Chapter 12

Trouble Codes, Electrical Tests, and Wiring Diagrams

Contents

12

1. INTRODUCTION

These electrical tests and wiring diagrams will help you in your diagnosis and troubleshooting. Use them along with the diagnosis and troubleshooting procedures detailed in Chapter 10 and Chapter 11.

The information can help you answer the question, when there is a trouble code, whether the component, the wiring, or the control unit is at fault.

For example, let's say that during diagnosis, you run Quick Test and get a trouble code 21 or 116. This means that there is a fault in the Engine Coolant Temperature (ECT) circuit. Using the electrical tests and the wiring diagrams, you can check ECT resistance, you can check voltage in the circuit with Key On Engine Off (KOEO), and you can check wiring harness continuity from the ECT to the control unit. See Fig. 1.

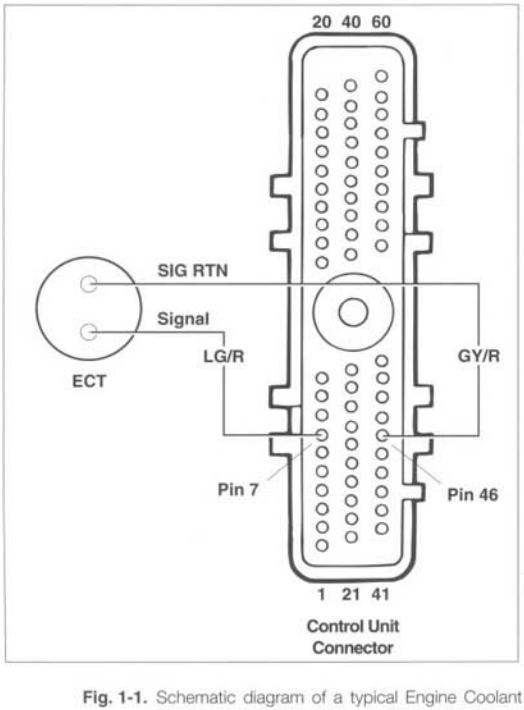

Fig. 1-1. Schematic diagram of a typical Engine Coolant Temperature (ECT) sensor circuit. Disconnect harness connector from sensor to test sensor resistance. Disconnect control unit connector to check wiring continuity to sensor connector.

CAUTION —
Do not probe harness connectors from the front. The connector sockets may be damaged by the probe. Test only by using an appropriate breakout box (BOB) or by backprobing the connector.

The electrical tests and wiring diagrams are divided into two parts, by engine control system. As I've discussed, most Ford/Lincoln-Mercury vehicles operate with Ford EEC-IV systems, while most Probes, Escort/Tracers with 1.8L engines, Capri and Festiva use MECS. The first part is for all 1988 and later Ford and Lincoln-Mercury vehicles employing EEC-IV electronic engine control systems. The second part is for all 1989 and later Ford vehicles employing Mazda Engine Control System (MECS).

1.1 Terminology

Beginning in 1993, some of the names of the engine-control components were changed to comply with the SAE standardization J1930, in order to provide common terms for the same general part throughout the automotive industry. For more information on terminology changes, see Chapter 1. This chapter uses the terminology applicable for the years 1988–1992. For reference, **Table a** lists those terms and their equivalents that changed in 1993.

Table a. 1993 and Later J1930 Terms

1988–1992 Term	1993 Equivalent
Air Charge Temperature (ACT)	Intake Air Temperature (IAT)
Barometric Pressure (BP)	BARO
Check Engine Light (CEL)	Malfunction Indicator Light (MIL)
Control Module/Electronic Control Assembly (ECA)	Powertrain Control Module (PCM)
Crankshaft Position Sensor (CPS)	CKP
Distributorless Ignition System (DIS)	Electronic Ignition (EI)—Low Data Rate
DIS / EDIS / TFI Module	Ignition Control Module (ICM)
Electro-drive Fan (EDF)	Low Fan Control (LFC)
Electronic Distributorless Ignition (EDIS)	Electronic Ignition (EI)—High Data Rate
Heated Exhaust Gas Oxygen (HEGO)	Heated Oxygen Sensor (HO2S)
High-speed Electro-drive Fan (HEDF)	High Fan Control (HFC)
Idle Speed Control (ISC)	Idle Air Control (IAC)
Inertia Switch (IS)	Inertia Fuel Shut-Off Switch (IFS)
Intake Air Control (IAC)	Intake Manifold Runner Control (IMRC)
Integrated Relay Control Module (IRCM)	Constant Control Relay Module (CCRM)
Profile Ignition Pickup (PIP)	CKP
Self-Test Connector (STC)	Data Output Line (DOL)
Self-Test Output (STO)	Data Link Connector (DLC)

continued on next page

Table a. 1993 and Later J1930 Terms (cont'd)

1988–1992 Term	1993 Equivalent
Spark Angle Word (SAW)	Spark Output (SPOUT)
Thermactor Air–Bypass (TAB)	Air Injection Reaction Bypass (AIRB)
Thermactor Air–Diverter (TAD)	Air Injection Reaction Diverter (AIRD)
Thick Film Integrated-IV (TFI-IV) Ignition	Distributor Ignition (DI)
Vane Air Temperature (VAT)	Intake Air Temperature (IAT)
Variable Reluctance (VRIS)	Crankshaft Position (CKP)

1.2 *Using the Trouble Code Tables*

As you saw in Chapter 10, all Ford vehicles store and read out trouble codes—numerical representations of faults detected in the engine control system. The trouble code tables will tell you what the numbers mean.

For example, a 2-digit numerical code **21** indicates that when the control module tested the Engine Coolant Temperature sensor (ECT), it found that ECT resistance was not what was expected (out of Self-Test range).

Earlier Ford vehicles with EEC-IV engine control systems have 2-digit trouble codes. More current EEC-IV systems have more complex engine controls. They need 3-digit codes to cover all of the complexities. All Ford vehicles with Mazda Engine Control Systems (MECS) have 2-digit trouble codes.

1.3 Using the Electrical Tests

The electrical tests are arranged in alphabetical order, by component or system repair group acronym. Thus for a trouble code indicating an ECT circuit fault, you would turn to the electrical test repair group with the head **ECT**.

Each electrical test repair group contains information on circuit operation, troubleshooting, component location, wire color, and electrical test results (voltage or resistance). For pin out numbers (the control unit terminals where the wires lead), see the applicable wiring diagram for the engine.

1.4 Using the Wiring Diagrams

The wiring diagrams are arranged by engine family and year, with model differences noted where applicable. Vehicle Identification Number (VIN) codes help you further determine which is the correct diagram for your engine. Where engines may be the same from one year to the next, they are covered by one diagram.

Remember that Ford engines with a similar displacement may have a different air flow sensor type, either Mass Air Flow (MAF) or Manifold Air Pressure (MAP). The MAF sensor is clearly visible, while the MAP sensor is usually on the bulkhead. Some engines are also Sequential Fuel Injection (SFI), but you cannot tell sequential-injection engine controls from the outside. To know whether the engine is SFI you must check the VIN code. The VIN check digit is usually the **8th** digit. See Fig 1-2.

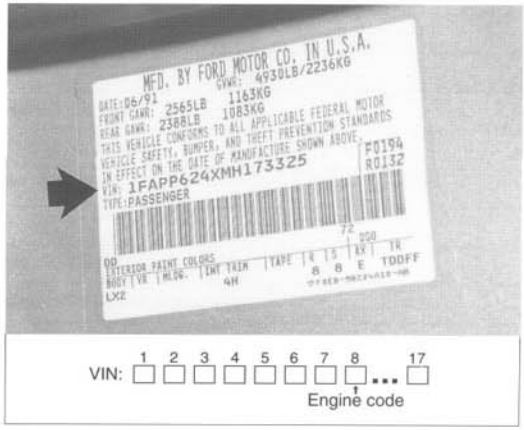

Fig. 1-2. VIN, shown here on door jamb, will help you identify engine in your car. Look for eighth digit in VIN.

In a few cases, the installation of Automatic Transmissions or Transaxles makes a difference. Look for Automatic Transaxle OverDrive Electronic (AXODE), Electronic 4-speed OverDrive (E4OD), and 4-speed Electronic Automatic Transaxle (4EAT). All of these differences are noted in the wiring diagram header.

For 1988-92 Mazda Engine Control System (MECS) vehicles, look for the Vane Air Flow (VAF) sensor. I caution you again that on the 1993 and later Probe 2.0L with automatic transaxle (4EAT) you'll find MECS, while with manual (MTX) you'll find EEC-IV.

Notice the form of the wiring diagrams differs slightly. Beginning in 1992, diagrams are simplified, eliminating the wires to the connectors, but all pin outs are still numbered to help you in your troubleshooting.

Finally, remember that engines that look the same outside can operate with different engine controls. They can even be different displacements, as with 3.8L and 3.0L, so be sure of the engine size and fuel injection type in your vehicle before you begin any servicing.

2-Digit Trouble Codes (EEC-IV)

EEC-IV 2-Digit Trouble Codes

Code	Conditions			Definition
11	O	R	C	System PASS
12		R		Cannot control rpm during ER Self-Test high rpm check
13		R		Cannot control rpm during ER Self-Test low rpm check
14			C	PIP circuit failure
15	O			EEC [PCM*] Read Only Memory (ROM) test failed
			C	EEC [PCM*] Keep Alive Memory (KAM) test failed
16	O			Ignition Diagnostic Monitor (IDM) signal not received
		R		RPM too low to perform HEGO [H02S*] test
17		R		RPM below Self-Test limit with ISC off
18		R		SPOUT circuit open or Spark Angle Word (SAW) circuit failure
			C	Loss of tach input / IDM circuit failure / SPOUT circuit grounded
19	O			Failure in EEC [PCM*] internal voltage
		R		RPM erratic, dropped too low during test
			C	Cylinder Identification (CID) circuit failure
21	O	R		ECT out of Self-Test range
22	O	R	C	MAP/BP [BARO*] out of Self-Test range
23	O	R	C	TP out of Self-Test range
24	O	R		ACT [IAT*] or VAT input out of Self-Test range
25		R		KS signal is not sensed in Dynamic Response Test
26	O	R		MAF or VAF input out of Self-Test range Transmission Oil Temperature (TOT) sensor out of Self-Test range (4.9L, 5.0L truck)
28	O	R		VAT sensor out of Self-Test range
			C	Loss of primary tach (IDM)—right side
29			C	Insufficient input from the Vehicle Speed Sensor (VSS)
31	O	R	C	EVP or PFE circuit below minimum voltage
32		R		EGR not controlling (2.3L MAP)
		R	C	EGR valve not seated
	O	R	C	EVP voltage below closed limit (SONIC) / EPT circuit voltage low (PFE)
33		R	C	EGR valve opening not detected
34		R		EGR valve opening not detected (2.3L MAP)
	O	R	C	Insufficient EGR flow / Excessive exhaust back pressure; or EVP voltage above closed limit (SONIC) / PFE sensor voltage high or out-of-range

KEY: O = Key On Engine Off (KOEO), R = Engine Running (ER), C = Continuous Memory

*1993 and later terminology

continued on next page

2-Digit Trouble Codes (EEC-IV)

EEC-IV 2-Digit Trouble Codes (continued)

