3. Electrical Tests

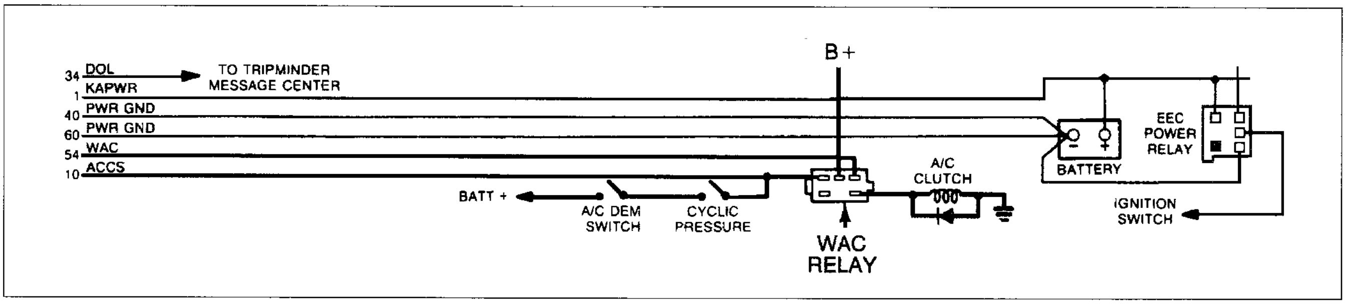
ACC (also ACCS, ACD)

Circuit Description

Air Conditioning Clutch (ACC), also known as A/C Cycling Switch (ACCS), and A/C Duty (ACD), signals the control module each time battery voltage is applied to the A/C clutch. Its purpose is to feedforward a load signal. Without this signal, the A/C compressor load would reduce idle rpm. Instead, based on the ACC signal, the control module acts to increase idle air flow to maintain idle rpm, even with the added load. Idle air flow is increased in CFI cars by the Idle-Speed Control-D.C. Motor (ISC-DCM), and in MFI/SFI vehicles by the Idle-Speed Control-ByPass Air (ISC-BPA).

An open between ACCS and the control module would result in a signal of 0v, allowing idle rpm drop when AC is engaged.

Circuit Schematic



ACC Circuit Wire Color (Pin #10)

Engine Family	1980–83	1984	1985	1986	1987
1.6L MFI	BK/Y H (1983)	BK/Y H	BK/Y H	BK/Y	
1.6L MFI TC		BK/Y H	BK/Y H		
1.9L CFI					BK/Y
1.9L MFI				BK/Y	BK/Y
2.3L HSC CFI			BK/Y H	BK/Y	BK/Y
2.3L OHC MFI					BK/Y
2.3L OHC MFI Turbo, Mustang, SVO		BK/Y H	BK/Y	BK/Y	BK/Y
2.3L OHC MFI Turbo, Thunderbird, XR-7				LG/P	BK/Y
2.5L CFI MTX				PR/LB	PK/LB
2.5L CFI ATX				PK/LB	PK/LB
3.0L MFI				PR/LB	PR/LB
3.8L CFI		BK/Y	BK/Y	BK/Y	BK/Y
3.8L MFI					BK/Y
5.0L CFI	BK/Y H	BK/Y H	BK/Y H		
5.0L SFI				LG/P	LG/P
Truck					
2.3L HC MFI			BK/Y H	BK/Y	BK/Y
2.9L MFI				BK/Y	BK/Y
3.OL MFI				BK/Y	BK/Y
4.9L MFI					BK
5.0L MFI			BK	LG/P	BK/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					

12

ACT

Circuit Description

Air Charge Temperature (ACT) provides information about intake air temperature, or manifold air temperature. With colder air, ACT signals cause increased injector pulse-time, increased cold-enrichment fuel flow, and advanced spark timing.

Look for the ACT usually in the air cleaner or Fuel Charging Assembly of CFI engines. In MFI engines, it may be in the manifold, and may be called Manifold Charge Temperature (MCT).

ACT is similar in operation to Vane Air Temperature. VAT operates in 1984-87 1.6L and 2.3L MFI engines, using the same connector pins, but operating with different values for resistance at specified temperatures.

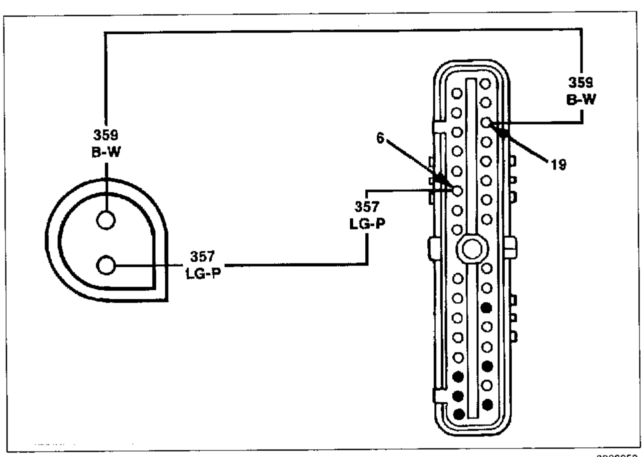
An open between ACT and the control module will result in a constant VREF signal, 5.0v (EEC-III, 9.0v). A short will result in approximately 0v. Corrosion in the circuit at terminal connections results in higher-than-normal voltage, signalling a cold engine, resulting in an over-rich mixture

ACT Circuit Wire Colors (Pin #25*)

Engine Family/Year	Wire Color
2.3L HC MFI Truck, 1985–87	Y/R
4.9L MFI F-Series, Bronco, 1987	Y/R
4.9L MFI Econoline, 1987	R/BK
5.0L MFI Truck, 1986–87	Y/R
All others	LG/P

*1980–82 5.0L CFI use Pin #6

ACT Circuit



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Test Data

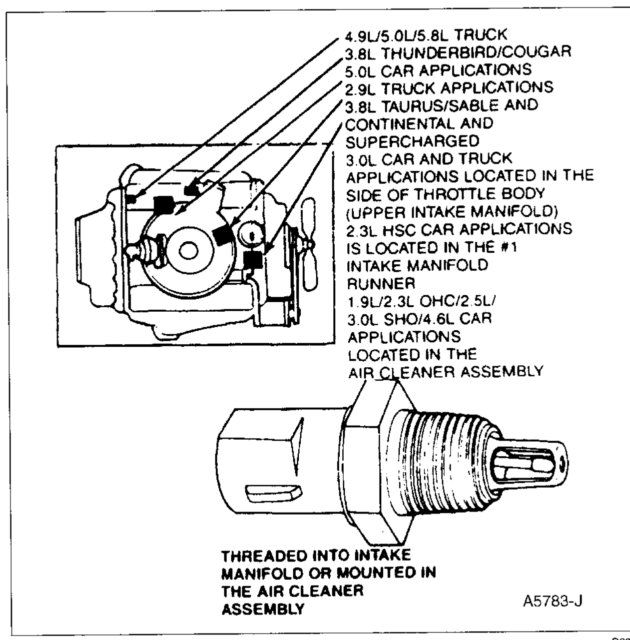
ACT SENSOR DATA
Voltage values calculated for VREF = 5.0v (9.0v EEC-III)
(These values may vary ± 15% due to sensor and VREF variations)

TEMPERATURE °F	TEMPERATURE °C	VOLTAGE Volts	RESISTANCE K ohms
248	120	0.28	1.18
230	110	0.36	1.55
212	100	0.47	2.07
194	90	0.61	2.80
176	80	0.80	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

A12843-A

0020059

Component Locator



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ACT Sensor Tests

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

BOO

Circuit Description

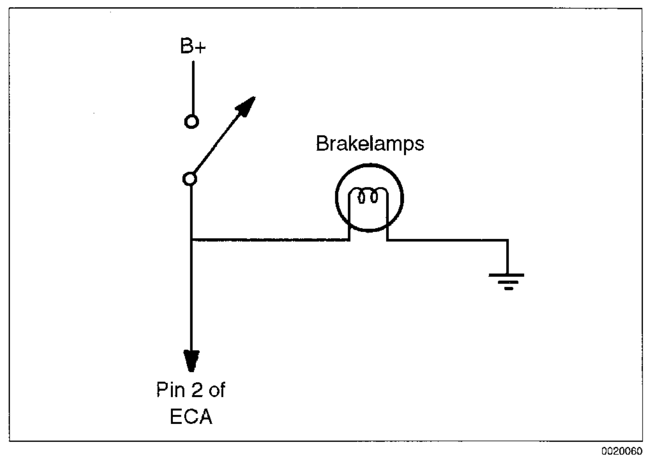
Brake On/Off (BOO) switch provides a 12-volt signal to the control module when the switch is closed. It is wired to the stoplamp circuit. BOO is used on selected EEC-IV vehicles, primarily by the Torque Converter Clutch lock/unlock strategy. For more information see Chapter 4.

