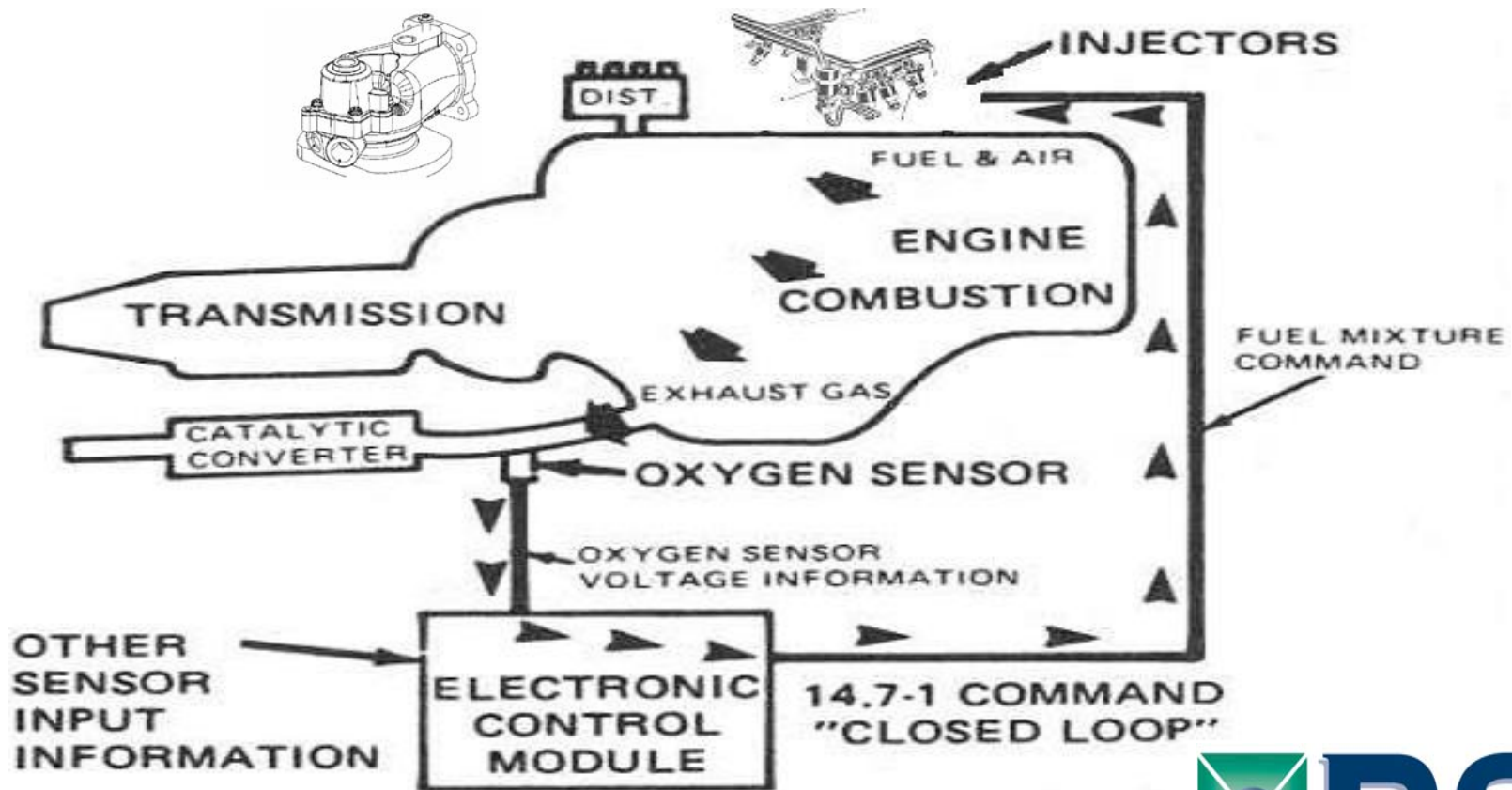
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Closed Loop Fuel Control

3.0 Throttle Body



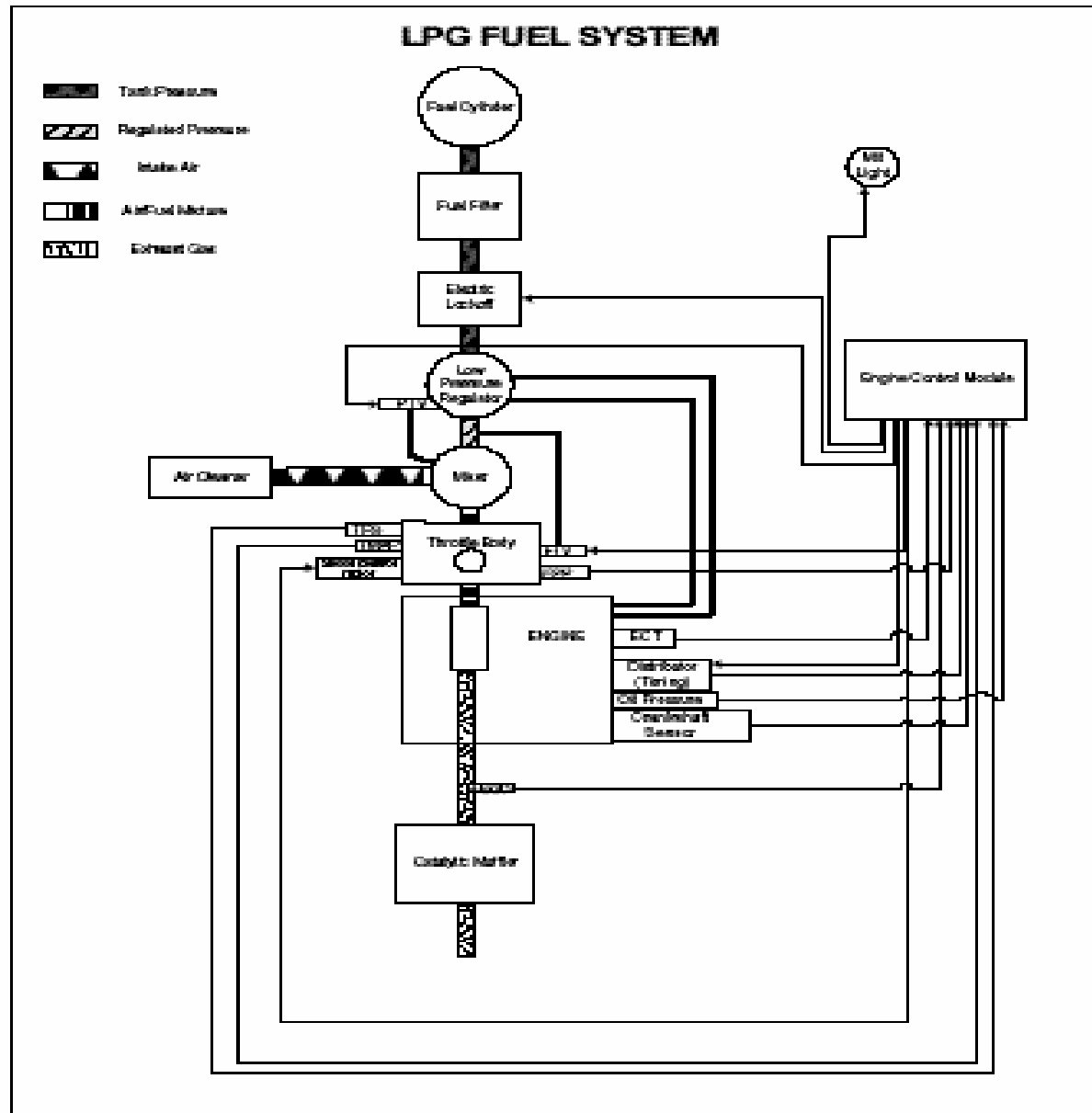
4.3 Injector Rail



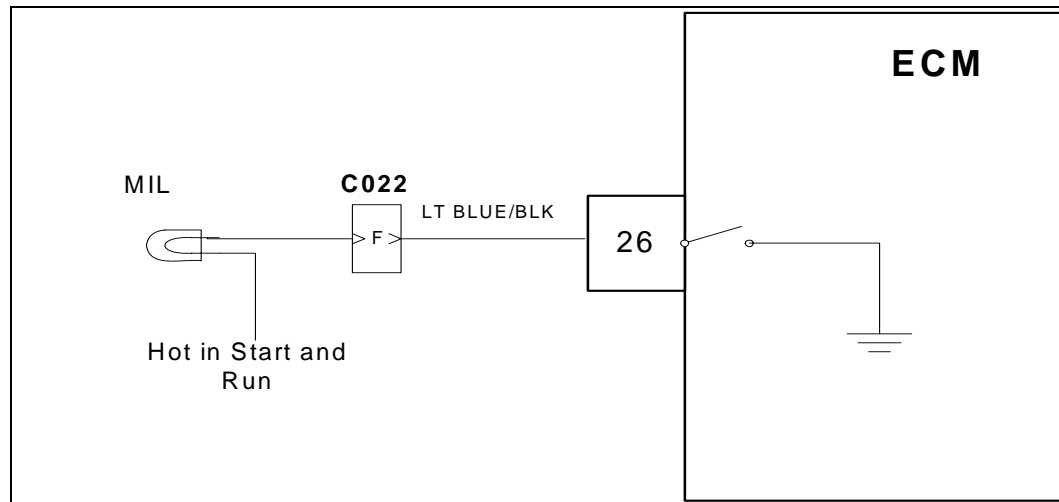


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MIL (Malfunction Indicator Lamp)

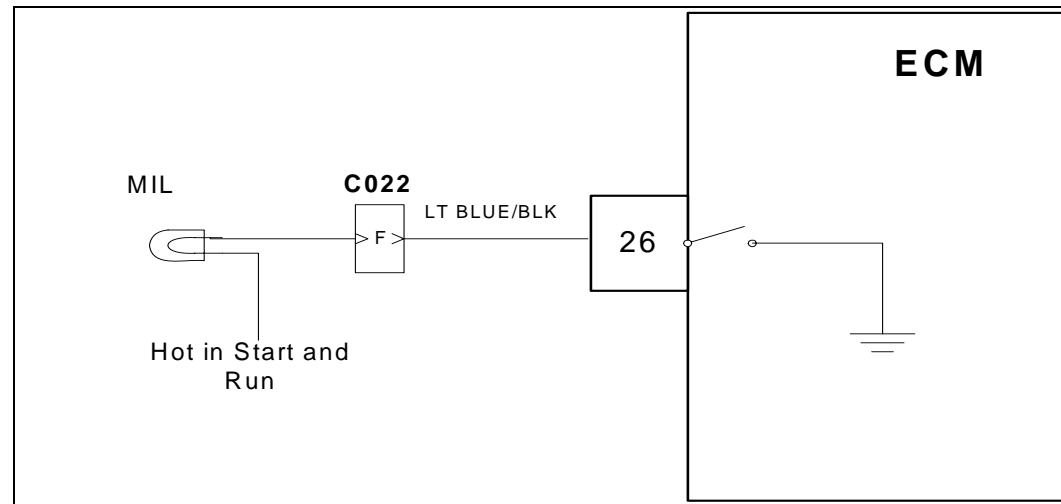


Notifies the driver of a problem with the emission control system.



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Most engine control system related problems that affect emissions or driveability of the vehicle will set a (DTC) Diagnostic Trouble Code and illuminate the Malfunction Indicator Lamp.

The lamp should come on when the key is in the ON position and the engine is not running (Bulb Check Function)

Once the engine is in start or run mode, the lamp should go off.

