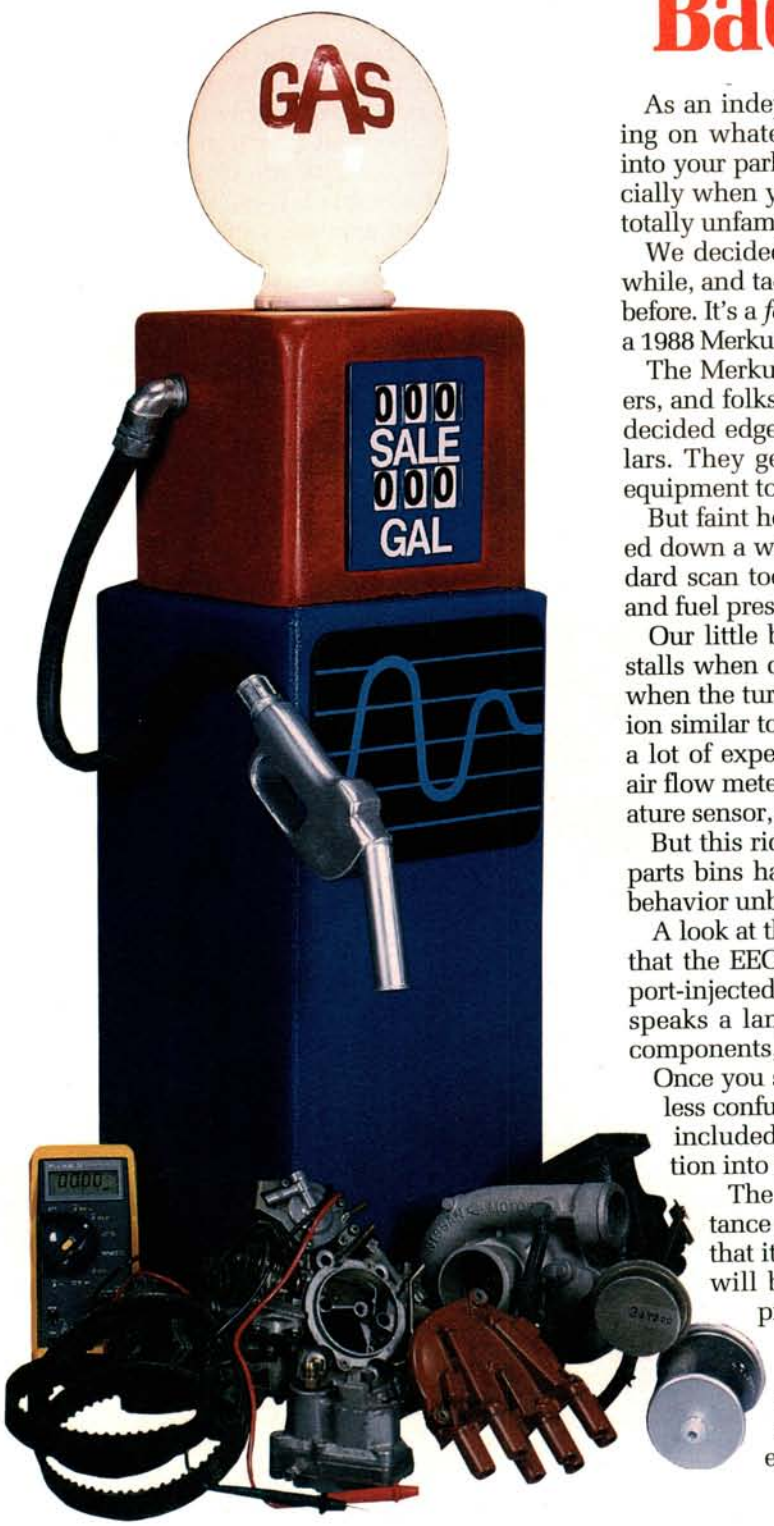
Driveability Clinic

Back to Basics



As an independent repair shop tech, you get stuck working on whatever comes chugging, grinding, and smoking into your parking lot. It can be a frustrating experience, especially when you're dealing with a car and system which are totally unfamiliar to you.