When troubleshooting the BOO switch, check the brake lights and their ground. The circuit receives a secondary ground through the stop light bulbs, so a burned-out bulb can affect the BOO signal.

BOO Signal Wire Color (Pin #2)

Engine Family / Model	1985	1986	1987
2.3L MFI Mustang, Capri			R/LG
2.3L MFI Thunderbird			LG
2.5L CFI		R/LG	R/LG
3.0L MFI		R/LG	R/LG
2.3L Ranger	LG	LG	LG
2.3L Aerostar	R/LG	R/LG	R/LG
2.9L Ranger, Bronco II		LG	LG
3.0L Aerostar		R/LG	R/LG
Wiring Color Code: LG–Light Green; R–Red			

BOO Circuit



ECT

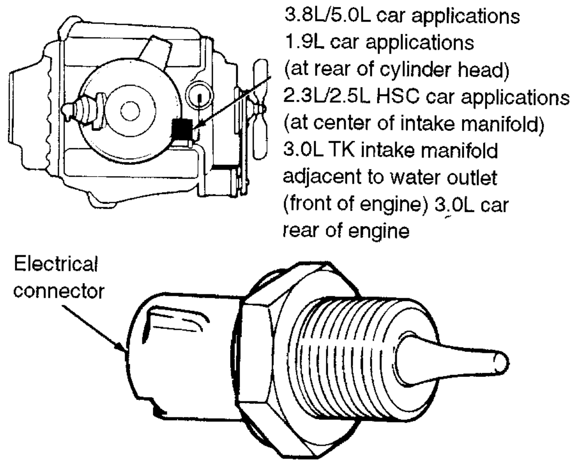
Circuit Description

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.

ECT signal affects air/fuel ratio, ignition timing, EGR flow, idle rpm. ECT signals dashboard engine-temperature gauge on electronic instrument cluster applications.

An open between ECT and the control module results in a constant 5v signal at the control module. 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. Extra resistance could cause hard cold starts.

Component Locator



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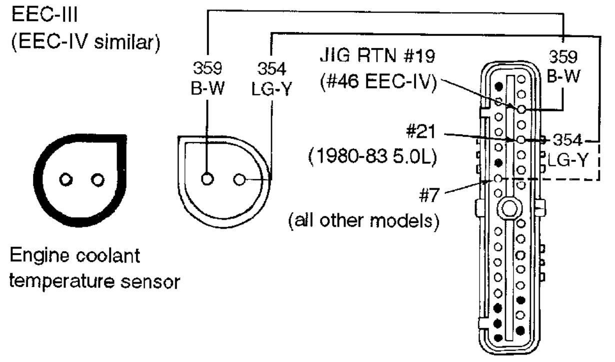
Test Data



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ECT SENSOR DATA * Voltage values calculated for VREF=5.0v (These values may vary ± 15% due to sensor and VREF variations). (VREF 1980-83 = 9.0v)

TEMPERATURE		VOLTAGE*	RESISTANCE
°F	°C	Volts	K ohms
248	120	0.28	1.18
230	110	0.36	1.55
212	100	0.47	2.07
194	90	0.61	2.80
176	80	0.80	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

0020066

Circuit Description

Electro-Drive Fan (EDF) control turns the low speed (primary) fan on and off. The EDF fan relay is part of the Integrated Relay Control Module (IRCM). The EEC-IV control module turns on the fan by applying voltage to the EDF pin to energize (close) the EDF relay.

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

EDF Signal Wire Color

- Tan/Orange

EDF Electrical Tests

Test	Conditions	Test Result	If Not
Signal wire	–Key off, disconnect IRCM connector and control module connector –Measure continuity between pin 55 of control module connector, and pin 1 (1986) or pin 14 (1987) of IRCM –Reconnect control module connector	Continuity	Wiring fault
Low speed fan circuit	–Key off, disconnect IRCM connector –Jumper pins at IRCM connector: 1986 2.5L HSC: 7 and 2 1987 2.5L HSC: 2 and 3 1986 3.0L: 7 and 2 1987 3.0L: 2 and 3 1987 2.3L Turbo: 2 and 3 –Key On	Low Speed fan runs	Either cooling fan or wiring to fan faulty, or power from pin 1 of control module faulty (Note: there is a voltage-dropping resistor in this circuit, which could be faulty)
EDF Relay	–Above tests show no problems	NA	If fan still does not run, then EDF relay in IRCM or IRCM wiring is most likely faulty

EGO

Circuit Description

Exhaust Gas Oxygen (EGO) sensor detects oxygen content in the exhaust gas to check engine combustion. When heated by exhaust gases, EGO generates voltage. Some V-type engines operate with two EGO sensors, one for each bank. Some EGO have only a signal wire. They ground through the mounting in the exhaust manifold. Others operate with two wires, one a separate grounding circuits to the control module through pin 49.

> ***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, only measure EGO output after running the engine several minutes to heat the sensor. You'll know it is heated when the EGO output keeps changing from less than 0.4v to more than 0.6v, continuously. Lack of changing voltage from a hot sensor may be caused by contamination—such as from fuel in the engine oil. Before discarding the sensor, change crankcase oil and filter and retest.

An open or a short-to-ground between a sensor and control module results in a 0v signal, similar to a lean mixture signal, so the engine runs rich. A poor connection increases resistance, dropping voltage signal to computer, with a similar lean signal, rich-running condition.

Failure of an oxygen sensor or its circuit is the leading cause of failure to pass emission tests.

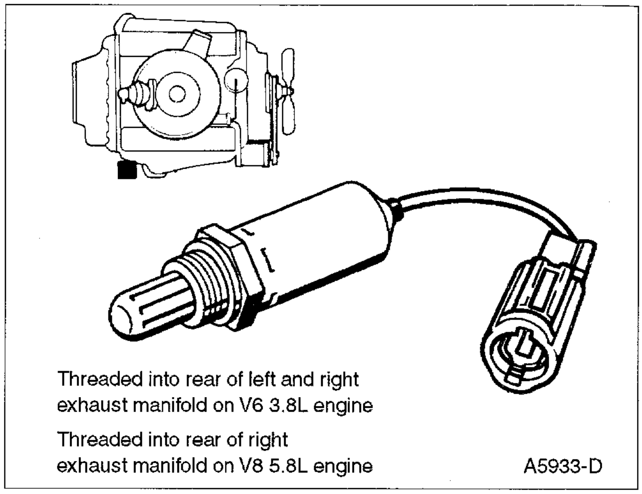
Wiring Colors

- Signal:
  1985 3.8/5.0L: Dark Green/Orange
  All others: Dark Green/Purple
- Ground (where applicable): Orange

Pin Numbers

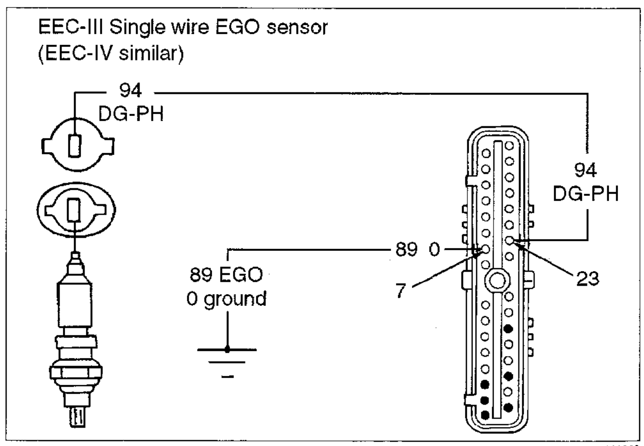
- Signal:
  EEC-III: #23
  1983 1.6L: #6
  All Others: #29
- Ground (where applicable): 49

Component Locator



0020067

Circuit



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EGO Electrical Tests

Test	Conditions	Test Results	If Not
EGO SIGNAL	–Key off, disconnect EGO sensor connector –Connect DMM between EGO SIGNAL and negative (–) battery terminal –Run engine for 2 minutes at 2000 rpm	0.5 volts or greater	EGO sensor may be faulty
EGO response to exhaust	–Key off, disconnect EGO sensor connector –Connect DMM between EGO 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	EGO sensor may be faulty

EGR On / EVR

Circuit Description

Exhaust Gas Recirculation On (EGR On) uses a vacuum valve to recirculate a portion of the exhaust gas back into the engine intake. There are four types of EGR on the cars covered by this book, all controlled by the EEC control module:

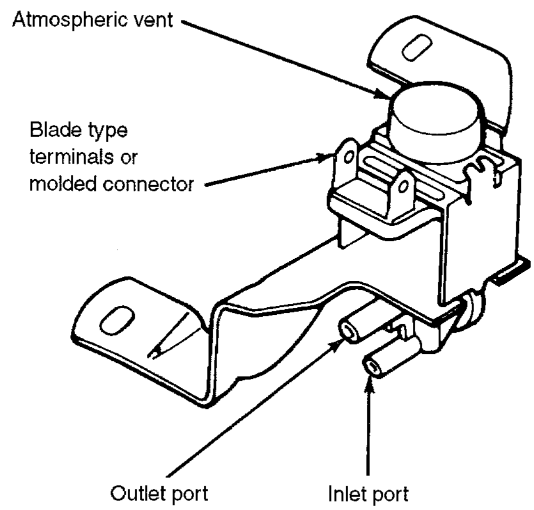
- EGR On
- EGRC / EGRV
- EGR On / BVT
- EVR (both EVP and PFE)

EGR On solenoid controls vacuum flow to the EGR valve. EGR On is a single solenoid valve controlled by the control module. The control module supplies VPWR to the solenoid, then grounds the circuit to open the solenoid. There is no feedback to the control module in EGR On systems.