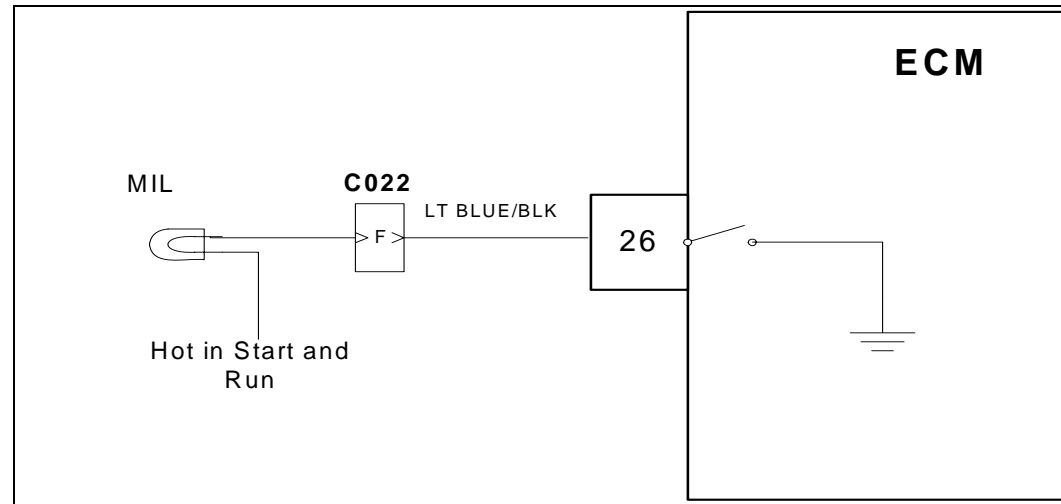
If the lamp illuminates while the engine is in the start or run mode, there is a current Diagnostic Trouble Code.





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Power is supplied to the bulb through the ignition switch.

The ECM provides ground to illuminate the lamp.

It will also display DTC's that have been stored due to a system malfunction. (Blink Code Function)





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Diagnostic Trouble Codes (DTC)

Diagnostic Trouble Codes are set when the Spectrum ECM (Electronic Control Module) runs a diagnostic self-test and the test fails.

If the system continues to fail the test, the lamp will stay illuminated and the DTC is current (**Active**).

All DTC's are stored as (**Historical Faults**) until they are cleared.

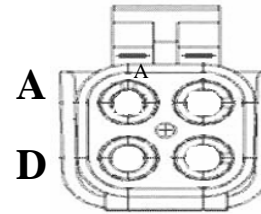
All DTC's except the ECM related DTC's will automatically clear from memory if the DTC does not reset within 100 consecutive engine run cycles.

While a Diagnostic Trouble Code is current for a sensor, the ECM may assign a default "limp home" value and use that value in its control strategy.





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Blink Code Function

Diagnostic Link Connector

If you do not have access to a laptop computer, it is still possible to access the Diagnostic Trouble Codes stored in the memory of the Spectrum system ECM using a diagnostic jumper and the MIL. With the key off connect diagnostic pins **A** and **D**. Turn the ignition on but do not start the vehicle. The Malfunction Indicator Lamp (MIL) will begin to flash. The MIL displays three digit codes by flashing the first digit, pausing, then flashing the second digit, pausing, and then flashing the third digit. The MIL will first display a 166 three times. Code 166 indicates that the ECM based diagnostic routines are functioning. Then, any Diagnostic Trouble Codes stored in memory will display three times each. The MIL will then start over with the code 166.





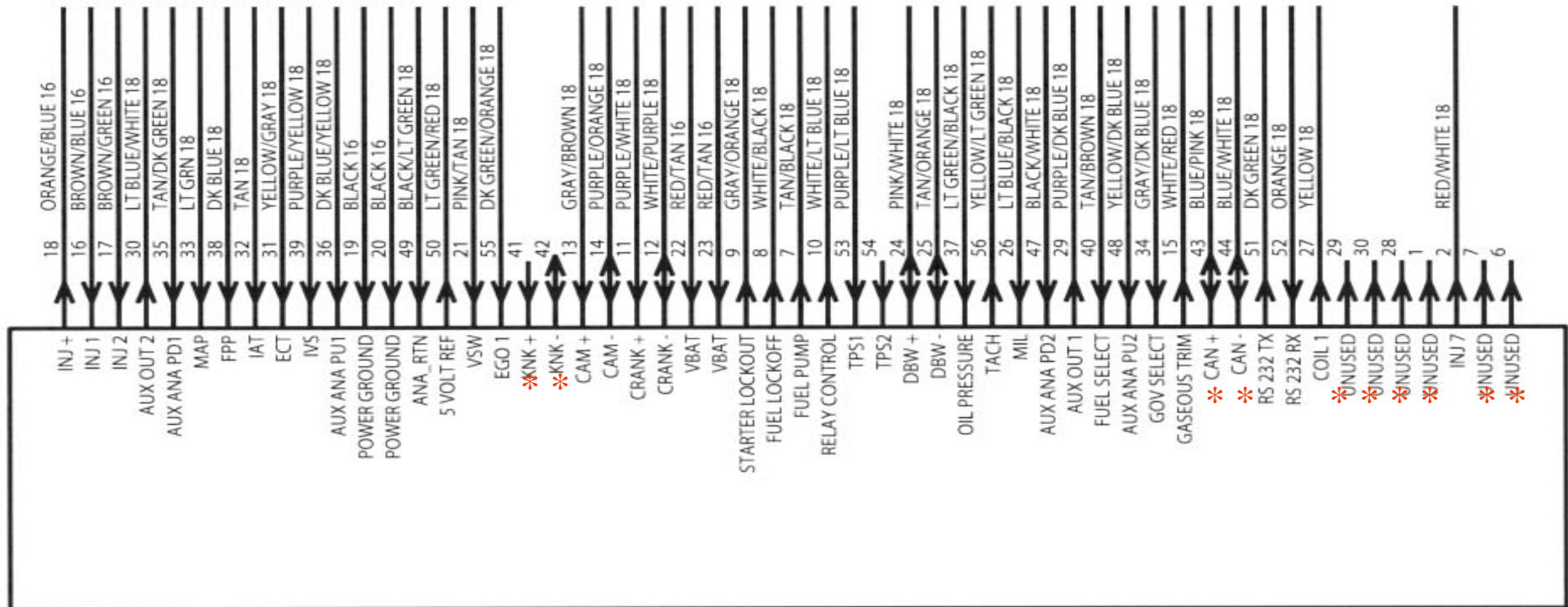
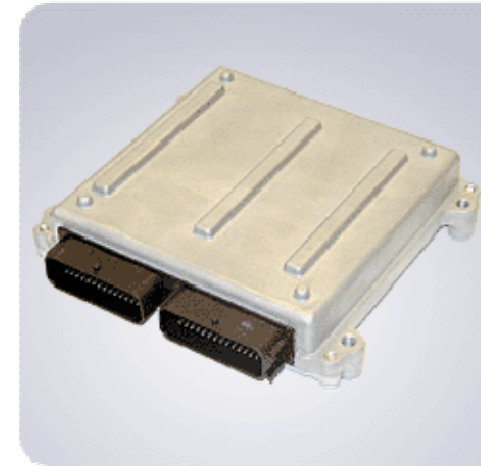
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ECM (Electronic Control Module) 56 Pin Connector

32 Bit Processor

Under hood temperature compatible

Extended Capabilities out to 2007 Model Year





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ECM Non Volatile Memory

Diagnostic Trouble Codes will be cleared from the system ECM memory by moving the ignition key to the OFF position and removing the (F1) system battery fuse for at least 15 seconds.

This will erase all of the Diagnostic codes stored in the computer memory including the adaptive learn.

It will not erase the fuel calibration.

It will not erase the computer serial identification

It will not erase the internal hour meter





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ECM Flash Memory

Flash programming helps minimize the risk of ESD damage

ECM fuel calibrations are downloaded to the ECM using the diagnostic link connector

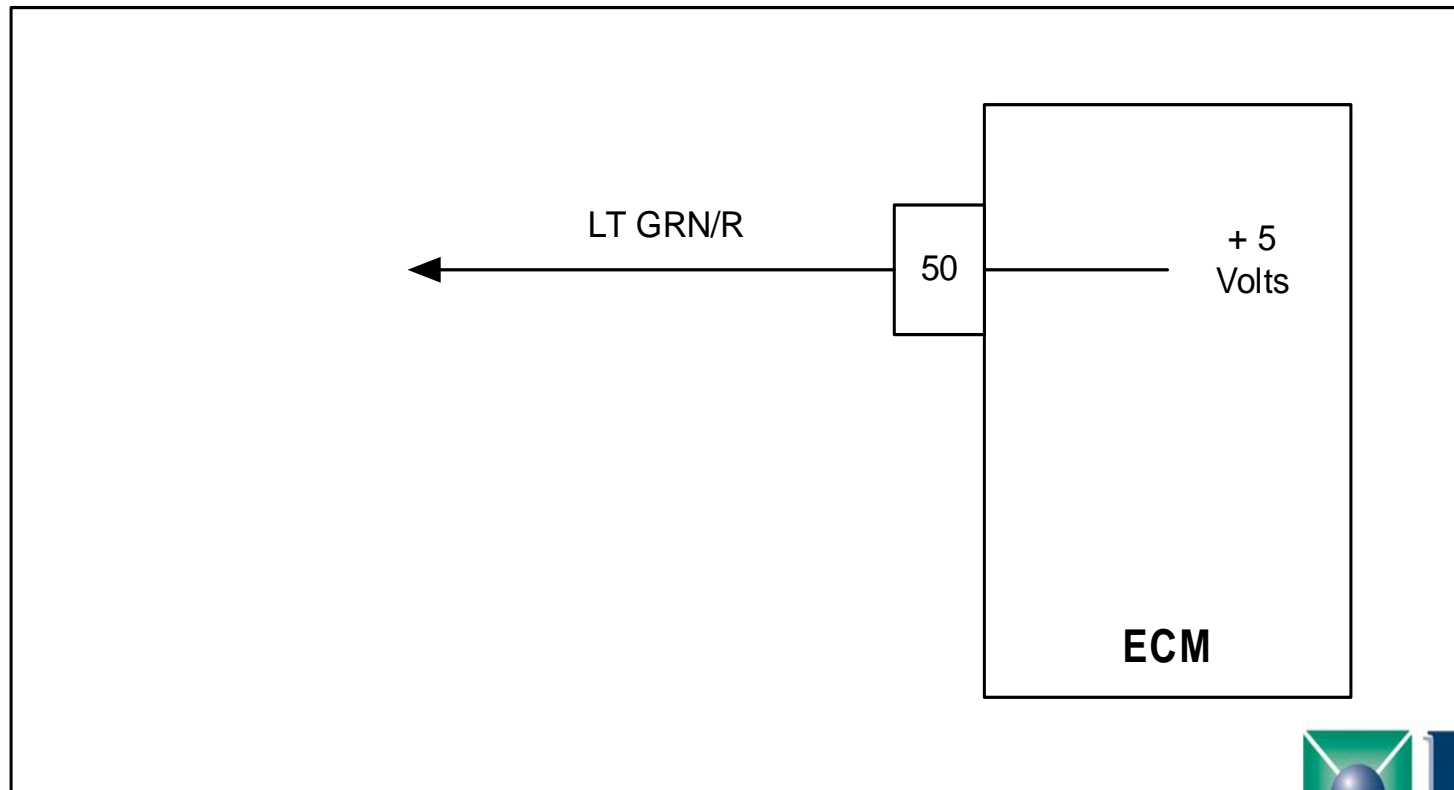
Software calibration updates are available for in field use without disassembling the ECM to replace an E-PROM





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ECM Provides an external 5 volt reference to engine sensors