Code	Conditions			Definition
35		R		RPM too low for EGR test (2.3L MAP)
	O	R	C	EVP / PFE circuit above maximum voltage
39			C	AXOD converter bypass clutch not applying properly
41		R		HEGO [H02S*] circuit indicates system lean (right H02S)
			C	No HEGO [H02S*] switch detected—always lean (right H02S)
42		R		HEGO [H02S*] circuit indicates system rich (right H02S)
			C	No HEGO [H02S*] switch detected—always rich
43			C	HEGO [H02S*] lean at wide open throttle
44		R		Secondary Air Injection system inoperative (right side)
45		R		Secondary Air Injection upstream during Self-Test
			C	DIS coil pack 3 circuit failure or Coil 1 primary circuit failure
46		R		Secondary Air Injection not bypassed during Self-Test
			C	DIS coil pack 1 circuit failure or Coil 2 primary circuit failure
47	O			4 x 4 switch is closed (E4OD)
		R		Measured air flow low at base idle
48		R		Measured air flow high at base idle
			C	DIS coil pack 2 circuit failure or loss of secondary tach (IDM)—left side; Coil 3 primary circuit failure
49			C	SPOUT signal defaulted to 10 degrees BTDC or 1-2 shift error (E4OD)
51	O		C	ECT sensor fault or circuit open
52	O			PSPS [PSP*] circuit is open
		R		PSPS always staying open or closed
53	O		C	TP circuit above maximum voltage
54	O		C	ACT [IAT*] or VAT sensor fault, circuit open
55		R		Key power input to processor is open
56	O		C	MAF or VAF circuit above maximum voltage TOT sensor failure or circuit grounded (4.9L truck)
57	O			Octane Adjust service pin in use / circuit grounded
			C	AXOD Neutral Pressure Switch NPS circuit failed open
58	O		C	VAT indicated -40° F/ circuit open (1.9L VAF)
59	O			AXOD 4/3 pressure switch circuit failed closed or Idle adjust service pin in use (2.9L MAP)
	C		C	AXOD 4/3 pressure switch circuit failed open or 2-3 shift error (E4OD)
	O		C	Low speed fuel pump circuit failure

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*1993 and later terminology

continued on next page

2-Digit Trouble Codes (EEC-IV)

EEC-IV 2-Digit Trouble Codes (continued)

Code	Conditions			Definition
61	O		C	ECT sensor fault, or circuit grounded
62	O			AXOD 4/3 or 3/2 pressure switch circuit failed closed
			C	Converter clutch error (E4OD)
63	O		C	TP circuit below minimum voltage
64	O		C	ACT [IAT*] or VAT sensor fault, or circuit grounded
65		R		Overdrive Cancel Switch (OCS) not changing state (E4OD)
			C	Never went to closed loop fuel
66		R	C	MAF or VAF circuit below minimum voltage
	O		C	TOT sensor input is less than Self-Test minimum or VAF circuit below minimum voltage (E4OD)
67	O			Neutral Pressure Switch (NPS) circuit open (3.0L MAP, 3.0L MAF-SFI, 3.8L SFI)
			C	Clutch switch circuit failure
	O	R		Neutral Drive Switch (NDS) circuit open; A/C input high
	O		C	Manual Lever Position (MLP) sensor out of range; A/C input high (4.9L MAP, 5.8L MAP)
68	O		C	VAT circuit grounded
	O	R	C	AXOD Transmission Temperature Switch (TTS) failed open
69	O			AXOD 4/3 or 3/2 pressure switch circuit failed closed
			C	AXOD 4/3 or 3/2 pressure switch circuit failed open; 3-4 shift error (E4OD)
70			C	EEC-IV data transmission circuit failed (DCL)
71			C	Software re-initialization detected or Cluster Control Assembly (CCA) circuit failed
72			C	Power interrupt detected or Message Center Control Assembly (MCCA) circuit failed
		R		Insufficient MAP / BP or MAF output change during Dynamic Response Test
73	O			Insufficient throttle position change
		R		Insufficient TP output change during Dynamic Response Test
74		R		BOO brake on/off circuit failure--not actuated during test
75		R		BOO brake on/off circuit closed--always high
76		R		Insufficient VAF output change during Dynamic Response Test
77		R		Brief WOT not sensed during Self-Test / Operator error
79	O			A/C on / Defrost on during Self-Test
81	O			Insufficient Idle Air Solenoid (IAS) output voltage change when activated (3.0L MAF-SFI) Secondary Air Injection Diverter AM2 [AIRD*] solenoid circuit failure
82	O			Secondary Air Injection Bypass AM1 [AIRB*] solenoid circuit failure Supercharger bypass circuit failure (3.8L MAF-SFI SC)

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*1993 and later terminology

continued on next page

2-Digit Trouble Codes (EEC-IV)

EEC-IV 2-Digit Trouble Codes (continued)

Code	Conditions			Definition
83	O			EGRC solenoid circuit failure (2.3L MAP)
	O			High speed electro-drive fan HEDF [HFC*]circuit failure
	O		C	Low speed fuel pump relay circuit open (3.0L MAF-SFI)
84	O	R		EGR Vacuum Regulator (EVR) circuit failure
85			C	Adaptive fuel lean limit reached
	O	R		Canister Purge (CANP) circuit failure
86	O		C	Adaptive fuel rich limit reached Adaptive fuel limit reached or 3-4 Shift Solenoid circuit failure
87	O	R	C	Fuel pump primary circuit failure
88	O			Electro-drive fan EDF [FC*] circuit failure
			C	Loss of dual plug input control
89	O			AXOD Lock-Up Solenoid LUS circuit failed or Clutch Converter Override (CCO) circuit failure
91	O			Shift Solenoid 1 (SS1) circuit failure
		R		HEGO [H02S*] circuit indicates system lean (left H02S)
			C	No HEGO [H02S*] switching detected (left H02S)
92	O			Shift Solenoid 2 (SS2) circuit failure
		R		HEGO [H02S*] circuit indicates system rich (left H02S)
93	O			TP sensor input low at maximum D.C. motor extension Coast Clutch Solenoid (CCS) circuit failure (E4OD)
94	O			Converter Clutch Control (CCC) solenoid circuit failure
		R		Secondary Air Injection system inoperative (left side)
95	O		C	Fuel pump secondary circuit failure
96	O		C	High speed fuel pump relay circuit open; Fuel pump secondary circuit failure
97	O			Overdrive Cancel Indicator Light (OCIL) circuit failure
98	O			Electronic Pressure Control (EPC) driver failure in processor
		R		Hard fault is present - FMEM mode
99	O		C	Electronic Pressure Control (EPC) circuit failure
		R		EEC system has not learned to control idle
No Codes				Unable to initiate Self-Test or unable to output code
Codes Not Listed				Codes displayed are not applicable to the vehicle being tested
KEY: O = Key On Engine Off (KOEO), R = Engine Running (ER), C = Continuous Memory				

*1993 and later terminology

3-Digit Trouble Codes (EEC-IV)

EEC-IV 3-Digit Trouble Codes

Code	Conditions			Definition
111	O	R	C	System Pass
112	O		C	Air Charge Temp ACT [IAT*] Sensor circuit below minimum voltage/ 254°F indicated
113	O		C	Air Charge Temp ACT [IAT*] Sensor circuit above maximum voltage/ -40°F indicated
114	O	R		Air Charge Temp ACT [IAT*] higher or lower than expected during KOEO, ER
116	O	R		Engine Coolant Temp (ECT) higher or lower than expected during KOEO, ER
117	O		C	Engine Coolant Temp (ECT) Sensor circuit below minimum voltage/ 254°F indicated
118	O		C	Engine Coolant Temp (ECT) Sensor circuit above maximum voltage/ -40°F indicated
121	O	R	C	Closed Throttle Voltage higher or lower than expected
122	O		C	Throttle Position (TP) Sensor circuit below minimum voltage
123	O		C	Throttle Position (TP) Sensor circuit above maximum voltage
124			C	Throttle Position (TP) Sensor voltage higher than expected
125			C	Throttle Position (TP) Sensor voltage lower than expected
126	O	R	C	MAP or BP [BARO*] Sensor higher or lower than expected
128		R		MAP vacuum circuit failure
129		R		Insufficient Mass Air Flow (MAF) change during Dynamic Response Test
136		R		HEGO [HO2S-2*] sensor circuit indicates system always lean
137		R		HEGO [HO2S-2*] sensor circuit indicates system always rich
139			C	No Oxygen Sensor (HEGO) [HO2S-2*] Switches detected
144			C	No Oxygen Sensor (HEGO) [HO2S-1*] Switches detected
157			C	Mass Air Flow (MAF) Sensor circuit below minimum voltage
158	O		C	Mass Air Flow (MAF) Sensor circuit above maximum voltage
159	O	R		Mass Air Flow (MAF), higher or lower than expected during KOEO, ER
167		R		Insufficient Throttle Position change during Dynamic Response Test
171			C	Fuel system at adaptive limits, Oxygen Sensor (HEGO) [HO2S-1*] unable to switch
172		R	C	Lack of Oxygen Sensor (HEGO) [HO2S-1*] Switches, indicates lean
173		R	C	Lack of Oxygen Sensor (HEGO) [HO2S-1*] Switches, indicates rich
174			C	HEGO switching time is slow
175			C	Lack of Oxygen Sensor (HEGO) [HO2S-2*] switching, fuel system at adaptive limits (front side)
176			C	HEGO [HO2S-2*] sensor circuit indicates system always lean (Front side)
177			C	HEGO [HO2S-2*] sensor circuit indicates system always rich (Front side)
178			C	HEGO switching time is slow
179			C	Fuel system at lean adaptive limit at part throttle, system rich

KEY: O - Key On Engine Off (KOEO) R = Engine Running (ER) C = Continuous Memory

*1993 and later terminology

continued on next page

3-Digit Trouble Codes (EEC-IV)

EEC-IV 3-Digit Trouble Codes (continued)

Code	Conditions			Definition
181			C	Fuel system at rich adaptive limit at part throttle, system lean
182			C	Fuel system at lean adaptive limit at idle, system rich
183			C	Fuel system at rich adaptive limit at idle, system lean
184			C	Mass Air Flow (MAF) higher than expected
185			C	Mass Air Flow (MAF) lower than expected
186			C	Injector pulse width higher than expected
187			C	Injector pulse width lower than expected
188			C	Fuel system at part throttle lean adaptive limit, system rich
189			C	Fuel system at part throttle rich adaptive limit, system lean
191			C	Fuel system at idle lean adaptive limit, system rich
192			C	Fuel system at idle rich adaptive limit, system lean
211			C	Profile Ignition Pickup (PIP) circuit failure
212			C	Loss of Ignition Diagnostic Monitor (IDM) input to ECA/ SPOUT circuit grounded
213		R		SPOUT circuit open
214			C	Cylinder Identification (CID) circuit failure
215			C	EEC [PCM*] Processor detected Coil 1 primary circuit failure
216			C	EEC [PCM*] Processor detected Coil 2 primary circuit failure
217			C	EEC [PCM*] Processor detected Coil 3 primary circuit failure
218			C	Loss of Ignition Diagnostic Monitor (IDM) signal-left side
219			C	SPOUT signal defaulted to 10 degrees BTDC/SPOUT circuit open
222			C	Loss of Ignition Diagnostic Monitor (IDM) signal-right side
223			C	Loss of Dual Plug Inhibit (DPI) control
224			C	Erratic Ignition Diagnostic Monitor (IDM) input to processor
225		R		Knock not sensed during Dynamic Response Test
226	O			Ignition Diagnostic Monitor (IDM) signal not received
311		R		Thermactor [AIR*] air system inoperative (right side)
312		R		Thermactor [AIR*] air upstream during Self-Test
313		R		Thermactor [AIR*] air not bypassed during Self-Test
314		R		Thermactor [AIR*] air system inoperative (left side)
326		R	C	PFE/DPFE [EGR*] sensor circuit voltage lower than expected
327	O	R	C	PFE/DPFE [EGR*] circuit below minimum voltage
328	O	R	C	EGR closed valve voltage lower than expected
KEY: O - Key On Engine Off (KOEO) R = Engine Running (ER) C = Continuous Memory				