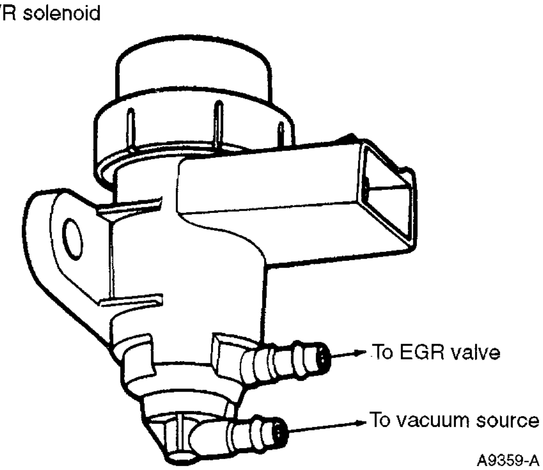
EGR Vacuum Regulator (EVR) also uses a single solenoid, controlled by the control module, with the addition of feedback about EGR valve position. The EGR Valve Position (EVP) sensor and Pressure Feedback EGR (PFE) sensor provide feedback signals to the control module. They are covered elsewhere in this section.

Component Locator

EGR on solenoid



EVR solenoid



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Solenoid Electrical Tests

Test	Conditions	Test Results	If Not
EGR On resistance	–Key off, wait 10 seconds –Disconnect solenoid harness –Connect ohmmeter to solenoid terminals	65 to 110 ohms	Solenoid may be faulty
EVR resistance	–Key off, wait 10 seconds –Disconnect solenoid harness –Connect ohmmeter to solenoid terminals	4.9L and 5.8L: 20 to 45 ohms all others: 20 to 70 ohms	EVR solenoid may be faulty
VPWR at solenoid (both)	–Key off, disconnect solenoid harness –KOEO, measure voltage at vehicle harness connector between VPWR and battery negative (–) terminal	Voltage greater than 10.5 volts	Wiring to EEC module or module may be faulty

EGRC / EGRV

Circuit Description

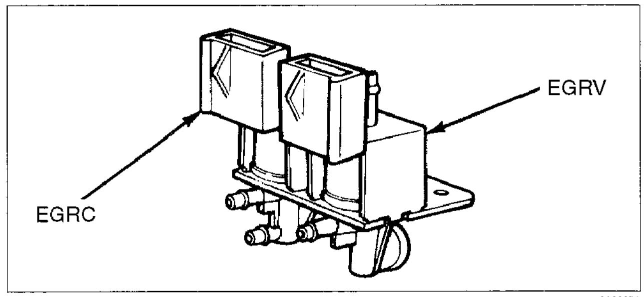
Exhaust Gas Recirculation On (EGR) uses a vacuum valve to recirculate a portion of the exhaust gas back into the engine intake. There are four types of EGR on the cars covered by this book, all controlled by the EEC control module:

- EGR On
- EGRC / EGRV
- EGR On / BVT
- EVR (both EVP and PFE)

EGRC / EGRV solenoid valves control the position of the EGR valve. The solenoids are supplied with VPWR. The EEC control module then varies the application of ground to the EGR Control (EGRC) valve (normally closed) and the EGR Vent (EGRV) valve (normally open).

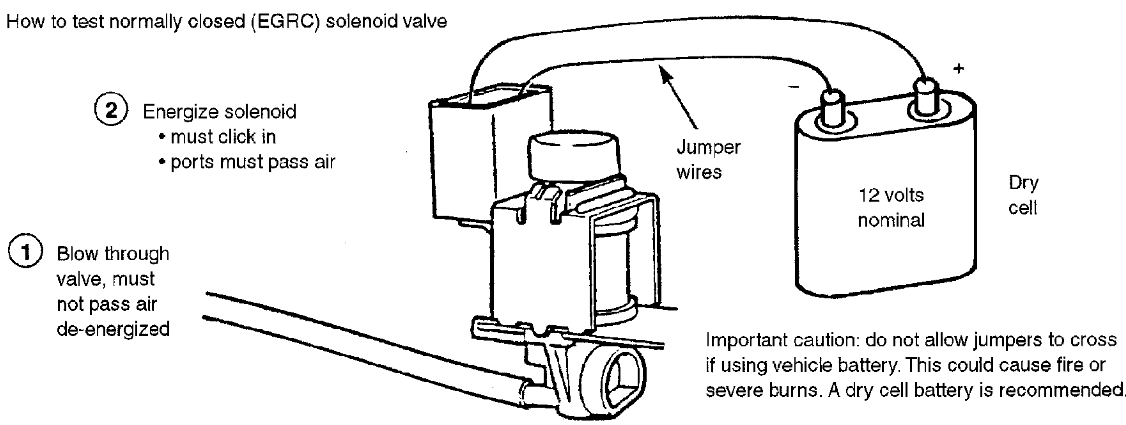
The EGR Valve Position (EVP) sensor provides feedback signals to the control module. It is covered elsewhere in this section.

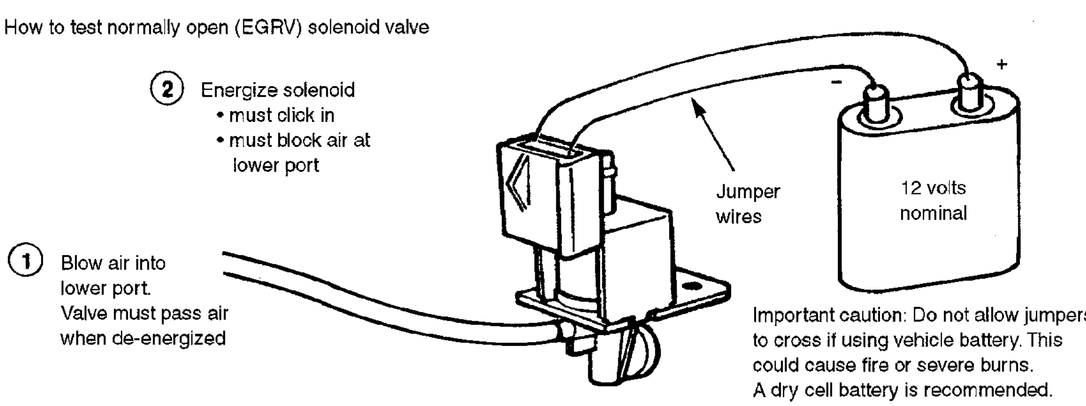
Component Locator



EGRC / EGRV Solenoid Electrical Tests

Test	Conditions	Test Results	If Not
EGRC / EGRV resistance	–Key off, wait 10 seconds –Disconnect solenoid harness –Connect ohmmeter to solenoid terminals	32 to 64 ohms	Solenoid may be faulty





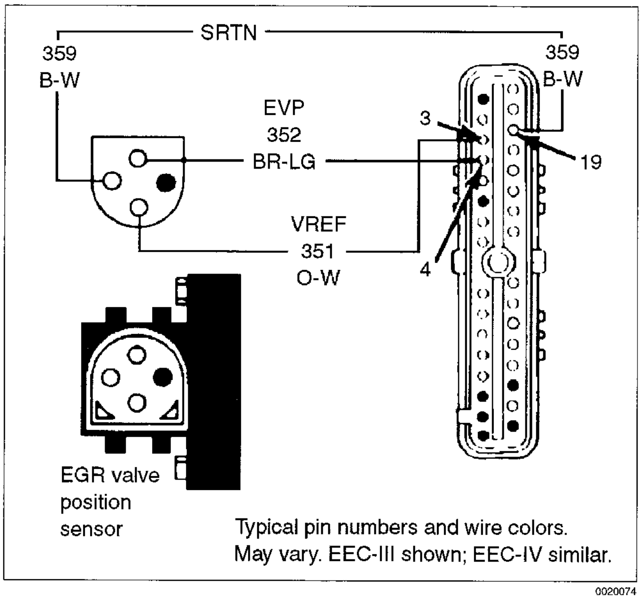
Test	Conditions	Test Results	If Not
VPWR at solenoid (both)	–Key off, disconnect solenoid harness –KOEO, measure voltage at vehicle harness connector between VPWR and battery negative (–) terminal	Voltage greater than 10.5 volts	Wiring to EEC module or module may be faulty

