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PCM®

PCM PRO BOSS GT-40 EFI
Diagnostic Servicing

This manual contains information on the following FORD Power Products:

- 5.0 L Engine
- 5.8 L Engine

This manual is similar to FORD's "Powertrain Control/Emissions Diagnosis" manual for automotive applications.

The primary focus of this service manual is on diagnosis of the FORD EEC-IV Electronic Fuel Injection System. For further information on the 5.0L and 5.8L engines, refer to the following:

- Ford Power Product's; "Industrial and Marine Engines" service manual #194-209.
- FORD's; "Light Truck" service manual set #12107.

Section Description

SECTION 1 - HOW TO USE THIS MANUAL
Contains information on the manual as a whole

SECTION 2 - GENERAL INFORMATION
Contains descriptive information on the EFI, TFI-IV and EEC-IV systems. An important step in diagnosis is to understand the system you are trying to fix.

SECTION 3 - DIAGNOSIS
Contains complete step-by-step diagnosis for the EEC-IV, EFI and TFI-IV systems.

SECTION 4 - SPECIFICATIONS
Allows for quick access to fastener torque's and engine specifications.

SECTION 5 - GLOSSARY
There is extensive use of acronyms (letter abbreviations for words). Diagnostic procedures may be difficult and confusing if you are not familiar with, or know where to find, these terms.

SECTION 6 - DIAGRAMS
Provides for handy access to vacuum and electrical schematic diagrams. Also shows wire and pin identification.

SECTION 7 - SAFETY
Before performing any tests or checks, always read this section which gives safety related information.

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SECTION 2A
ELECTRONIC ENGINE CONTROL (EEC-IV)

GENERAL INFORMATION

Additional Information

This service manual will alert you to certain procedures that must be done very carefully. If you ignore this information, you could:

- Injure yourself or people around you.
- Injure the boat operator, boat passengers, or people around the boat.
- Damage the FORD Power Product or it's systems.

Understand the following before proceeding:

NOTE: Gives you information that controls correct assembly and operation of the product

CAUTION: Identifies information that will help prevent damage to machinery.

WARNING: ALERTS YOU TO THE POSSIBILITY OF DANGER AND IDENTIFIES INFORMATION THAT WILL HELP PREVENT INJURIES

This service manual is written for qualified, factory-trained service technicians familiar with the use of FORD Service Tools. This service manual tells you how to correctly maintain and service the FORD Power Product and it's systems. When correctly serviced, the FORD Power Product will be reliable and safe to operate.

Use only FORD recommended service tools when called for in the service procedure. Use of procedures or service tools, that are not recommended in this manual, may result in personal injury and/or damage to the FORD Power Product.