*1993 and later terminology

continued on next page

3-Digit Trouble Codes (EEC-IV)

EEC-IV 3-Digit Trouble Codes (continued)

Code	Conditions			Definition
332		R	C	Insufficient EGR flow detected
334	O	R	C	EGR closed-valve voltage higher than expected
335	O			PFE/DPFE [EGR*] sensor voltage out of Self-Test range
336		R	C	PFE [EGR*] sensor circuit voltage higher than expected
337	O	R	C	PFE/DPFE [EGR*] circuit above maximum voltage
338			C	Engine coolant temperature [ECT*] lower than normal
339			C	Engine coolant temperature [ECT*] higher than normal
341	O			Octane Adjust Service Pin in use or circuit open
411		R		Cannot control rpm during ER low rpm check
412		R		Cannot control rpm during ER high rpm check
452			C	Insufficient input from Vehicle Speed Sensor (VSS)
511	O			EEC [PCM*] Processor Read Only Memory (ROM) test failure
512			C	EEC [PCM*] Processor Keep Alive Memory (KAM) test failure
513			C	Failure in EEC [PCM*] processor internal voltage
519	O			Power Steering Pressure Switch PSPS [PSP*] circuit open
521		R		Power Steering Pressure Switch PSPS [PSP*] circuit did not change states
522	O			Vehicle not in PARK or NEUTRAL [PNP*] during KOEO
524	O		C	Low speed fuel pump circuit open (battery to ECA)
525	O			Vehicle was either in gear or AC was on during Self-Test
526	O			Neutral Pressure Switch NPS [PNP*] circuit closed; A/C on
527	O			Neutral Drive Switch NDS [PNP*] circuit open/ A/C on
528			C	Clutch Switch Circuit failure
529			C	Data Communications Link DCL or EEC [PCM*] processor circuit failure
533			C	Data Communications Link DCL or Electronics Instrument Cluster (EIC) circuit failure
536		R	C	Brake On/Off (BOO) circuit failure / not actuated during ER
538		R		Insufficient RPM change during ER Dynamic Response Test or operator error
539	O			AC On/Defrost ON during KOEO
542	O		C	Fuel Pump secondary circuit failure
543	O		C	Fuel Pump secondary circuit failure
551	O			IAS [IAC*] circuit failure
552	O			Air management 1 AM1 [AIRB*] circuit failure
553	O			Air management 2 AM2 [AIRB*] circuit failure

KEY: O - Key On Engine Off (KOEO) R = Engine Running (ER) C = Continuous Memory

*1993 and later terminology

continued on next page

3-Digit Trouble Codes (EEC-IV)

EEC-IV 3-Digit Trouble Codes (continued)

Code	Conditions			Definition
554	O			Fuel Pressure Regulator Control (FPRC) solenoid circuit failure
556	O		C	Fuel Pump Relay primary circuit failure
557	O		C	Fuel Pump primary circuit failure
558	O			EGR Vacuum Regulator (EVR) circuit failure
559	O			Air Conditioning ON (ACON) relay circuit failure
563	O			High Speed Electro-Drive Fan HEDF [HFC*] circuit failure
564	O			Electro-Drive Fan EDF [FC*] circuit failure
565	O			Canister Purge (CANP) circuit failure
566	O			3-4 Shift Solenoid circuit failure
617			C	1-2 shift error (E40D)
618			C	2-3 shift error (E40D)
619			C	3-4 shift error (E40D)
621	O			Shift Solenoid #1 (SS1) circuit failure
622	O			Shift Solenoid #2 (SS2) circuit failure
624	O		C	Electronic Pressure Control (EPC) solenoid or driver circuit failure
625	O			Electronic Pressure Control (EPC) driver open in ECA
626	O			Coast Clutch Solenoid (CCS) circuit failure (E40D)
627	O		C	Converter Clutch Control solenoid circuit failure
628	O		C	Lock-Up Solenoid (LUS) failure, excessive clutch slippage
629	O			Converter Clutch Control circuit failure or Lock-Up Solenoid (LUS) circuit failure
631	O			Overdrive Cancel Indicator Light (OCIL) circuit failure
632		R		Overdrive Cancel Switch (OCS) not changing state (E40D)
633	O			4 x 4 switch is closed (E40D)
634			C	Manual Lever Position (MLP) sensor voltage out of Self-Test range or A/C on (E40D)
636	O	R		Transmission Oil Temperature (TOT) sensor voltage out of Self-Test range
637	O		C	Transmission Oil Temperature (TOT) sensor voltage out of Self-Test maximum
638	O		C	Transmission Oil Temperature (TOT) sensor voltage below Self-Test minimum
639		R	C	Insufficient input from the Transmission Speed Sensor (TSS)
641	O			Shift solenoid #3 (SS3) circuit failure
643	O		C	Converter Clutch Control (CCC) circuit failure
645			C	Incorrect gear ratio obtained for first gear
646			C	Incorrect gear ratio obtained for second gear

KEY: O - Key On Engine Off (KOEO) R = Engine Running (ER) C = Continuous Memory

*1993 and later terminology

continued on next page

3-Digit Trouble Codes (EEC-IV)

EEC-IV 3-Digit Trouble Codes (continued)

Code	Conditions			Definition
647			C	Incorrect gear ratio obtained for third gear
648			C	Incorrect gear ratio obtained for fourth gear
649			C	Electronic Pressure Control (EPC) range failure
651			C	Electronic Pressure Control (EPC) circuit failure
652	O			Modulated Converter Clutch Control (MCCC) solenoid output circuit error
654				MLP sensor not in Park position
656				Converter Clutch Control (CCC) continuous slip error detected
998 r				Hard fault present (FMEM mode)
NO CODES				Unable to initiate Self-Test or unable to output Self-Test codes
CODES NOT LISTED				Service codes displayed are not applicable to the vehicle being tested
KEY: O - Key On Engine Off (KOEO) R = Engine Running (ER) C = Continuous Memory				

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MECS Trouble Codes

MECS Trouble Codes

Code	Definition
01	Ignition Diagnostic Monitor (IDM) or Crankshaft Position Sensor (CKP)
02	Crankshaft Position Sensor #2 (CKP2)
03	Cylinder Identification (CID) Sensor
04	Crankshaft Position Sensor #1 (CKP1)
05	Knock Sensor (KS)
06	Vehicle Speed Sensor (VSS)
08	Volume Air Flow (VAF) or Measuring Core Volume Air Flow (MC-VAF) Sensor
09	Engine Coolant Temperature (ECT) Sensor
10	Intake Air Temperature (IAT) Sensor
12	Throttle Position (TP) Sensor
14	Barometric Pressure (BARO) Sensor
15	(Left) Heated Oxygen Sensor (LHO2S) Voltage Always Below 0.55V
16	EGR Valve Position (EVP) Sensor
17	(Left) Heated Oxygen Sensor (LHO2S) Voltage Does Not Change
23	Right Heated Oxygen Sensor (RHO2S) Voltage Always Below 0.55V
24	Right Heated Oxygen Sensor (RHO2S) Voltage Does Not Change
25	Fuel Pressure Regulator Control (FPRC) Solenoid
26	Canister Purge (CANP) Solenoid
28	EGR Control (EGRC) Solenoid
29	EGR Vent (EGRV) Solenoid
34	Idle Air Control (IAC) Solenoid
41	Variable Resonance Induction System (VRIS) Solenoid #1 or High Speed Inlet Air (HSIA) solenoid
42	Turbocharger Boost Control Solenoid (BOOST)
46	Variable Resonance Induction System (VRIS) Solenoid #2
55	Pulse Shift Generator (PSG)
56	Transmission Oil Temperature (TOT) sensor
57	Reduce Torque Signal #1 (RTS1) (to PCM)
58	Reduce Torque Signal #2 (RTS2) (to PCM)
59	Torque Reduce / Engine Coolant Temperature Signal (TRS) (from PCM)
60	1-2 Shift Solenoid (SS1)
61	2-3 Shift Solenoid (SS2)
62	3-4 Shift Solenoid (SS3)
63	Torque Converter Clutch Control (TCCC) Solenoid

*1993 and later terminology

continued on next page

MECS Trouble Codes

MECS Trouble Codes (continued)

Code	Definition
64	Downshift Solenoid (DSS)
65	Torque Converter Clutch (TCC) Solenoid
66	Line Pressure Solenoid (LPS)
67	Low Cooling Fan (LFAN) Relay
69	Cooling Fan Engine Coolant Temperature (ECTF) Sensor
STO LO always ON	Not able to initiate diagnostic test mode
STO LO always ON and no codes (Blank SUPER STAR II)	Pass Code

n next page

ACT (EEC-IV)

Circuit Description

Air Charge Temperature (ACT*) sensor provides information about intake air temperature. It is a thermistor, in series with a fixed resistor in the control unit. Its resistance changes with temperature. Voltage in the circuit is equal to VREF minus the voltage drop across the fixed resistor and the ACT. For more information see Chapter 4.

An open between the ACT and the control module will result in a constant 5.0 volt signal. A short will result in approximately 0 volts in the circuit. Corrosion in the circuit at terminal connections results in higher-than-normal voltage due to the voltage drop.

ACT Circuit Wire Color

	1988	1989	1990	1991	1992	1993–On
Engine Family	**Wire color**					
Car						
1.9L MA SFI	—	—	W/GR	W/GR	W/GR	W/GR
2.0L MA SFI	—	—	—	—	W/LG	W/LG
2.3L OHC MFI	LG/P	LG/R	LG/R	GY	GY	GY
2.3L MA MFI	—	—	L/GR	—	—	—
2.3L MFI TURBO	PK/BK	—	—	—	—	—
2.3L HSC MFI	LG/P	LG/P	LG/P	LG/P	GY	GY
2.5L AXODE SFI	—	—	—	LG/P	—	—
2.9L MFI	—	—	BR/Y	—	—	—
3.0L MFI	LG/P	LG/P	Probe Y all others LG/P	Y	Y	—
3.0L MA SFI	—	—	—	—	GY	GY
3.0L AXODE SFI	—	—	—	LG/P	LG/P	GY
3.0L SHO SFI	—	LG/P	LG/P	LG/P	GY	GY
3.2L SHO SFI	—	—	—	—	—	GY
3.8L MFI AXOD	LG/P	LG/P	LG/P	Taurus/Sable LG/P Continental GY	Taurus/Sable LG/P Continental GY	GY
3.8L RWD MFI	LG/P	LG/P	LG/P	LG/P	LG/P	GY
3.8L SC SFI	—	LG/P	LG/P	LG/P	LG/P	GY
4.6L SFI	—	—	—	LG/P	Crown Victoria/ Marquis LG/P Town Car GY	GY
4.6L 4V	—	—	—	—	—	GY
5.0L SFI	LG/P	LG/P	LG/P	LG/P	GY	
5.0L MAF SFI	LG/P	LG/P	LG/P	Mustang GY all others LG/P	GY	GY
Truck						
2.3L MFI	Y/R	Y/R	Y/R	GY	GY	GY
2.9L MFI	LG/P	LG/P	LG/P	GY	GY	GY
2.9L MAF MFI	—	—	LG/P	—		—
3.0L MFI	LG/P	LG/P	LG/P	LG/P		—
3.0L MAF MFI	—	—	—	GY	GY	GY
4.0L MAF MFI	—	—	LG/P	Aerostar LG/P Ranger/Exp. GY	GY	GY GY
4.9L MFI	Y/R	Y/R	F-series, Bronco G/Y E-series Y/R	F-series, Bronco G/Y E-series Y/R	GY	GY
Wiring Color Code	BK–Black, BL–Blue, BR–Brown, DB–Dark Blue, DG–Dark Green, GR–Green, GY–Gray, LB–Light Blue, LG–Light Green, N–Natural, O–Orange, P–Purple, PK–Pink, R–Red, T–Tan, W–White, Y–Yellow					

continued on next page

*1993 and later called IAT—see glossary

ACT (EEC-IV)

