

CODE 13

OXYGEN SENSOR CIRCUIT (OPEN CIRCUIT) 5.0L (VIN E) "F" CARLINE (TBI)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "D7" and "D6". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volt). The O₂ sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down through about .10 volt if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360°C (600°F). An open sensor circuit or cold sensor causes "Open Loop" operation.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 13 will set:
 - Engine at normal operating temperature.
 - At least 2 minutes engine time after start.
 - O₂ signal voltage steady between .35 and .55 volts.
 - Rpm above 1600.
 - Throttle position sensor signal above 5% (about .3 volts above closed throttle voltage).
 - All conditions must be met for about 60 seconds.

If the conditions for a Code 13 exist, the system will not go "Closed Loop."

2. This will determine if the sensor is at fault or the wiring or ECM is the cause of the Code 13.

3. To perform this test, use only a high impedance digital volt ohmmeter. This test checks the continuity of CKTs 412 and 413. If CKT 413 is open, the ECM voltage on CKT 412 will be over .6 volts (600 mV).

Diagnostic Aids:

Normal "Scan" voltage varies between 100 mV to 999 mV (.1 and 1.0 volt), while in "Closed Loop." Code 13 sets in one minute, if voltage remains between .35 and .55 volts.

Refer to "Intermittents" in Section "B".

CODE 13
OXYGEN SENSOR CIRCUIT
(OPEN CIRCUIT)
5.0L (VIN E) "F" CARLINE (TBI)

1 ENGINE AT NORMAL OPERATING TEMPERATURE (ABOVE 80°C/176°F).
 • RUN ENGINE ABOVE 1200 RPM FOR TWO MINUTES.
 • DOES "SCAN" TOOL INDICATE "CLOSED LOOP"?

NO

YES

2 • DISCONNECT O₂ SENSOR.
 • JUMPER HARNESS CKT 412 (ECM SIDE) TO GROUND.
 • "SCAN" TOOL SHOULD DISPLAY O₂ VOLTAGE BELOW .2 VOLT (200 mV) WITH ENGINE RUNNING. DOES IT?

CODE 13 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO

YES

3 • REMOVE JUMPER.
 • IGNITION "ON", ENGINE "OFF".
 • CHECK VOLTAGE OF CKT 412 (ECM SIDE) AT O₂ SENSOR HARNESS CONNECTOR USING A DVM.

FAULTY O₂ SENSOR CONNECTION OR SENSOR.

.3-.6 VOLT
(300 - 600 mV)

OVER .6 VOLT
(600 mV)

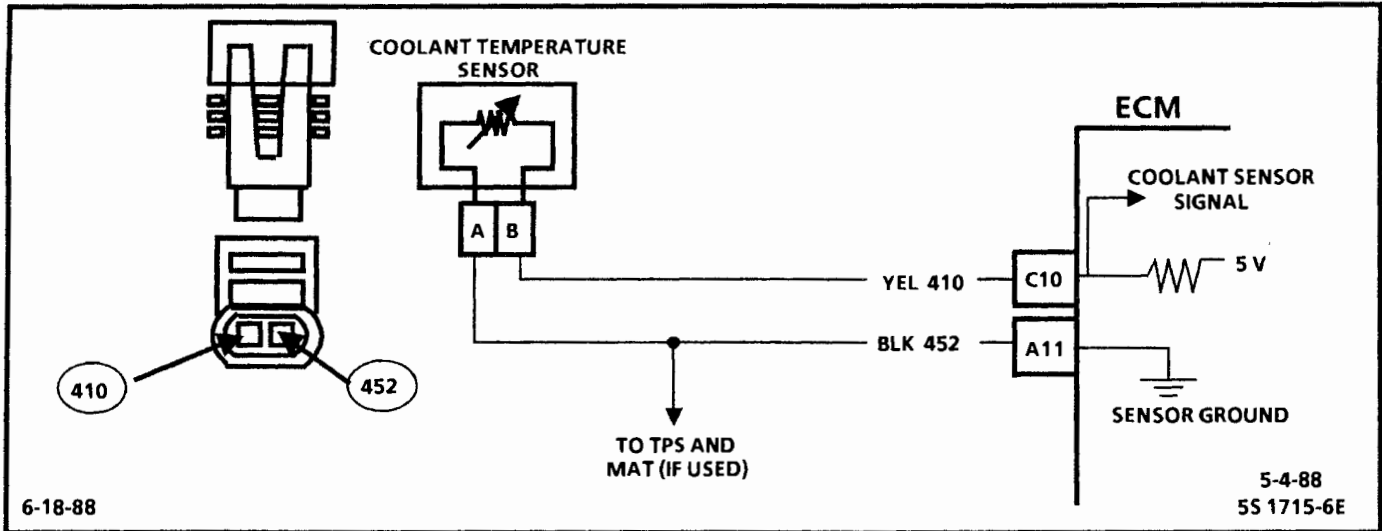
LESS THAN .3
VOLT (300 mV)

FAULTY ECM.

OPEN CKT 413
OR
FAULTY CONNECTION
OR
FAULTY ECM.

OPEN CKT 412
OR
FAULTY ECM CONNECTION
OR
FAULTY ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 14

COOLANT TEMPERATURE SENSOR CIRCUIT (HIGH TEMPERATURE INDICATED) 5.0L (VIN E) "F" CARLINE (TBI)

Circuit Description:

The coolant temperature sensor uses a thermistor to control the signal voltage at the ECM. The ECM applies a voltage on CKT 410 to the sensor. When the engine coolant is cold the sensor (thermistor) resistance is high, therefore the ECM will see high signal voltage.

As the engine coolant warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature (85°C-95°C or 185°F-203°F) the coolant sensor signal voltage will be about 1.5 to 2.0 volts.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 14 will set if:
 - Signal voltage indicates a coolant temperature above 135°C (275°F) for 2 seconds.
2. This test will determine if CKT 410 is shorted to ground which will cause the conditions for Code 14.

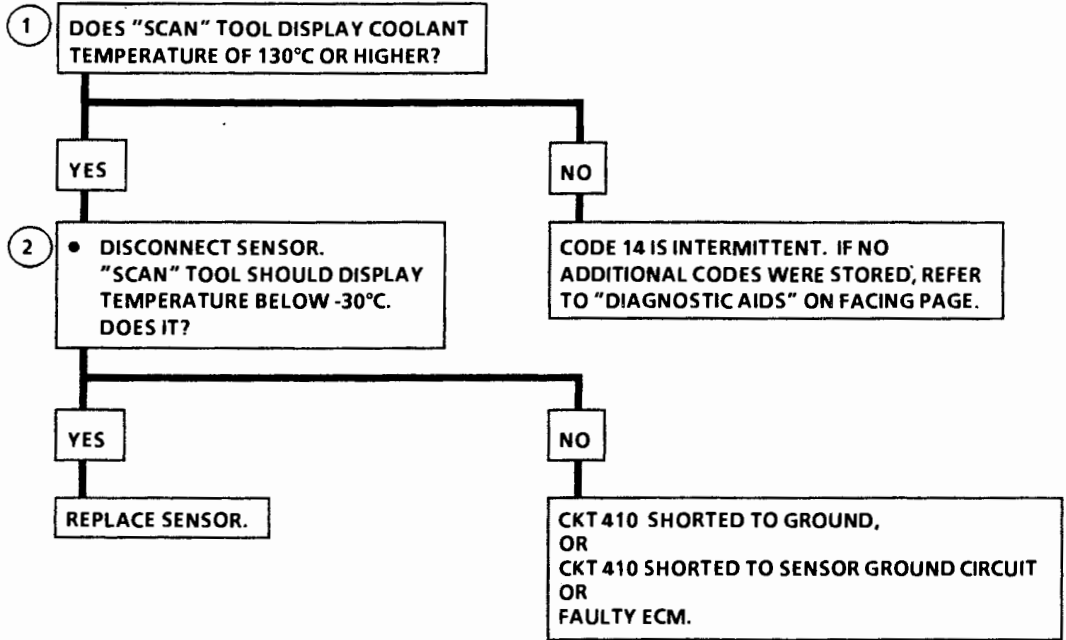
Diagnostic Aids:

Check harness routing for a potential short to ground in CKT 410.

"Scan" tool displays engine temperature in degrees centigrade. After engine is started, the temperature should rise steadily to about 90°C (194°F) then stabilize when the thermostat opens.

Refer to "Intermittents" in Section "B".

