

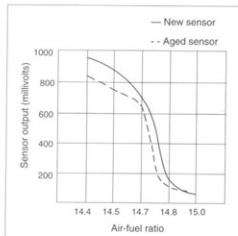
1988–1993

Ford Fuel Injection & Electronic Engine Control

How to Understand, Service, and Modify



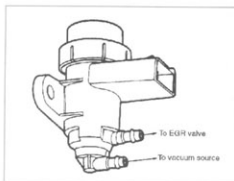
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Foreword



Author Charles O. Probst, SAE

Did you know that, in most Ford engine-control systems:

- The computer is continuously learning about how the engine is operating, and continuously adapting to the individual car and driver, the engine condition, the fuel in the tank, and the driving style.
- The computer keeps track of the small electric currents that control the engine, monitoring the signals to see they are operating properly. If any signal strays from the prescribed limits, the computer can guide diagnosis and troubleshooting of the problem.
- The control system can operate 120 times per second to manage the fuel injection and the ignition timing, sometimes modifying the control for each cylinder, all at 7200 rpm.

What does this mean to those who read this book?

For those of you who service the engine-control systems, it means satisfying your customers the first time, reducing costly come-backs. Knowing about the fundamentals and the operation of Ford systems, you will make sense of the trouble codes so you can troubleshoot with the least hassle.

For those of you who drive these cars, you will have more operating satisfaction and confidence. You will know how the engine operates under normal conditions. You will learn that the engine control system can handle minor failures until service; it can even "limp home" with most major failures.

As an automotive engineer who has spent most of my career in technical training, I write to simplify the explanations of these complex systems by providing considerable detail within a straightforward structure. I write with a wide range of experience including: showing Ford dealers how to detail a used car, showing the astronauts how to drive the Rover on the Moon, and developing service training for fuel-injection technicians.

Within the pages of this book I hope to tell you everything you always wanted to know about Ford EEC-III and EEC-IV Electronic Engine Control, so that you can get the most out of Ford systems.

Charles O. Probst

Glossary: 1993 and Later

To improve servicing, all manufacturers have worked with SAE (the Society of Automotive Engineers) to create common terms that apply to the same part from different manufacturers. Because of this, some of the terminology you see from 1993 on may differ from that used on 1988-92 vehicles.

Where revised terminology is different it is listed under the column "Old Term." For a complete listing of 1988-1992 terminology see the inside front cover. This page lists Ford component and system terminology for 1993 models.

1993 and Later Terminology

Acronym	1993 and Later Term	Old Term
ACC	Air Conditioning Clutch	
ACD	Air Conditioning Demand	
ACON	Air Conditioning On	
AIR	Secondary Air Injection	AM, CT, MTA
AIRB	Secondary Air Injection Bypass	AM1, TAB
AIRD	Secondary Air Injection Diverter	AM2, TAD
BARO	Barometric Pressure	BP
B+	Battery Positive Voltage	BATT+
BOO	Brake On/Off	
BPA	Bypass Air	
CAC	Charge Air Cooler	Intercooler
CANP	Canister Purge	
CCD	Computer Control Dwell	DI
CCRM	Constant Control Relay Module	IRCM
CID	Cylinder Identification	
CKP	Crankshaft Position Sensor	CPS, VRS
DI	Distributor Ignition	CBD, TFI
DLC	Data Link Connector	Self-Test connector
DOHC	Dual Overhead Cam	
DOL	Data Output Line	
DPFE	Delta Pressure Feedback EGR	
DPI	Dual Plug Inhibit	
DRL	Daytime Running Lamps	
DTM	Diagnostic Test Mode	Self-Test mode
DTC	Diagnostic Trouble Code	Self-Test code
EAP	Electronic Air Pump	
ECT	Engine Coolant Temperature	
EEC	Electronic Engine Control	
EGR	Exhaust Gas Recirculation	
EGRT	EGR Temperature	
EI	Electronic Ignition	DIS EDIS
(low data rate, high data rate)		
EPT	EGR Pressure Transducer	
EVP	EGR Valve Position	
EVR	EGR Vacuum Regulator	
FC	Fan Control	EDF
FF sensor	Flexible Fuel sensor	
FFV	Flexible Fuel Vehicle	
FP	Fuel Pump	
FPM	Fuel Pump Monitor	
FPRC	Fuel Pressure Regulator Control	
GND	Ground	
HDL	Headlamp	
HFC	High Fan Control	HEDF
HFP	High Fuel Pump	
HO	High Output	
HO2S	Heated Oxygen Sensor	HEGO
HSC	High Swirl Combustion	
IAC	Inlet Air Control	ISC
IAC BPA	Idle Air Control Bypass Air	ISC-BPA
IAT	Intake Air Temperature	ACT
ICM	Ignition Control Module	DIS Module EDIS Module TFI Module
IDM	Ignition Diagnostic Monitor	
IFS switch	Inertia Fuel Shutoff Switch	IS
IMRC	Intake Manifold Runner Control	IAC