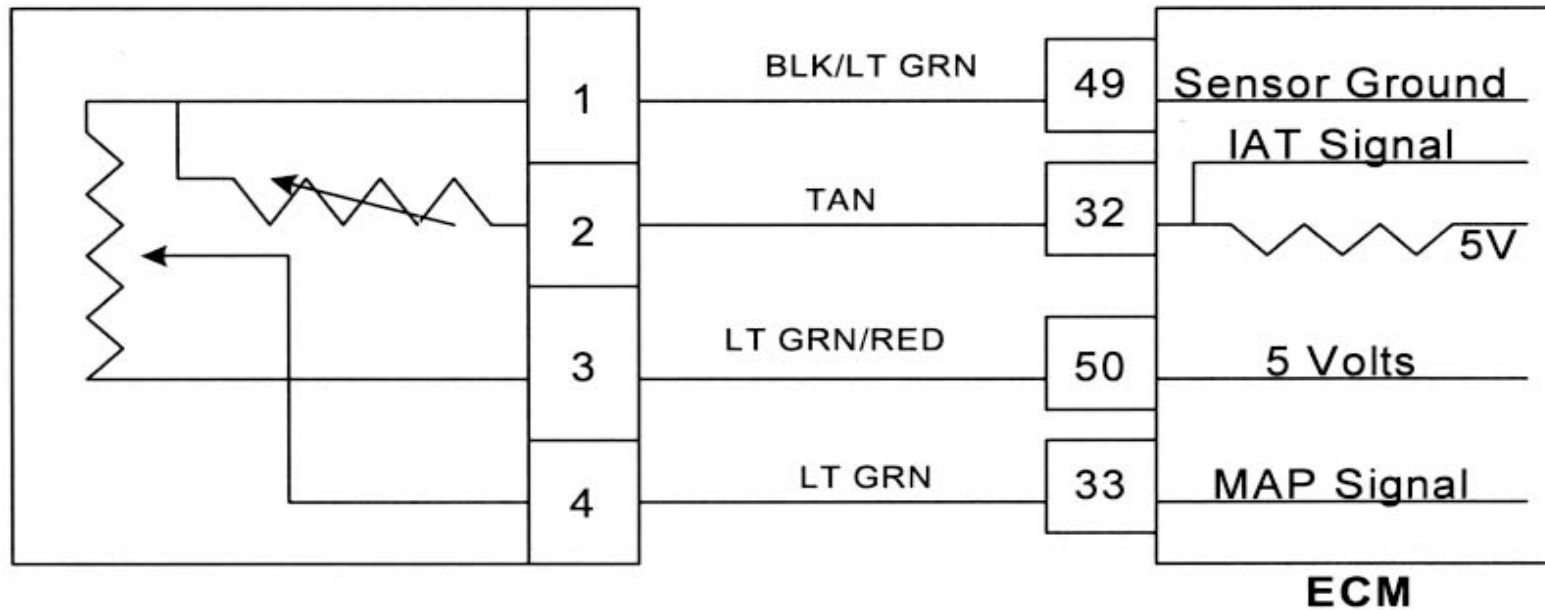




ECM also provides an internal 5 volt reference

Sensor load creates a voltage drop at the internal resistor

Voltage drop is used by the ECM to determine sensor value



* Internal reference shown pin 32

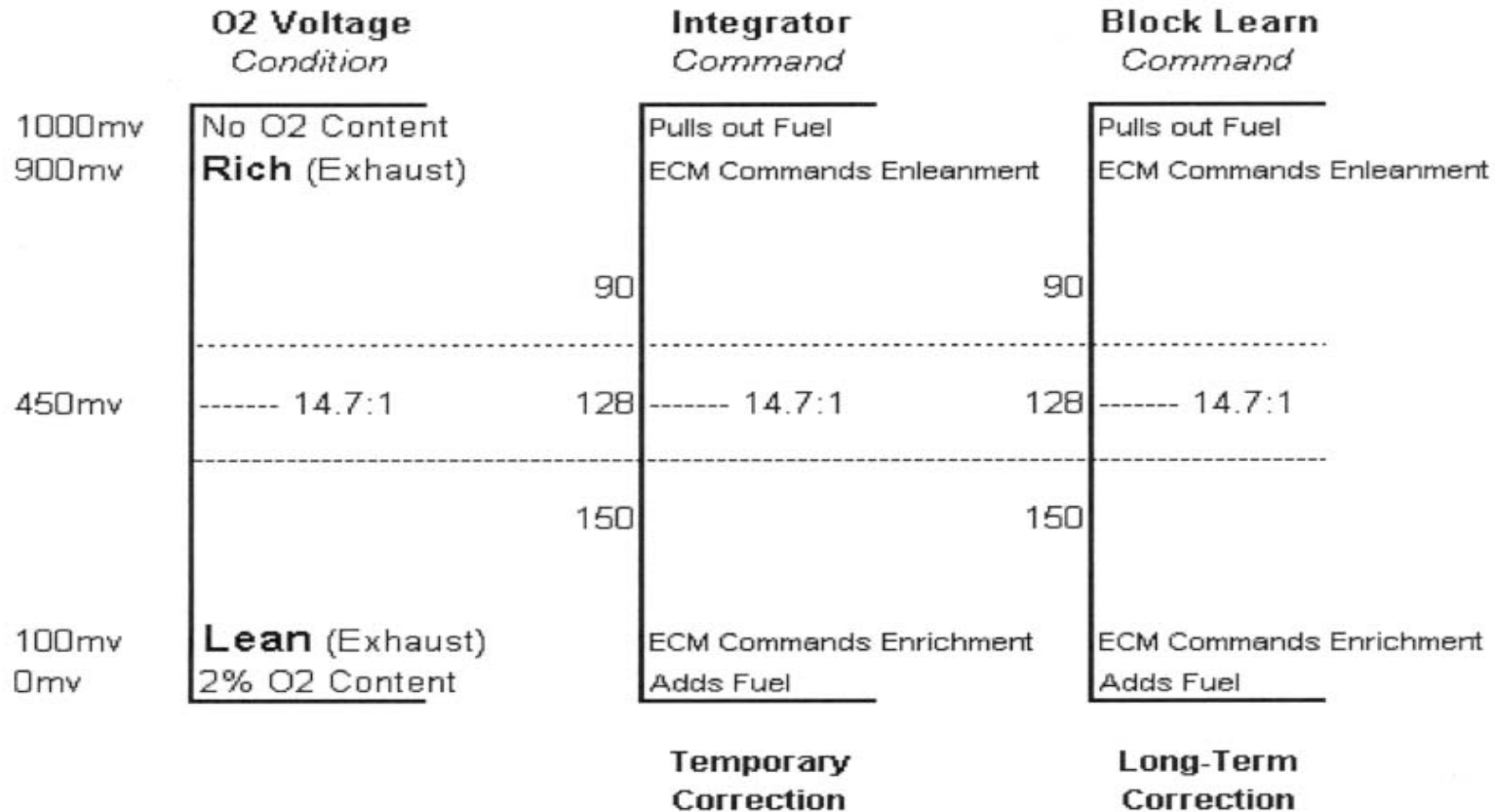
*External reference shown pin 50



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Adaptive Learn





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Adaptive (Block) Learn





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ESD (Electrostatic Discharge)



Electronic components used in control systems are often designed to carry very low voltage, and are very susceptible to damage caused by electrostatic discharge.

It possible for less than 100 volts of static electricity to cause damage to some electronic components. By comparison, it takes as much as 4,000volts for a person to even feel the zap of a static discharge.

There are several ways for a person to become statically charged. The most common methods of charging are by friction and by induction.

An example of charging by friction is a person sliding across a truck seat, in which a charge of as much as 25,000 volts can build up.

Charging by induction occurs when a person with well insulated shoes stands near a highly charged object and momentarily touches ground.

Static charges of either type can cause damage, therefore, it is important to use care when handling and testing: electronic components.



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Using a Laptop Computer to Diagnose the Spectrum System

Minimum System Requirements

Pentium II 450 Processor

Win98SE, 2000 and XP Operating Systems

64 MB Ram for Win98

128 MB Ram for Win2000

256 MB Ram for WinXP

Serial Port (RS232) or USB 1.1 or 2.0 connection

USB interface for Win2000 and XP only.

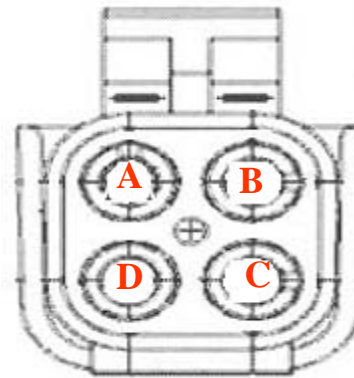




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Diagnostic Link

RS 232



**Diagnostic Link Connector
(DLC)**

Pin	Wire Color	Function
A *	Orange	RS232 RX
B	Dark Green	RS232 TX
C	Lt Green/Red	5 Volt Ref
D *	Black/Lt Green	Ana Rtn

* **Blink Code Mode**





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PC DST Screen 1

EDIS ECI Serial Communications
_ | | X

File Page Flash Comm Port Plot/Log Help

←
→

Gauges
Not Connected

response...
Link error - attempting reconnect...

Toggle Page - F9

PSI/ECM Interface
MIL

Manifold Pressure

0 psia

Coolant Temperature

0 deg F

Intake Air Temperature

0 deg F

System Variables

Engine Speed	0	rpm
Min Governor Setpoint	0	rpm
Max Governor Setpoint	0	rpm
Pulse width	0.00	ms
EGO1	0.000	volts
EGO2	0.000	volts
Hour meter	0.000	hours
Cumulative starts	0	starts

Foot Pedal Position

0 %

Throttle Position

0 %

Battery Voltage

0.0 volts

System State

Run Mode	Stopped
Power Mode	Sleep
Fuel Type	Gasoline
Fuel Control Mode	Open Loop
Governor switch state	None
Active governor type	None
Active governor mode	Disabled
Oil pressure state	OK

Serial number: 0

Hardware model: 0000000

Manufacture date: 0-0-0

Software model: 0000000

Init cal model: 0000000

Init cal date: 0-0-0

Current cal model: 0000000

Current cal date: 0-0-0

Make ScreenShot Prtscr

Edit

Setup

Information/Order

End

Start
Citrix Program Nei...
Standard Desktop ...
DTC632
PSI Display
Local Disk (C:)
11:59 AM



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PC DST Screen 2

EDIS ECI Serial Communications

File Page Flash Comm Port Plot/Log Help

RawVolts
Not Connected

EEControls, Inc.
Control and Instrumentation Specialists

response...
Link error - attempting reconnect...

Toggle Page - F9

Raw Volts Display MIL

Engine Speed	<input type="text" value="0"/>	rpm	TPS1_raw	<input type="text" value="0.000"/>	volts	Fuel select voltage	<input type="text" value="0.0"/>	volts
Manifold Pressure	<input type="text" value="0.00"/>	psia	TPS2_raw	<input type="text" value="0.000"/>	volts	Gov1 select voltage	<input type="text" value="0.0"/>	volts
Coolant Temperature	<input type="text" value="0.0"/>	deg F	MAP_raw	<input type="text" value="0.000"/>	volts	Gov2 select voltage	<input type="text" value="0.0"/>	volts
Cylinder Head Temp	<input type="text" value="0.0"/>	deg F	FPP1_raw	<input type="text" value="0.000"/>	volts	Oil pressure voltage	<input type="text" value="0.0"/>	volts
Manifold Temperature	<input type="text" value="0.0"/>	deg F	IVS/FPP2_raw	<input type="text" value="0.000"/>	volts			
Intake Air Temperature	<input type="text" value="0.0"/>	deg F	KNK_raw	<input type="text" value="0.000"/>	volts			
			EG01_raw	<input type="text" value="0.000"/>	volts			
Vbat	<input type="text" value="0.0"/>	volts	ECT_raw	<input type="text" value="0.000"/>	volts			
Vsw	<input type="text" value="0.0"/>	volts	IAT_raw	<input type="text" value="0.000"/>	volts			
			AUX_PD1_raw	<input type="text" value="0.000"/>	volts			
			AUX_PD2_raw	<input type="text" value="0.000"/>	volts			
			AUX_PD3_raw	<input type="text" value="0.000"/>	volts			
			AUX_PU1_raw	<input type="text" value="0.000"/>	volts			
			AUX_PU2_raw	<input type="text" value="0.000"/>	volts			
			AUX_PU3_raw	<input type="text" value="0.000"/>	volts			

Start | Citrix Program... | Standard Des... | DTC632 | PSI Display | Local Disk (C:) | 12:00 PM



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PC DST Screen 3

EDIS ECI Serial Communications

File Page Flash Comm Port Plot/Log Help

Faults
Not Connected

EControls, Inc.
Control and Instrumentation Specialists

response...
Link error - attempting reconnect...