We decided that it was time to stand in your shoes for a while, and tackle a problem car and system we'd never seen before. It's a *foreign* car that isn't quite as foreign as it looks — a 1988 Merkur — and it uses a Ford EEC IV computer system.

The Merkur was originally sold at Lincoln/Mercury dealers, and folks wrenching down at the Sign of the Cat have a decided edge in any competition for customers' repair dollars. They get factory EEC training and have enough test equipment to fill Yankee Stadium.

But faint heart never won fair maiden's hand, so we hunted down a wiring diagram, a breakout box from OTC, a standard scan tool, our trusty DVOM, an oscilloscope, vacuum and fuel pressure gauges, and then dove in.

Our little blue Merkur bogs badly off idle, stumbles and stalls when cold, and blows nimbus clouds of black smoke when the turbo boost gets up a full head of steam. In a fashion similar to last month's Mitsubishi-built Dodge, it has had a lot of expensive parts replaced, including: the computer, air flow meter, ignition module, baro sensor, coolant temperature sensor, and the knock sensor.

But this rich diet of components from the Big Blue Oval's parts bins have done nothing to curb the car's appetite for behavior unbecoming to a fine *German* sports coupe.

A look at the fuel system wiring diagram for this car shows that the EEC IV system isn't radically different from other port-injected systems used on BMWs and Toyotas. But Ford speaks a language all their own when they label various components, and that may be the biggest hurdle of all.

Once you start speaking Fordese, the EEC system gets a lot less confusing, and certainly a lot less intimidating. We've included a list of common Fordisms and their translation into English.

The last thing we want to emphasize is the importance of returning to basic tests when a car decides that it doesn't want to play fair. In a lot of cases, there will be multiple reasons for a specific driveability problem that may not all show up at once.

As we progressed through a number of "fixes" we saw steady improvement in the car's performance. But no single repair or adjustment was a cure-all. In the end, a repeat of basic tests enabled us to catch the final problem "in the act."

— By Ralph Birnbaum

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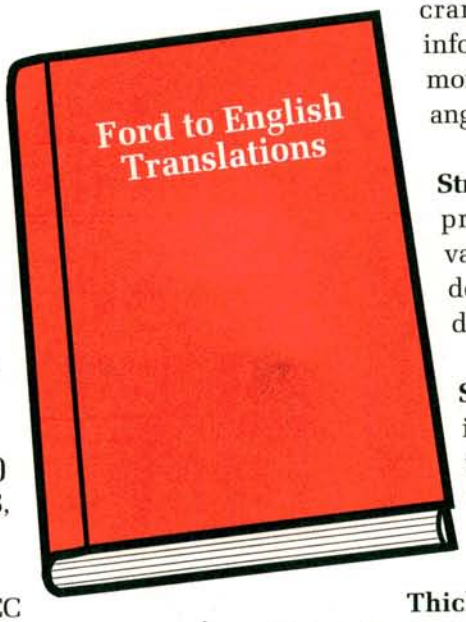
Here are some of the Fordisms we'll use in this article. Some will look familiar, others may not.



Baro — This one is just what it sounds like. But the Baro sensor on our Merkur is not hooked to the intake manifold, so it senses Baro only. Pure baro sensors have a small plastic cap on the nipple where the manifold vacuum line would normally connect. The Baro sensor's output is measured in Hertz.

Engine Coolant Temperature (ECT) sensor —You probably call this the CTS, or Coolant Temperature Sensor.

Electronic Engine Control (EEC) — EEC is not something your kid screams when walking through a haunted house on Halloween.

Electronic Control Assembly (ECA) — The "black box."

EGO or HEGO — Exhaust Gas Oxygen sensor, or **Heated Exhaust Gas Oxygen** sensor. Leggo my Hego.

ISC — The **Idle Speed Controller** which regulates the amount of air bypassing the throttle to provide the correct idle speed for a cold engine, or to compensate for accessory loads.

Keep Alive Memory (KAM) — A constant battery voltage which keeps the ECA from forgetting its own name when you shut off the ignition key.

KS — Knock Sensor

Manifold Absolute Pressure (MAP) —Common enough, but remember, the MAP or BARO sensors on this system don't put out an analog signal, rather they send a digital signal, measurable in Hertz.