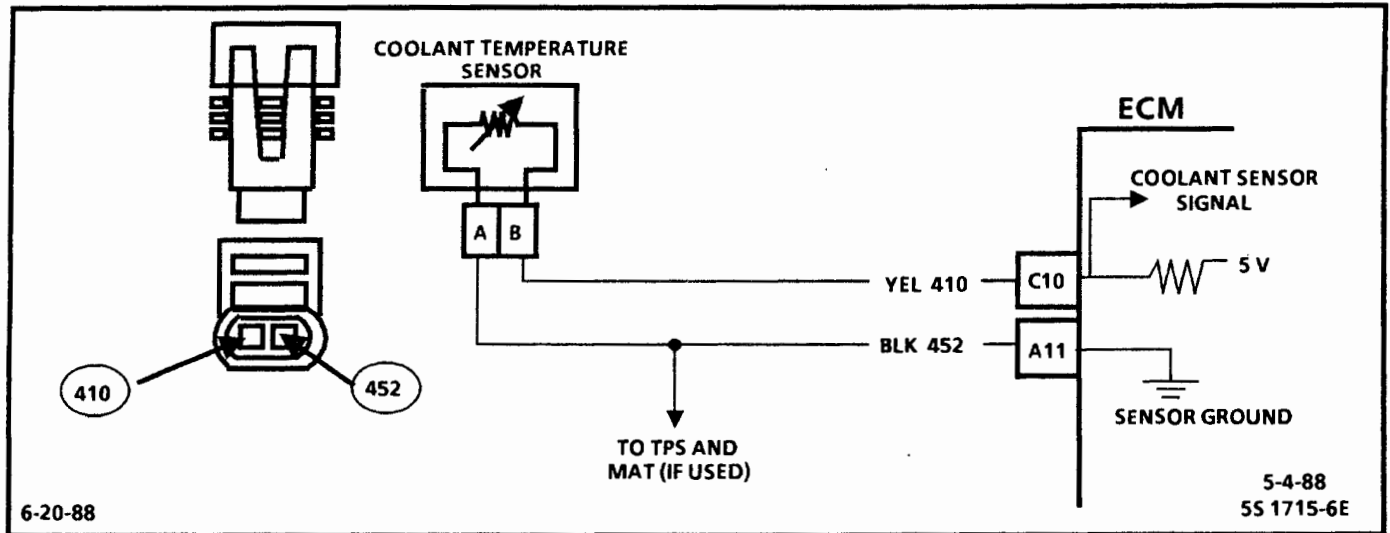
CODE 14
COOLANT TEMPERATURE SENSOR CIRCUIT
 (HIGH TEMPERATURE INDICATED)
 5.0L (VIN E) "F" CARLINE (TBI)



DIAGNOSTIC AID

COOLANT SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 15

COOLANT TEMPERATURE SENSOR CIRCUIT (LOW TEMPERATURE INDICATED) 5.0L (VIN E) "F" CARLINE (TBI)

Circuit Description:

The coolant temperature sensor uses a thermistor to control the signal voltage at the ECM. The ECM applies a voltage on CKT 410 to the sensor. When the engine coolant is cold, the sensor (thermistor) resistance is high, therefore, the ECM will see high signal voltage.

As the engine coolant warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature (85°C-95°C or 185°F-203°F) the coolant sensor signal voltage will be about 1.5 to 2.0 volts at the ECM.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

- Code 15 will set if:
 - Engine running longer than 30 seconds
 - Engine coolant temperature less than -30°C (-22°F), for 3 seconds
- This test simulates a Code 14. If the ECM recognizes the low signal voltage, (high temperature) and the "Scan" reads 130°C (266°F) or above, the ECM and wiring are OK.
- This test will determine if CKT 410 is open. There should be 5 volts present at sensor connector if measured with a DVM.

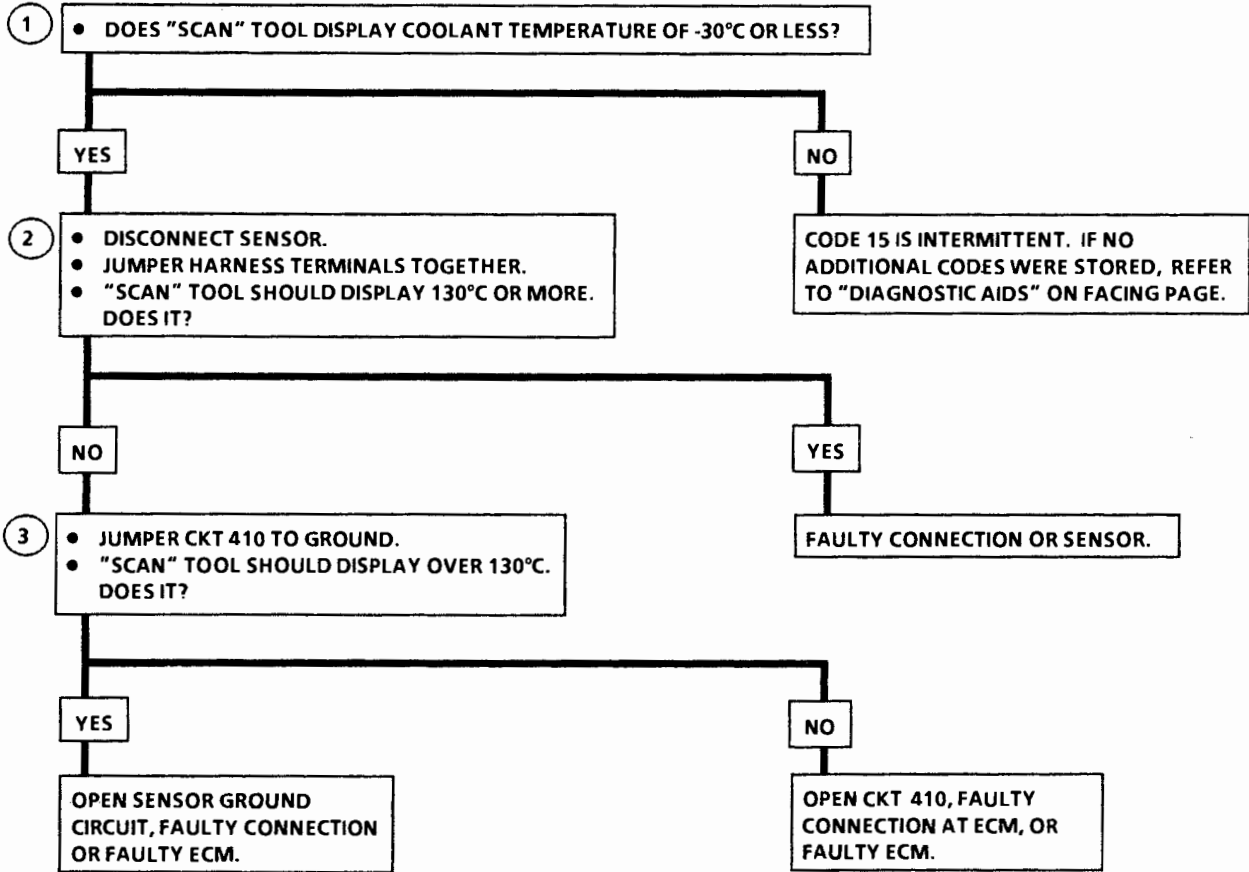
Diagnostic Aids:

A "Scan" tool reads engine coolant temperature in degrees centigrade. After engine is started the temperature should rise steadily to about 90°C (194°F) then stabilize when the thermostat opens.

If Code 21 is also set, check CKT 452 for faulty wiring or connections. Check terminals at sensor for good contact.

Refer to "Intermittents" in Section "B".