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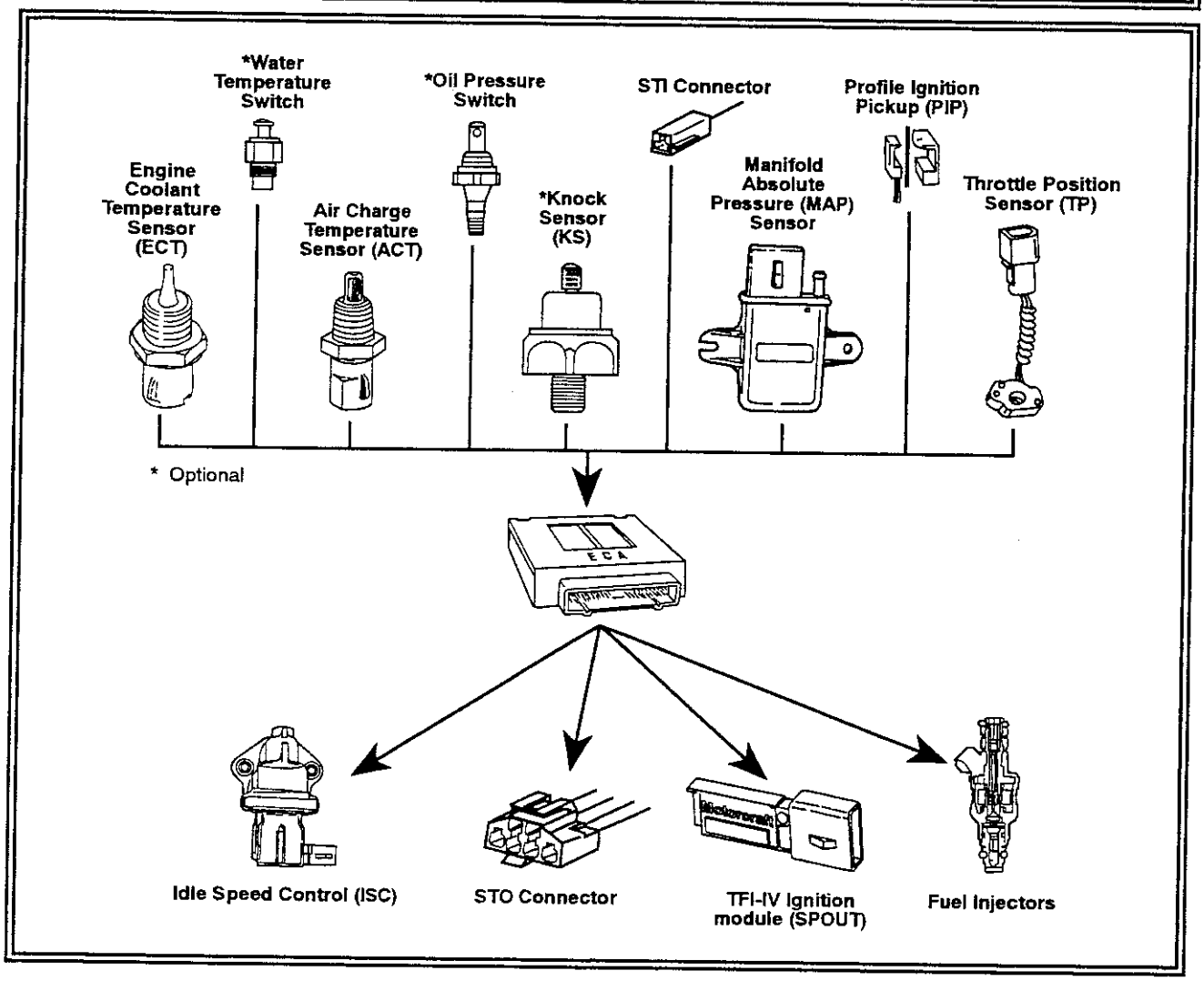
SECTION 2
GENERAL INFORMATION

WARNING: BEFORE PERFORMING ANY TESTS OR CHECKS RECOMMENDED IN THIS CHAPTER, READ THE SECTION CALLED SAFETY AT THE END OF THIS MANUAL.

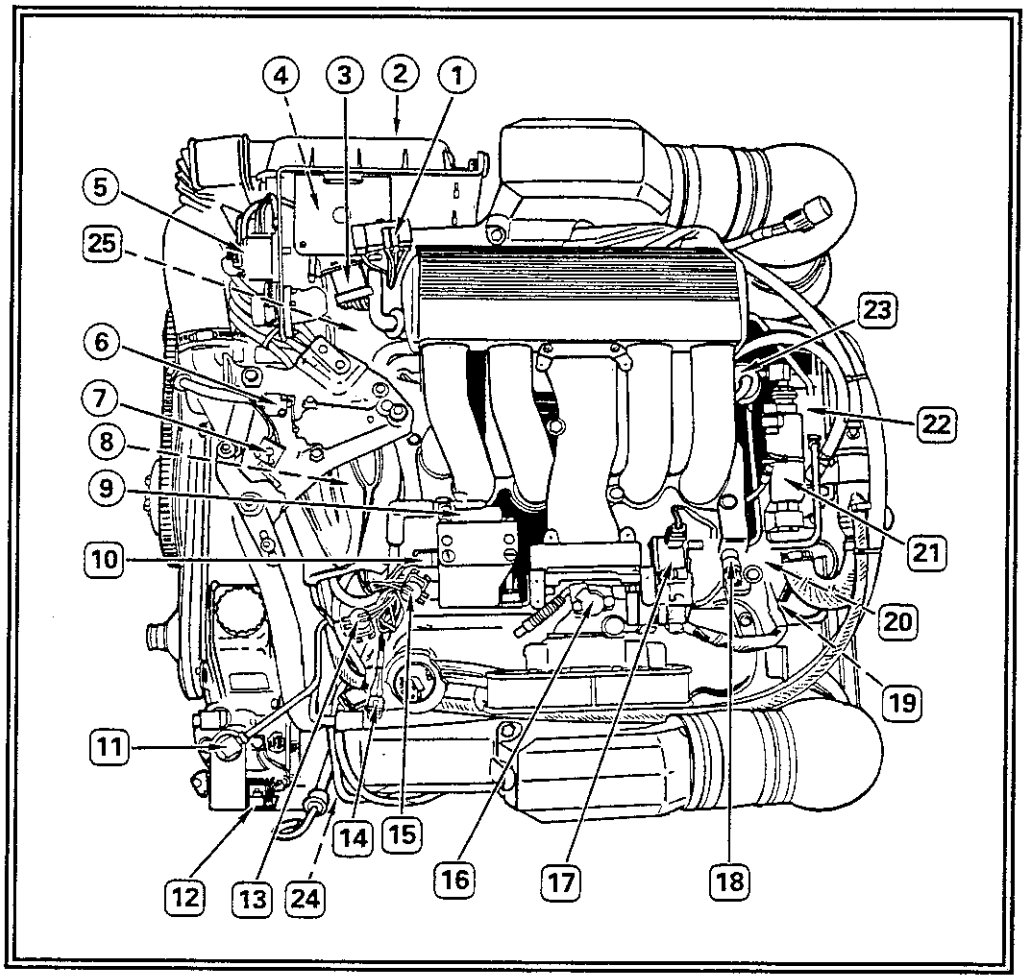
SECTION 2A - Electronic Engine Control (EEC-IV)