Neutral Drive Switch (NDS) — On our automatic transmission-equipped car, this tells the ECA if the car is in Neutral/Park, or in gear.

Profile Ignition Pickup (PIP) — A Hall effect signal from the distributor which provides crank position and engine speed information to the ECA. You may be more familiar with the terms crank angle sensor and tach.

Strategy — This is the ECA's preprogrammed plan for adjusting various outputs to different output devices. Many of us refer to a fuel delivery or ignition timing "map."

SPOUT — Spark Output — This is the output signal from the ECA to the TFI module. It controls when the secondary spark is delivered by the coil.

Thick Film Integrated (TFI) module — This is the ignition module which receives a signal from the ECA. It is mounted to the outside of the distributor.

TP — You may say TPS for **Throttle Position** sensor.

Vane Airflow (VAF) sensor — The air flow meter.

Vane Air Temperature (VAT) — This is a thermistor in the VAF which is designed to measure air intake temperature.

Here are the inputs determining injector pulse width and ignition timing. In addition to controlling injector ON time, the ECA uses these inputs to calculate timing advance. There is no vacuum or centrifugal advance in the distibutor on this car.

PIP		**Neutral/ Drive Switch**
ECT	**KS**	**VAT**
VAF		
BARO	**TPS**	

And the outputs we're concerned with at the moment:

- **ISC**
- **Ignition Timing**
- **Injector ON Time**
- **EGR Vent Solenoid**
- **Turbo Boost Solenoid (Boost Limiter) Wide Open Throttle cut off for A/C.**

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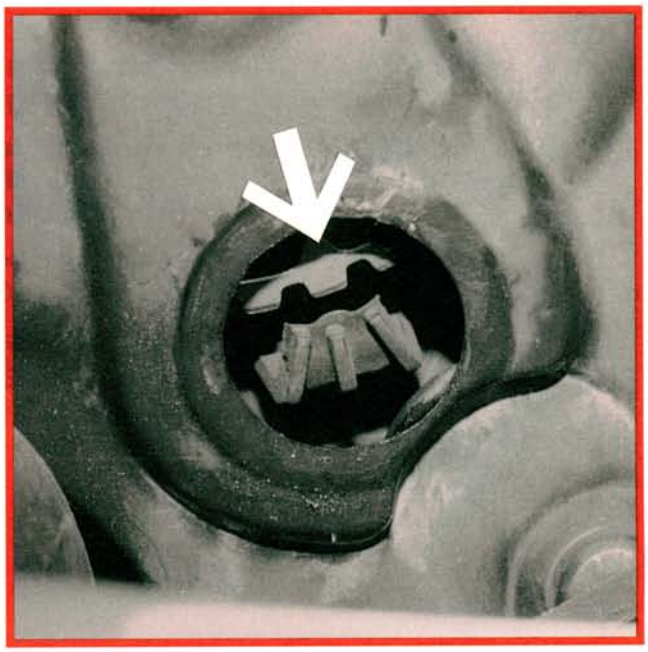
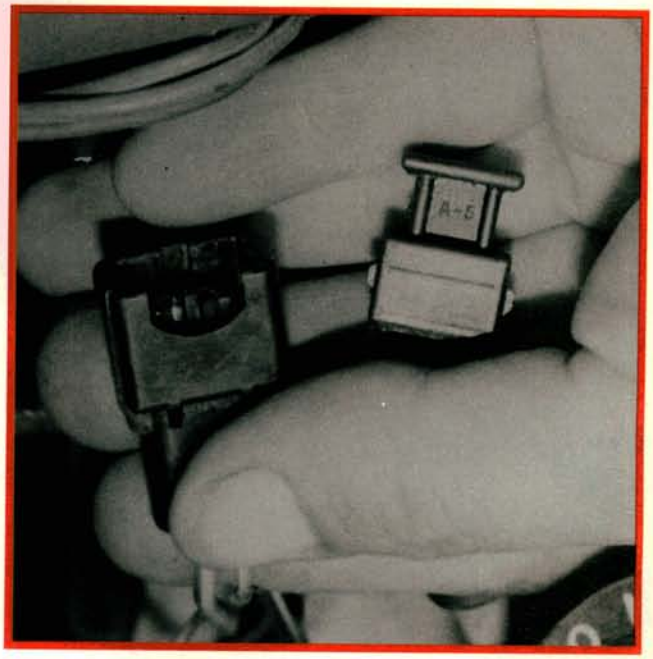
1 We've learned our lesson from the last two problem cars to appear in this space, so we'll start with a thorough check of the battery and charging system. We are careful to verify the integrity of both the engine and chassis grounds. See "Sixteen Minutes" in the January '91 issue of *Import Service* for details.