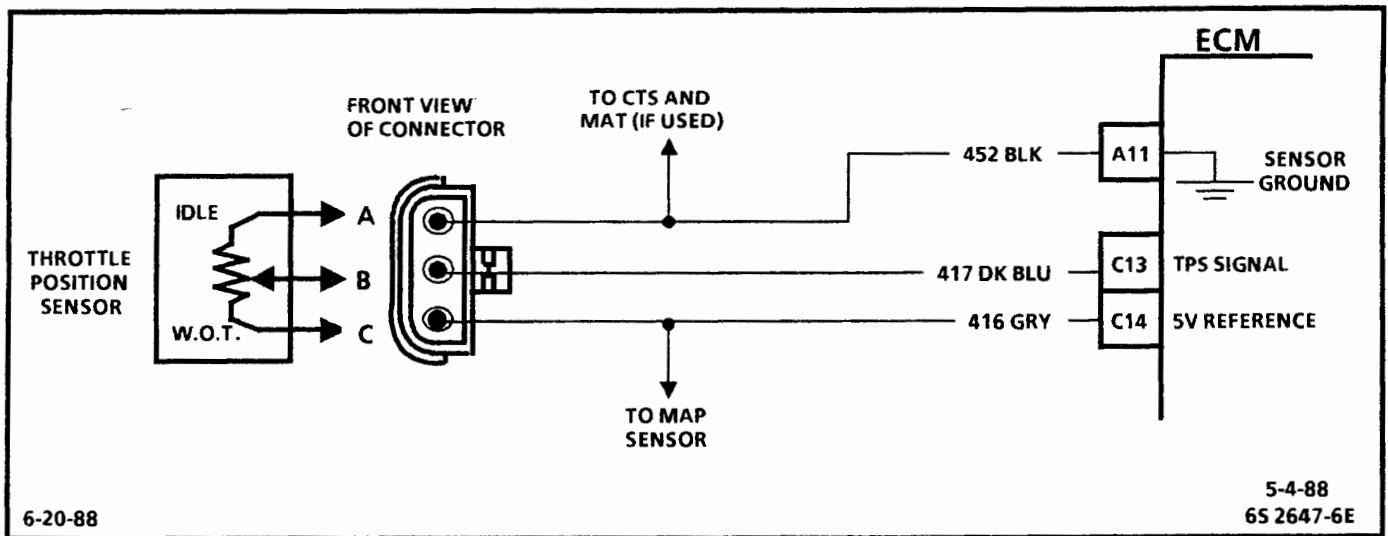
CODE 15
COOLANT TEMPERATURE SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
5.0L (VIN E) "F" CARLINE (TBI)



DIAGNOSTIC AID

COOLANT SENSOR		
TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)		
°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 21

THROTTLE POSITION SENSOR (TPS) CIRCUIT (SIGNAL VOLTAGE HIGH) 5.0L (VIN E) "F" CARLINE (TBI)

Circuit Description:

The throttle position sensor (TPS) provides a voltage signal that changes relative to the throttle blade. Signal voltage will vary from about .5 at idle to about 5 volts at wide open throttle.

The TPS signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM controlled outputs.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

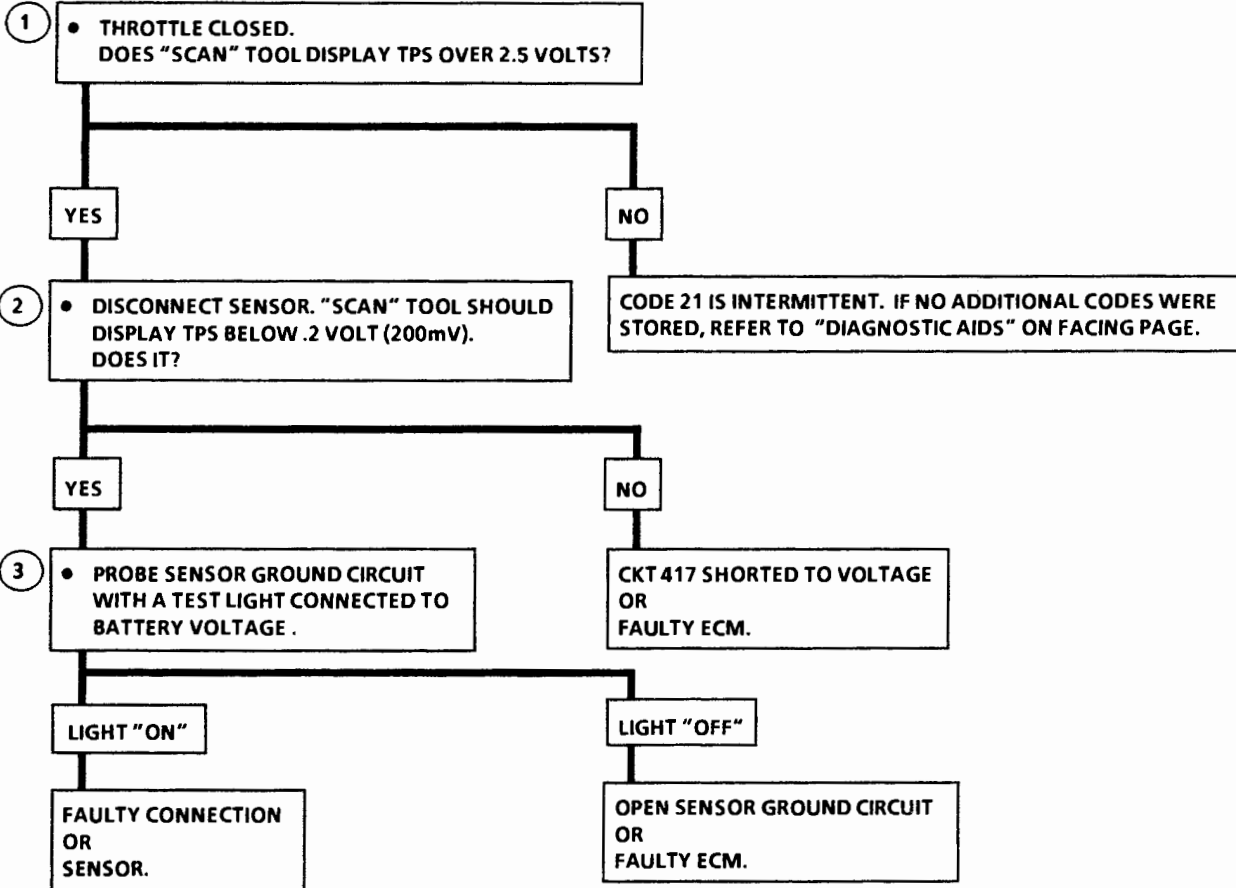
1. Code 21 will set if:
 - TPS signal voltage is greater than 2.5 volts
 - All conditions met for 8 seconds
 - MAP less than 52 kPa (or greater than 15" HG)
2. With the TPS sensor disconnected, the TPS voltage should go low if the ECM and wiring are OK.
3. Probing CKT 452 with a test light checks the 5 volt return circuit, because a faulty 5 volts return will cause a Code 21.

Diagnostic Aids:

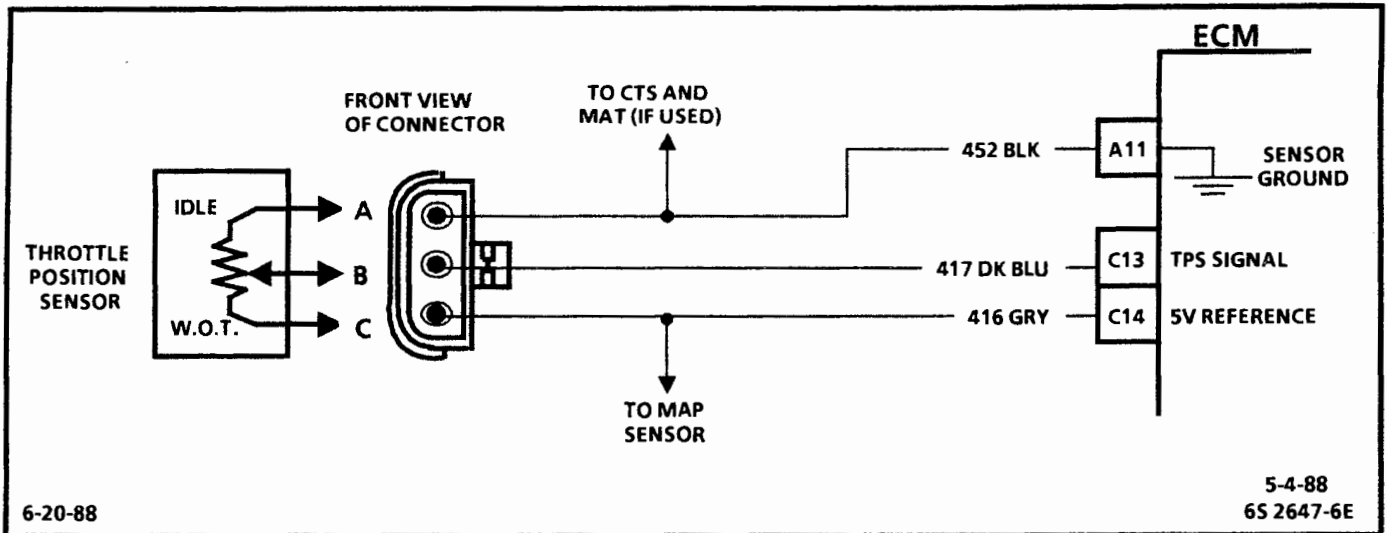
A "Scan" tool reads throttle position in volts. The signal voltage when the throttle is closed should be less than 1.25 volts. With ignition "ON" or at idle, voltage should increase at a steady rate as throttle is moved toward WOT.