1993 and Later Terminology (cont'd)

Acronym	1993 and Later Term	Old Term
KAM	Keep Alive Memory	
KAPWR	Keep Alive Power	
KS	Knock Sensor	
LFC	Low Fan Control	EDF
LFP	Low Fuel Pump	
MAF	Mass Air Flow	
MAP	Manifold Absolute Pressure	
MECS	Mazda Engine Control System	
MFI	Multiport Fuel Injection	EFI
MIL	Malfunction Indicator Light	CEL
MLP	Manual Lever Position	
OC	Oxidation Catalytic Converter	COC
OCT ADJ	Octane Adjust	
OHC	Overhead Cam	
PAIR	Pulsed Secondary Air Injection	MPA, PA
PCM	Powertrain Control Module	ECA, ECM, ECU
PCV	Positive Crankcase Ventilation	
PFE	Pressure Feedback EGR	EPT
PIP	Profile Ignition Pickup	
PNP switch	Park/Neutral Position Switch	NDS NGS
PSOM	Programmable Speedometer/ Odometer Module	
PSP switch	Power Steering Pressure Switch	PSPS
PWR GND	Power Ground	
REDOX	Reduction Oxidation Catalytic Converter	
SC	Supercharger/Supercharged	
SD	Speed Density	
SFI	Sequential Multiport Fuel Injection	SEFI
SHO	Super High Output	
SIG RTN	Signal Return	
SIL	Shift Indicator Light	
SPOUT	Spark Output	SAW, SPOUT
SS	Shift Solenoid	
STI	Self-Test Input	
STO	Self-Test Output	
TB	Throttle Body	
TBI	Throttle Body Injection	CFI
TC	Turbocharger/Turbocharged	
TCC	Torque Converter Clutch	CCC, CCO
TCC solenoid	Torque Converter Clutch Solenoid	LUS, MLUS
TCM	Transmission Control Module	4EAT module
TCS	Transmission Control Switch	
TOT	Transmission Oil Temperature	
TP	Throttle Position	
TRD	Transmission Range Drive	
TROD	Transmission Range Overdrive	
TRL	Transmission Range Low	
TRR	Transmission Range Reverse	
TSS	Transmission Speed Sensor	TSS
TWC	Three-way Catalytic Converter	
VAF	Volume Air Flow	
VCRM	Variable Control Relay Module	IRCM
VPWR	Vehicle Power	
VREF	Voltage, Reference	
VSS	Vehicle Speed Sensor	
WOT	Wide Open Throttle	

Please read these warnings and cautions before proceeding with maintenance and repair work.

WARNING—

● Some repairs may be beyond your capability. If you lack the skills, tools and equipment, or a suitable workplace for any procedure described in this manual, we suggest you leave such repairs to an authorized dealer service department, or other qualified shop.

● Manufacturers are constantly improving their cars. Sometimes these changes, both in parts and specifications, are made applicable to earlier models. Therefore, before starting any major jobs or repairs to components on which passenger safety may depend, consult your authorized dealer about Technical Bulletins that may have been issued since the editorial closing of this book.

● Do not re-use any fasteners that are worn or deformed in normal use. Many fasteners are designed to be used only once and become unreliable and may fail when used a second time. This includes, but is not limited to, nuts, bolts, washers, self-locking nuts or bolts, circlips and cotter pins. Always replace these fasteners with new parts.

● Never work under a lifted car unless it is solidly supported on stands designed for the purpose. Do not support a car on cinder blocks, hollow tiles or other props that may crumble under continuous load. Never work under a car that is supported solely by a jack. Never work under the car while the engine is running.

● If you are going to work under a car on the ground, make sure that the ground is level. Block the wheels to keep the car from rolling. Disconnect the battery negative (-) terminal (ground strap) to prevent others from starting the car while you are under it.