Toggle Page - F9

Fault Access MIL

Parameter	Value	Unit
Engine Speed	0	rpm
Manifold Pressure	0.00	psia
Coolant Temperature	0.0	deg F
Cylinder Head Temp	0.0	deg F
Manifold Temperature	0.0	deg F
Intake Air Temperature	0.0	deg F
Vbat	0.0	volts
Vsw	0.0	volts
Hour meter	0.000	hours
Cumulative starts	0	starts

System States

Run Mode	Stopped
Fuel Type	Gasoline
Fuel Control Mode	Open Loop
Governor switch state	None
Active governor type	None
Active governor mode	Disabled
Oil pressure state	OK

DBW Variables

TPS command	0.0	%
TPS position	0.0	%
FPP command	0.0	%
FPP position	0.0	%
TPS1 voltage	0.000	volts
TPS2 voltage	0.000	volts
FPP1 voltage	0.000	volts
FPP2 voltage	0.000	volts
IVS voltage	0.000	volts

Closed-Loop Control

EGO1	0.000	volts
Closed-loop 1	0.0	%
Adaptive 1	0.0	%
EGO2	0.000	volts
Closed-loop 2	0.0	%
Adaptive 2	0.0	%

Carburetor Adjustment Controls

Force CL inactive: Normal

PWM trim mode: Auto

PWM trim duty-cycle: 0.0 %

Rich / Lean slider

Digital Input Voltages

Fuel select voltage	0.0	volts
Gov1 select voltage	0.0	volts
Gov2 select voltage	0.0	volts
Oil pressure voltage	0.0	volts

Diagnostic Modes

Spark kill	Normal
Injector kill	Normal
DBW test mode	Off
External power	Automatic

Flight Data Base Definitions	SnapShot Base Definitions	SnapShot Custom Definitions
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

Historic Faults

Active Faults

Flight Data

Windows: Start, Citrix Program..., Standard Des..., DTC632, PSI Display, Local Disk (C:)

12:01 PM

EDIS ECI Serial Communications

File Page Flash Comm Port Plot/Log Help

Service
Not Connected

EControls, Inc.
Control and Instrumentation Specialists

response...
Link error - attempting reconnect...


Toggle Page - F9

Service Screen


Clear Faults

MIL


Engine Speed

 RPM

Coolant Temperature

 deg F

Closed-Loop Switch

Normal  Adjustment

Fuel Control Mode

Open Loop

Clear Adaptive


Adaptive Learn State

Non-Zero

Rich

Lean

Mixture



The Mixture graph shows a vertical axis with 'Rich' at the top and 'Lean' at the bottom. A white curve starts near the top, dips slightly, then rises sharply to a peak in the rich region before falling back towards the lean region. The area under the curve is shaded grey.

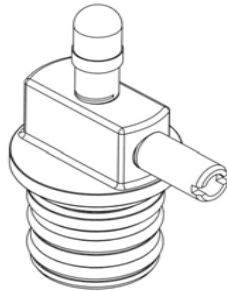


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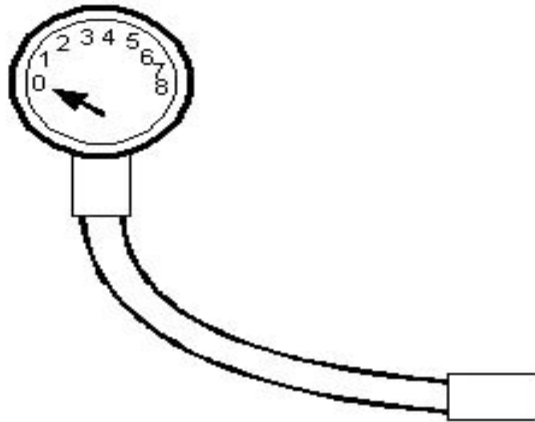
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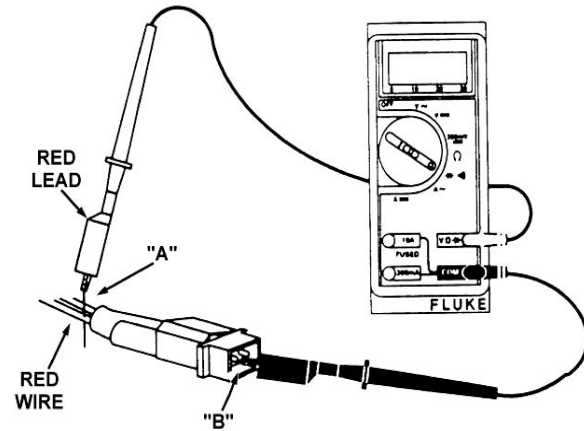
ITK-2 Pressure Test Kit



AF4-31105



Fuel Injection Pressure Gauge



**High Impedance DVOM
with Duty Cycle %**



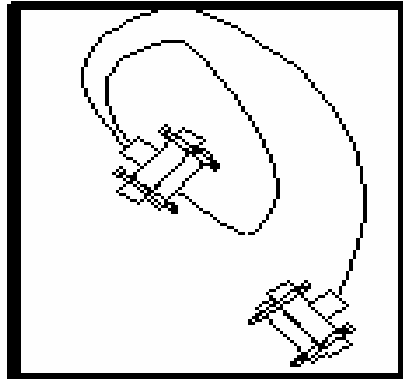
12 Volt Test Lamp



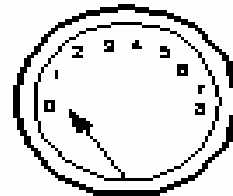
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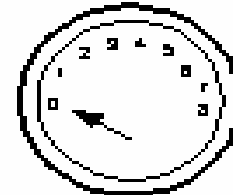
SPECTRUM SPECIAL TOOL KIT



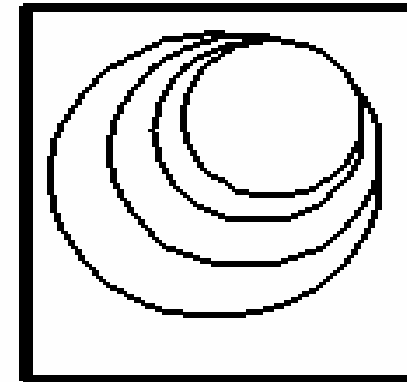
PDA TO Harman Cable



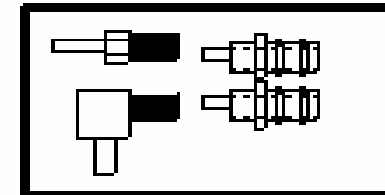
UPFLOW GAUGE



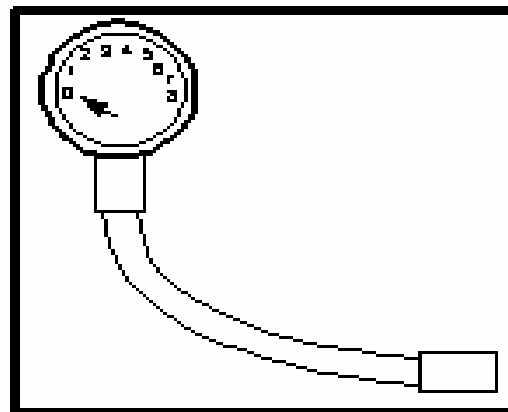
UPFLOWS GAUGE



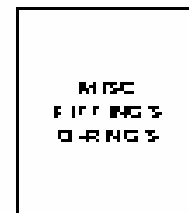
VACUUM HOSE



TEST ENGINE FITTINGS



GASOLINE PRESSURE TEST GAUGE



MISC
FITTINGS
&
O-RINGS

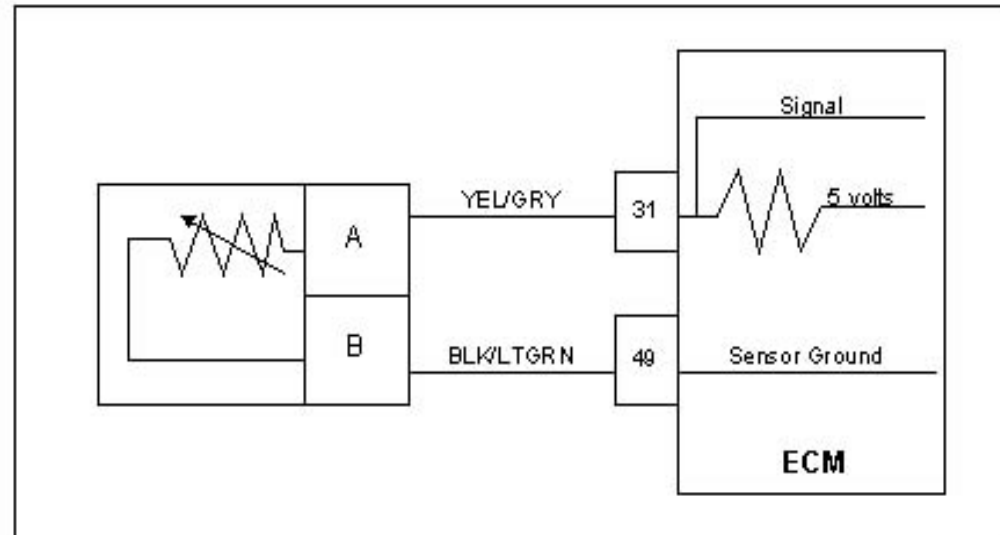


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DTC 122-ECT Low Voltage

Using the DTC Schematic:

Pin numbers, connector letters
and wire colors



Provides additional test criteria for the DTC

What function the DTC is designed to indicate
When the ECM runs the diagnostic sensor test
MIL reaction to the DTC

How the ECM will react during the fault

Provides some general circuit operation

Conditions for Setting the DTC

- Engine Coolant Temperature
- Check Condition-Engine Running
- Fault Condition- ECT sensor voltage less than 0.05
- MIL-On during active fault and for 2 seconds after active fault
- Adaptive-Disabled during active fault
- Closed Loop-Enabled

Circuit Description

The ECT (Engine Coolant Temperature) sensor is a temperature sensitive resistor located in the engine coolant. It is used for the engine airflow calculation, gasoline cold enrichment and to enable other temperature dependant features. The ECM provides a voltage divider circuit so that when the coolant is cool, the signal reads higher voltage, and lower when warm. This fault will set if the signal voltage is less than 0.05 volts anytime the engine is running. The ECM will use a default value for the ECT sensor in the event of this fault.



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Using the DTC chart:

The chart starts with the MIL check to validate the MIL function.

The chart ends with the instruction to remove any test equipment (except the DST) Diagnostic Scan Tool. Additional specific instructions are provided depending on the DTC to verify a successful repair.