An open in CKT 452 will result in a Code 21. Refer to "Intermittents" in Section "B".

CODE 21
THROTTLE POSITION SENSOR (TPS) CIRCUIT
 (SIGNAL VOLTAGE HIGH)
 5.0L (VIN E) "F" CARLINE (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 22

THROTTLE POSITION SENSOR (TPS) CIRCUIT (SIGNAL VOLTAGE LOW) 5.0L (VIN E) "F" CARLINE (TBI)

Circuit Description:

The throttle position sensor (TPS) provides a voltage signal that changes relative to the throttle blade. Signal voltage will vary from about .5 at idle to about 5 volts at wide open throttle.

The TPS signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM controlled outputs.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 22 will set if:
 - Engine running
 - TPS signal voltage is less than about .2 volt for 3 seconds.
2. Simulates Code 21: (high voltage) If the ECM recognizes the high signal voltage the ECM and wiring are OK.
3. The TPS has an auto zeroing feature. If the voltage reading is within the range of 0.35 to 0.7 volts, the ECM will use that value as closed throttle. If the voltage reading is out of the auto zero range at closed throttle replace the TPS, refer to Section "6E2-C1" On-Car Service.

4. This simulates a high signal voltage to check for an open in CKT 417. The "Scan" tool will not read up to 12 volts, but what is important is that the ECM recognizes the signal on CKT 417.

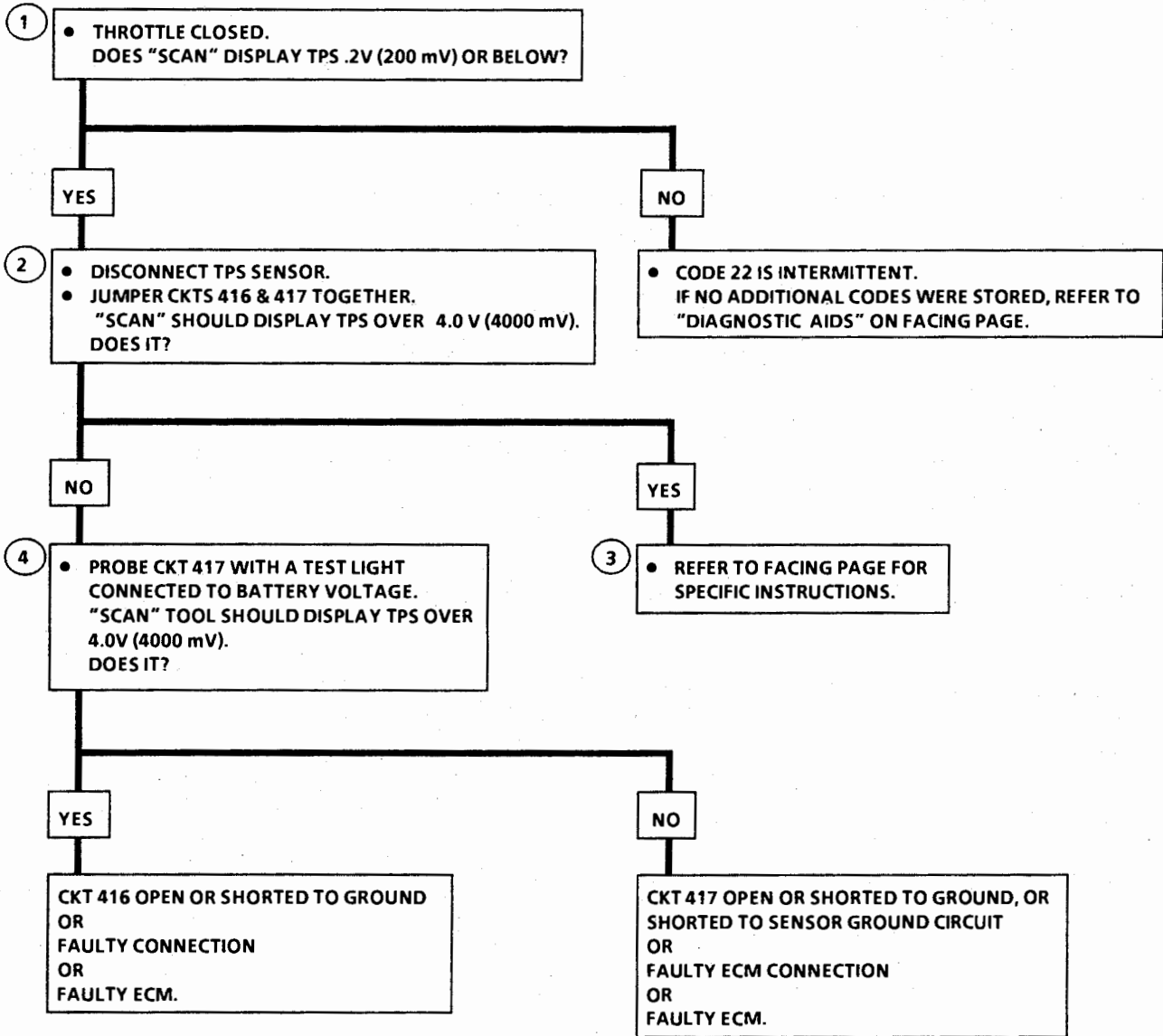
Diagnostic Aids:

The signal voltage when the throttle is closed should be less than 1.25 volts. With ignition "ON" or at idle, voltage should increase at a steady rate as throttle is moved toward WOT.

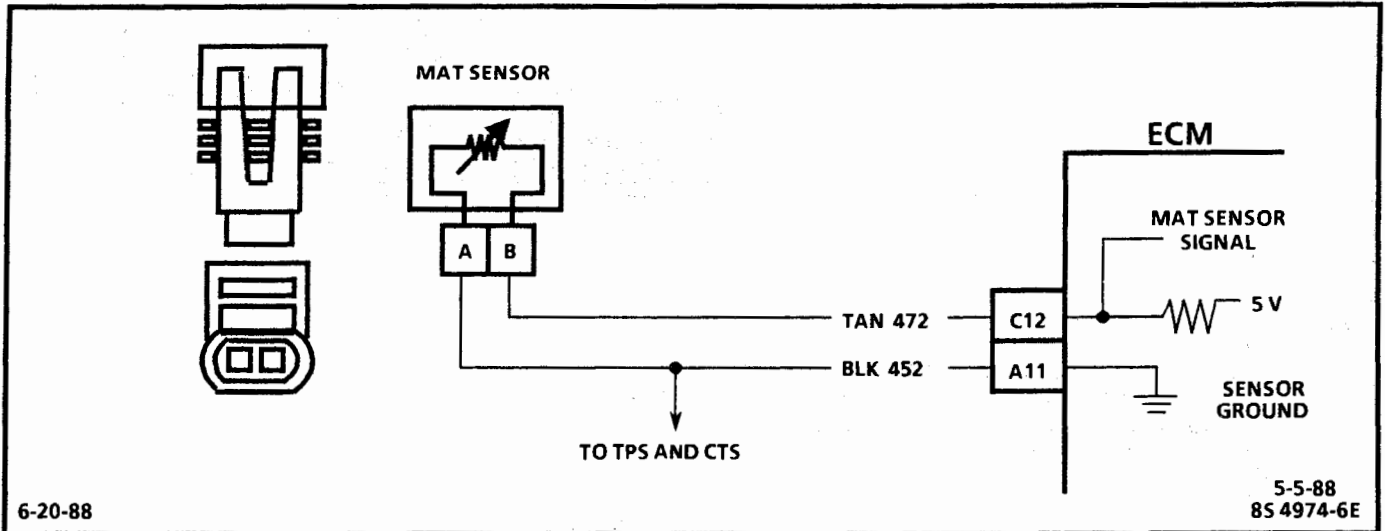
An open or short to ground in CKT 416 or CKT 417 will result in a Code 22.