FORD's EEC-IV system is an electronic engine control system that consists of a network of electronic and electromechanical components. This system will continuously vary engine operation in order to meet programmed engine operating parameters.

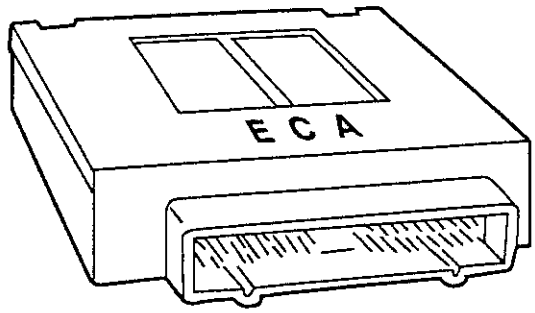
The Electronic Control Assembly (ECA) receives its information from various types of sensors such as switches, thermistors, potentiometers, Hall Effect devices, signal generators and electrical inputs.

The commands from the ECA are performed by actuators. Actuators can be electrically controlled solenoids, motors, relays or other devices. Solenoids are normally used to control fuel and idle air flow.



"Vapor Separator System" - Typical Component Location

1. STO and STI Connectors
2. Electronic Control Assembly (ECA)
3. Manifold Absolute Pressure (MAP) Sensor
4. EEC System Relay
5. ECA and Dash Panel Circuit Breakers
6. Shift Assist Switch (SAS)
7. Neutral Drive Switch (NDS)
8. Hall Effect (PIP Signal) Switch
9. E-core Coil
10. Thick Film Ignition (TFI) Module
11. Low Pressure Fuel Pump
12. Fuel Pump Circuit Breaker and Relay
13. Engine Coolant Temperature (ECT) Sensor
14. Spark Output (SPOUT) Connector
15. Air Charge Temperature (ACT) Sensor
16. Throttle Position (TP) Sensor
17. Idle Speed Control - Bypass Air (ISC-BPA) Solenoid
18. Fuel Injectors (INJ)
19. Knock Sensor (KS) and Module
20. PCV Valve
21. High Pressure Fuel Pump
22. Fuel Reservoir/Vapor Separator
23. Fuel Pressure Regulator
24. Oil Pressure Switch (S.L.O.W.)
25. Water Temperature Switch (S.L.O.W.)