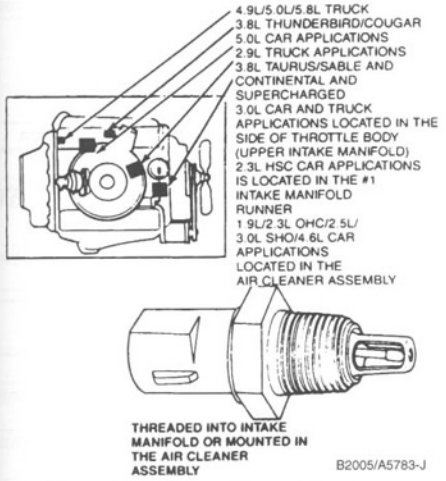
ACT Circuit Wire Color (continued)

	1988	1989	1990	1991	1992	1993–On
Engine Family	**Wire color**					
5.0L MFI	Y/R	Y/R	F-series, Bronco G/Y E-series Y/R	F-series, Bronco G/Y E-series Y/R	GY	GY
5.8L MFI	Y/R	Y/R	F-series, Bronco G/Y E-series Y/R	F-series, Bronco G/Y E-series Y/R	GY	GY
Wiring Color Code	BK–Black, BL–Blue, BR–Brown, DB–Dark Blue, DG–Dark Green, GR–Green, GY–Gray, LB–Light Blue, LG–Light Green, N–Natural, O–Orange, P–Purple, PK–Pink, R–Red, T–Tan, W–White, Y–Yellow					

ACT Sensor Tests

Test	Conditions	Test Results	If Not
Sensor resistance	–Disconnect sensor connector –Measure across sensor terminals	See table below	Sensor may be faulty
Circuit voltage	–Sensor connected –KOEO	See table below	Wiring to control unit or control unit faulty

Component Locator



Test Data

ACT SENSOR DATA

Voltage values calculated for VREF = 5.0v (These values may vary ± 15% due to sensor and VREF variations)

TEMPERATURE °F	TEMPERATURE °C	VOLTAGE Volts	RESISTANCE K ohms
248	120	0.28	1.18
230	110	0.36	1.55
212	100	.47	2.07
194	90	.61	2.80
176	80	.80	3.84
158	70	1.04	5.37
140	60	1.35	7.60
122	50	1.72	10.97
104	40	2.16	16.15
86	30	2.62	24.27
68	20	3.06	37.30
50	10	3.52	58.75

B2006/A12843-A

12

*1993 and later called ACT—see glossary

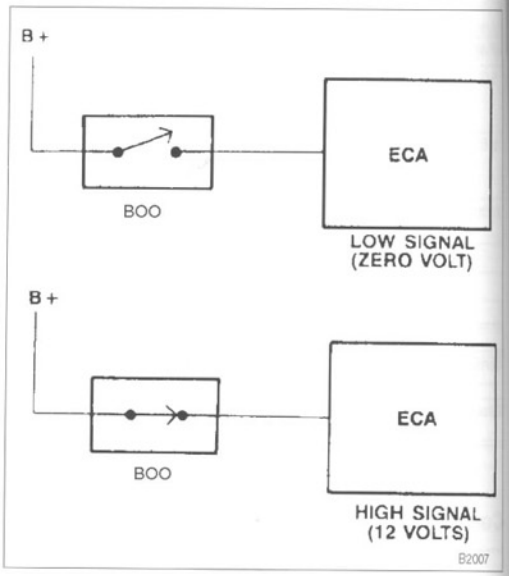
BOO (EEC-IV)

Circuit Description

Brake On/Off (BOO) switch provides a 12 volt signal to the control unit when the switch is closed. It is wired to the stoplamp circuit. The BOO input is used primarily by the Torque Converter Clutch lock/unlock strategy. For more information see Chapter 4.

When troubleshooting the BOO switch, check the brake lights and their ground. The circuit receives a secondary ground through the stop light bulbs.

Test Data



BOO Signal Wire Color

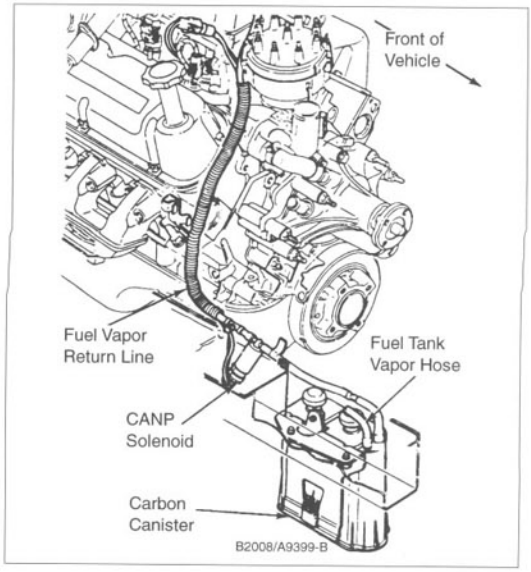
1988	1989	1990	1991	1992	1993–On
Mustang (2.3L OHC), Taurus/Sable, Aerostar: R/LG All others: LG	Mustang (2.3L OHC), Taurus/Sable, Aerostar: R/LG All others: LG	Mustang, Taurus/Sable, Aerostar: R/LG Town Car: DG/W All others: LG	Taurus/Sable, Aerostar: R/LG All others: LG	Taurus/Sable, Aerostar: R/LG Escort/Tracer: GR All others: LG	Taurus/Sable, Aerostar: R/LG Escort/Tracer: GR All others: LG
Wiring Color Code	BK–Black, BL–Blue, BR–Brown, DB–Dark Blue, DG–Dark Green, GR–Green, GY–Gray, LB–Light Blue, LG–Light Green, N–Natural, O–Orange, P–Purple, PK–Pink, R–Red, T–Tan, W–White, Y–Yellow				

CANP (EEC-IV)

Circuit Description

Canister Purge (CANP) valve and solenoid are controlled by the PCM to regulate the flow of fuel vapors from the EVAP canister to the fuel system. The canister is normally closed. When the control unit energizes the solenoid it opens, allowing fuel vapors to be drawn into the engine. For more information see Chapter 4.

Component Locator



Typical location of CANP solenoid.

CANP Circuit Wire Color

1988	1989	1990	1991	1992	1993–On
GY/Y	GY/Y	Probe: W/BK All others: GY/Y	Probe: W/BK All others: GY/Y	1.9L MAF SFI: O/W 3.0L MFI: W/BK All others: GY/Y	1.9L MAF SFI: O/W All others: GY/Y
Wiring Color Code	BK–Black, BL–Blue, BR–Brown, DB–Dark Blue, DG–Dark Green, GR–Green, GY–Gray, LB–Light Blue, LG–Light Green, N–Natural, O–Orange, P–Purple, PK–Pink, R–Red, T–Tan, W–White, Y–Yellow				

CANP Solenoid Tests

Test	Conditions	Test Result	If Not
Solenoid resistance	–Disconnect solenoid connector –Measure across solenoid terminals	40 to 90 ohms	Solenoid may be faulty
Circuit voltage	–Disconnect solenoid connector –Measure between VPWR at harness connector and battery ground –KOEO	10.5 volts or greater	Power circuit or wiring faulty
Solenoid integrity	–Disconnect solenoid connector –KOEO –Apply 16 inHg. (53 kPa) of vacuum to manifold side of solenoid	Holds vacuum for at least 20 seconds	Solenoid may be faulty
EEC control	–Disconnect solenoid connector –Connect DVOM across harness connector: positive lead to VPWR, negative to CANP –KOEO –Depress and release throttle several times	CANP circuit cycles 0.5 volts or greater	Circuit wiring or control unit faulty

DIS (EEC-IV)

Circuit Description

Distributorless Ignition System (DIS*) consists of a crankshaft mounted Hall sensor providing a PIP signal, a coil pack or coil packs, a Hall cylinder identification sensor providing a CID signal, and a DIS control module.

When troubleshooting, note that both PIP and CID are digital signals. They should switch between VBAT and GND as the engine turns. Using an LED test lamp is a quick way to see that the sensors are generating a signal. Also note that proper operation of the DIS system depends on good grounds. The DIS module IGN GND is internal through the mounting screws. Always check the mounting screws for tightness and make sure there is no corrosion.

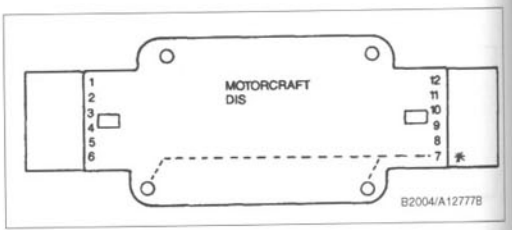
DIS Module Inputs/Outputs

Signal*	DIS Module Terminal
VBAT	1
CID	2
PIP to EEC	3
PIP	4
SPOUT	5
DPI	6
IGN GROUND	7 (internal via mounting holes)
COIL	8
COIL	9
COIL	10
COIL	11
IDM	12
*=where applicable	

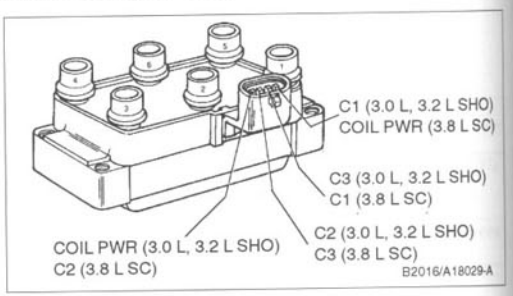
WARNING —
The DIS ignition system is a high-energy system operating in a dangerous voltage range which could prove to be fatal if exposed terminals or live parts are contacted. Use extreme caution when working on a vehicle with the ignition on or the engine running.

CAUTION —
Do not use an incandescent test lamp to test electronic components. Use only an LED test lamp.