Refer to "Intermittents" in Section "B".

CODE 22
THROTTLE POSITION SENSOR (TPS) CIRCUIT
 (SIGNAL VOLTAGE LOW)
 5.0L (VIN E) "F" CARLINE (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 23

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT (LOW TEMPERATURE INDICATED) 5.0L (VIN E) "F" CARLINE (TBI)

Circuit Description:

The manifold air temperature (MAT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage (about 5 volts) on CKT 472 to the sensor. When the manifold air is cold, the sensor (thermistor) resistance is high, therefore, the ECM will see a high signal voltage. If the manifold air is warm, the sensor (thermistor) resistance is low, therefore, the ECM will see a low voltage.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 23 will set if:
 - A signal voltage indicates a manifold air temperature below -30°C (-22°F) for 12 seconds.
 - Time since engine start is 1 minute or longer
2. A Code 23 will set, due to an open sensor, wire or connection. This test will determine if the wiring and ECM are OK.
3. This will determine if the MAT sensor signal CKT 472 or the MAT sensor ground CKT 452 is open.

Diagnostic Aids:

A "Scan" tool indicates the temperature of the air in the air cleaner because the MAT sensor is mounted in the air cleaner.

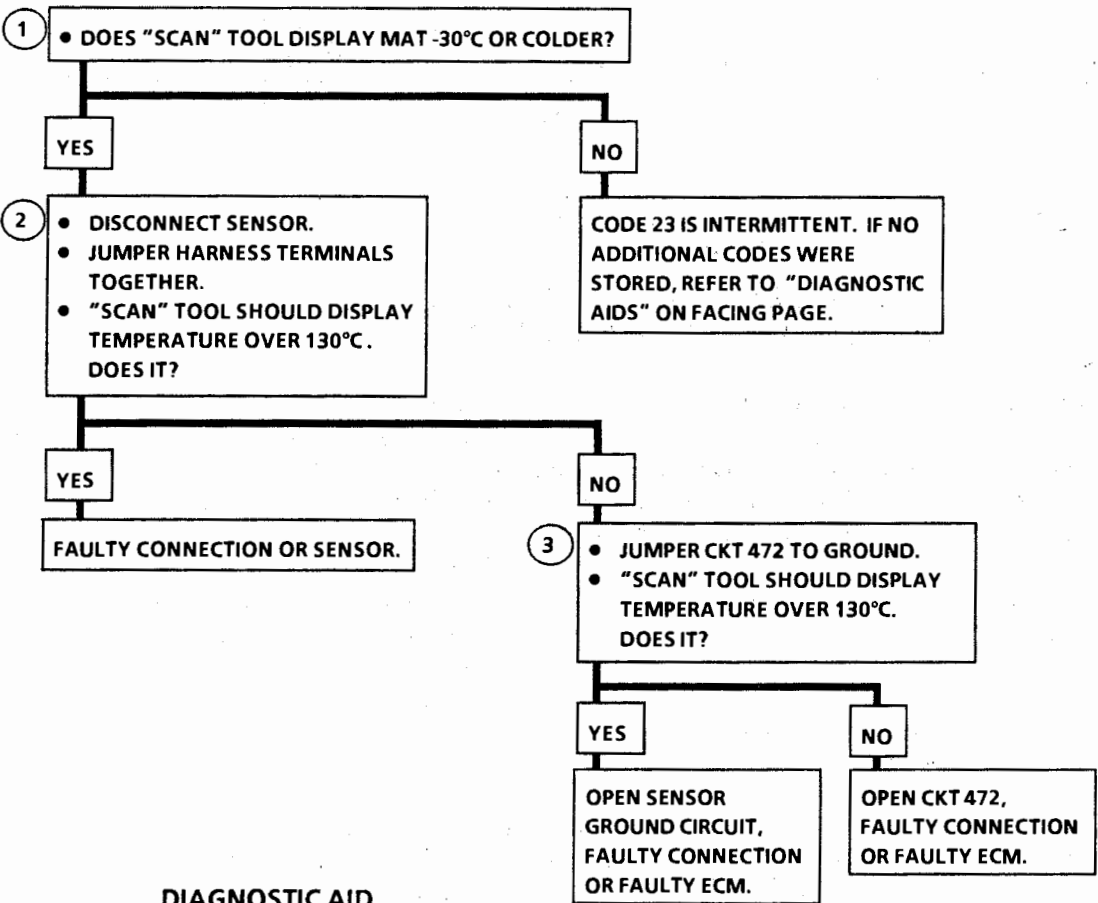
Carefully check harness and connections for possible open CKT 472 or CKT 452.

Refer to "Intermittents" in Section "B".

If the engine has been allowed to sit overnight, the manifold air temperature and coolant temperature values should read within a few degrees of each other. After the engine is started, the MAT will increase due to Thermac operation and underhood temperatures.

CODE 23

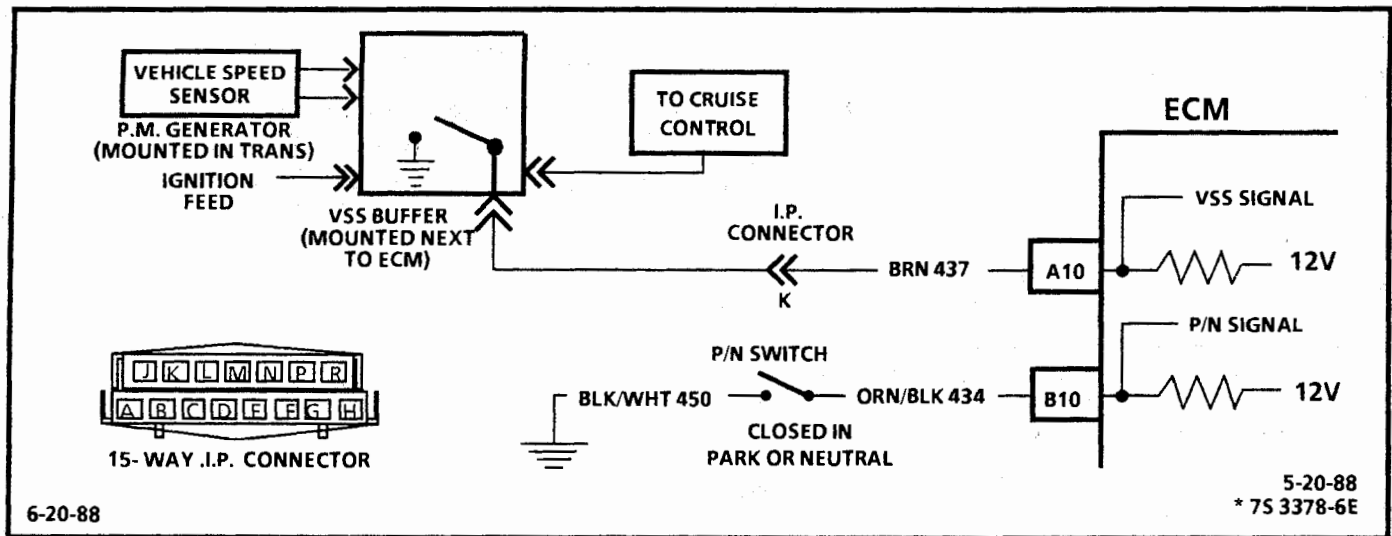
MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT (LOW TEMPERATURE INDICATED) 5.0L (VIN E) "F" CARLINE (TBI)



DIAGNOSTIC AID

MAT SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 24

VEHICLE SPEED SENSOR (VSS) CIRCUIT 5.0L (VIN E) "F" CARLINE (TBI)

Circuit Description:

The ECM applies and monitors 12 volts on CKT 437. CKT 437 connects to the vehicle speed sensor which alternately grounds CKT 437 when drive wheels are turning. This pulsing action takes place about 2000 times per mile and the ECM will calculate vehicle speed based on the time between "pulses".

A "Scan" reading should closely match with speedometer reading with drive wheels turning.

Disregard a Code 24 set when drive wheels are not turning.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

- Code 24 will set if:
 - CKT 437 voltage is constant
 - Engine speed is between 1400 and 3600 rpm
 - TPS is less than 2% throttle opening
 - Low load condition
 - Not in park or neutral
 - All conditions must be met for 4 seconds

These conditions are met during a road load deceleration.
- A voltage of less than 1 volt, at the 15-way I/P connector indicates that the CKT 437 wire may be shorted to ground. Disconnect CKT 437 at the vehicle speed sensor buffer.