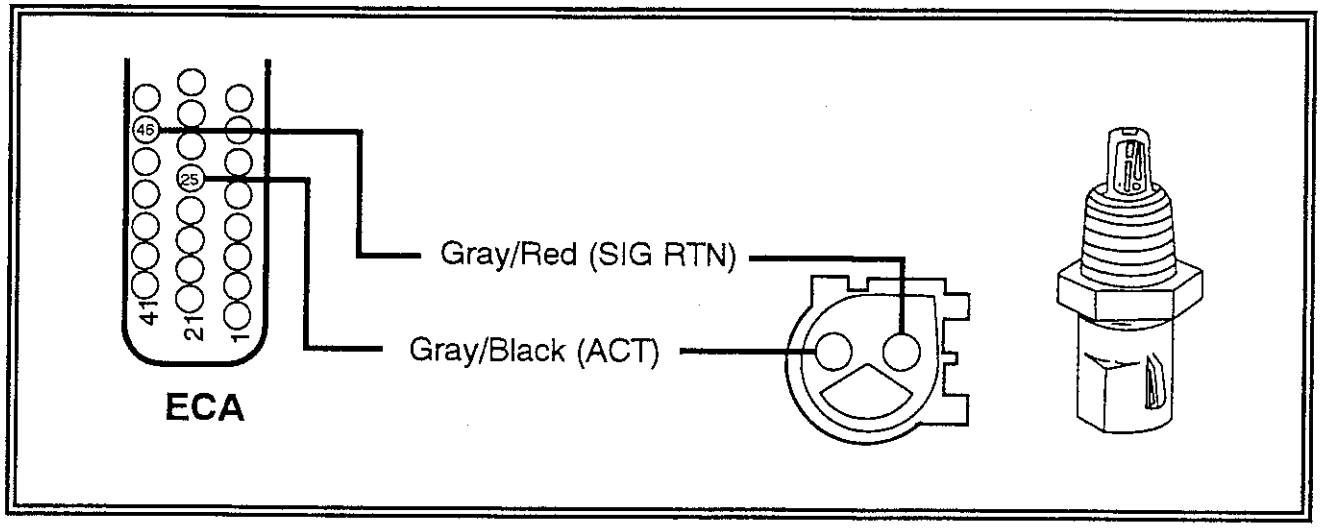


Electronic Control Assembly (ECA) -12A650-

The heart of the EEC system is the Electronic Control Assembly (ECA). The ECA is linked to all EEC-IV components by an engine wiring harness, and is sealed against dirt and moisture. The job of the ECA is to monitor and control engine operating conditions. Certain criteria is programmed into the circuitry of the ECA such as engine size, and data representing various operating conditions that could be encountered by a boater. The ECA is also known as the "Processor".

The ECA uses computer technology to "re-tune" the engine while it is operating to compensate for changes in load, speed, temperature and air density. The microprocessor contained in the ECA is capable of making the necessary computations to provide adjustment of ignition timing and air/fuel ratio.

Sensors provide the ECA with information on engine operating conditions and air density at which the boat is being operated. Potentiometers and other sensors that operate as voltage dividers require a constant source of reference voltage to provide an accurate signal. This reference voltage, abbreviated VREF, is regulated in and supplied by the ECA. The reference voltage is nominally 5 volts.



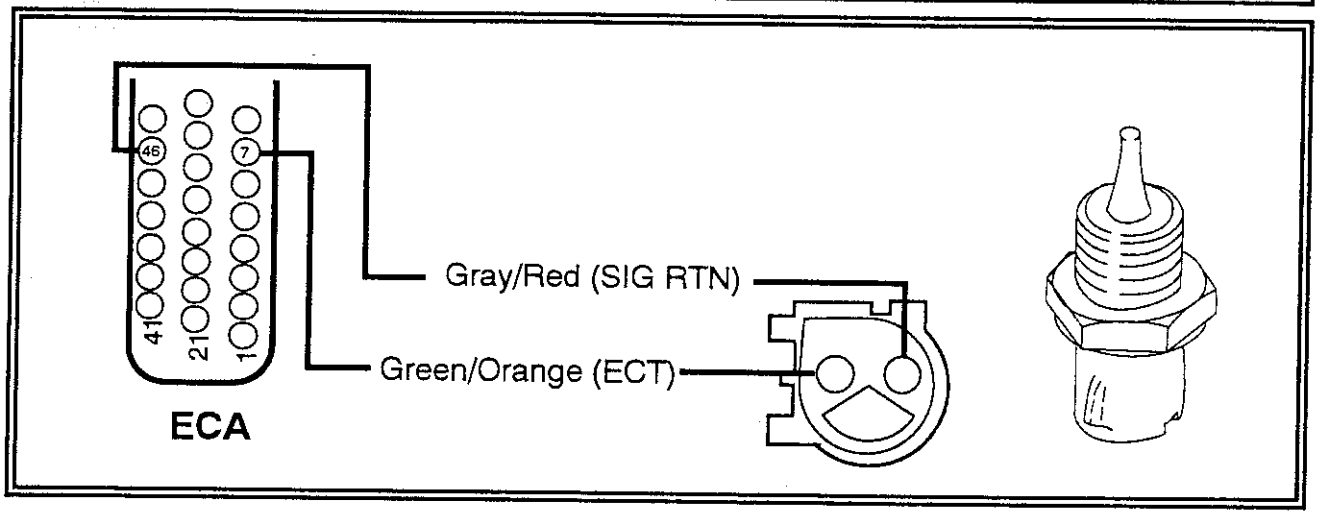
Air Charge Temperature (ACT) Sensor -12A697-

The Air Charge Temperature (ACT) sensor is a thermistor, which is a resistor with resistance changing with temperature. When resistance decreases, voltage decreases, and vice versa. The ECA will store a service code in memory if the component or circuit fails. The ACT is mounted in a brass housing that threads directly into the intake manifold air passage. It measures the temperature of the air/fuel mixture entering the engine. The ECA uses the ACT signal to adjust spark advance and air/fuel ratio in accordance with changes in incoming air temperatures.