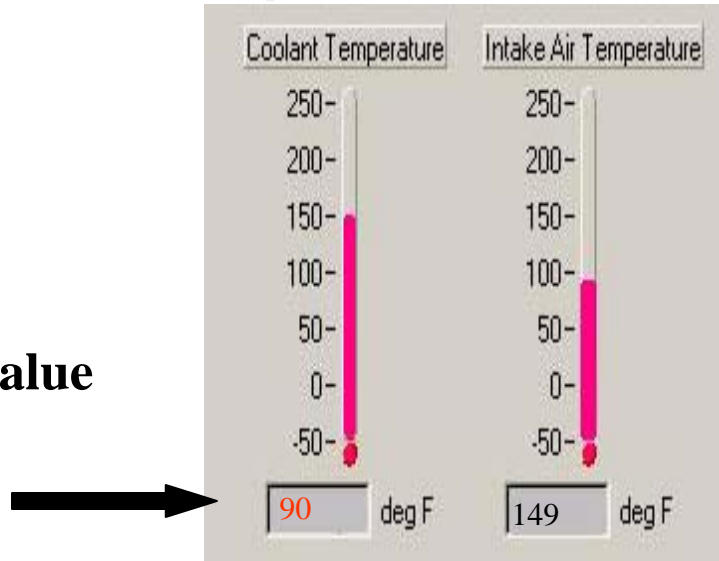
DTC 122- ECT VOLTAGE LOW

Step	Action	Value(s)	Yes	No
1	Did you perform the On-Board (OBD) System Check?	-	Go to Step (2)	Go to OBD System Check Section
2	<ul style="list-style-type: none"> ▪ Key On ▪ DST (Diagnostic Scan Tool) connected in ▪ System Data Mode Does DST display ECT voltage of 0.05 or less?		Go to step (3)	Intermittent problem Go to Intermittent section
3	<ul style="list-style-type: none"> ▪ Key Off ▪ Disconnect the ECT wire harness connector ▪ Key On Does the DST display ECT voltage of 4.9 volts or greater?		Go to step (4)	Go to step (5)
4	Replace ECT sensor. Is the replacement complete?		Go to Step (5)	-
5	<ul style="list-style-type: none"> ▪ Key OFF ▪ Disconnect ECM wire harness connector ▪ Check for continuity between ECT sensor connector signal pin A and ECT sensor ground pin B Do you have continuity between them?	-	Repair the circuit as necessary. Refer to Wiring Repairs in Engine Electrical.	Go to step (6)
6	<ul style="list-style-type: none"> ▪ Check for continuity between ECT sensor connector signal circuit pin A and engine ground. Do you have continuity?	-	Repair the circuit as necessary. Refer to Wiring Repairs in Engine Electrical.	Go to step (7)
7	Replace ECM. Refer to ECM replacement in the Engine Control Section. Is the replacement complete?	-	Go to step (8)	-
8	<ul style="list-style-type: none"> ▪ Remove all test equipment except the DST. ▪ Connect any disconnected components, fuses, etc. ▪ Using the DST clear DTC information from the ECM. ▪ Turn the ignition OFF and wait 30 seconds. ▪ Start the engine and operate the vehicle to full operating temperature ▪ Observe the MIL ▪ Observe engine performance and drivability ▪ After operating the engine within the parameters of DTC-122 check for any stored codes. Does the engine operate normally with no stored codes?		System OK	Go to OBD System Check



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Default Value



Actual



TPS1_raw	0.000	volts
TPS2_raw	0.000	volts
MAP_raw	0.000	volts
FPP1_raw	0.000	volts
IVS/FPP2_raw	0.000	volts
KNK_raw	0.000	volts
EG01_raw	0.000	volts
ECT_raw	4.95	volts
IAT_raw	0.000	volts
AUX_PD1_raw	0.000	volts
AUX_PD2_raw	0.000	volts
AUX_PD3_raw	0.000	volts
AUX_PU1_raw	0.000	volts
AUX_PU2_raw	0.000	volts
AUX_PU3_raw	0.000	volts

The ECM provides default values for critical sensor inputs to protect the engine system from possible damage.

If a DTC for a sensor is current, the gauge screen display value for that sensor may be a default value. The voltage value in the “raw” voltage screen will be the actual sensor voltage.

Always use the voltage value when performing diagnostics unless directed otherwise by the diagnostic chart.



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ECM Protection Systems

Certain DTC codes that set will result in system power reduction, or complete engine shutdown.

The ECM is programmed to do this in the event a failure is determined to cause possible risk to the operator, damage to the engine or catalytic converter.

Some code groups will provide a warning to a possible shutdown

Example:

DTC 113-IAT Higher than expected 1

DTC 114-IAT Higher than expected 2



IMPCO 2004 Emissions Certified Engine Training Program

DTC 113-IAT Higher Than Expected 1 (Bosch® TMAP)

Conditions for Setting the DTC

- 1 Intake Air Temperature
- 1 Check Condition-Engine Running
- 1 Fault Condition-Intake Air Temperature greater than 200 degrees F. and engine RPM greater than 1000
- 1 MIL-On
- 1 Adaptive-Disabled during active fault
- 1 Power Derate (Level 1)

Circuit Description

The TMAP is a combined IAT (Intake Air Temperature) and MAP (Manifold Absolute Pressure) sensor. A temperature sensitive resistor is used in the TMAP located in the intake manifold of the engine. It is used to monitor incoming air temperature, and the output in conjunction with other sensors is used to determine the airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower when warm. The IAT is a calculated value based mainly on the IAT sensor at high airflow, and influenced more by the ECT (Engine Coolant Temperature) at low airflow. This fault will set if the Intake Air Temperature is greater than 200 degrees F. with engine RPM greater than 1000. Power Derate 1 will be enforced during this fault. Maximum throttle position is limited to 50% and the MIL lamp will be on.

Diagnostic Aids

* This fault will set when inlet air is much hotter than normal. The most common cause of high inlet air temperature is a problem with the inlet air system. Ensure that the air inlet is not obstructed, modified or damaged.

* Inspect the air inlet system for cracks or breaks that may allow unwanted under hood air in to the air inlet system



SPECTRUM

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DTC 114-IAT Higher Than Expected 2 (Bosch® TMAP)

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Conditions for Setting the DTC

- Intake Air Temperature
- Check Condition-Engine Running
- Fault Condition-Intake Air Temperature greater than 210 degrees F engine RPM greater than 1000
- MIL-On for active fault and for 15 seconds after active fault
- Adaptive-Disabled during active fault
- Engine Shut Down

Circuit Description

The TMAP is a combined IAT (Intake Air Temperature) and MAP (Manifold Absolute Pressure) sensor. A temperature sensitive resistor is used in the TMAP located in the intake manifold of the engine. It is used to monitor incoming air temperature, and the output in conjunction with other sensors is used to determine the airflow to the engine. The ECM provides a voltage divider circuit so that when the air is cool, the signal reads higher voltage, and lower when warm.

The IAT is a calculated value based mainly on the IAT sensor at high airflow, and influenced more by the ECT (Engine Coolant Temperature) at low airflow. This fault will set if the Intake Air Temperature is greater than 210 degrees F and engine RPM is greater than 1000. The MIL lamp will be on during this active fault and the engine will shut down



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Intermittent problems

Intermittent problems may be the most difficult to resolve.

Before starting the diagnostic procedures for intermittent DTC follow these preliminary checks:

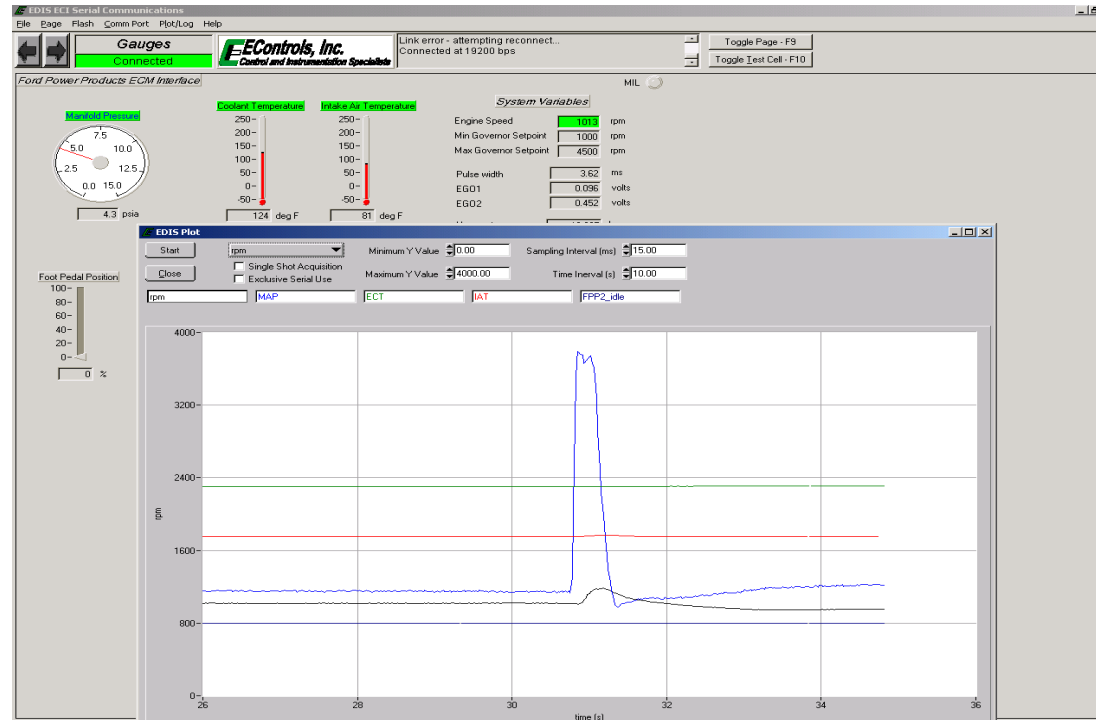
- ECM ground connections must be clean, tight, and in their proper location.
- Vacuum hoses for splits, kinks and proper connections
- Air leaks at the throttle body, throttle control unit and intake manifold sealing surfaces
- Ignition wires for cracking, hardness, proper routing and carbon tracking
- Wiring for proper connections, pinches, cuts.
- Sensor connectors for damage, corrosion and contamination



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Intermittent Problems



Graphing the Voltage Values

The system diagnostic monitoring software includes graphing and data logging capability. These features greatly enhance the ability to diagnose and repair intermittent problems with the system. The graphing feature allows sensor inputs and select control output variables to be plotted in real-time while the engine is running.



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The screenshot displays the EDIS ECI Serial Communications software interface. The title bar reads "EDIS ECI Serial Communications" and the menu bar includes "File", "Page", "Flash", "Comm Port", "Plot/Log", and "Help". The main window is divided into several sections:

- Faults:** Shows "Connected" status and "EControls, Inc. Control and Instrumentation Specialists" logo.
- System States:** Displays engine parameters such as Engine Speed (1401 rpm), Manifold Pressure (4.95 psia), and various temperatures.
- DBW Variables:** Shows TPS command (0.0%), TPS position (0.1%), FPP command (0.0%), and other sensor readings.
- Digital Input Voltages:** Lists voltages for Fuel select (10.4V), Fuel pump (13.8V), Gov1 (20.6V), Gov2 (20.6V), Overspeed (5.0V), and Oil pressure (5.0V).
- Diagnostic Modes:** Includes Spark kill (Normal), Injector kill (Normal), and DBW test mode (Off).
- Historic Faults:** Lists MAP voltage low, IAT voltage high, and ECT voltage high.
- Active Faults:** Lists ECT voltage high.
- Flight Data Base Definitions:** A list of parameters including rpm, iMAP, FPP_pct, TPS_pct, CL_BM1, CL_BM2, Vbat, Pw_avg, A_BM1, A_BM2, fuel_state, run_tm_sec, rpm, iMAP, iECT, iIAT, CL_BM1, CL_BM2, Vbat, FPP_pct, TPS_pct, EGO1_volts, EGO2_volts, Pw_avg, TRIM_DC, and HM_hours.

The System Fault screen is used to view and clear DTC's



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The screenshot displays the EDIS ECT Serial Communications software interface. The top menu bar includes File, Page, Flash, Comm Port, Plot/Log, and Help. The main window is titled "Faults" and shows a "Connected" status. The interface is divided into several sections:

- Fault Access:** Shows MIL (Malfunction Indicator Lamp) status.
- System States:** Displays engine parameters such as Engine Speed (1401 rpm), Manifold Pressure (4.95 psia), Coolant Temperature (195.0 deg F), and Run Mode (Running).
- DBW Variables:** Shows fuel and throttle related variables like TPS command (0.0 %), FPP position (0.0 %), and TPS1 voltage (0.484 volts).
- Closed-Loop Control:** Displays EGO1, EGO2, and adaptive control values.
- Digital Input Voltages:** Shows fuel select, fuel pump, and governor voltages.
- Diagnostic Modes:** Includes Spark kill, Injector kill, and DBW test mode settings.
- Historic Faults:** Lists stored faults such as MAP voltage low, IAT voltage high, and ECT voltage high.
- Active Faults:** Lists currently active faults, such as ECT voltage high.
- Flight Data Base Definitions:** A list of parameters and their current values, including rpm, MAP, FPP_pct, TPS_pct, CL_BM1, CL_BM2, Vbat, PW_avg, A_BM1, A_BM2, FPP_pct, TPS_pct, EGO1_volts, EGO2_volts, PW_avg, TRIM_DC, and HM_hours.

Checking Diagnostic Trouble Codes

The System Fault screen contains a listing of all of the **historic** and **Active** DTC set within the system. If a DTC is stored in memory, the screen will display that fault in the history column. If the fault is active it will also show up in that column.