DIS Module



DIS 6 Cylinder Coil



DIS Electrical Tests

Test	Conditions	Test Results	If Not
PIP to control unit	–Connect DMM or LED test light between PIP wire and negative (–) battery terminal –Crank engine	3 to 7 volts or Test light blinks	Crank sensor, crank sensor power or ground, or wiring faulty
SPOUT to DIS module	–PIP signal OK –Connect DMM or LED test light between SPOUT wire and negative (–) battery terminal –Crank engine	3 to 7 volts or Test light blinks	Control unit or wiring faulty
IDM to control unit	–Connect DMM or LED test light between IDM wire and negative (–) battery terminal –Crank engine	3 to 7 volts or Test light blinks	DIS module or wiring faulty
CID at sensor	–Connect LED test light between CID CS wire and negative (–) battery terminal –Crank engine	Test light blinks	CID sensor or wiring faulty
COIL PWR	–Connect LED test light between COIL PWR (VBAT) wire and negative (–) battery terminal –Key on	Test light on	COIL PWR wiring faulty

*1993 and later called EI—see glossary

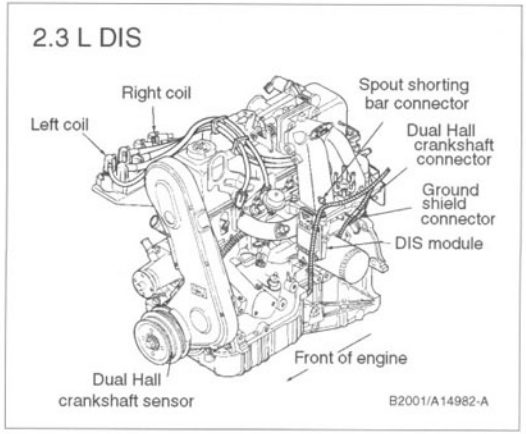
DIS (EEC-IV)

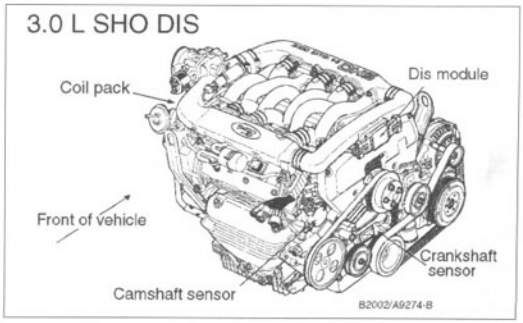
DIS Signal Wire Colors

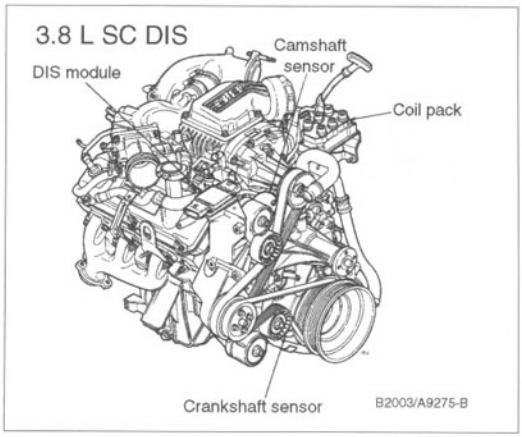
Signal	Wire color
Car:	
2.3 L	
PIP	GY/O
SPOUT	PK
CID	DB/O
IDM	T/Y
IGN GND	O/R
3.0, 3.2L SHO SFI	
PIP	DB
SPOUT	Y/LG
CID	DG
IDM	GY/O
IGN GND	BK/O
3.8 L SC SFI	
PIP	DB
SPOUT	Y/LG
CID	DG
IDM	DG/Y T/Y 1992–On
IGN GND	LB
Truck:	
2.3 L	
PIP	DB 1989–90 GY/O 1991–)n
SPOUT	Y/LG 1989–90 PK 1991–On
CID	GY 1993 only
IDM	LG/P 1989 DG/Y 1990 T/Y 1991–On
IGN GND	BK/O 1989–90 O/R 1991–On

Wiring Color Code: BK–Black, BL–Blue, BR–Brown, DB–Dark Blue, DG–Dark Green, GY–Gray, LB–Light Blue, LG–Light Green, N–Natural, O–Orange, P–Purple, PK–Pink, R–Red, T–Tan, W–White, Y–Yellow

Component Locator







12

ECT (EEC-IV)

Circuit Description

Engine Coolant Temperature (ECT) sensor provides information about engine temperature by changing resistance. The change in resistance changes voltage flow in the circuit. The sensor resistance decreases as the surrounding temperature increases.

A short will result in approximately 0 volts in the circuit. Corrosion in the circuit at terminal connections results in higher-than-normal voltage due to the voltage drop at the connection.

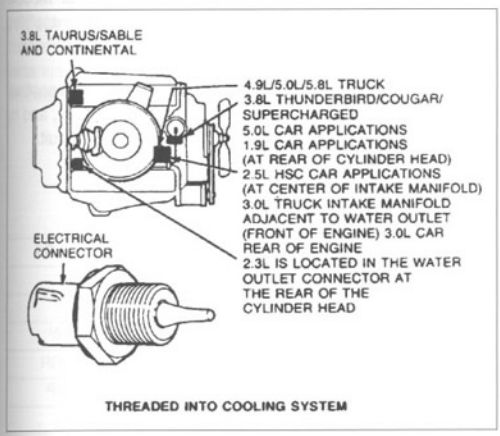
ECT Circuit Wire Color

Engine Family	1988	1989	1990	1991	1992	1993–On
Car:	**Wire color**					
1.9L MA SFI	LG/Y	LG/Y	BL/W	BL/W	BL/W	BL/W
2.0L MA SFI	—	—	—	—	Y/BK	Y/BK
2.3L OHC MFI	LG/Y	LG/Y	LG/Y	LG/R	LG/R	LG/R
2.3L MA MFI	—	—	LG/Y	—	—	—
2.3L MFI TURBO	LG/Y	LG/Y	—	—	—	—
2.3L HSC MFI	LG/Y	LG/Y	LG/Y	LG/R	LG/R	LG/R
2.5L AXODE SFI	—	—	—	LG/R	—	—
2.9L MFI	—	—	BR/GN	—	—	—
3.0L MFI	LG/Y	LG/Y	Probe YR all others LG/Y	Y/R	Y/R	—
3.0L MA SFI	—	—	—	—	LG/R	LG/R
3.0L AXOD SFI	—	—	—	LG/R	LG/R	LG/R
3.0L SHO SFI	—	LG/Y	LG/Y	LG/Y	LG/R	LG/R
3.2L SHO SFI	—	—	—	—	—	LG/R
3.8L MFI AXOD	LG/Y	LG/Y	LG/Y	LG/R	LG/R	LG/R
3.8L RWD MFI	LG/Y	LG/Y	LG/Y	LG/Y	LG/R	LG/R
3.8L SC SFI	—	LG/Y	LG/Y	LG/Y	LG/R	LG/R
4.6L SFI	—	—	—	LG/R	LG/R	LG/R
5.0L SFI	LG/Y	LG/Y	LG/Y	LG/R	LG/R	—
5.0L MAF SFI	LG/Y	LG/Y	LG/Y	Thunderbird/ Cougar LG/Y all others LG/R	LG/R	LG/R
Truck:						
2.3L MFI	LG/Y	LG/Y	LG/Y	LG/R	LG/R	LG/R
2.9L MFI	LG/Y	LG/Y	LG/Y	LG/R	LG/R	LG/R
2.9L MAF MFI	—	—	LG/Y	—	-	
3.0L MFI	LG/Y	LG/Y	LG/Y	LG/R	-	
3.0L MAF MFI	—	—	—	LG/R	LG/R	LG/R
4.0L MAF MFI	—	—	LG/Y	LG/R	LG/R	LG/R
4.9L MFI	LG/Y	LG/Y	F-series, Bronco LG/B E-series LG/Y	F-series, Bronco LG/R E-series LG/P	LG/R	LG/R
5.0L MFI	LG/Y	LG/Y	F-series, Bronco LG/R E-series LG/Y	LG/R	LG/R	LG/R
5.8L MFI	Y/R	LG/Y	F-series, Bronco LG/R E-series LG/Y	LG/R	GY	LG/R
Wiring Color Code	BK–Black, BL–Blue, BR–Brown, DB–Dark Blue, DG–Dark Green, GR–Green, GY–Gray, LB–Light Blue, LG–Light Green, N–Natural, O–Orange, P–Purple, PK–Pink, R–Red, T–Tan, W–White, Y–Yellow					

EEC-IV ENGINE COOLANT TEMPERATURE (ECT) SENSOR

ECT (EEC-IV)

Component Locator

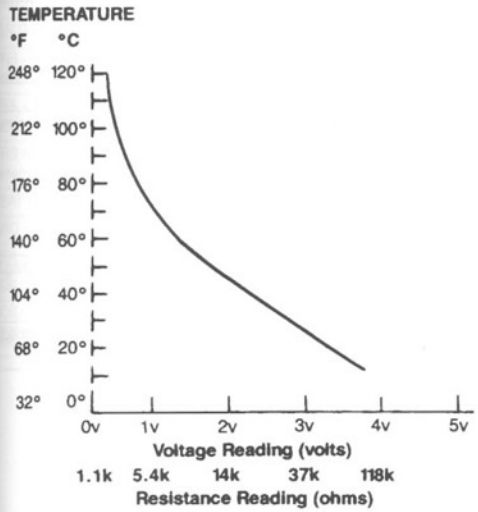


ECT Sensor Tests

Test	Conditions	Test Results	If Not
Sensor resistance	–Disconnect sensor connector –Measure across sensor terminals	See table below	Sensor may be faulty
Circuit voltage	–Sensor connected –KOEO	See table below	Wiring to control unit or control unit faulty

Test Data

ECT Sensor Graph



ECT SENSOR DATA * Voltage values calculated for VREF=5.0v (These values may vary ± 15% due to sensor and VREF variations).

TEMPERATURE		VOLTAGE*	RESISTANCE
°F	°C	Volts	K ohms
248	120	0.28	1.18
230	110	0.36	1.55
212	100	.47	2.07
194	90	.61	2.80
176	80	.80	3.84
158	70	1.04	5.37
140	60	1.35	7.60
122	50	1.72	10.97
104	40	2.16	16.15
86	30	2.62	24.27
68	20	3.06	37.30
50	10	3.52	58.75

12

EDF (EEC-IV)

Circuit Description

Electro-Drive Fan (EDF*) control turns the low speed (primary) fan on and off.

On the 1.9L and 2.0L MAF SFI engines, the EDF fan relay is a separate relay. The EEC-IV control unit turns on the fan by grounding the EDF pin to energize (close) the relay.

On all except the 1.9L and 2.0L MAF SFI engines, the EDF fan relay is part of the Integrated Relay Control Module (IRCM). The EEC-IV control unit turns on the fan by applying voltage to the EDF pin to energize (close) the relay.

Troubleshoot the circuit by checking the signal wire continuity from the EEC-IV control unit to the relay or IRCM, and by checking power, ground, and continuity in the fan circuit.

EEC-IV EDF Signal Wire Color

	1988	1989	1990	1991	1992	1993-On
Engine Family	**Wire color**					
Car						
1.9L MA SFI	—	—	Y/W	Y/W	Y/W	Y/W
2.0L MA SFI	—	—	—	—	BK/GR	BK/GR
2.3L OHC MFI	—	—	—	LG/P	LG/P	LG/P
2.3L MFI TURBO	T/O	—	—	—	—	—
2.3L HSC MFI	—	—	—	—	T/O	T/O
2.5L AXODE SFI	—	—	—	T/O	—	—
3.0L MFI	T/O	T/O	Probe Y/GR all others T/O	Y/GR	Y/GR	—
3.0L MA SFI	—	—	—	—	T/O	T/O
3.0L AXODE SFI	—	—	—	T/O	T/O	T/O
3.0L SHO SFI	—	T/O	T/O	T/O	T/O	T/O
3.2L SHO SFI	—	—	—	—	—	T/O
3.8L MFI AXOD	T/O	T/O	T/O	Taurus/Sable T/O Continental DB	Taurus/Sable T/O Continental DB	Taurus/Sable T/O Continental DB
3.8L SC SFI	—	T/O	T/O	T/O	T/O	T/O
Wiring Color Code	BK–Black, BL–Blue, BR–Brown, DB–Dark Blue, DG–Dark Green, GR–Green, GY–Gray, LB–Light Blue, LG–Light Green, N–Natural, O–Orange, P–Purple, PK–Pink, R–Red, T–Tan, W–White, Y–Yellow					

EDF Electrical Tests

Test	Conditions	Test Result	If Not
With IRCM IRCM/Fan circuit	–Key off, disconnect IRCM connector –KOEO –3.0L SHO: Measure between pins: 1,2 and ground –3.8L: Measure between pins: 3,4 and ground –All other models: Measure between pins: 1,2,6,7 and ground	10.5 volts or greater	Check for open in battery power circuit
With IRCM Low speed fan circuit	–Key off, disconnect IRCM connector –Disconnect cooling fan, jumper pins 1 and 3 at IRCM connector	Battery voltage at cooling fan connector	Check power to IRCM, check wiring to cooling fan
Without IRCM Low speed fan circuit	–Key off, disconnect cooling fan connector –KOEO	Battery voltage at cooling fan connector	Check power to EDF fan relay, check wiring to cooling fan

*1993 and later called FC or LFC—see glossary

EDIS (EEC-IV)

Circuit Description

Electronic Distributorless Ignition System (EDIS*) consists of a crankshaft mounted toothed wheel and a variable reluctance sensor, a coil pack or coil packs, and an EDIS control module.