EVP

Circuit Description

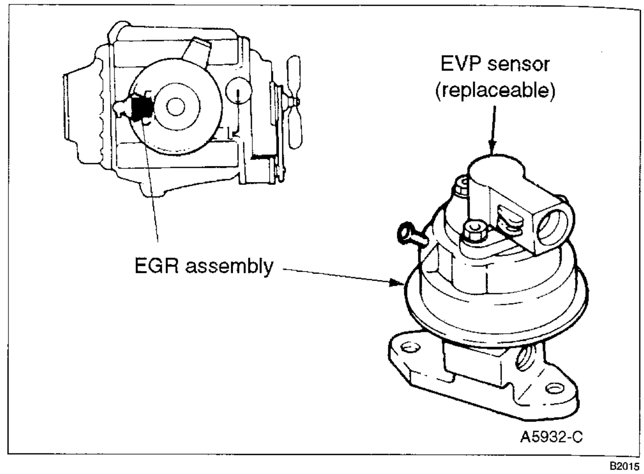
EGR Valve Position (EVP) sensor is attached to the EGR valve to provide the EEC-IV system with a signal indicating the valve position. It is serviceable as a separate unit.

EVP Terminals



Typical pin numbers and wire colors. May vary. EEC-III shown; EEC-IV similar.

Component Locator



EVP Pin #s / Wire Colors

Year/Model	EVP	SIG RTN	VREF
EEC-III	4 ; BR/LG	19 ; BK/W	3 ; OR/W
1986 2.5L HSC	27 ; G/LG	46 ; LG/W	26 ; OR/W
All Others	27 ; BR/LG	46 ; BK/W	26 ; OR/W

EVP Sensor Tests

Test	Conditions	Test Results	If Not
EVP Movement	–Key off, disconnect EVP sensor connector –Connect DVOM 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 (If DVOM reading jumps or drops out, sensor is worn in one place. Replace sensor.)
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 (8 to 10 volts EEC-III)	Wiring or EEC module may be faulty

Circuit Description

High-speed Electro-Drive Fan (HEDF) control turns the high speed (secondary) fan on and off on Automatic Transmission equipped cars. The HEDF fan relay is part of the Integrated Relay Control Module (IRCM). The EEC-IV control module 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 module to the IRCM, and by checking power, ground, and continuity in the fan circuit.

HEDF Signal Wire Color

- Pink

HEDF Electrical Tests

Test	Conditions	Test Result	If Not
Signal wire	–Key off, disconnect IRCM connector and control module connector –Measure continuity between pin 52 of control module connector, and pin 3 (1986) or pin 17 (1987) of IRCM –Reconnect control module connector	Continuity	Wiring fault
High speed fan circuit	–Key off, disconnect IRCM connector –Jumper pins at IRCM connector: 1986 2.5L HSC: 3 and 1 1987 2.5L HSC: 6 and 3 1986 3.0L: 3 and 2 1987 3.0L: 6 and 3 1987 2.3L Turbo: 6 and 3 –Key On	High Speed fan runs	Either cooling fan or wiring to fan faulty, or power from pin 1 of control module faulty
HEDF Relay	–Above tests show no problems	NA	If fan still does not run, then HEDF relay in IRCM or IRCM wiring is most likely faulty

HEGO

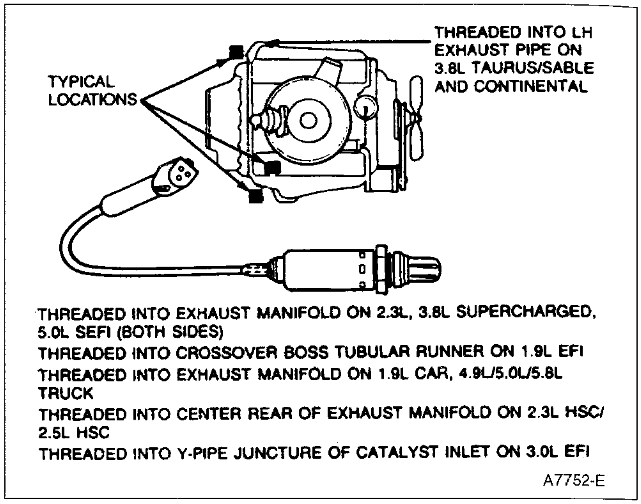
Circuit Description

Heated Exhaust Gas Oxygen (HEGO) sensor detects oxygen content in the exhaust gases. 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.

> ***WARNING —***
> *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.

Component Locator



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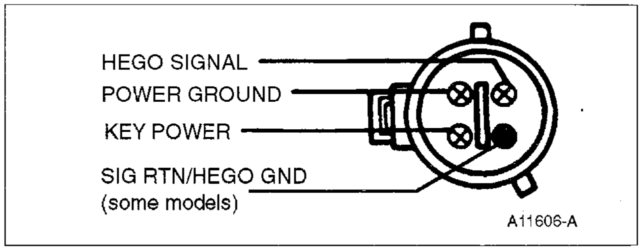
HEGO Connector (HEGO side)



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HEGO Electrical Tests

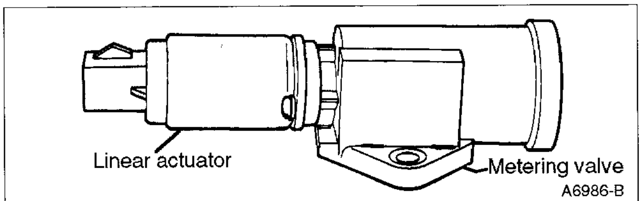
Test	Conditions	Test Results	If Not
HEGO SIGNAL	–Key off, disconnect HEGO sensor connector –Connect DMM between HEGO SIGNAL and negative (–) battery terminal –Run engine for 2 minutes at 2000 rpm	0.5 volts or greater	HEGO sensor may be faulty
HEGO response to exhaust	–Key off, disconnect HEGO sensor 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

ISC-BPA

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, act as an electronic dashpot, and provide air for engine start. The ISC-BPA is controlled by the EEC-IV control module. 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 Solenoid



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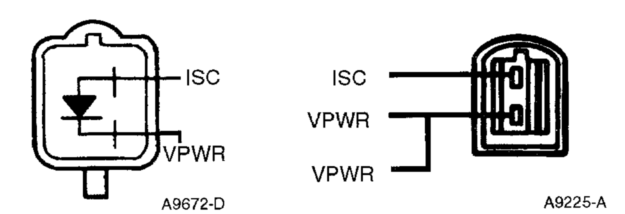
ISC Solenoid Connector and Vehicle Harness Connector



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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

Circuit Description

Knock Sensor (KS) detects engine detonation (spark knock). When knock occurs, a voltage signal is generated by the sensor. KS signals cause the EEC-IV module to retard spark timing. Since KS generates voltage, it does not require VREF.

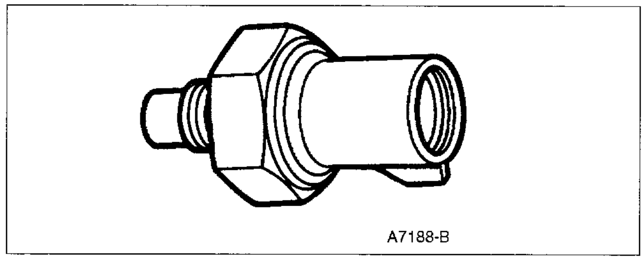
Knock Sensors begin in 1983 models, particularly turbo 2.3L engines. Typical models are Mustang, SVO Mustang, Thunderbird/Capri, Merkur XR4Ti, 3.0L Taurus/Sable, 3.8L Mustang/Capri, 2.3L Ranger/Aerostar, 2.9L, 3.0L, 4.9L, 5.0L.

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 the test is being performed. Higher altitude may cause lean fuel mixtures and spark knock.

An open or short-to-ground results in a 0v signal to the control module. Poor connection between sensor and control module may drop signal voltage to hide the knock.