If voltage remains less than 10 volts, then CKT 437 wire is grounded or open. If 437 is not grounded or open, check for a faulty ECM connector or ECM.

Diagnostic Aids:

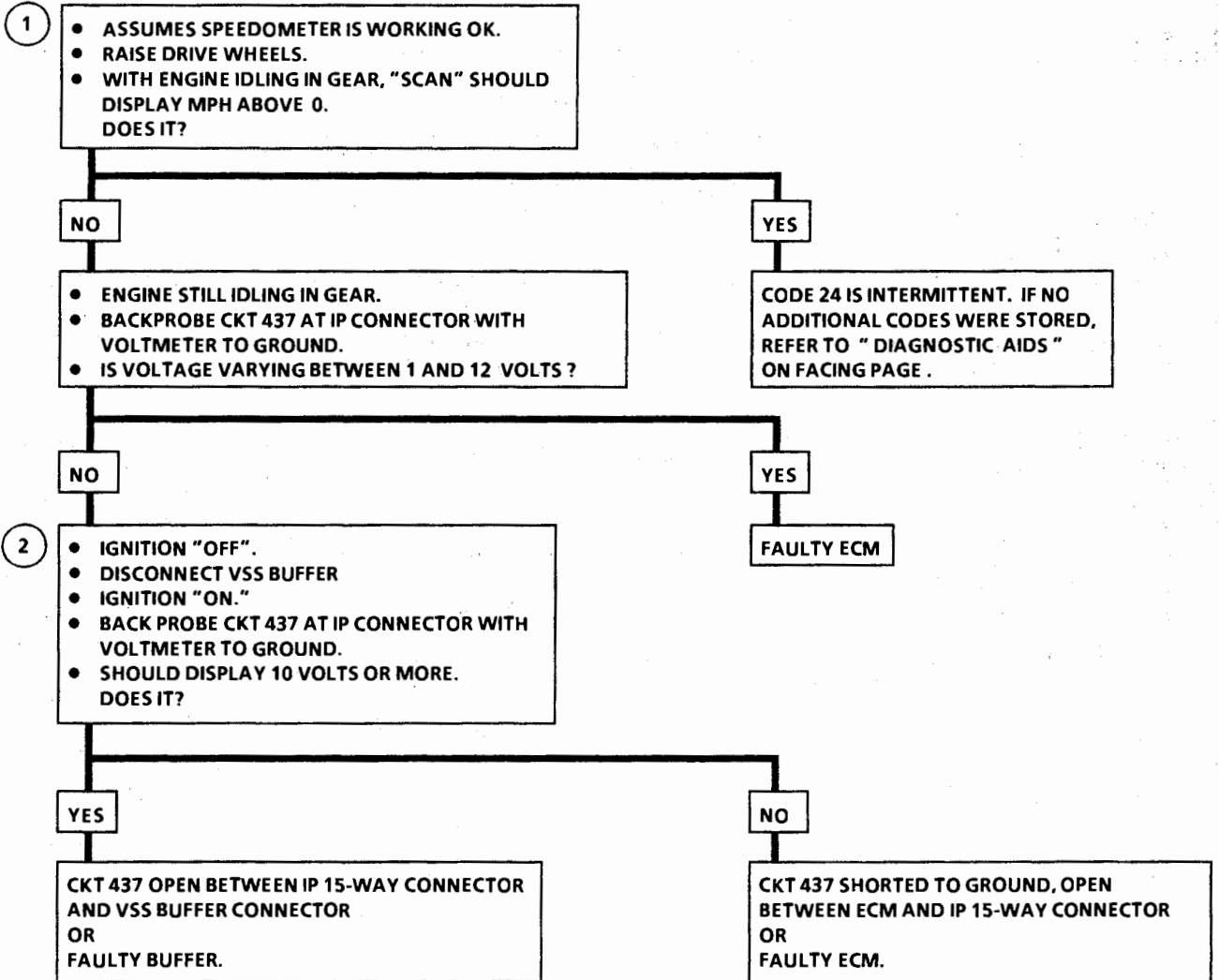
If "Scan" displays vehicle speed, check park/neutral switch CHART C-1A on vehicle with automatic transmission. If switch is OK, check for intermittent connections. An open or short to ground in CKT 437 will result in a Code 24. Refer to Section "8A" for complete wiring diagram.

Refer to "Intermittents" in Section "B".

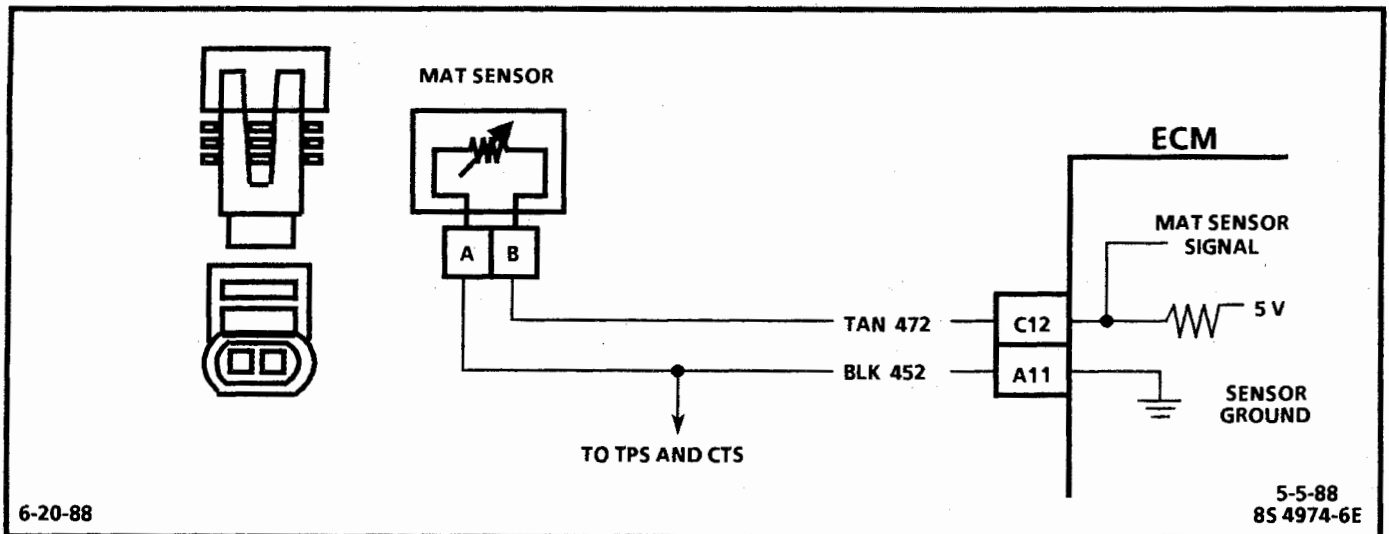
CODE 24

VEHICLE SPEED SENSOR (VSS) CIRCUIT 5.0L (VIN E) "F" CARLINE (TBI)

NOTE: TO PREVENT MISDIAGNOSIS, THE TECHNICIAN SHOULD REVIEW ELECTRICAL SECTION "8A" OR THE ELECTRICAL TROUBLESHOOTING MANUAL AND IDENTIFY THE TYPE OF VEHICLE SPEED SENSOR USED PRIOR TO USING THIS CHART. DISREGARD CODE 24 IF SET WHEN DRIVE WHEELS ARE NOT TURNING.



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 25

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT (HIGH TEMPERATURE INDICATED) 5.0L (VIN E) "F" CARLINE (TBI)

Circuit Description:

The manifold air temperature (MAT) sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage (about 5 volts) on CKT 472 to the sensor. When manifold air is cold, the sensor (thermistor) resistance is high, therefore, the ECM will see a high signal voltage. If the manifold air is warm, the sensor (thermistor) resistance is low, therefore, the ECM will see a low signal voltage.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 25 will set if:
 - Signal voltage indicates a manifold air temperature greater than 150°C (302°F) for 2 seconds.
 - Time since engine start is 2 minutes or longer.
 - Vehicle speed has to be greater than 5 MPH.