ACT Sensor Data

Temp. °F	Temp. °C	Voltage*	Resistance
248	120	.28	1.18
212	100	.47	2.07
176	80	.80	3.84
140	60	1.35	7.60
104	40	2.16	16.15
68	20	3.06	37.30
32	0	3.87	94.98
-4	-20	4.33	271.20

*Voltage values calculated for VREF=5 volts (may vary ± 15% due to sensor and VREF variations)



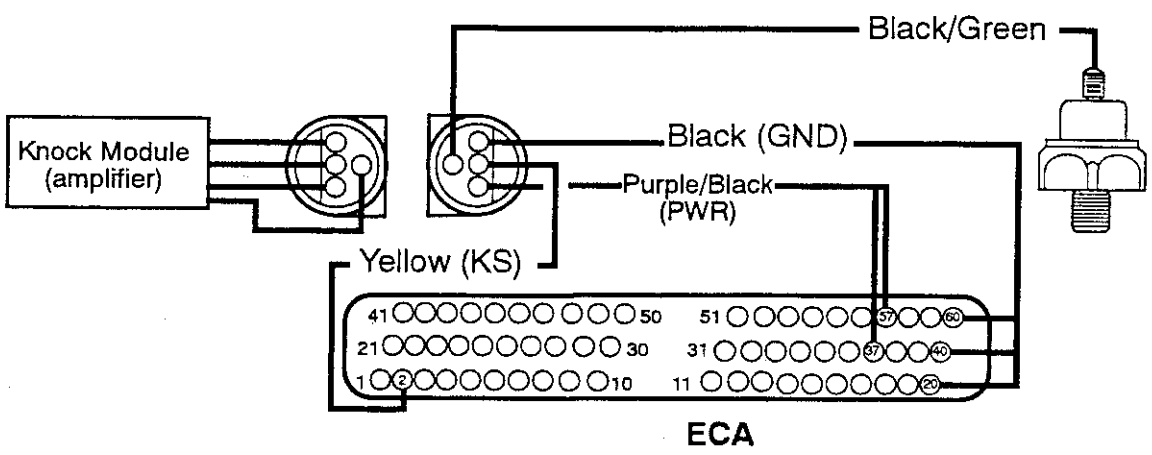
Engine Coolant Temperature (ECT) Sensor -12A648-

The ECT is a thermistor, which is a resistor that changes resistance with temperature. When resistance decreases, voltage decreases, and vice versa. The ECA will store a service code in memory if the component or circuit fails, or if a thermostat malfunction lowers water temperature below 140°F or raises it above 180°F. The ECT is mounted in a brass housing that threads directly into an intake manifold water passage, bringing the tip of the sensor in direct contact with the engine coolant. The ECA uses the ECT to modify spark advance and air/fuel ratio in accordance with changes in engine temperature.

ECT Sensor Data

Temp. °F	Temp. °C	Voltage*	Resistance
248	120	.28	1.18
212	100	.47	2.07
176	80	.80	3.84
140	60	1.35	7.60
104	40	2.16	16.15
68	20	3.06	37.30
32	0	3.87	94.98
-4	-20	4.33	271.20