Component Locator



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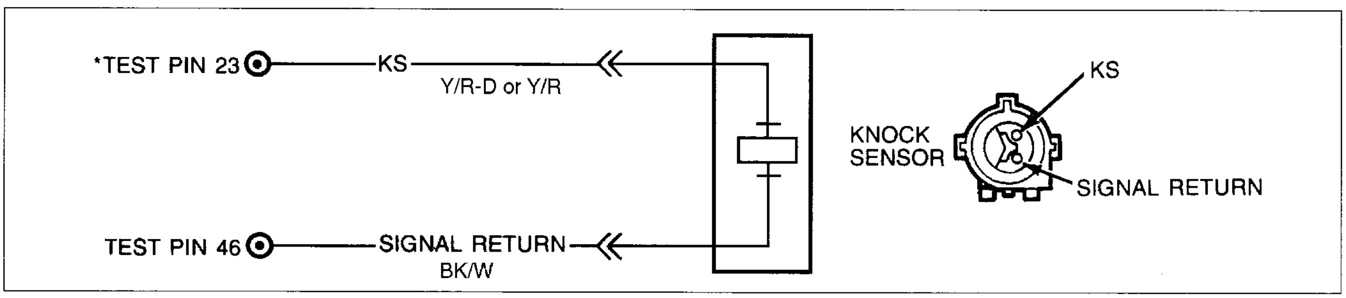
KS Circuit



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KS Electrical Tests

Test	Conditions	Test Results	If Not
Run Engine Running Self-Test	–Look for Dynamic Self-Test Code –Do Not depress throttle –Tap exhaust manifold with 4 oz. hammer	Trouble Code generated	Continue testing
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

12

MAP/BP

Circuit Description

Manifold Absolute Pressure (MAP) sensor senses intake manifold pressure and sends a frequency signal to the EEC 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 module to compensate for changes in altitude.

In some EEC-IV engines, MAP sensor normally signals the control module about Manifold Absolute Pressure, switching over briefly to signal about Barometric Pressure. In other EEC-IV engines, MAP sensor is separate from BP. Both MP and BAP are sensed continuously. On EEC-III engines, look for two sensors in one housing, measuring both MAP and BP.

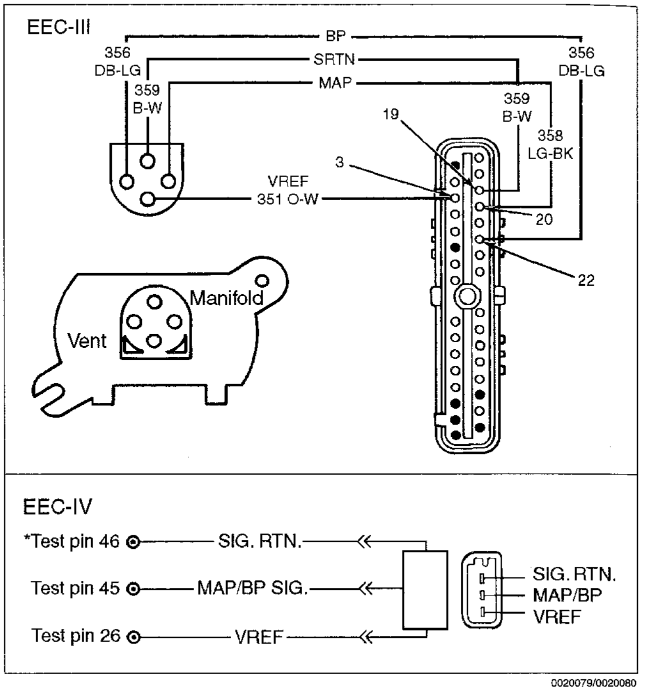
When troubleshooting the MAP or MAP/BP sensor always begin by checking for air leaks in the intake and vacuum systems. Repair as necessary. The sensor can be checked using a frequency meter and a hand held vacuum pump with gauge. Begin by checking that the sensor holds vacuum. If it doesn't, replace it.

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.

An open or short to ground between MAP or BP and the control module results in a constant 0v signal at the control module. A poor connection between sensor and control module results in a weak signal that cannot be recognized by the frequency-to-voltage converter.

Remember this sensor generates frequency signals from VREF so you need a *digital* volt-ohmmeter (DVOM) to read frequency converted to voltage. Analog voltmeter readings are worthless.

MAP/BP Circuit



MAP/BP Voltage

Elevation (FT)	EEC-III	EEC-IV
0–1500	7.6–8.4v	1.51–1.66v
1501–2500	7.2–8.1	1.48–1.59
2501–3500	6.9–7.8	1.44–1.56
3501–4500	6.7–7.3	1.41–1.52
4501–5500	6.6–7.2	1.39–1.49

Scope Check

Hook scope to MAP/BP signal wire. Look for good square wave, sign of a good sensor. When you apply vacuum to the vacuum port, look for smooth expanding of the pattern.

- With no vacuum, measure about 6.25ms (about 160 cycles per second) or 160 Hertz
- With full vacuum, look for about 10.8ms (about 93 Hertz)
- Apply vacuum and hold for 30 seconds. Steady needle indicates no vacuum leaks

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 (EEC-IV) 8 to 10 volts (EEC-III)	Check VREF circuit
MAP/BP Sensor	–Connect MAP connector –Backprobe MAP connector between MAP wire and battery negative (–) terminal –Vary vacuum using pump –KOEO	See table above	MAP/BP sensor may be faulty

MTA (TAB/TAD)

Circuit Description

Managed Thermactor Air (MTA) solenoids (also known as AM1/AM2, or Thermactor Air Bypass/Thermactor Air Diverter (TAB/TAD) solenoids) direct secondary air to either the exhaust manifold or catalytic converter. Opening and closing of the solenoids is controlled by grounding the circuit in the control module.

Look for Thermactor in the larger engines. TAD and TAB solenoids receive vehicle power through the power relay, Red wire (Black/Yellow in a few cases).

Test Data

Check the TAB/TAD solenoids for internal vacuum leaks by connecting a vacuum pump to the supply port and a vacuum gauge to the output port of one solenoid. Apply a vacuum of 15 in.Hg (50 kPa) and observe gauge. Gauge reading should hold for each solenoid.

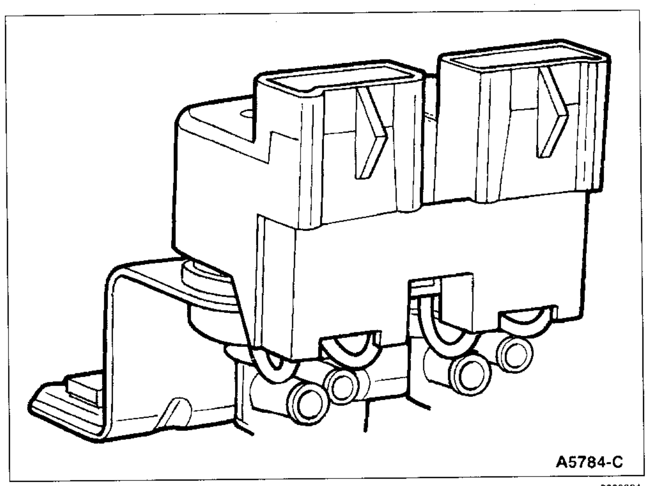
Check for VPWR with the key on, engine off (KOEO) after disconnecting the solenoid connector. VPWR should be 10.5 volts or greater. If not, check wiring for continuity or corrosion.

Solenoid resistance at solenoid terminals should be 51–108 ohms (45–90 ohms EEC-III). If not replace the solenoid.

If solenoid operates and wiring to the control module is OK, then the control module may be faulty.

With TAB disconnected, try to blow through valve; it is normally closed so it should not pass air. Connect 12v to TAB. When you energize TAB, listen for solenoid click, and be sure you can blow through it. TAD (normally closed) should work the same as TAB. NOTE: Typical procedure. Some Thermactor valves differ.

Component Locator



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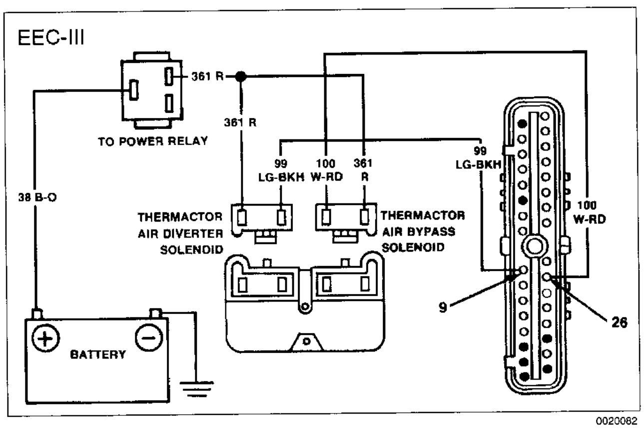
MTA Circuits