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The screenshot displays the EDIS ECI Serial Communications software interface. The top menu bar includes File, Page, Flash, Comm Port, Plot/Log, and Help. The main window is divided into several sections:

- Faults:** Shows 'Connected' status and a 'Link error - attempting reconnect... Connected at 19200 bps' message.
- System States:** Displays engine parameters such as Engine Speed (1401 rpm), Manifold Pressure (4.95 psia), Coolant Temperature (195.0 deg F), and various sensor readings.
- DBW Variables:** Shows TPS command (0.0 %), FPP command (0.0 %), and various voltage readings (TPS1, TPS2, FFP1, FFP2, IVS).
- Closed-Loop Control:** Displays EGO1, EGO2, and Adaptive control values.
- Digital Input Voltages:** Shows Fuel select, Fuel pump, Gov1, Gov2, Overspeed, and Oil pressure voltages.
- Diagnostic Modes:** Includes Spark kill (Normal) and DBW/test mode (Off).
- Historic and Active Faults:** Lists faults such as MAP voltage low, IAT voltage high, and ECT voltage high.
- Flight Data and Snapshots:** Provides a list of parameters for data collection and snapshot definitions.

Clearing Diagnostic Trouble Codes

To clear a DTC from memory use the arrow keys or mouse to move then Press the Enter key to clear the fault from memory. **NOTE:** Record faults before erasing them for reference during diagnostics.



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EDIS ECI Serial Communications

File Page Flash Comm Port Plot/Log Help

Faults **EControls, Inc.** **Control and Instrumentation Specialists** Link error - attempting reconnect... Connected at 19200 bps

Toggle Page - F9
Toggle Test Cell - F10

Fault Access		System States		DBW Variables		Coil Number (firing order)	Spark Coil dwell ms	Injector Number (firing order)	Injector-on low-side voltage	Injector-off low-side voltage
Engine Speed	1027 rpm	Run Mode	Running	TPS command	3.8 %	1	4.26	1	0.1	14.4
Manifold Pressure	4.35 psia	Fuel Type	Gasoline	TPS position	3.7 %	2	4.26	2	0.1	14.2
Coolant Temperature	97.6 deg F	Fuel Control Mode	CL Active	FPP command	0.0 %	3	0.00	3	0.2	14.1
Cylinder Head Temp	97.6 deg F	Governor switch state	Gov3	FPP position	0.0 %			4	0.4	14.1
Manifold Temperature	78.9 deg F	Active governor type	Min	TPS1 voltage	0.696 volts			5	0.0	0.0
Intake Air Temperature	78.7 deg F	Active governor mode	Droop	TPS2 voltage	4.267 volts			6	0.0	0.0
Vbat	13.8 volts	Brake input level	Open	FPP1 voltage	0.434 volts					
Vsw	13.7 volts	Oil pressure state	OK	FPP2 voltage	0.000 volts					
Hour meter	12.628 hours			IVS voltage	5.000 volts					
Cumulative starts	39 starts									

Closed-Loop Control		Digital Input Voltages		Diagnostic Modes	
EGD1	0.882 volts	Fuel select voltage	10.4 volts	Normal	
Closed-loop 1	0.0 %	Fuel pump voltage	13.6 volts	Coil 1 (FO)	
Adaptive 1	0.0 %	Gov1 voltage	20.6 volts	Coil 2 (FO)	
EGD2	0.452 volts	Gov2 voltage	20.6 volts	Coil 3 (FO)	
Closed-loop 2	0.0 %	Overspeed voltage	5.0 volts	Coil 4 (FO)	
Adaptive 2	0.0 %	Oil pressure voltage	5.0 volts	Coil 5 (FO)	
				Coil 6 (FO)	

Flight Data Custom Definitions	SnapShot Base Definitions	SnapShot Custom Definitions
EMPTY	fueL_state	EMPTY
EMPTY	run_tmr_sec	EMPTY
EMPTY	rpm	EMPTY
EMPTY	rMAP	EMPTY
EMPTY	rECT	EMPTY
EMPTY	rIAT	EMPTY
EMPTY	CL_BM1	EMPTY
EMPTY	CL_BM2	EMPTY
EMPTY	Vbat	EMPTY
EMPTY	FPP_pct	EMPTY
EMPTY	TPS_pct	EMPTY
EMPTY	EGD1_volts	EMPTY
EMPTY	EGD2_volts	EMPTY
EMPTY	PW_avg	EMPTY
EMPTY	TRIM_DC	EMPTY
EMPTY	HM_hours	EMPTY

Historic Faults	Active Faults

Ignition System Test



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Spark Kill

The screenshot shows the EDIS ECT Serial Communications software interface. The top menu bar includes File, Page, Flash, Comm Port, Plot/Log, and Help. The main window is divided into several sections:

- Faults:** Shows MIL status as Connected.
- System Status:** Displays engine speed (1027 rpm), manifold pressure (4.35 psia), coolant temperature (97.6 deg F), cylinder head temperature (97.6 deg F), manifold temperature (78.9 deg F), intake air temperature (78.7 deg F), vbat (13.8 volts), vsw (13.7 volts), hour meter (12.628 hours), and cumulative starts (39).
- Digital Input Voltages:** Shows fuel select voltage (10.4 volts), fuel pump voltage (13.6 volts), Gov1 voltage (20.6 volts), Gov2 voltage (20.6 volts), overspeed voltage (5.0 volts), and oil pressure voltage (5.0 volts).
- DBW Variables:** Shows TPS command (3.8 %), TPS position (3.7 %), FPP command (0.0 %), FPP position (0.0 %), TPS1 voltage (0.696 volts), TPS2 voltage (4.267 volts), FPP1 voltage (0.434 volts), FPP2 voltage (0.000 volts), and IVS voltage (5.000 volts).
- Diagnostic Modes:** A dropdown menu is open, showing options: Normal (selected), Coil 1 (FD), Coil 2 (FD), Coil 3 (FD), Coil 4 (FD), Coil 5 (FD), and Coil 6 (FD).
- Injector Data:** A table showing injector numbers, spark coil dwell times, and injector-on/off low-side voltages.
- Historic and Active Faults:** Two empty boxes for fault history.
- Snapshot Base Definitions:** A list of parameters including fuel_state, run_tmi_sec, rpm, TFS_pct, IMAP, CL_BM1, IECT, CL_BM2, IAT, Vbat, CL_BM1, CL_BM2, A_BM1, A_BM2, Vbat, FPP_pct, TPS_pct, EGO1_volts, EGO2_volts, PW_avg, TRIM_DC, and RM_hours.

The Spark Kill diagnostic mode allows the technician to disable the ignition on individual cylinders. If the Spark Kill diagnostic mode is selected with the engine running below 1000 RPM, the **minimum throttle command will lock into the position it was in when the test mode was entered** (similar to IAC disabled in automotive systems). If the Spark System Test mode is selected with the engine running above 1000 RPM, the throttle will continue to operate normally.



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Spark Kill Continued

The screenshot shows the E-Controls, Inc. diagnostic software interface. The top bar indicates 'EDIS ECT Serial Communications' and 'Connected'. The main display area is divided into several sections:

- Faults:** Shows 'Connected' status.
- System Status:** Displays engine speed (1027 rpm), manifold pressure (4.35 psia), coolant temperature (97.6 deg F), and other engine parameters.
- DBW Variables:** Shows TPS command (3.8 %), FPP position (0.0 %), and various voltage readings.
- Digital Input Voltages:** Shows fuel select voltage (10.4 volts), fuel pump voltage (13.6 volts), and other input voltages.
- Diagnostic Modes:** A dropdown menu is open, showing 'Spark Kill' selected, with options for 'Normal', 'Coil 1 (FO)', 'Coil 2 (FO)', 'Coil 3 (FO)', 'Coil 4 (FO)', 'Coil 5 (FO)', and 'Coil 6 (FO)'. The 'Spark Kill' button is highlighted.
- Historic Faults and Active Faults:** Two empty boxes for fault history.
- Snapshot Definitions:** A table for defining snapshot data points.

Injector Number	low-side voltage	Injector-off low-side voltage
1	0.1	14.4
2	0.1	14.2
3	0.2	14.1
4	0.4	14.1
5	0.0	0.0
6	0.0	0.0

Disabling Ignition Outputs

To disable the ignition system for an individual cylinder, use the mouse to highlight the “Spark Kill” button and select the desired coil. The spark output can be re-enabled by using the mouse to highlight the “Spark Kill” button and selecting “Normal”. If the engine is running below 1000 RPM, the spark output will stay disabled for **15 seconds and then re-set**. If the engine is running above 1000 RPM, the spark output will stay disabled for **5 seconds and then re-set**. This test mode has a timeout of 10 minutes.

Record the rpm drop related to each spark output disabled.

The Spark outputs are arranged in the order which the engine fires, not by cylinder number.



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Injector Kill

The screenshot shows the EDIS ECT Serial Communications software interface. The top menu bar includes File, Page, Flash, Comm Port, Plot/Log, and Help. The status bar indicates 'Connected' and 'Link error - attempting reconnect... Connected at 19200 bps'. The main display area is divided into several sections:

- Fault Access:** MIL (Malfunction Indicator Lamp) status.
- System States:** Run Mode (Running), Fuel Type (Gasoline), Fuel Control Mode (CL Active), Governor switch state (Gov3), Active governor type (Min), Active governor mode (Droop), Brake input level (Open), Oil pressure state (OK).
- DBW Variables:** TPS command (3.3%), TPS position (3.5%), FPP command (0.0%), FPP position (0.0%), TPS1 voltage (0.685 volts), TPS2 voltage (4.275 volts), FPP1 voltage (0.448 volts), FPP2 voltage (0.000 volts), IVS voltage (5.000 volts).
- Closed-Loop Control:** EGO1 (0.503 volts), Closed-loop 1 (4.5%), Adaptive 1 (0.0%), EGO2 (0.452 volts), Closed-loop 2 (0.0%), Adaptive 2 (0.0%).
- Digital Input Voltages:** Fuel select voltage (10.2 volts), Fuel pump voltage (13.7 volts), Gov1 voltage (20.6 volts), Gov2 voltage (20.6 volts), Overspeed voltage (5.0 volts), Oil pressure voltage (5.0 volts).
- Diagnostic Modes:** Spark kill (Normal), Injector kill (selected), DBW test mode (Normal).
- Historic Faults:** Empty list.
- Active Faults:** Empty list.
- Flight Data Custom Definitions:** A list of parameters including FPP_pct, TPS_pct, CL_BM1, CL_BM2, Vbat, FW_avg, A_BM1, A_BM2, Vbat, FPP_pct, TPS_pct, EGO1_volts, EGO2_volts, FW_avg, TRIM_DC, and RM_hours.

The Injector Kill mode is used to disable individual fuel injectors. If the Injector Kill mode is selected with the engine running below 1000 RPM, the **minimum throttle command will lock into the position it was in when the test mode was entered** (similar to IAC disable in automotive systems) If the Injector Kill mode is selected with the engine running above 1000 RPM, the throttle will continue to operate normally.



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Disabling Injectors

The screenshot shows the E-Controls, Inc. diagnostic software interface. The main window displays various engine parameters and diagnostic modes. The 'Diagnostic Modes' section is highlighted, showing a dropdown menu with 'Normal' selected. The 'Injector 3' is selected in the 'Digital Input Voltages' section. The 'DBW Variables' section shows the following data:

DBW Variable	Value	Unit
TPS command	3.3	%
TPS position	3.3	%
FFP command	0.0	%
FFP position	0.0	%
TPS1 voltage	0.685	volts
TPS2 voltage	4.275	volts
FFP1 voltage	0.448	volts
FFP2 voltage	0.000	volts
IVS voltage	5.000	volts

The 'Injector-on low-side voltage' and 'Injector-off low-side voltage' columns show values of 0.3, 0.1, 0.4, 0.2, 0.0, and 0.0 for injectors 1 through 6 respectively.