2 Now we hook up a scan tool to the diagnostic port (arrow) near the battery, and check for codes. We get a passing grade from the ECA diagnostic output (code 11). This system will store codes, but won't offer any serial data, so we're not going to get any help here. Looks like it's back to the basics.

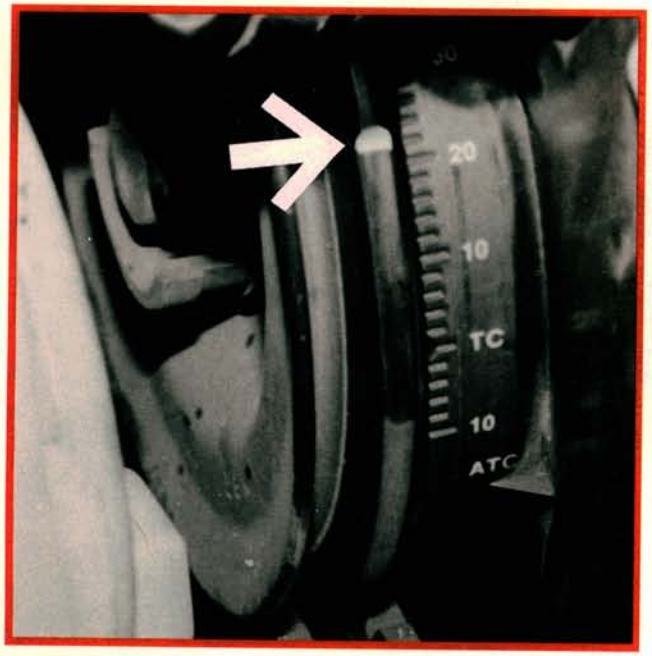


3 The car passes a four gas test at idle. We test fuel pressure, and manifold vacuum at idle. Vacuum seems to be a little low, and the car stumbles badly off idle. But exhaust backpressure isn't excessive. We check cam timing by aligning cam and crank to TDC number 1. Again, we find nothing wrong.

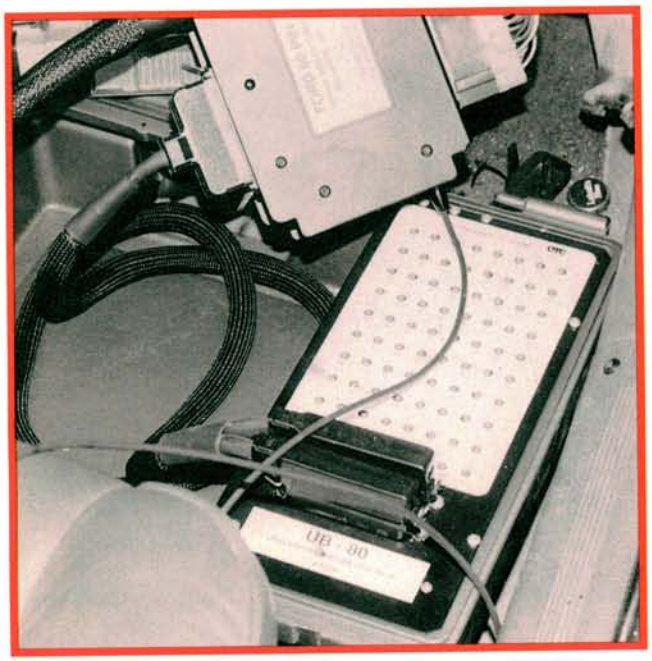
4 Base ignition timing never changes on these transistorized cars, right? But a new TFI module has been installed. We remove the bridge connector from the harness near the distributor and check base timing. Sure enough, the base timing is 12 degrees retarded, and the distributor is loose.