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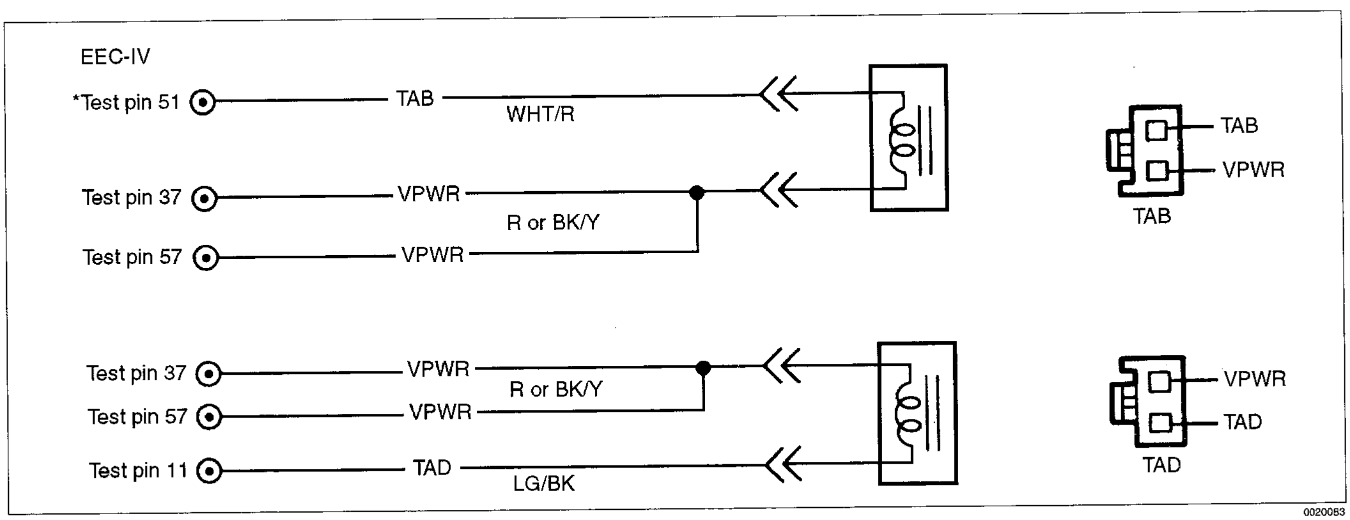

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12

PFE (EGR)

Circuit Description

Pressure Feedback EGR (PFE) sensor converts a varying exhaust gas pressure value into an analog voltage which is sent to the EEC-IV module. The EEC-IV module uses this information to compute the optimal EGR flow. The PFE sensor can be tested using a vacuum pump and gauge. Begin by checking the pressure input hose to the sensor for blockage and correct as necessary.

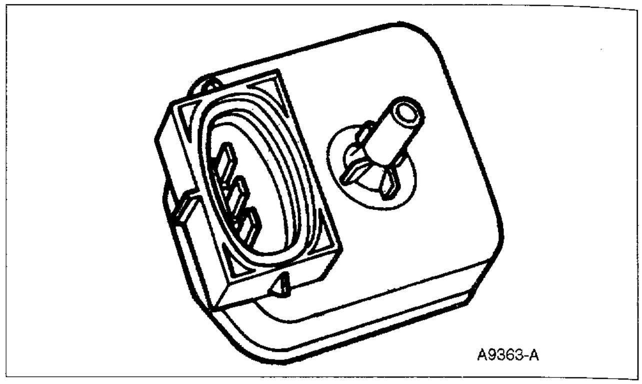
> ***CAUTION —***
> *To avoid possible sensor damage, do not exceed pressure/vacuum range shown below when testing.*

> **NOTE —**
> Trouble code 34 could be due to a lack of exhaust system pressure, caused by shop exhaust extraction equipment.

PFE Sensor Test Values

Pressure		Vacuum	PFE Voltage
psi	kPa	in.Hg	Volts
1.82	12.5	3.70	4.75
1.36	9.42	2.79	4.38
0.91	6.25	1.85	4.0
0.46	3.17	0.94	3.63
0	0	0	3.25
–2.47	–17.0	–5.03	1.22
–3.63	–25.0	–7.40	0.25
Note: values may vary ± 15 percent due to sensor and VREF variations			

PFE Sensor



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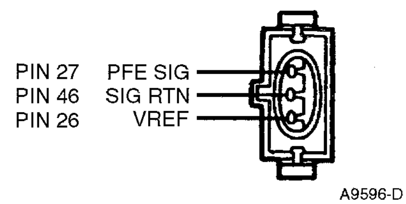
PFE Sensor Connector



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PFE Electrical Tests

Test	Conditions	Test Results	If Not
For Code 31 (PFE signal less than 0.2 volts)	–Key off, disconnect PFE sensor connector –Jumper PFE circuit to VREF at harness connector –Perform KOEO Self-Test	Code 35 generated (ignore other codes)	–No codes at all: internal short in wiring to control module, or control module faulty –If 35 generated, replace PFE sensor –If 35 not generated, check VREF
For code 35 (PFE signal more than 4.8 volts)	–Key off, disconnect PFE sensor connector –Perform KOEO Self-Test	Code 31 generated (ignore other codes)	–If 31 generated, replace PFE sensor –If 31 not generated, either internal short in wiring to control module, or control module faulty
VREF	–Key off, disconnect PFE connector –KOEO, measure voltage between VREF and SIG RTN at vehicle harness connector	4 to 6 volts	Check VREF circuit
PFE/DPFE Sensor	–Connect PFE connector –Connect DVOM (backprobe or BOB) between PFE wire and SIG RTN –ER, vary vacuum using pump	See table above	PFE sensor may be faulty

TFI-IV (PIP, SPOUT)

Circuit Description

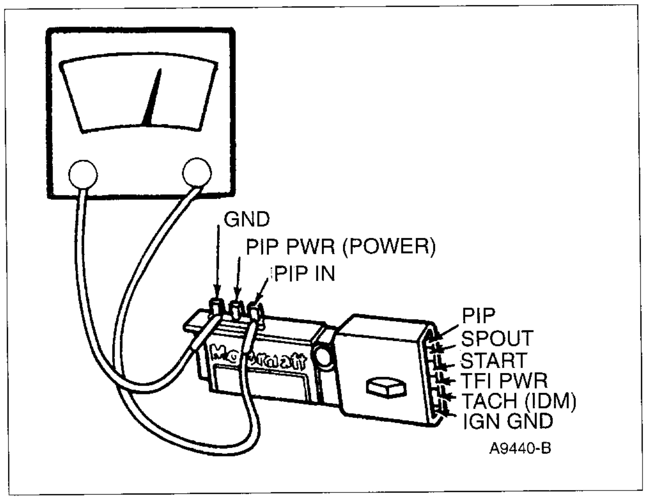
Thick Film Ignition-IV (TFI-IV) uses solid state integrated circuits. A Hall sender in the distributor creates a signal (PIP) indicating crankshaft position for the EEC control module. The EEC control module triggers the TFI module with a signal (SPOUT) to fire the ignition coil.

Problems can be caused by a bent vane in the distributor. Remember that a no-spark condition may also be caused by a fault in power to the coil, or by a faulty coil. Always begin by checking the power supply and ground to the TFI module.

If there is no PIP signal but the module has power and ground, and there is continuity in the module (PIP IN to PIP PWR), then the Hall sender is probably faulty.

> ***WARNING —***
> *The TFI-IV 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.*

TFI-IV Module (Testing)



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TFI-IV Electrical Tests

Test	Conditions	Test Results	If Not
Distributor ground	–Connect DVOM between distributor base and engine block	Continuity (less than 2 ohms)	Fault in distributor ground, check distributor mounting
Power to TFI module, engine run	–Key off, disconnect TFI-IV connector –KOEO, measure voltage at harness connector between TFI PWR and distributor base	Battery voltage	Fault in power circuit from ignition switch
Power to TFI module, engine crank	–Key off, disconnect TFI-IV connector –Measure voltage at vehicle harness connector between START and distributor base (ground) –Engine Crank	8 to 10 volts	Fault in power circuit from ignition switch
PIP signal	–TFI connector connected –Backprobe TFI connector at PIP with DVOM or LED test lamp –Engine Crank	3 to 6 volts, or LED test lamp blinks	If TFI module tests OK as shown below then Hall sender is faulty
SPOUT	–TFI connector connected –Backprobe TFI connector at SPOUT with DVOM or LED test lamp –Engine Crank	3 to 6 volts or LED test lamp blinks	Check wiring to control module. If OK, control module may be faulty
TFI Module tests (See illustration above)	–Remove distributor from engine –Remove TFI module from distributor –Probe with ohmmeter at Hall/TFI module connector		
GND to PIP IN		Greater than 500 Ohms	TFI module faulty
PIP PWR to PIP IN		Less than 2000 Ohms	TFI module faulty
PIP PWR to TFI PWR		Less than 200 Ohms	TFI module faulty
GND to IGN GND		Less than 2 Ohms	TFI module faulty
PIP IN to PIP		Less than 200 Ohms	TFI module faulty

12

TPS

Circuit Description

Throttle Position Sensor (TPS) provides the EEC module with a variable voltage that represents throttle position.