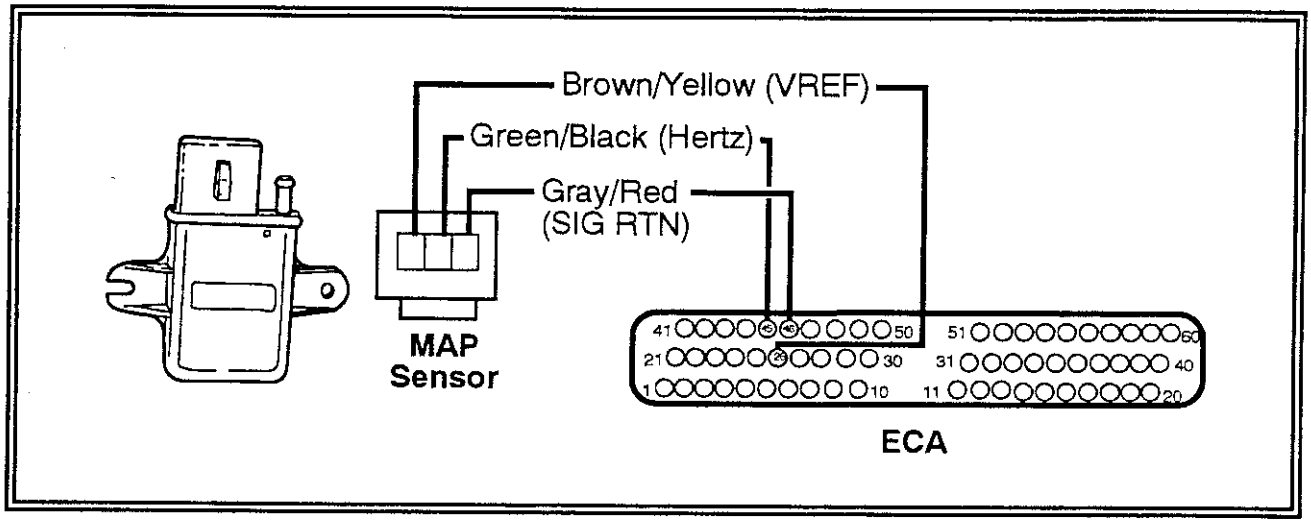
*Voltage values calculated for VREF=5 volts (may vary ± 15% due to sensor and VREF variations)



Knock Sensor (KS) -12A699- (optional)

The Knock Sensor is a signal generating device called an accelerometer. It detects engine detonation (knocking), and converts this frequency signal into a voltage. The sensor consists of a piezoelectric element mounted in a threaded metal housing. Vibrating the element generates the voltage signal. Special construction makes the element only sensitive to the particular engine vibrations associated with knocking.

When spark knock occurs, the Knock Sensor produces a pulsing electrical signal. This signal is put through an amplifier and then sent to the ECA. The ECA then immediately retards spark timing until knock is no longer sensed, or up to a maximum of 8° retard. The engine will return to normal spark advance after the MAP sensor detects a 3-4 in. Hg. change in engine vacuum.