5 Removing the bridge connector stopped computer control of the timing advance, and placed the timing in base mode. We adjust the base timing to the spec on the under hood sticker (in this case, 10 degrees BTDC). Then we reinstall the plug and check to make sure the ECA is advancing the timing.

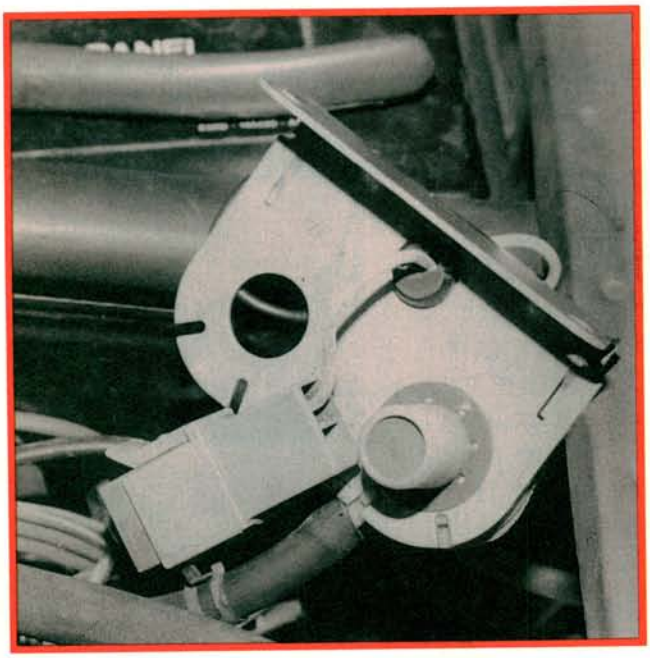


6 The ECA is computing and adjusting the timing advance as we rev the engine. We test drive the car and are really excited about the improvement in low and midrange performance — right up until the turbo boost really kicks in. We still get a cloud of pure black exhaust smoke at this point.

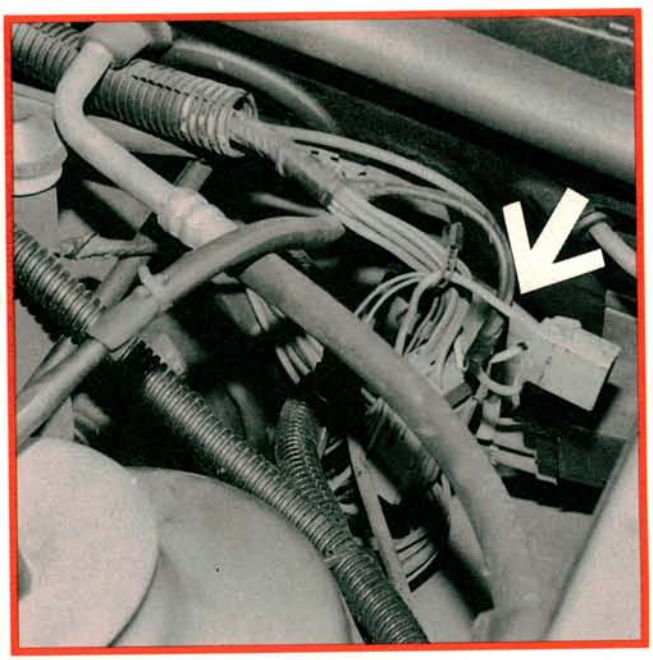


7 It's time to hook up the breakout box and start pin out tests. We're especially concerned with inputs which affect injector ON time, and do a pin-by-pin test of PIP, TP, and ECT inputs. We also check the Baro sensor frequency signal. But once again, each input value is at the recommended spec.

8 The Baro sensor has us wondering, however. This particular sensor is Baro and Baro only. It's not connected to the manifold at all. The ECT senses WOT from the TP and high tach from the PIP signal, but how does it sense boost? A thorough search of our wiring diagram offers no clues.