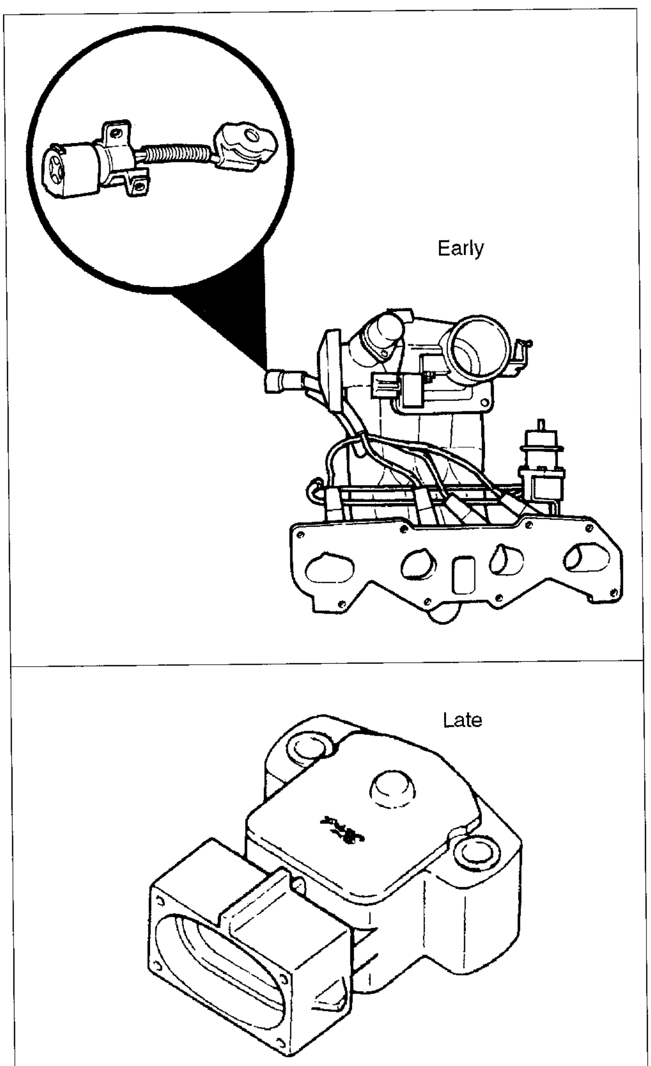
TPS Voltage Signal

Throttle Position	EEC-III (VREF 9.0)	EEC-IV (VREF 5.0)
Closed throttle	1.8–2.75 volts	0.6 volts
Full throttle	Approx. 8.5 volts	4.5 volts

Voltage should increase smoothly as the throttle is opened. Any glitch indicates a dropout in the TPS wiper, and the TPS should be replaced.

There are two types of TPS. Early ones are linear; later are rotary. Some early rotary style can be adjusted if out of spec.

TPS (Rotary)

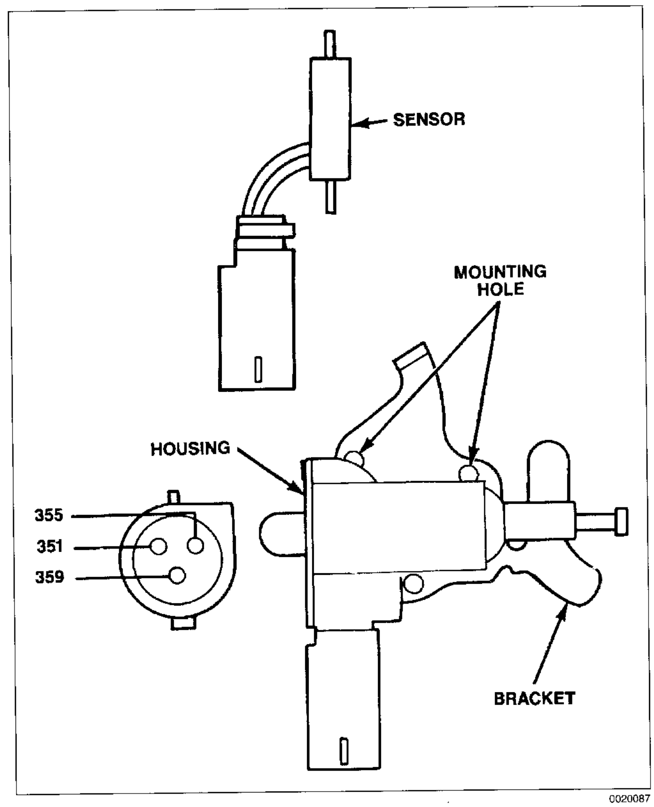


TPS Opens & Grounds

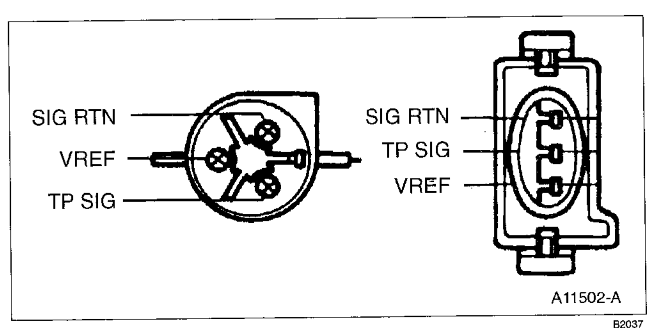
An open results in a 0v. signal if there is a fault in one of the following: a) VREF; b) signal return; c) sensor itself; d) VREF side of wiper. In contrast, an open results in VREF, 5v or 9v signal if the open is in the ground line, or on the ground side of wiper. A short-to-ground in either VREF or signal return results in a 0v signal.

Higher-than-normal resistance in VREF results in lower voltage input, tending to cause lean mixtures and misfire. Higher than normal resistance in the ground results in higher voltage input, tending to cause rich mixtures.

TPS (Linear)



Rotary TPS Harness Connectors



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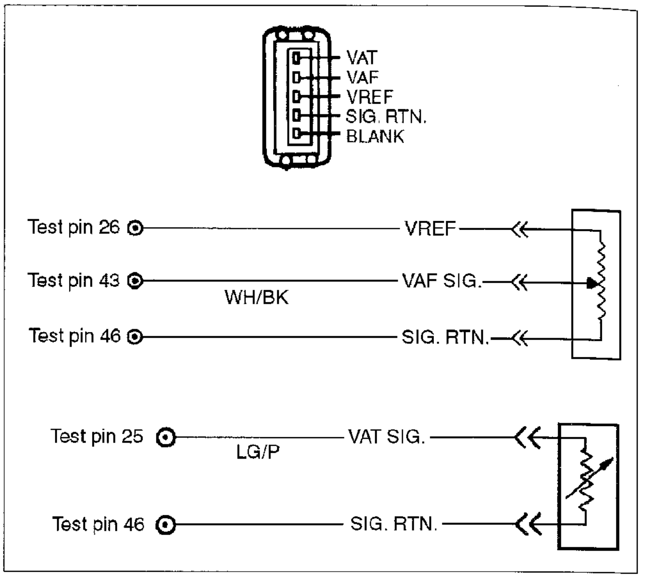
VAF/VAT

Circuit Description

Vane Air Flow (VAF) sensor provides the EEC-IV module with a voltage signal that represents the amount of air flowing into the engine. The VAF air vane is attached to a potentiometer. The air vane moves as the intake air volume changes, changing the voltage. When troubleshooting the VAF sensor, begin by checking for air leaks in the intake system that cause unmetered air to enter. Check that the VAF sensor is not binding or sticking and remove all residue and intake deposits using a cleaner. The VAF sensor cannot be repaired.

Vane Air Temperature (VAT) sensor provides the EEC-IV module with a voltage that changes with ambient temperature. The VAT sensor is similar in operation to the ACT sensor. The VAT sensor is in the vane air meter and is not replaceable. It can be tested using an ohmmeter.



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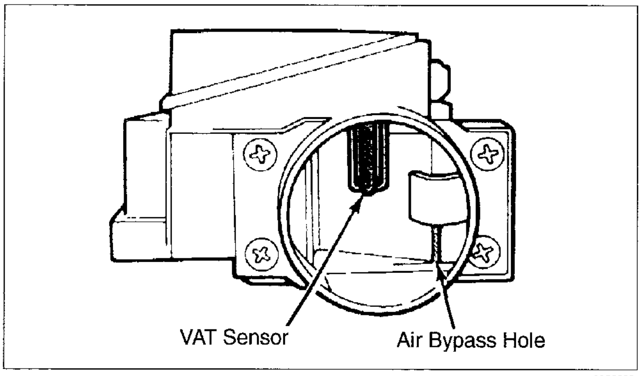
Vane Air Meter



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VAT Sensor Values

Temperature	Resistance
32° F	5800 ohms
65° F	2700 ohms
185° F	300 ohms
220° F	180 ohms
240° F	125 ohms

VAF/VAT Electrical Tests

Test	Conditions	Test Results	If Not
VREF	–Key off, wait 10 seconds –Disconnect VAF connector –Probe between VREF and SIG RTN at VAF vehicle harness connector –KOEO	4 to 6 volts	Check VREF circuitry and wiring
VAF SIG	–Key off, wait 10 seconds –Backprobe VAF connector between VAF and SIG RTN with DMM –KOEO –Move air vane meter through entire range	Variable voltage from 1 to 5 volts without any breaks as air vane is moved through range	Faulty Vane Air Meter
VAT SIG	–Key off, wait 10 seconds –Disconnect VAF connector –Probe VAF connector between VAT SIG and SIG RTN with DMM	Resistance value as specified at a particular temperature (See table above)	Faulty Vane Air Meter

VPWR

Circuit Description

Vehicle Power (VPWR or VBAT) is battery voltage distribution to certain output actuators when the key is on. The EEC Power Relay (located in the IRCM on some models) supplies VPWR to these various electrical components. A failure in the VPWR circuit will result in a no start condition.