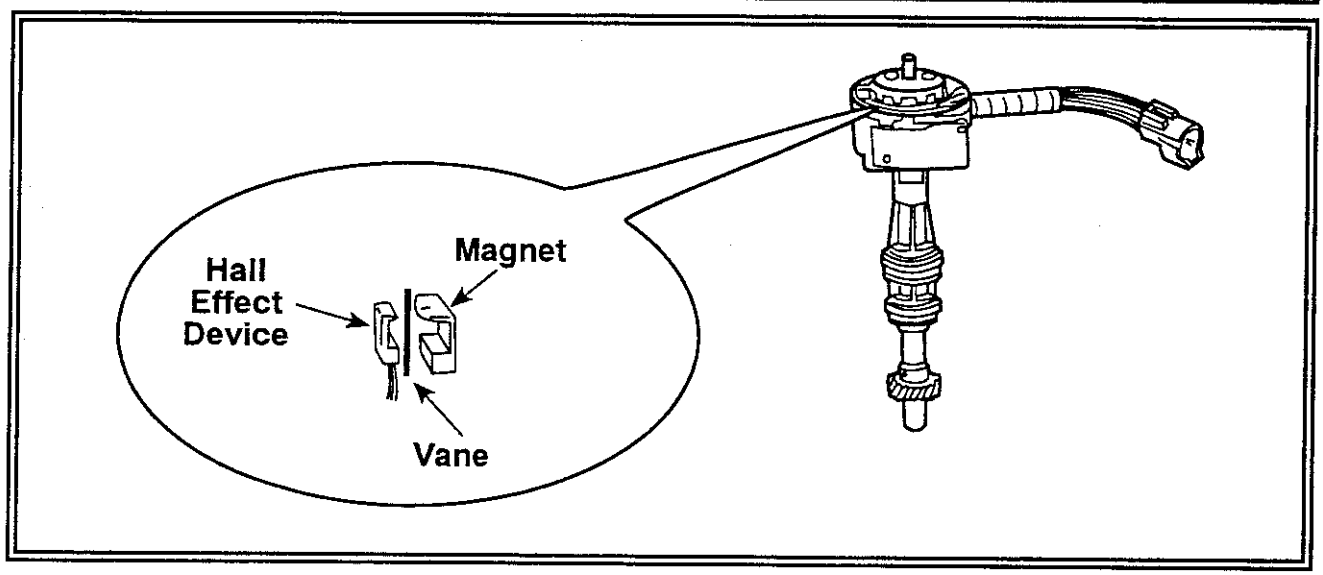


Manifold Absolute Pressure (MAP) Sensor -9F479-

The MAP sensor is used as a barometric sensor for air density compensation by updating the ECA during Key On/Engine Off, and whenever the engine is at wide-open throttle. The ECA uses MAP for spark advance and air/fuel ratio control by sensing load changes at its vacuum port. A reference voltage is supplied by the ECA to the MAP sensor. The MAP outputs a frequency signal that corresponds to manifold absolute pressure (vacuum). As vacuum increases, frequency decreases and visa versa. This gives the ECA information on engine load. A signal return wire completes the circuit back to the ECA. The ECA will store a service code in memory if the component or circuit fails.

MAP Sensor Data

Manifold Vacuum		Frequency
in. (Hg)	kPa	Hz
0	0	159
6	20.3	141
12	40.6	125
18	61.0	109
24	81.3	95
30	101.6	80

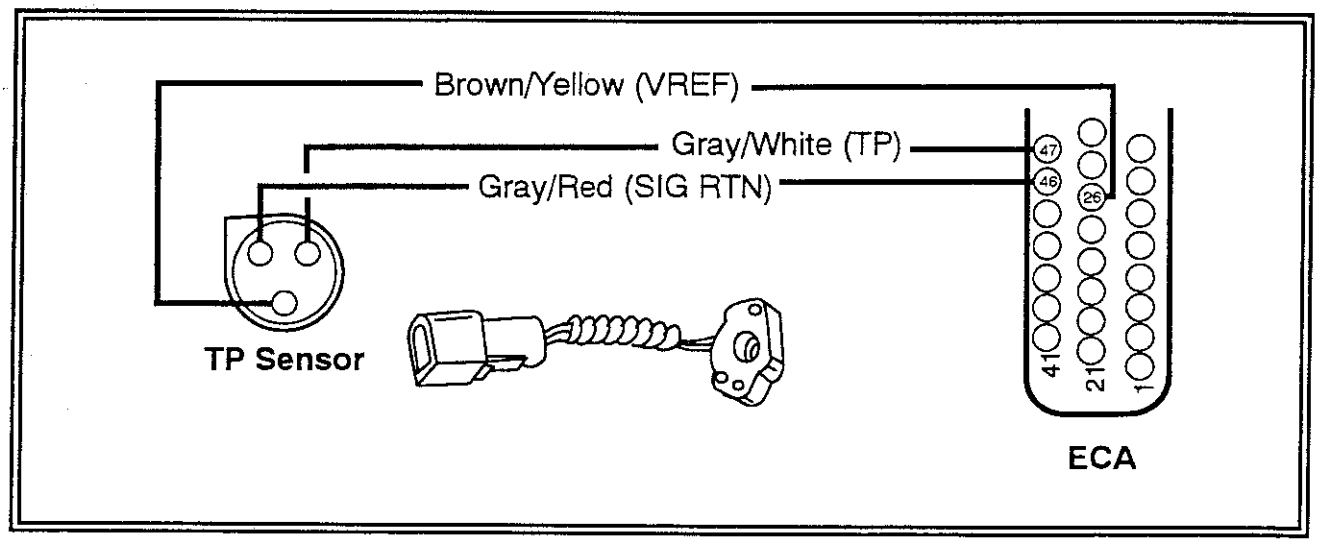


Profile Ignition Pickup (PIP)

The distributor supplies crankshaft position and RPM information to the ECA using voltage pulses (a PIP signal) sent by the Hall Effect switch. The PIP signal is used for spark and fuel injector timing.

The PIP signal is generated by a magnet, a Hall effect device and a slotted cup driven by the distributor shaft. When a window is in front of the Hall Effect device, the device is off and a low voltage signal is produced. As the slotted cup is turned and a vane passes in front of the Hall Effect device, the device is turned on and a high voltage signal is produced. One vane is narrower than the others; it provides a crankshaft position signal to the ECA called "Signature PIP". Continuous distributor rotation produces a pulsating DC wave.