To disable an injector, use the mouse to select the desired. The word “Normal” will change to the Injector you have selected. The injector driver can be re-enabled by selecting again. If the engine is running below 1000 RPM, the injector driver will stay **disabled for 15 seconds** and then re-set. If the engine is running above 1000 RPM, the injector driver will stay **disabled for 5 seconds** and then re-set. Record the drop in rpm.



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Throttle Test

EDIS ECI Serial Communications

File Page Flash Comm Port Plot/Log Help

Faults Link error - attempting reconnect...
Connected at 19200 bps Toggle Page - F9
Connected Toggle Test Cell - F10

Fault Access MIL

Engine Speed	0	rpm	Run Mode	Stopped	TPS command	0.0	%	Coil Number (firing order)	Spark Coil dwell ms	Injector Number (firing order)	Injector-on low-side voltage	Injector-off low-side voltage
Manifold Pressure	14.38	psia	Fuel Type	Gasoline	TPS position	0.1	%	1	4.25	1	0.2	13.4
Coolant Temperature	113.3	deg F	Fuel Control Mode	Open Loop	FPP command	0.0	%	2	4.25	2	0.1	13.4
Cylinder Head Temp	113.3	deg F	Governor switch state	Gov3	FPP position	0.0	%	3	0.00	3	0.2	13.4
Manifold Temperature	113.3	deg F	Active governor type	Min	TPS1 voltage	0.489	volts	4	0.1	4	0.1	13.4
Intake Air Temperature	81.6	deg F	Active governor mode	Droop	TPS2 voltage	4.472	volts	5	0.0	5	0.0	0.0
Vbat	12.8	volts	Brake input level	Open	FPP1 voltage	0.451	volts	6	0.0	6	0.0	0.0
Vsw	12.5	volts	Oil pressure state	Low - Ignored	FPP2 voltage	0.000	volts					
Hour meter	12.658	hours			IVS voltage	5.000	volts					
Cumulative starts	39	starts										

System States

DBW Variables

Closed-Loop Control

EGO1	0.000	volts	Fuel select voltage	10.4	volts
Closed-loop 1	0.0	%	Fuel pump voltage	0.0	volts
Adaptive 1	0.0	%	Gov1 voltage	20.6	volts
EGO2	0.452	volts	Gov2 voltage	20.6	volts
Closed-loop 2	0.0	%	Overspeed voltage	5.0	volts
Adaptive 2	0.0	%	Oil pressure voltage	0.0	volts

Digital Input Voltages

Diagnostic Modes

Spark kill Normal

Injector kill Normal

[DBW test mode](#) Enabled

Off

Enabled

Flight Data Base Definitions	Snapshot Base Definitions	Snapshot Custom Definitions
rpm	fuel_state	EMPTY
rMAP	run_tm_sec	EMPTY
FPP_pct	rpm	EMPTY
TPS_pct	rMAP	EMPTY
CL_BM1	iECT	EMPTY
CL_BM2	iAT	EMPTY
Vbat	CL_BM1	EMPTY
PW_avg	CL_BM2	EMPTY
A_BM1	A_BM1	
A_BM2	A_BM2	
	Vbat	
	FPP_pct	
	TPS_pct	
Flight Data Custom Definitions	EGO1_volts	
EMPTY	EGO2_volts	
EMPTY	PW_avg	
	TRIM_DC	
	IHM_hours	

Historic Faults

Active Faults



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Drive By Wire Test Mode

The screenshot shows the EDIS ECU Serial Communications software interface. The main window displays various engine parameters and diagnostic modes. The 'Faults' section shows 'Connected' status. The 'System States' section includes 'Run Mode' (Stopped), 'Fuel Type' (Gasoline), and 'Fuel Control Mode' (Open Loop). The 'DBW Variables' section shows 'TPS command' (0.0 %), 'TPS position' (0.1 %), and 'FPP command' (0.0 %). The 'Digital Input Voltages' section shows 'Fuel select voltage' (10.4 volts), 'Fuel pump voltage' (0.0 volts), and 'Gov1 voltage' (20.6 volts). The 'Diagnostic Modes' section shows 'Spark kill' (Normal), 'Injector kill' (Normal), and 'DBW test mode' (Enabled). The 'Historic Faults' and 'Active Faults' sections are empty. The 'Flight Data' section shows 'Custom' definitions for 'EGD1_volts', 'EGD2_volts', 'PW_avg', 'TRIM_DC', and 'HM_hours'.

To select this test mode the engine must be off but the key must be in the **ON** position.

The DBW (Drive By Wire) test mode allows the technician to control the throttle directly with the foot pedal or throttle input and is used during some diagnostic routines specified to the FPP and TPS sensors. Drive by cable (DBC) systems may also call for the use of this function for diagnostics.

FPP position displays the current position of the foot pedal as a percentage. FPP volts display the voltage which the ECM is reading from the FPP sensor.

TPS Command displays the commanded throttle position expressed as a percentage, which is being sent to the throttle. TPS Position is the actual percent of throttle opening



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Total Fuel Correction Sum

The screenshot shows the EDIS ECI Serial Communications software interface. The 'Closed-Loop Control' section is highlighted with a black arrow pointing to the 'Adaptive 1' value of -5. The 'Carburetor Adjustment Controls' section shows the 'Primary trim valve (FTV)' and 'Secondary trim valve (PTV)' both set to 0.0%.

Parameter	Value	Unit
Engine Speed	0	rpm
Manifold Pressure	14.70	psia
Coolant Temperature	200.0	deg F
Cylinder Head Temp	200.0	deg F
Manifold Temperature	200.0	deg F
Intake Air Temperature	78.2	deg F
Vbat	12.6	volts
Vsw	12.6	volts
Hour meter	0.083	hours
Cumulative starts	6	starts

Parameter	Value	Unit
Run Mode	Stopped	
Fuel Type	Propane	
Fuel Control Mode	Open Loop	
Governor switch state	None	
Active governor type	Min	
Active governor mode	Disabled	
Oil pressure state	Low - Ignored	

Parameter	Value	Unit
TPS command	30.0	%
TPS position	23.7	%
FPP command	0.0	%
FPP position	0.0	%
TPS1 voltage	3.490	volts
TPS2 voltage	0.005	volts
FPP1 voltage	0.010	volts
FPP2 voltage	4.095	volts
IVS voltage	4.125	volts

Parameter	Value	Unit
EGO1	0.452	volts
Closed-loop 1	5	%
Adaptive 1	-5	%
EGO2	0.000	volts
Closed-loop 2	0.0	%
Adaptive 2	0.0	%

Parameter	Value	Unit
DTC 612	FPP1 voltage low	
DTC 121	ECT voltage high	

Flight Data Base Definitions	Snapshot Base Definitions	Snapshot Custom Definitions
rpm	fuel_state	EMPTY
rMAP	run_tmr_sec	EMPTY
FPP_pct	rpm	EMPTY
TPS_pct	rMAP	EMPTY
CL_BM1	ECT	EMPTY
CL_BM2	iIAT	EMPTY
Vbat	CL_BM1	EMPTY
Pw_avg	CL_BM2	EMPTY
A_BM1	A_BM1	
A_BM2	A_BM2	
	Vbat	
	FPP_pct	

The total fuel correction is calculated by adding the Closed Loop 1 and Adaptive 1 values. In the example above we have a closed loop 1 value of (5) and an adaptive 1 value of (-5). In this case the total fuel correction would be zero.



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Multiple Code Set

The screenshot displays the EDIS ECI Serial Communications software interface. The top menu bar includes File, Page, Flash, Comm Port, Plot/Log, and Help. The main window is divided into several sections:

- Faults:** Shows a "Connected" status and a "Link error - attempting reconnect..." message.
- Fault Access:** Includes a MIL indicator and a list of engine parameters such as Engine Speed (600 rpm), Manifold Pressure (14.69 psia), and Coolant Temperature (200.0 deg F).
- System States:** Displays Run Mode (Running), Fuel Type (Propane), and Fuel Control Mode (Open Loop).
- DBW Variables:** Lists various sensor voltages like TPS command (65.1%), TPS1 voltage (3.495 volts), and TPS2 voltage (0.005 volts).
- Closed-Loop Control:** Shows EGO1 (0.453 volts), EGO2 (0.000 volts), and Adaptive 1/2 (0.0%) values.
- Carburetor Adjustment Controls:** Features a slider for Primary trim valve (FTV) at 49.7% and Secondary trim valve (PTV) at 35.0%.
- Digital Input Voltages:** Shows Fuel select voltage (0.0 volts), Gov1 select voltage (0.0 volts), Gov2 select voltage (0.0 volts), and Oil pressure voltage (5.0 volts).
- Diagnostic Modes:** Includes Spark kill (Normal), Injector kill (Normal), and DEW test mode (Off).
- Historic Faults:** Lists DTC 121: ECT voltage high, DTC 612: FPP1 voltage low, and DTC 143: CRANK input invalid during start.
- Active Faults:** Lists DTC 121: ECT voltage high and DTC 612: FPP1 voltage low.
- Flight Data and SnapShot:** Contains tables for Base Definitions and Custom Definitions for various engine parameters.

In the event of a multiple code set, always start the DTC diagnostic with the lowest numerical code first. The DTC strategy is set up to provide a logical diagnostic path to the most efficient repair. As shown in the example above, repairing DTC 121 may also correct DTC 612



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Diagnostic Communication Error

The ECM 5 volt reference circuit powers the Spectrum diagnostic link cable. In the event that the 5 volt reference signal is open or shorted to ground, you will not be able to connect to the system. If you are unable to connect, follow the quick checks listed below:

Be sure you are using the correct password and latest software for the system you are connecting to.

Check the ECM system power and ground circuits. Refer to DTC 261 for the power schematic. Also check for +12 switched power at ECM pin 21 with the ignition key on.

Check for power at the DLC connector for +5 volts between pins C (LT GRN/RED) and pin D (BLK) with the ignition key in the on position.

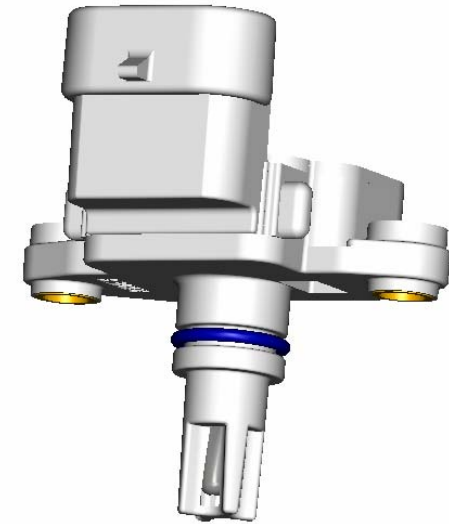
You may still be able to retrieve a code using the blink code function if none of the above recommendations prove useful. In the event of a 5 volt reference signal malfunction, DTC 531 or 532 should set. If you find one of these codes using the blink code function, follow the DTC diagnostic chart recommendations in the DTC section of this manual.



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TMAP SENSOR

The TMAP is a combined IAT (Intake Air Temperature) and MAP (Manifold Absolute Pressure) sensor. A temperature sensitive resistor is used in the TMAP located in the intake manifold of the engine. It is used to monitor incoming air temperature, and the output in conjunction with other sensors is used to determine the airflow to the engine.



Manifold Absolute Pressure (MAP) Sensor

The Manifold Absolute Pressure Sensor monitors the changes in intake manifold vacuum which result from engine load variations. These pressure changes are relayed to the electronic control unit in the form of electrical signals.

The sensor also indicates the changes in atmospheric pressure due to changes in altitude.

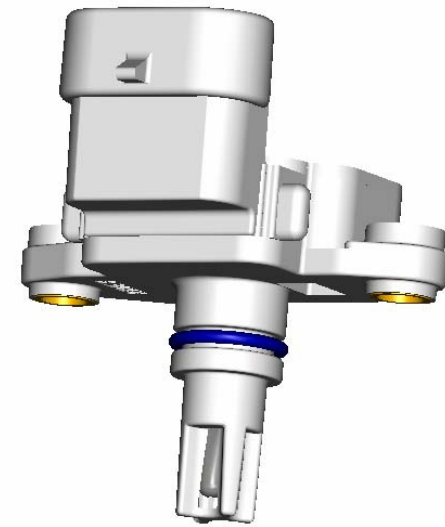
The manifold air pressure sensor is mounted to the intake manifold.