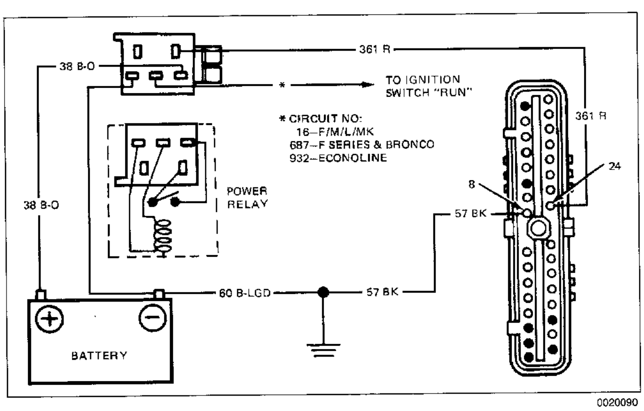
EEC-IV VPWR Inputs/Outputs

Signal	EEC-IV Module Pin	Description
VPWR	37, 57	Power distribution
KEY POWER		Ignition key input to EEC power relay in IRCM
KAPWR		Battery voltage at all times
GND or PWR GND	40, 60	Ground

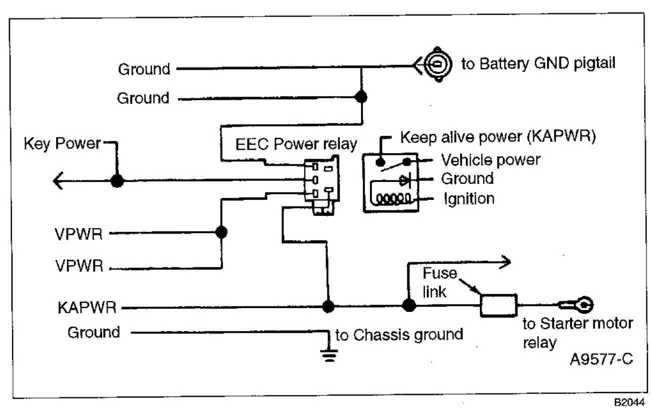
VPWR Electrical Tests

Test	Conditions	Test Results	If Not
VPWR	–Key On or Key in Crank position –Measure voltage with DMM between VPWR and battery negative (–) terminal	10.5 volts or greater	–Check for open or short in VPWR circuit –Check EEC Power Relay in IRCM, ground wiring, and key power circuit –Check continuity of VPWR wiring from IRCM to EEC-IV module
KEY POWER	–Key On, Engine Off –Engine Running	10.5 volts or greater	–Check ignition switch and wiring
GROUND	–Measure continuity to battery negative (–) terminal	5 Ohms or less	Check ground cable and straps
KAPWR		10.5 volts or greater	Check battery positive (+) cable and battery

Typical EEC-III VPWR Circuit



Typical EEC-IV VPWR Circuit



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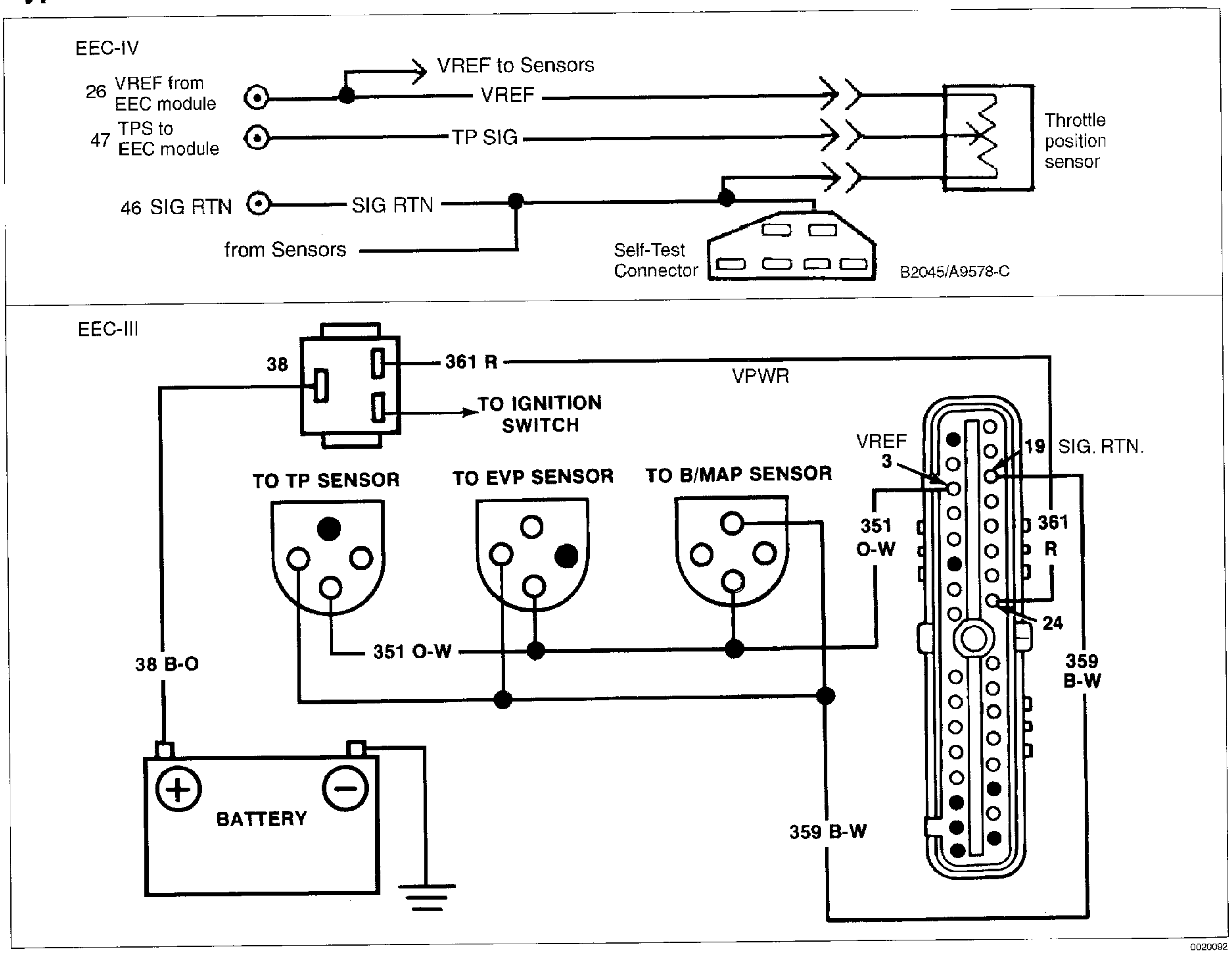
VREF

Circuit Description

Reference Voltage (VREF) is a voltage supply used for various sensors such as TPS, EVP/PFE, MAP, and VAF. The VREF voltage should be 5 volts on EEC-IV or 9 volts on EEC-III, with a small variance (± 0.1v.) an acceptable range. The VREF supply is generated internally by the EEC module. Begin troubleshooting by checking for VPWR and GND to the EEC module. To isolate problems with sensors that use VREF, disconnect one sensor at a time and re-measure VREF.

Typical EEC VREF Circuit



VREF Electrical Tests

Test	Conditions	Test Results	If Not
VREF	–Key on or Key in crank position –Measure voltage with DVOM between VREF and SIG RTN –Note: measure VREF and TPS	5 ± 0.1 volts (EEC-IV) 9 ± 0.1 volts (EEC-III)	Check for power and ground to EEC module Check for open or short in VREF circuit Check for faulty sensor connected to VREF, check continuity of wiring
VPWR	–Key On, Engine Off –Key On, Engine Running	10.5 volts or greater	Check EEC Power Relay in IRCM
KEY POWER	–Key On, Engine Off –Key On, Engine Running	10.5 volts or greater	Check ignition switch and wiring
GROUND	–Measure continuity to battery negative (–) terminal	5 Ohms or less	Check ground cable and straps
SIG RTN	–Measure continuity between SIG RTN and battery negative (–) terminal	5 Ohms or less	Check wiring to EEC-IV module