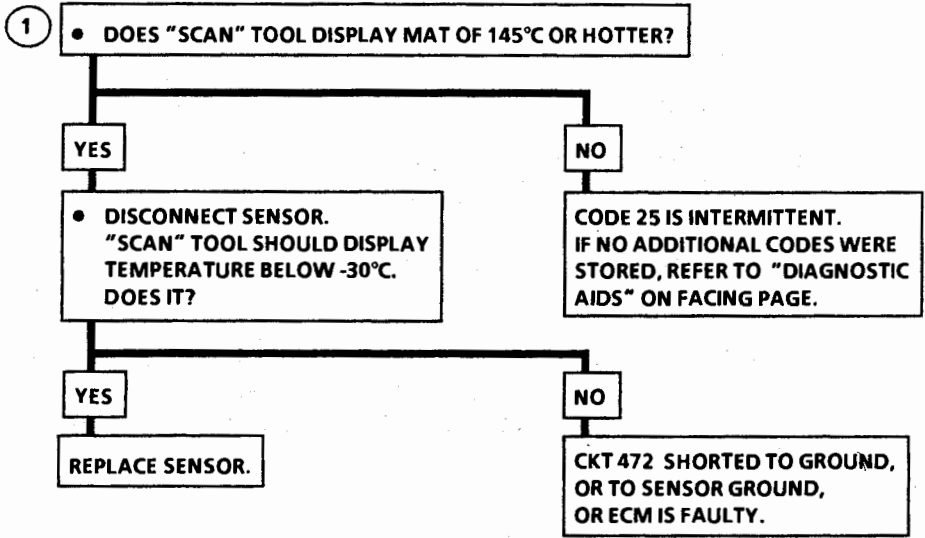
Diagnostic Aids:

Manifold air temperature on a "Scan" tool indicates the temperature of the air in the air cleaner, because the MAT sensor is located in the air cleaner. If the engine has been allowed to sit overnight, the manifold air temperature and coolant temperature values should read within a few degrees of each other. After the engine is started, the MAT will increase due to Thermac operation and underhood temperatures, however, MAT will rarely exceed 80°C. If a higher MAT than 80°C is noted, check for proper Thermac operation. Use Section "C14".

Check harness routing for possible short to ground in CKT 472.

Refer to "Intermittents" in Section "B".

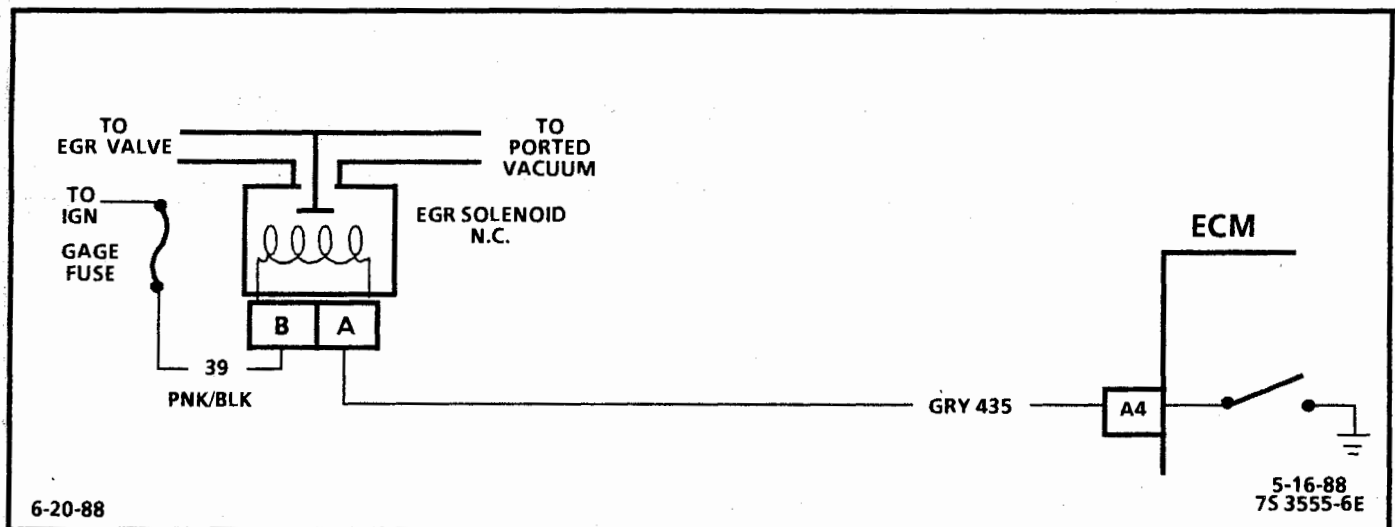
CODE 25
MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
5.0L (VIN E) "F" CARLINE (TBI)



DIAGNOSTIC AID

MAT SENSOR		
TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)		
°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 32

EXHAUST GAS RECIRCULATION (EGR) CIRCUIT 5.0L (VIN E) "F" CARLINE (TBI)

Circuit Description:

The ECM operates a solenoid to control the exhaust gas recirculation (EGR) valve. This solenoid is normally closed. By providing a ground path, the ECM energizes the solenoid which then allows vacuum to pass to the EGR valve.

The ECM monitors EGR effectiveness by de-energizing the EGR control solenoid thereby shutting off vacuum to the EGR valve diaphragm. With the EGR valve closed, manifold vacuum will be greater than it was during normal EGR operation and this change will be relayed to the ECM by the MAP sensor. If the change is not within the calibrated window, a Code 32 will be set.

The ECM will check EGR operation when:

- Vehicle speed is above 50 mph
- Engine vacuum is between 40 and 51 kPa (or 12" HG and 15" HG)
- No change in throttle position while test is being run

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Checks for EGR solenoid stuck open.
2. Checks for EGR solenoid always being energized.
3. Grounding diagnostic "test" terminal should energize EGR solenoid and vacuum should drop.
4. Negative backpressure EGR valve should hold vacuum with engine "OFF."
5. When engine is started, exhaust backpressure should cause vacuum to bleed off and valve to fully close.

Diagnostic Aids:

Vacuum lines should be thoroughly checked for internal restrictions. The ECM uses the MAP sensor for checking EGR operation. If there is a question of MAP sensor accuracy use CHART C-1D MAP output check in Section "C".

If no problems are found refer to "Intermittents" in Section "B".

CODE 32 EXHAUST GAS RECRICULATION (EGR) CIRCUIT 5.0L (VIN E) "F" CARLINE (TBI)

BEFORE USING THIS CHART CHECK FOR MANIFOLD VACUUM TO EGR SOLENOID, THERE SHOULD BE AT LEAST 25 kPa (7" HG) OF VACUUM AT 2000 RPM. CHECK VACUUM HOSES FOR LEAKS OR RESTRICTIONS.

- 1
- DISCONNECT EGR SOLENOID VACUUM HARNESS.
 - ROTATE HARNESS AND REINSTALL ONLY THE EGR VALVE SIDE,
 - IGNITION "ON", ENGINE STOPPED.
 - GROUND DIAGNOSTIC TERMINAL.
 - INSTALL A HAND HELD VACUUM PUMP WITH GAGE TO MANIFOLD SIDE OF EGR SOLENOID.
 - APPLY VACUUM AND OBSERVE EGR VALVE DIAPHRAGM.
 - VALVE SHOULD MOVE.
- DOES IT?

YES

NO

- 2
- UNGROUND DIAGNOSTIC TERMINAL.
 - VACUUM SHOULD BLEED OFF AND VALVE SHOULD CLOSE.
- DOES IT?

- CONNECT VACUUM PUMP TO EGR VALVE SIDE OF HARNESS.
 - APPLY VACUUM AND OBSERVE VALVE.
 - VALVE SHOULD MOVE.
- DOES IT?

YES

NO

YES

NO

- 4
- IGNITION "OFF"
 - CONNECT A VACUUM PUMP TO EGR VALVE.
 - USING A MIRROR, OBSERVE EGR DIAPHRAGM WHILE APPLYING VACUUM.
 - DIAPHRAGM SHOULD MOVE FREELY AND HOLD VACUUM FOR AT LEAST 20 SECONDS.
- DOES IT?

- DISCONNECT SOLENOID ELECTRICAL CONNECTOR.
- DOES VACUUM BLEED OFF?

YES

NO

- 3
- DISCONNECT EGR ELECTRICAL CONNECTOR.
 - CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINALS.
 - IGNITION "ON", ENGINE "OFF".
 - TEST LIGHT SHOULD LIGHT.
- DOES IT?

CKT 435 SHORTED TO GROUND OR FAULTY ECM.

REPLACE SOLENOID

FAULTY VACUUM HOSE TO EGR VALVE OR FAULTY VALVE.