● Never run the engine unless the work area is well ventilated. Carbon monoxide kills.

● Finger rings, bracelets and other jewelry should be removed so that they cannot cause electrical shorts, get caught in running machinery, or be crushed by heavy parts.

● Tie long hair behind your head. Do not wear a necktie, a scarf, loose clothing, or a necklace when you work near machine tools or running engines. If your hair, clothing, or jewelry were to get caught in the machinery, severe injury could result.

● Do not attempt to work on your car if you do not feel well. You increase the danger of injury to yourself and others if you are tired, upset or have taken medication or any other substance that may keep you from being fully alert.

● Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the car. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

● Catch draining fuel, oil, or brake fluid in suitable containers. Do not use food or beverage containers that might mislead someone into drinking from them. Store flammable fluids away from fire hazards. Wipe up spills at once, but do not store the oily rags, which can ignite and burn spontaneously.

● Always observe good workshop practices. Wear goggles when you operate machine tools or work with battery acid. Gloves or other protective clothing should be worn whenever the job requires working with harmful substances.

● Disconnect the battery negative (-) terminal (ground strap) whenever you work on the fuel system or the electrical system. Do not smoke or work near heaters or other fire hazards. Keep an approved fire extinguisher handy.

● Batteries give off explosive hydrogen gas during charging. Keep sparks, lighted matches and open flame away from the top of the battery. If hydrogen gas escaping from the cap vents is ignited, it will ignite gas trapped in the cells and cause the battery to explode.

● Connect and disconnect battery cables, jumper cables or a battery charger only with the ignition switched off, to prevent sparks. Do not disconnect the battery while the engine is running.

● Do not quick-charge the battery (for boost starting) for longer than one minute. Wait at least one minute before boosting the battery a second time.

● Do not allow battery charging voltage to exceed 16.5 volts. If the battery begins producing gas or boiling violently, reduce the charging rate. Boosting a sulfated battery at a high charging rate can cause an explosion.

● Some cars covered by this book may be equipped with a supplemental restraint system (SRS) that automatically deploys an airbag in the event of a frontal impact. The airbag is inflated by an explosive device. Handled improperly or without adequate safeguards, it can be accidentally activated and cause serious injury.

● Greases, lubricants and other automotive chemicals contain toxic substances, many of which are absorbed directly through the skin. Read manufacturer's instructions and warnings carefully. Use hand and eye protection. Avoid direct skin contact.

CAUTION—

● Manufacturers offer extensive warranties, especially on components of fuel delivery and emission control systems. Therefore, before deciding to repair a car that may still be covered wholly or in part by any warranties issued by the manufacturers, consult your authorized dealer. You may find that he can make the repair for free, or at minimal cost.

● Part numbers listed in this manual are for identification purposes only, not for ordering. Always check with your authorized dealer to verify part numbers and availability before beginning service work that may require new parts.

● Before starting a job, make certain that you have all the necessary tools and parts on hand. Read all the instructions thoroughly, do not attempt shortcuts. Use tools appropriate to the work and use only replacement parts meeting manufacturer specifications. Makeshift tools, parts and procedures will not make good repairs.

● Use pneumatic and electric tools only to loosen threaded parts and fasteners. Never use these tools to tighten fasteners, especially on light alloy parts. Always use a torque wrench to tighten fasteners to the tightening torque specification listed.

● Be mindful of the environment and ecology. Before you drain the crankcase, find out the proper way to dispose of the oil. Do not pour oil onto the ground, down a drain, or into a stream, pond or lake. Consult local ordinances that govern the disposal of wastes.

● On cars equipped with anti-theft radios, make sure you know the correct radio activation code before disconnecting the battery or removing the radio. If the wrong code is entered into the radio when power is restored, that radio may lock up and be rendered inoperable, even if the correct code is then entered.

● Connect and disconnect a battery charger only with the battery charger switched off.

● Do not quick-charge the battery (for boost starting) for longer than one minute. Wait at least one minute before boosting the battery a second time.

● Sealed or "maintenance free" batteries should be slow-charged only, at an amperage rate that is approximately 10% of the battery's ampere-hour (Ah) rating.

● Do not allow battery charging voltage to exceed 16.5 volts. If the battery begins producing gas or boiling violently, reduce the charging rate. Boosting a sulfated battery at a high charging rate can cause an explosion.