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TMAP SENSOR

Air Inlet Temperature

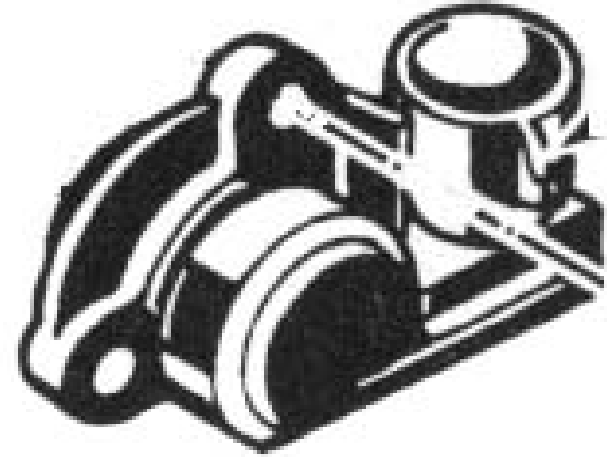


The Air Temperature Sensor is variable temperature sensitive resistor. The IAT sensor monitors the manifold air temperature which is a factor in air density measurement. The engine air/fuel ratio is maintained constant even though the engine air density varies.



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TPS (Throttle Position Sensor)



The Throttle Position Sensor is connected to the throttle shaft. Movement of the shaft causes the throttle shaft to rotate (opening or closing the throttle blades). The sensor tracks the shaft movement and position (closed throttle, wide open throttle, or any position in between), and transmits an electrical signal to the electronic control module. The electronic control module monitors the (throttle position) to aid in determining the fuel requirement for the particular situation (idle, acceleration, etc.)



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Heated Oxygen Sensor (HO2S)



The HO2S sensor is used to determine if the fuel flow to the engine is correct by measuring the oxygen content in the exhaust gas. The sensor generates voltage in the absence of oxygen, when the sensor reaches an operating temperature of above 600 degrees F.

The output voltage is zero to approximately one volt. The ECM uses this voltage information to correct the air fuel fuel mixture.

The Spectrum system uses a 4 wire sensor that includes a built in 12 volt heating element. This allows the sensor to operate independently of the exhaust gas temperature.



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ECT (Engine Coolant Temperature)

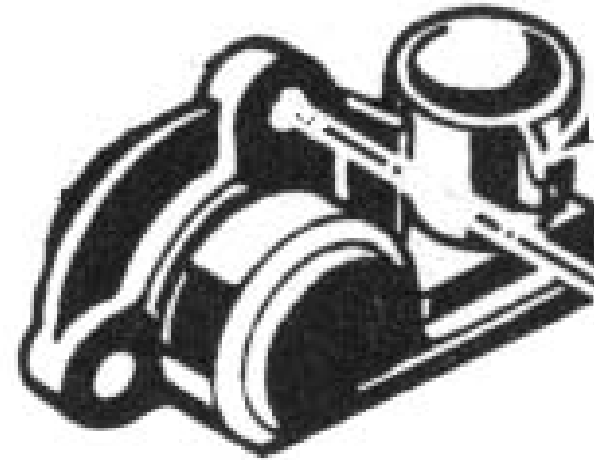


The ECT (Engine Coolant Temperature) sensor is a temperature sensitive resistor located in the engine coolant. It is used for the engine airflow calculation, gasoline cold enrichment, spark advance and to enable other temperature dependent features.



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FPP (Foot Pedal Position)



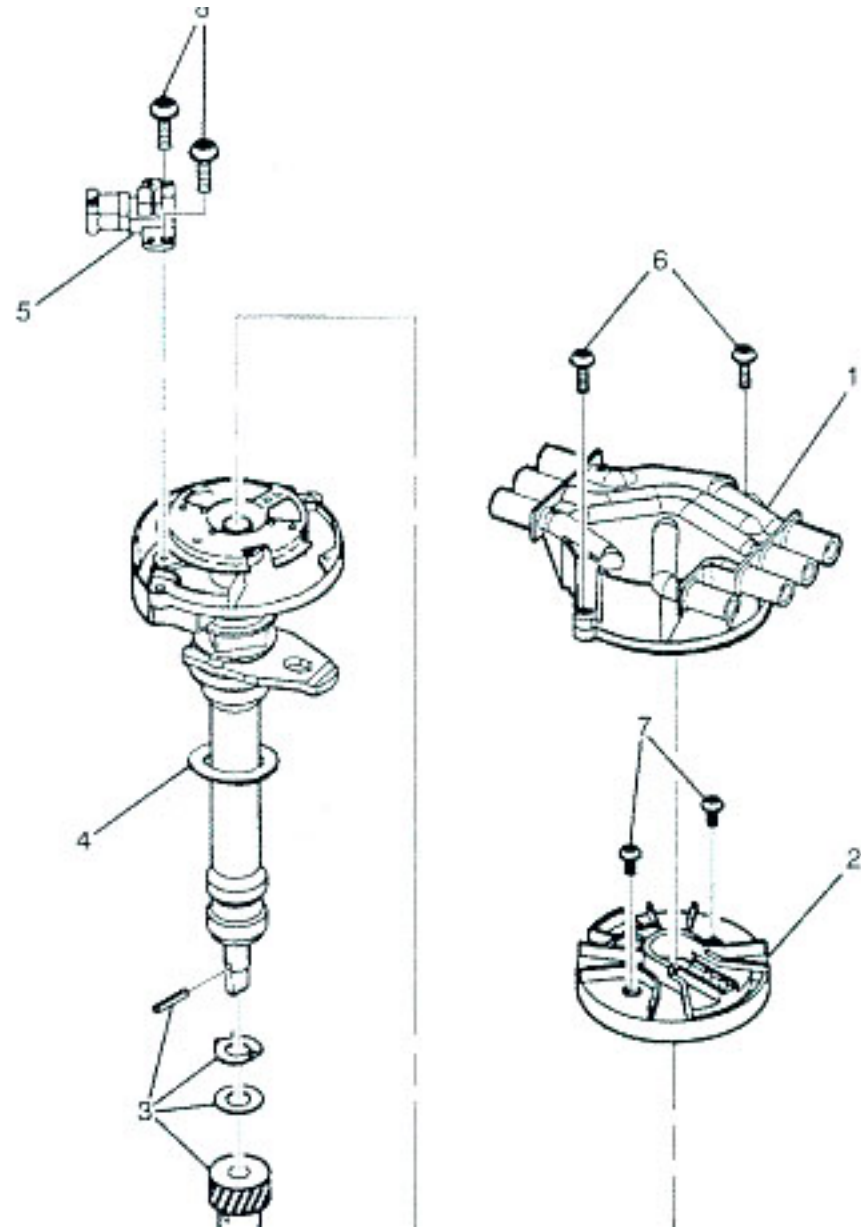
The Foot Pedal Position sensor uses a variable resistor to determine signal voltage based on pedal position. The sensor is very similar to the TPS.



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4.3 Camshaft Position Sensor (CMP)

The CMP (Camshaft Position Sensor) is used to synchronize the fuel and ignition timing systems.

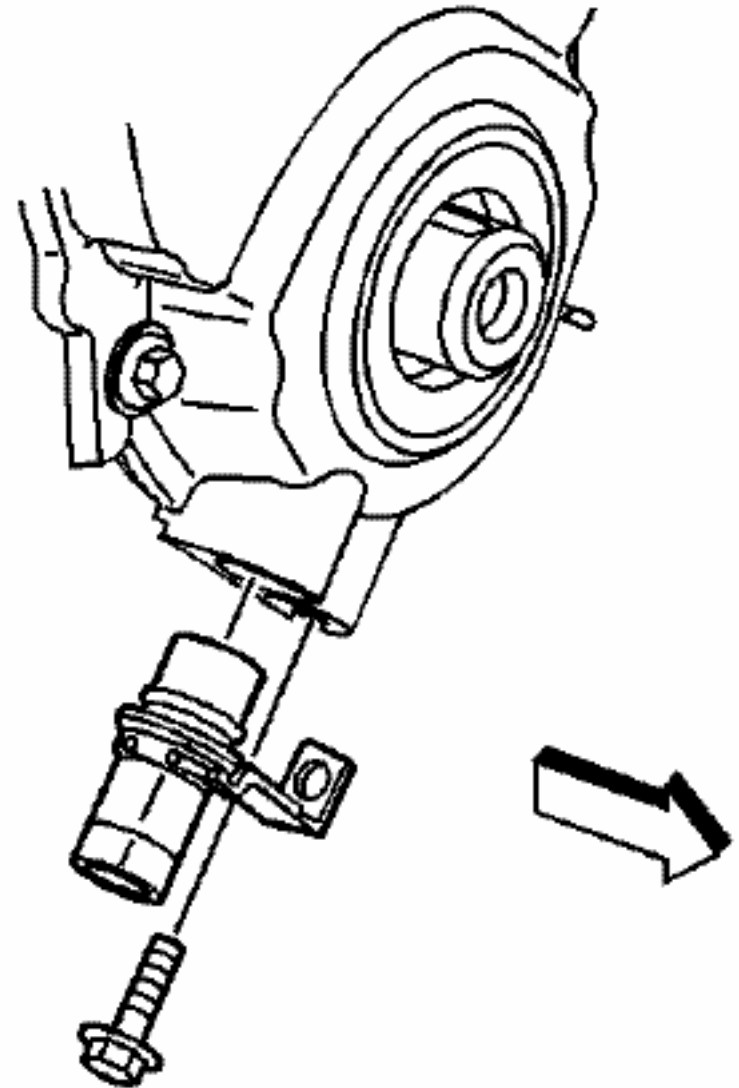




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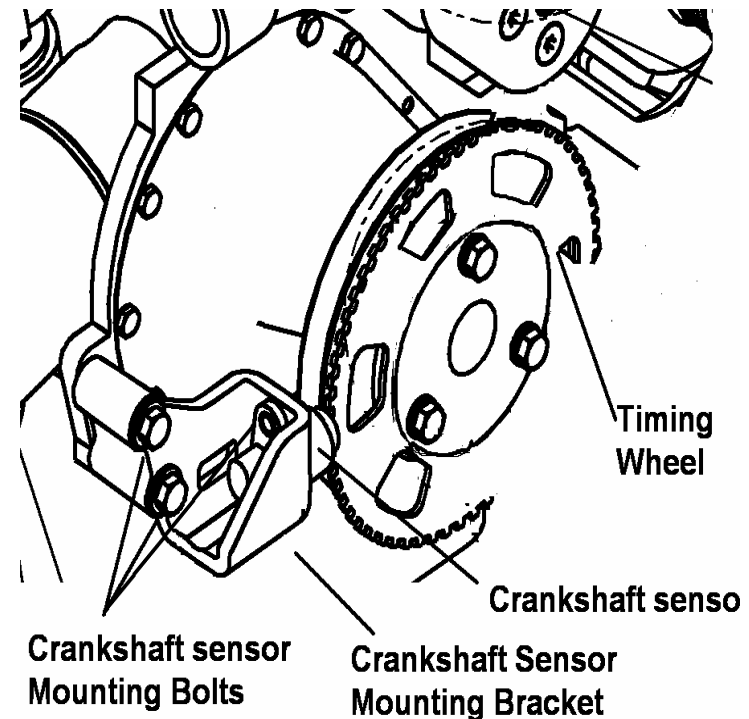
4.3 Crankshaft Position Sensor (CKP)

The CKP (Crankshaft Position Sensor) is a magnetic transducer mounted on the engine block adjacent to a pulse wheel located on the crankshaft. It determines crankshaft position by monitoring the pulse wheel. The Crankshaft position sensor is used to measure engine RPM and its signal is used to synchronize the ignition system.



3.0 Crankshaft Position Sensor (CKP)

The CKP (Crankshaft Position Sensor) is a magnetic transducer is bracket mounted on the front of the engine block. The timing wheel is connected to the crankshaft pulley. The CKP measures RPM and # 1 cylinder position by counting the missing teeth in the timing wheel





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