The distributor has no centrifugal or vacuum advance since the ECA controls spark timing. Other than setting base timing, no distributor adjustments are required. The distributor itself has no openings since it's used with a remote mounted TFI module. Thus it's referred to as "Closed Bowl". The ECA will store a service code in memory if the component or circuit fails.



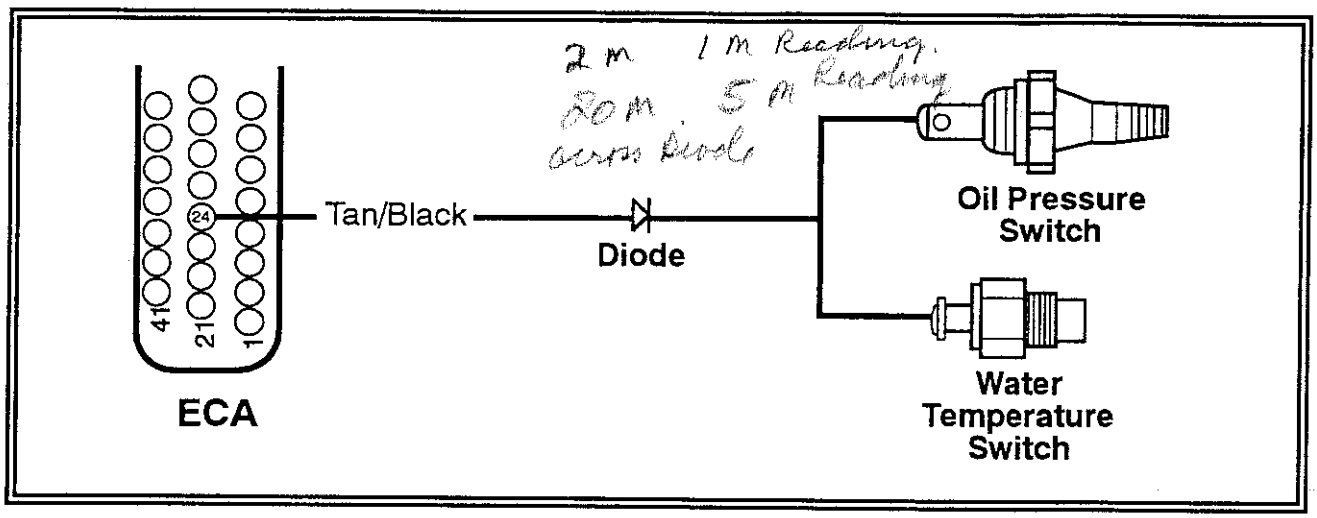
Throttle Position Sensor (TP) -9B989-

The Throttle Position sensor is a rotary type potentiometer. The sensor is located on the top of the throttle body, and is rotated by the throttle shaft. The sensor uses a five-volt reference voltage provided by the ECA. As the throttle shaft is rotated the ECA is provided with a voltage signal directly proportional to the opening angle of the throttle plate. As the opening increases, so does voltage. As the opening decreases, voltage does the same. A signal return wire completes the circuit back to the ECA. The ECA will store a service code in memory if the component or circuit fails.

TP Sensor Data

Throttle Angle °	*Voltage
0	.50
10	.97
20	1.44
30	1.90
40	2.37
50	2.84
60	3.31
70	3.78
80	4.24

*Voltage values calculated for VREF=5 volts
(These values may vary ± 15% due to sensor and VREF variations)



Oil Pressure and Water Temperature Switches (optional)

EFI engines are equipped with a Speed Limiting Operational Warning (S.L.O.W.) system that uses switches to monitor water temperature and oil pressure. Both switches are spliced to a common lead that connects to ECA pin 24. This circuit contains a diode that protects the ECA against damage from reverse battery polarity.

In the event of a water temperature overheat (200°F or higher) or loss of oil pressure (below 5 PSI), engine operation will noticeably change. The ECA will alter the injector firing sequence, the engine will run rough, and engine speed will drop to 2700 RPM. Below 2700 RPM the engine will run normally, but not above. The engine will remain in this S.L.O.W. operational mode as long as the cooling/oil pressure problem exists. After the problem is corrected and the water temperature or oil pressure returns to normal, the ECA will automatically allow the engine to resume proper operation. The ignition switch does not have to be turned off to reset the system.

One additional feature is provided: if the boat is equipped with an Audible Alarm kit, a warning horn will sound when the engine goes into the S.L.O.W. operational mode. If a component or the circuit fails, the ECA **WILL NOT** store a service code in memory.