WARNING —
The EDIS ignition system is a high-energy system operating in a dangerous voltage range which could prove to be fatal if exposed terminals or live parts are contacted. Use extreme caution when working on a vehicle with the ignition on or the engine running.

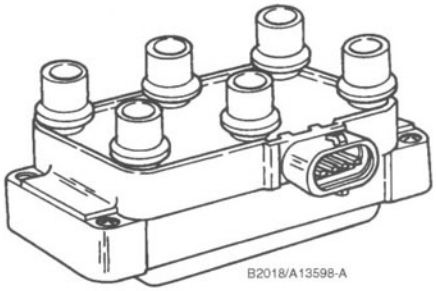
CAUTION —
Do not use an incandescent test lamp to test electronic components. Use only an LED test lamp.

When troubleshooting, note that PIP should switch between VBAT and GND as the engine turns. Using an LED test lamp is a quick way to see that the sensors are generating a signal. Also note that proper operation of the EDIS system depends on good grounds. Always check the module for a good ground and make sure there is no corrosion at the terminals.

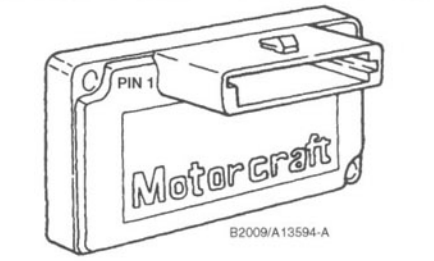
EDIS Module Inputs/Outputs

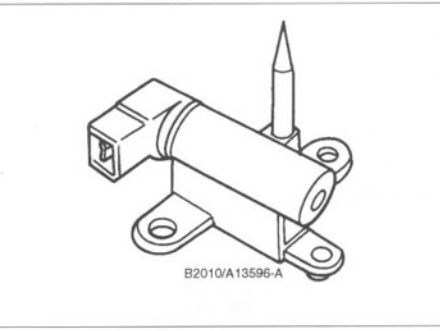
Signal[1]	EDIS Module Terminal
PIP (EDIS output signal)	1
IDM (diagnostic signal to EEC-IV)	2
SAW (EEC spark control signal)	3
IGN GND	4
VRS – (variable reluctance sensor negative)	5
VRS + (variable reluctance sensor positive)	6
VRS shield (variable reluctance sensor shield)	7
VBAT (battery positive)	8
GND (battery negative)	9
COIL (coil drive)	10
COIL/IDM	11
COIL (coil drive)	12
[1]=where applicable	

EDIS Coil



EDIS Module and VRS Sensor





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*1993 and later called EI—see glossary

EDIS (EEC-IV)

EDIS module wire colors

	1990	1991	1992	1993-On
Engine Family	**Wire color**			
Car:				
1.9 L SFI				
PIP	GR/W	GR/W	GR/W	GR/W
IDM	R	R	R	R
SAW	LG/W	LG/W	LG/W	LG/W
IGN GND	R/BL	R/BL	R/BL	R/BL
VBAT (VPWR)	W/R	W/R	W/R	W/R
4.6 L				
PIP	—	GY/O	GY/O	GY/O
IDM	—	T/Y	T/Y	T/Y
SAW	—	PK	PK	PK
IGN GND	—	O	O/R	O/R
Truck:				
4.0 L				
PIP	Aerostar: DB Ranger/Bronco II: BK/LB	Aerostar: DB Ranger/Explorer: GY/O	GY/O	GY/O
IDM	Aerostar: BK/Y Ranger/Bronco II: DG/Y	T/Y	T/Y	T/Y
SAW	Y/LG	Aerostar: Y/LG Ranger/Bronco II: PK	Aerostar: Y/LG Ranger/Bronco II: PK	PK
IGN GND	BK/O	O/R	O/R	O/R
VBAT (VPWR)	–	–	–	R
Wiring Color Code	BK–Black, BL–Blue, BR–Brown, DB–Dark Blue, DG–Dark Green, GR–Green, GY–Gray, LB–Light Blue, LG–Light Green, N–Natural, O–Orange, P–Purple, PK–Pink, R–Red, T–Tan, W–White, Y–Yellow			

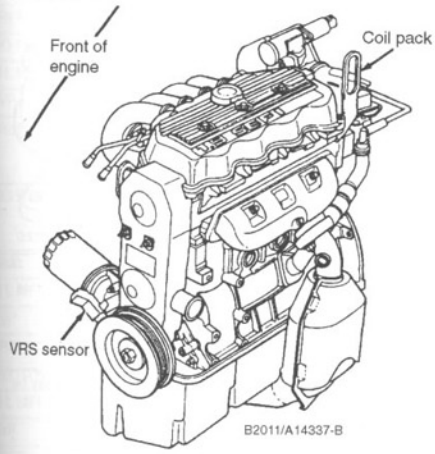
EDIS Electrical Tests

Test	Conditions	Test Results	If Not
PIP to control unit	–Connect DMM or LED test light between PIP wire and negative (–) battery terminal –Crank engine	Test light blinks	Crank sensor, crank sensor power or ground, EDIS module or wiring faulty
VRS at EDIS module	–Connect DMM between VRS (+) and VRS (–) at EDIS module –Crank engine	Greater than 1 volt AC	VRS sensor or sensor wiring may be faulty
VRS bias at EDIS module	–Connect DMM between VRS (+) and ground at EDIS module –Key on	1 to 2 volts DC	EDIS module may be faulty
VRS at sensor	–Disconnect VRS engine harness –Connect DMM at VRS (+) and VRS (–) sensor output –Crank engine	Greater than 1 volt AC	VRS sensor or sensor wiring may be faulty
VRS (+)	–Connect DMM at VRS (+) and VRS (–) –Key on, engine running	4 to 6 volts AC	VRS sensor or sensor wiring may be faulty

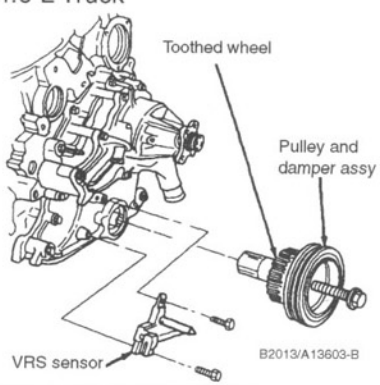
EDIS (EEC-IV)

Component Locator

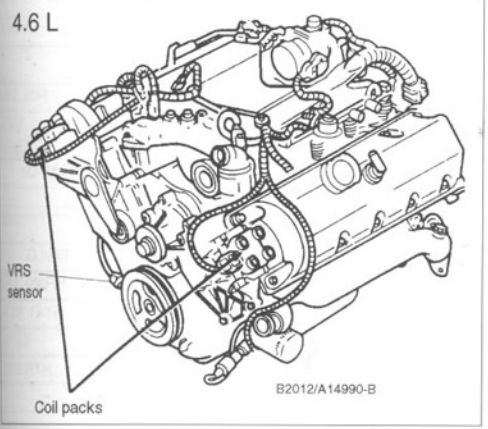
1.9 L SFI



4.0 L Truck



4.6 L



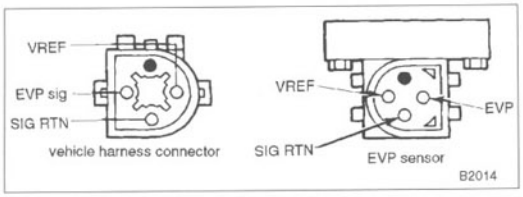
12

EVP (EEC-IV)

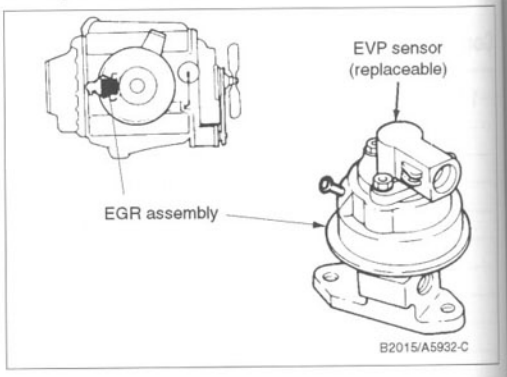
Circuit Description

EGR Valve Position (EVP) sensor is attached to the EGR valve to provide the EEC-IV system with a signal indicating the valve position. It is serviceable as a separate unit.

EVP Sensor Connectors



Component Locator



EVP Sensor Electrical Tests

Test	Conditions	Test Results	If Not
EVP resistance	–Key off, disconnect EVP sensor connector –Connect ohmmeter to connector at EVP SIG and VREF –Disconnect vacuum line to EGR –Connect vacuum pump, increase vacuum	5500 ohms to 100 ohms as vacuum increases to 33 kPa (10 in. Hg.)	EGR valve or EVP sensor may be faulty
VREF at EVP sensor	–Key off, disconnect EVP sensor connector –Key on, measure voltage at vehicle side of harness between VREF and SIG RTN	4 to 6 volts dc	Wiring or EEC-IV module may be faulty

EVP Circuit Wire Colors

Engine Family	1988	1989	1990	1991	1992	1993-On
Car:	**Wire color**					
2.3 L OHC MFI						
EVP	BR/LG	BR/LG	BR/LG	BR/LG	BR/LG	BR/LG
VREF	O/W	O/W	O/W	BR/W	BR/W	BR/W
SIG RTN	BK/W	BK/W	BK/W	GY/W	GY/R	GY/R
2.3 L MA MFI						
EVP	–	–	BR/LG	–	–	–
VREF	–	–	O/W	–	–	–
SIG RTN	–	–	BK/W	–	–	–
2.3 L HSC SFI						
EVP	–	–	–	–	BR/LG	–
VREF	–	–	–	–	BR/W	–
SIG RTN	–	–	–	–	GY/R	–
Wiring Color Code	BK–Black, BL–Blue, BR–Brown, DB–Dark Blue, DG–Dark Green, GR–Green, GY–Gray, LB–Light Blue, LG–Light Green, N–Natural, O–Orange, P–Purple, PK–Pink, R–Red, T–Tan, W–White, Y–Yellow					

continued on next page

EVP (EEC-IV)

EVP Circuit Wire Colors (continued)