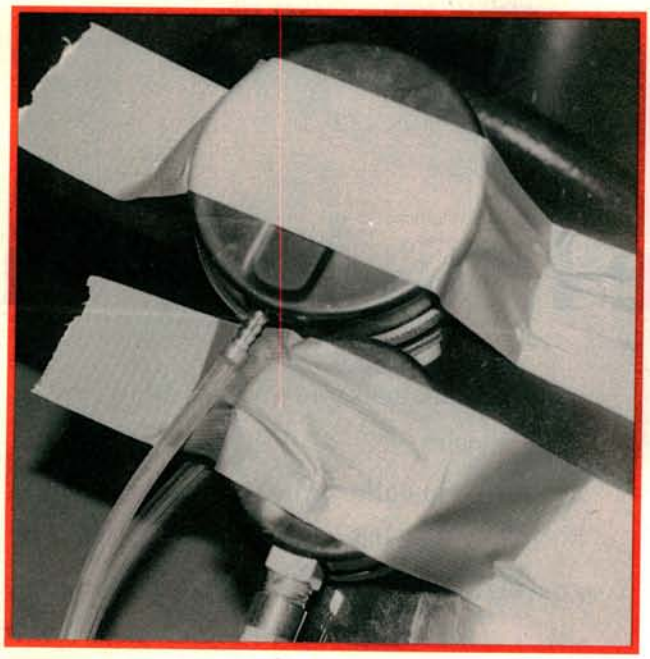
9 Out under the hood we start looking for anything and everything connected to manifold vacuum. Then we see a small vacuum switch on the left inner fender — and it's connected to manifold vacuum. We remove it and find that it's a simple switch-to-ground with one hose and one output wire.



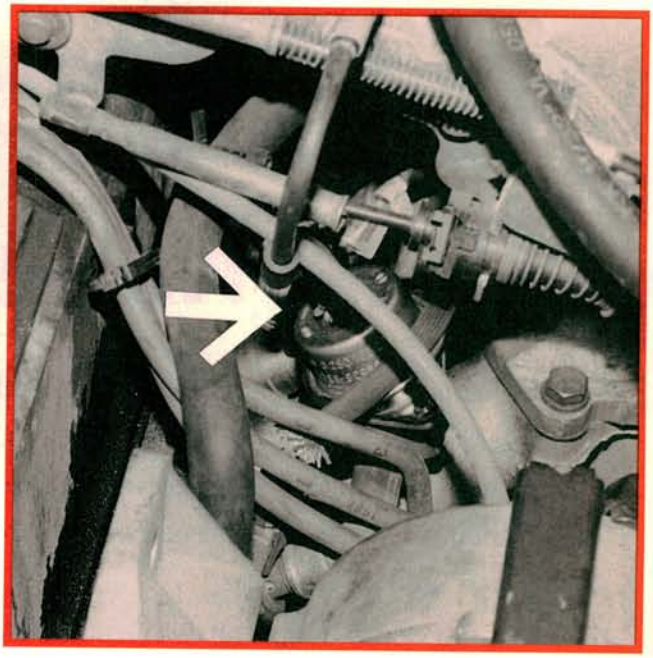
10 More research in a troubleshooting guide tells us that Ford likes the color Brown/Yellow for MAP wires. Sure enough, that's the color of the harness wire to the switch (arrow). We trace it back to terminal 34 at the ECA, which the wiring diagram says isn't used on this car.

11 We connect an ohmmeter to the switch, and exercise the switch's diaphragm with a vacuum/pressure pump, but the switch remains open. The parts man at the dealership says the part isn't used on our car, and we're forced to dig through the parts fiche until we find it on another car.

12 After installing the new switch, we drive the car, and for the first few miles we think we have it licked. But suddenly, out of nowhere, we get one last cloud of black smoke — much smaller, but it tells us that something still isn't right. The soot in the tailpipe confirms our worst suspicions.



13 EEC! We tape fuel pressure and vacuum gauges to the windshield, and a co-pilot monitors inputs at the breakout box while I drive. Sure we're tired of checking the same stuff again, but there doesn't seem to be much choice at the moment. We're rounding third, but aren't home yet.



14 We've checked fuel pressure repeatedly, and never found a problem. Then it happens. Regulated pressure shoots to 90 PSI — and then returns to normal — twice. The darned fuel pressure regulator is also bad, and it's sticking intermittently. A new regulator settles the issue, once and for all.