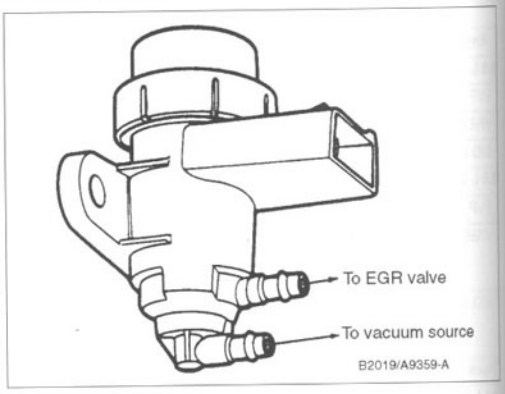
Engine Family	1988	1989	1990	1991	1992	1993-On
5.0 L SFI						
EVP	BR/LG	BR/LG	BR/LG	BR/LG	BR/LG	BR/LG
VREF	O/W	O/W	O/W	BR/W	BR/W	BR/W
SIG RTN	BK/W	BK/W	BK/W	GY/R	GY/R	GY/R
5.0 L MA SFI						
EVP	BR/LG	BR/LG	BR/LG	BR/LG	BR/LG	BR/LG
VREF	O/W	O/W	O/W	Thunderbird/ Cougar: O/W all others: BR/W	BR/W	BR/W
SIG RTN	BG/W	BK/W	BK/W	Thunderbird/ Cougar: BK/W all others: GY/R	GY/R	GY/R
Truck:						
2.3 L MFI						
EVP	BR/LG	BR/LG	BR/LG	BR/LG	BR/LG	BR/LG
VREF	O/W	O/W	O/W	BR/W	BR/W	BR/W
SIG RTN	BK/W	BK/W	BK/W	GY/R	GY/R	GY/R
4.9 L MFI						
EVP	BR/LG	BR/LG	BR/LG	BR/LG	BR/LG	BR/LG
VREF	O/W	O/W	F-series, Bronco: BR/W E-series: O/W	BR/W	BR/W	BR/W
SIG RTN	BK/W	BK/W	F-series, Bronco: GY/R E-series: BK/W	GY/R	GY/R	GY/R
5.0 L MFI						
EVP	BR/LG	BR/LG	BR/LG	BR/LG	BR/LG	BR/LG
VREF	O/W	O/W	F-series, Bronco: BR/W E-series: O/W	BR/W	BR/W	BR/W
SIG RTN	F-series, Bronco: BK/W Econoline: BR/W	BK/W	F-series, Bronco: GY/R E-series: BK/W	GY/R	GY/R	GY/R
5.8 L MFI						
EVP	BR/LG	BR/LG	BR/LG	BR/LG	BR/LG	BR/LG
VREF	O/W	O/W	BR/W	BR/W	BR/W	BR/W
SIG RTN	F-series, Bronco: BK/W Econoline: BR/W	BK/W	F-series, Bronco: GY/R E-series: BK/W	GY/R	GY/R	GY/R
Wiring Color Code	BK–Black, BL–Blue, BR–Brown, DB–Dark Blue, DG–Dark Green, GR–Green, GY–Gray, LB–Light Blue, LG–Light Green, N–Natural, O–Orange, P–Purple, PK–Pink, R–Red, T–Tan, W–White, Y–Yellow					

EVR (EEC-IV)

Circuit Description

EGR Vacuum Regulator (EVR) is an electromagnetic device that controls vacuum to the EGR valve. An electric current to the regulator's coil opens and closes a disc allowing more or less vacuum to reach the EGR valve.

EVR Solenoid



EVR Solenoid Electrical Tests

Test	Conditions	Test Results	If Not
EVR resistance	–Key off, wait 10 seconds –Disconnect EVR solenoid harness –Connect ohmmeter to solenoid	**4.9 L and 5.8 L**: 20 to 45 ohms **all others**: 20 to 70 ohms	EVR solenoid may be faulty
VPWR at EVR solenoid	–Key off, disconnect EVR solenoid harness –KOEO, measure voltage at EVR vehicle harness connector between VPWR and battery negative (–) terminal	Voltage greater than 10.5 volts dc	Wiring or EEC-IV module may be faulty

EVR Solenoid Wire Colors

Engine Family	Wire color
Car:	
1.9 L MA SFI	
EVR	W/BL
VPWR	W/R
2.0 L MA SFI	
EVR	W/BL
VPWR	W/R
2.3 L MA MFI	
EVR	DG
VPWR	R
2.3 L OHC MFI	
EVR	BR/PK
VPWR	R
2.3 L HSC MFI	
EVR	Y
VPWR	R
2.5 L AXODE SFI	
EVR	1991: BR/PK 1992: W
VPWR	1991: R 1992: R/BK

EVR Solenoid Wire Colors (continued)

Engine Family	Wire color
2.9 L MFI	
EVR	DG
VPWR	BK
3.0 L MFI	
EVR	1988–89: DG 1990: Probe: W, all others: DG 1991–92: W
VPWR	1988–89: R 1990 Probe: R/BK all others: R 1991–92: R/BK
3.0 L MA SFI	
EVR	Y
VPWR	R
3.0 L AXODE SFI	
EVR	BR/PK
VPWR	R
3.0 L SHO SFI	
EVR	1989–91: DG 1992–On: BR/PK
VPWR	R

continued on next page

EVR (EEC-IV)

EVR Solenoid Wire Colors (continued)

Engine Family	Wire color
3.2 L SHO SFI	
EVR	BR/PK
VPWR	R
3.8 L MFI AXOD	
EVR	1988–90: DG 1991–On: BR/PK
VPWR	R
3.8 L RWD MFI	
EVR	1988–91: DG 1992–On: BR/PK
VPWR	1988: BK/Y 1989–On: R
3.8 L SC SFI	
EVR	1989: Y 1990: DG
VPWR	R
4.6 L SFI	
EVR	BR/PK
VPWR	R
5.0 L SFI	
EVR	1988–90: DG 1991–On: BR/PK
VPWR	1988 Thunderbird/Cougar: BK/Y all others: R
5.0 L MA SFI	
EVR	1988–90 and '91TBird/Coug: DG 1991–On: BR/PK

EVR Solenoid Wire Colors (continued)

Engine Family	Wire color
VPWR	R
Truck:	
2.3 L MFI	
EVR	1989–90:DG 1991–On: BR/PK
VPWR	R
2.9 L MFI	
EVR	BR/PK
VPWR	R
4.0 L MA SFI	
EVR	BR/PK
VPWR	R
4.9 L MFI	
EVR	1988–89 all, and '90 E-Series: DG 1990 F-Series, Bronco: BR/PK 1991–On: BR/PK
VPWR	R
5.0 L MFI	
EVR	1988–89 all and '90 E-Series: DG 1990 F-Series, Bronco: BR/PK 1991–On: BR/PK
VPWR	R
5.8 L MFI	
EVR	1988–89 all and '90 E-Series: DG 1990 F-Series, Bronco: BR/PK 1991–On: BR/PK
VPWR	R

Wiring Color Code BK–Black, BL–Blue, BR–Brown, DB–Dark Blue, DG–Dark Green, GR–Green, GY–Gray, LB–Light Blue, LG–Light Green, N–Natural, O–Orange, P–Purple, PK–Pink, R–Red, T–Tan, W–White, Y–Yellow

12

HEDF (EEC-IV)

Circuit Description

High-speed Electro-Drive Fan (HEDF*) control turns the high speed (secondary) fan on and off.

On the 1.9 L and 2.0 L MAF SFI engines, the HEDF fan relay is a separate relay. The EEC-IV control unit turns on the fan by grounding the HEDF pin to energize (close) the relay.

On all except the 1.9 L and 2.0 L MAF SFI engines, the HEDF fan relay is part of the Integrated Relay Control Module (IRCM). The EEC-IV control unit turns on the fan by applying voltage to the HEDF pin to energize (close) the relay.

Troubleshoot the circuit by checking the signal wire continuity from the EEC-IV control unit to the relay or IRCM, and by checking power, ground, and continuity in the fan circuit.

HEDF Electrical Tests

Test	Conditions	Test Result	If Not
With IRCM IRCM/Fan circuit	–Key off, disconnect IRCM connector –KOEO –3.0L SHO: Measure between pins: 1,2 and ground –3.8L: Measure between pins: 3,4 and ground –All other models: Measure between pins: 1,2,6,7 and ground	10.5 volts or greater	Check for open in battery power circuit
With IRCM High speed fan circuit	–Key off, disconnect IRCM connector –Disconnect cooling fan, jumper pins 1 and 3 at IRCM connector	Battery voltage at cooling fan connector	Check power to IRCM, check wiring to cooling fan
Without IRCM High speed fan circuit	–Key off, disconnect cooling fan connector –KOEO	Battery voltage at cooling fan connector	Check power to HEDF fan relay, check wiring to cooling fan

EEC-IV HEDF Signal Wire Color

Engine Family	Wire color
Car	
1.9L MA SFI	R/BK
2.0L MA SFI	BL/GR
2.3L OHC MFI	LG/P
2.3L MFI TURBO	PK
2.3L HSC MFI	PK
2.5L AXODE SFI	LG/P
3.0L MFI	PK
3.0L MA SFI	LB
3.0L AXODE SFI	LG/P
3.0L SHO SFI	PK
3.2L SHO SFI	LG/P
3.8L MFI AXOD	1988–90:PK 1991–On: LG/P
3.8L SC SFI	1989–91: PK 1992–On: LG/P
Wiring Color Code BK–Black, BL–Blue, BR–Brown, DB–Dark Blue, DG–Dark Green, GR–Green, GY–Gray, LB–Light Blue, LG–Light Green, N–Natural, O–Orange, P–Purple, PK–Pink, R–Red, T–Tan, W–White, Y–Yellow	

*1993 and later called HFC—see glossary

HEGO (EEC-IV)

Circuit Description

Heated Exhaust Gas Oxygen (HEGO*) sensor detects oxygen content in the exhaust gasses. It sends a voltage signal to the EEC-IV control module. The sensor is electrically heated so the sensor output signal stabilizes more quickly. Some engines have two HEGO sensors: HEGOR and HEGOL.

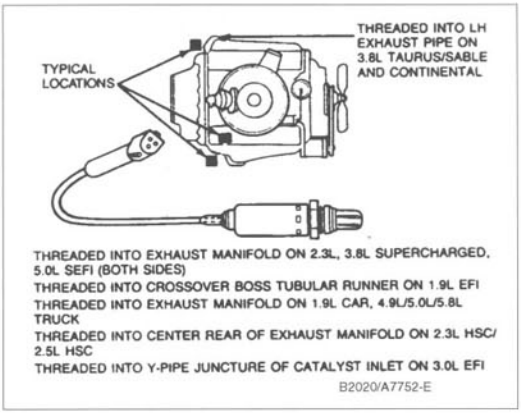
HEGO Inputs/Outputs

Signal[1]	Description
HEGO SIGNAL	Oxygen sensor output
HEGO GND	Oxygen sensor ground
KEY POWER	Power input for heating element
POWER GROUND	Heating element ground
[1]=where applicable	

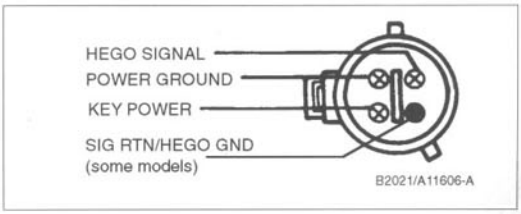
CAUTION —
Do not get any anti-seize compound or RTV sealer on the sensor tip or in the sensor slits. These chemicals will quickly foul the sensor element and render the sensor inoperative.

When troubleshooting, note that the HEGO signal should only be measured after the engine has run for several minutes. Fuel contaminated engine oil can affect HEGO readings. Always change the oil and oil filter if contamination is suspected. The HEGO heating element in the sensor can be tested using an ohmmeter.

HEGO Sensor



HEGO Connector (HEGO side)



HEGO Electrical Tests

Test	Conditions	Test Results	If Not
HEGO SIGNAL	–Key off, disconnect HEGO sensor connector –Connect DMM between HEGO SIGNAL and negative (–) battery terminal –Run engine for 2 minutes at 2000 rpm	0.5 volts or greater	HEGO sensor may be faulty
HEGO response to exhaust	–Key off, disconnect HEGO sensor connector –Connect DMM between HEGO SIGNAL and negative (–) battery terminal –Run engine for 2 minutes at 2000 rpm –Create vacuum leak (disconnect vacuum hose to intake manifold)	Voltage drops and fluctuates	HEGO sensor may be faulty
HEGO heater element	–Key off, disconnect HEGO sensor connector –Connect DMM between KEY POWER and POWER GROUND at sensor connector	2 to 5 ohms at room temperature	HEGO heater element faulty
KEY POWER	–Key off, disconnect HEGO sensor connector –Connect DMM between KEY POWER and POWER GROUND at vehicle connector –Key On	10.5 volts or greater	Check harness wiring and grounds

*1993 and later called HO2S—see glossary

ISC-BPA (EEC-IV)

Circuit Description

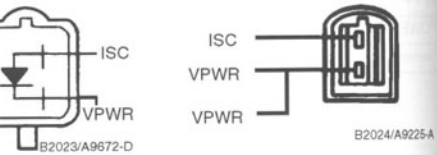
Idle Speed Control-Bypass Air (ISC-BPA*) solenoid is an actuator that allows air to pass around the throttle plate. Principle job is to control idle RPM. Secondary jobs: prevent engine stall - electronic dashpot, and provide air for engine start. The ISC-BPA is controlled by the EEC-IV control unit. When troubleshooting the ISC-BPA circuit, always begin by checking for air leaks in the intake system, and check fuel injector O-rings for cracking and sealing. Note that unmetered air can also cause idle problems. Perform the electrical tests in order.

ISC-BPA Inputs/Outputs

Signal	Description
ISC	Input to solenoid from EEC-IV
VPWR	Input to solenoid

ISC-BPA Solenoid

ISC Solenoid Connector and Vehicle Harness Connector



ISC-BPA Electrical Tests

Test	Conditions	Test Results	If Not
ISC-BPA Solenoid	–Key off –Connect engine tachometer –Start engine, disconnect ISC-BPA solenoid	rpm drops or engine stalls	ISC-BPA solenoid may be faulty
ISC-BPA Solenoid resistance	–Key off, disconnect ISC-BPA solenoid connector –Connect DMM (+) lead to solenoid VPWR pin, DMM (–) lead to solenoid ISC pin	7 to 13 ohms	ISC-BPA solenoid may be faulty
VPWR circuit to ISC-BPA	–Key off, disconnect ISC-BPA solenoid connector –Connect DMM between VPWR at vehicle harness connector, and battery ground terminal –KOEO	10.5 volts or greater	VPWR circuit wiring faulty
ISC-BPA signal from EEC-IV module	–ISC-BPA solenoid connected –Key off, backprobe with DMM between ISC wire at vehicle harness connector and battery ground terminal –ER, slowly increase and decrease rpm	Voltage varies between 3 and 11.5 volts	EEC-IV module or wiring may be faulty

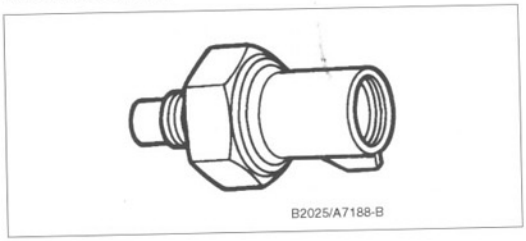
*1993 and later called IAC-BPA—see glossary

KS (EEC-IV)

Circuit Description

Knock Sensor (KS) is a sensor that detects engine detonation (spark knock). When knock occurs, a voltage signal is sent to the EEC-IV module which retards spark timing. On some engines, two knock sensors are used. The knock sensor is color coded to indicate frequencies for that particular engine, and should be replaced with one having the same color code. When troubleshooting the knock sensor circuitry, begin by checking the fuel quality, ignition timing, and altitude at which test is being performed.

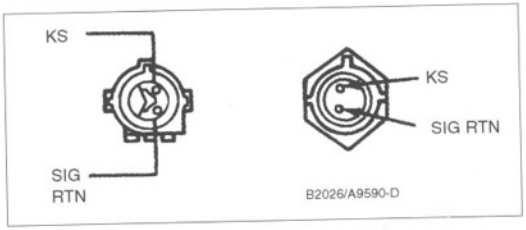
Knock Sensor


B2025/A7188-B

KS Inputs/Outputs

Signal	Description
KS	Input to EEC-IV module
SIG RTN	Signal return

Knock Sensor Vehicle Harness Connector and Knock Sensor Connector



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KS Electrical Tests

Test	Conditions	Test Results	If Not
Knock Sensor Circuit Voltage	–Key off, wait 10 seconds –Disconnect knock sensor connector –KOEO, measure voltage between KS and SIG RTN at vehicle harness connector	1 to 4 volts dc	EEC-IV module or wiring may be faulty
Knock Sensor Operation	–ER, knock sensor connected –DMM on VAC scale, backprobe connector –Slowly raise engine speed to 3000 rpm	AC Voltage reading increases	Knock Sensor may be faulty
Knock Sensor Operation	–ER, knock sensor connected –DMM on VAC scale, backprobe connector –Tap exhaust manifold with 4 oz. hammer	AC Voltage reading fluctuates	Knock Sensor may be faulty

MAF (EEC-IV)

Circuit Description

Mass Air Flow (MAF) sensor measures the mass of the air flowing into the engine. The sensor output is a DC signal ranging from about 0.5 to 5.0 volts, used by the EEC-IV module to vary fuel injector opening time. Power to the MAF sensor is controlled by the EEC-IV module. Ground is through the PWR GND circuit to the battery negative (–) terminal. The unit cannot be repaired. When troubleshooting the MAF sensor always begin by checking for air leaks in the intake system and repair as necessary.

NOTE —
Trouble code 26/159 can be generated by a high concentration of ambient exhaust gas—for example in an unvented or poorly vented garage.

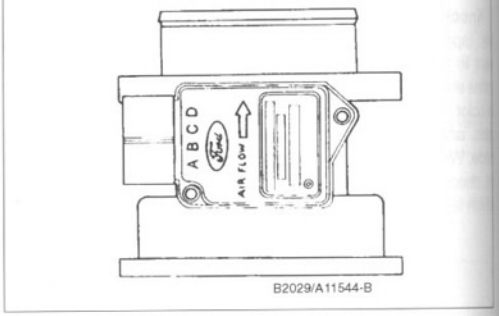
MAF Inputs/Outputs

Signal	Description
MAF SIG	Signal to EEC-IV module
MAF RTN	Signal return
VPWR	Vehicle power
PWR GND	Vehicle power ground

Typical* MAF Sensor Test Values

Speed	MAF Signal Voltage
Idle	0.6
20 mph	1.10
40 mph	1.70
60 mph	2.10
* values may vary based on vehicle load, temperature, and equipment	

Mass Air Flow Sensor



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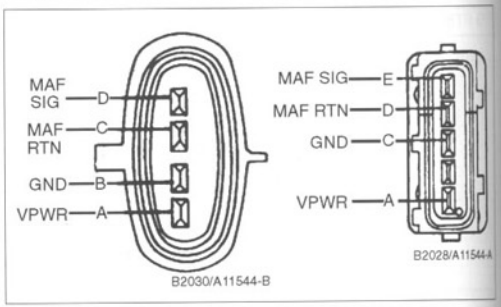
Mass Air Flow Sensor Connectors



B2030/A11544-B
B2028/A11544-A

MAF (EEC-IV)

MAF Electrical Tests

Test	Conditions	Test Results	If Not
VPWR and Ground	–Key off, disconnect MAF connector –Connect DVOM between VPWR and GND at vehicle harness connector –KOEO	10.5 volts or greater	Fault in VPWR circuit or in GND circuit to battery
MAF Circuit Short To Ground	–Key off, disconnect MAF connector –Connect DVOM between MAF SIG and MAF RTN, and MAF SIG and GND at vehicle harness connector	10,000 ohms or greater	Fault in wiring to control unit or faulty control unit
MAF Sensor Voltage	–MAF sensor connected –Backprobe MAF sensor connector between MAF and battery negative (–) terminal –ER	0.2 to 1.5 volts dc	MAF sensor may be faulty

MAP/BP (EEC-IV)

Circuit Description

Manifold Absolute Pressure (MAP) sensor measures the intake manifold pressure and sends a frequency signal to the EEC-IV module. The MAP sensor frequency decreases as vacuum increases. **Manifold Absolute Pressure/Barometric Pressure** (MAP/BP*) sensor is used to also sense barometric pressure allowing the EEC-IV module to compensate for changes in altitude.

When troubleshooting the MAP or MAP/BP sensor always begin by checking for air leaks in the intake system and vacuum system. Repair as necessary. The sensor can be checked using a frequency meter and a hand held vacuum pump with gauge. Begin by checking that the sensor holds vacuum.

If VREF and the MAP/BP sensor test OK, then either the wiring to the control unit or the control unit itself is faulty.

NOTE —

- Engine Running (ER) trouble codes generated during ER Self-Test may be due to a faulty vacuum hose or to excess EGR flow.
- Continuous memory codes may be due to a MAP sensor leak.

MAP Inputs/Outputs

Signal	Description
MAP or MAP/BP	Signal to EEC-IV module
SIG RTN	Signal return
VREF	Reference voltage input

MAP Sensor Test Values[1]

Manifold Vacuum		MAP Frequency
in-Hg	kPa	Hz
0	0	159
3	10.2	150
6	20.3	141
9	30.5	133
12	40.6	125
15	50.8	117
18	61.0	109
21	71.1	102
24	81.3	95
27	91.5	88
30	101.6	80

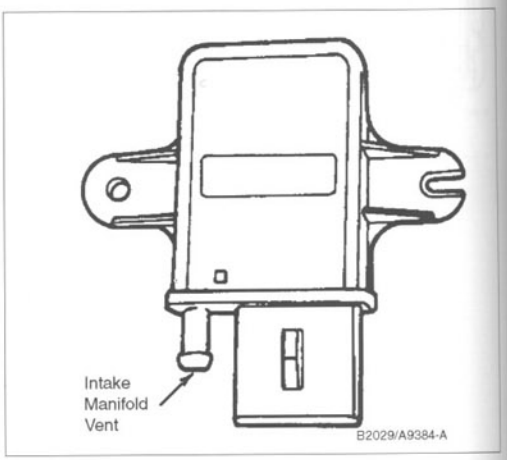
[1] based on barometric pressure of 30 in-Hg. Note: values may vary approximately ± 3 Hz

MAP/BP Sensor Test Values

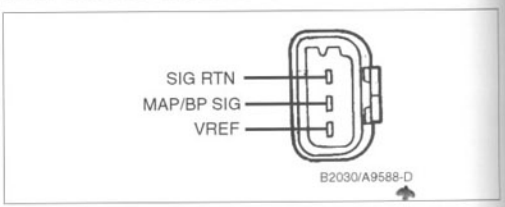
Barometric Pressure		MAP/BP Frequency
in-Hg	kPa	Hz
17.1	58	122.4
18.3	62	125.5
19.5	66	128.7
20.7	70	131.9
21.8	74	135.1
23.0	78	138.3
24.2	82	141.8
25.4	86	145.4
26.6	90	148.9
27.7	94	152.5
28.9	98	156.1
30.1	102	159.6
31	105	162.4

Note: values may vary approximately ± 3 Hz

MAP Sensor



MAP Sensor Terminals



*1993 and later called BARO—see glossary

MAP/BP (EEC-IV)

MAP and MAP/BP Electrical Tests

Test	Conditions	Test Results	If Not
VREF	–Key off, disconnect MAP/BP connector –Measure voltage between VREF and SIG RTN at vehicle harness connector –KOEO	4 to 6 volts dc (VREF)	Check VREF circuit
MAP Sensor	–Connect MAP connector –Backprobe MAP connector between MAP wire and battery negative (–) terminal –Vary vacuum using pump –ER	See table above	MAP sensor may be faulty
MAP/BP Sensor	–Connect MAP/BP connector –Backprobe MAP/BP connector between MAP wire and battery negative (–) terminal –Vary vacuum using pump –ER	See table above	MAP/BP sensor may be faulty