YES

NO

YES

NO

- 5
- APPLY 34 kPa (10" HG) VACUUM TO EGR VALVE.
 - START ENGINE AND IMMEDIATELY OBSERVE VACUUM GAGE ON VACUUM PUMP.
 - VALVE IS GOOD IF DIAPHRAGM HAS MOVED TO SEATED POSITION (VALVE CLOSED) AND VACUUM DROPPED WHILE STARTING ENGINE.

REPLACE EGR VALVE.

FAULTY SOLENOID CONNECTION OR FAULTY SOLENOID.

CONNECT TEST LIGHT BETWEEN HARNESS TERMINAL "A" AND GROUND.

NO LIGHT

LIGHT

REPAIR OPEN CKT 39.

REPAIR OPEN CKT 435. IF NOT OPEN, IT IS A FAULTY ECM.

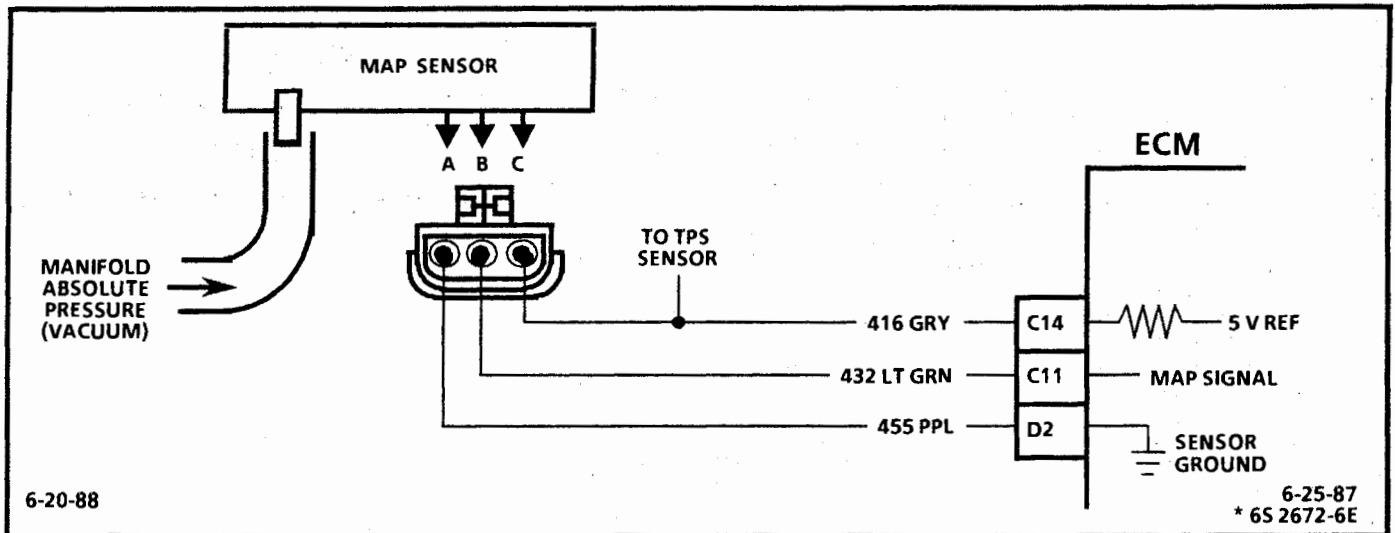
VACUUM DROPPED

NO VACUUM DROP

BE SURE VACUUM HOSE BETWEEN SOLENOID AND EGR VALVE IS OK. (NO LEAKS OR RESTRICTIONS) IF NO PROBLEM IS FOUND, THE EGR CIRCUIT IS OK.

- REMOVE EGR VALVE.
- CHECK PASSAGES FOR BEING PLUGGED. IF NOT PLUGGED, REPLACE VALVE,

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 33

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CIRCUIT (SIGNAL VOLTAGE HIGH - LOW VACUUM) 5.0L (VIN E) "F" CARLINE (TBI)

Circuit Description:

The manifold absolute pressure sensor (MAP) responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1-1.5 volts at idle to 4-4.5 volts at wide open throttle.

A "Scan" displays manifold pressure in volts. Low pressure (high vacuum) reads a low voltage while a high pressure (low vacuum) reads a high voltage.

If the MAP sensor fails the ECM will substitute a fixed MAP value and use the throttle position sensor (TPS) to control fuel delivery.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 33 will set when:

- Signal is too high, (kPa greater than 68 kPa or less than 9" HG), for a time greater than 5 seconds.
- TPS less than 4%

Engine misfire or a low unstable idle may set Code 33. Disconnect MAP sensor and system will go into backup mode. If the misfire or idle condition remains, see "Symptoms" in Section "B".

2. If the ECM recognizes the low MAP signal, the ECM and wiring are OK.

An open in CKT 455 will result in a Code 33.

With the ignition "ON" and the engine stopped, the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of vehicle altitude and is referred to as BARO. Comparison of this BARO reading with a known good vehicle with the same sensor is a good way to check accuracy of a "suspect" sensor. Reading should be the same, $\pm .4$ volt.

Also CHART C-1D can be used to test the MAP sensor.

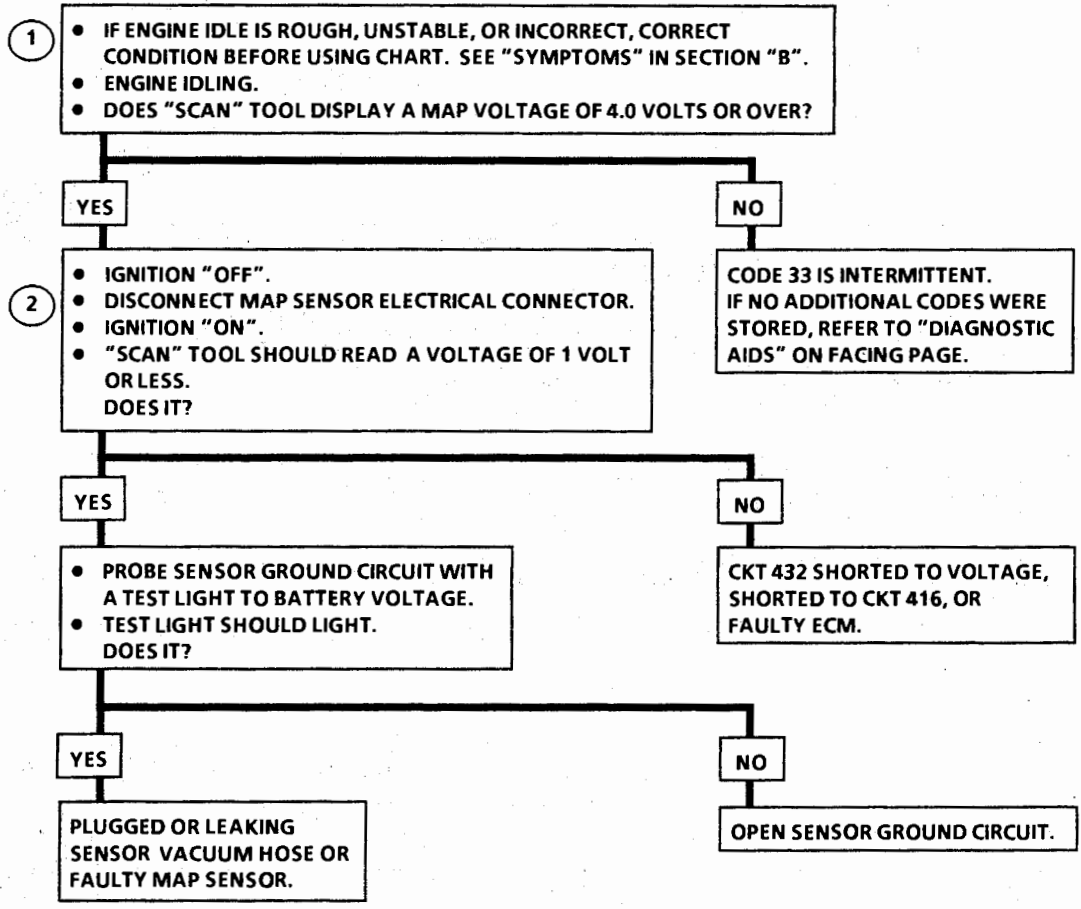
Refer to "Intermittents" in Section "B".

Diagnostic Aids:

If the idle is rough or unstable refer to "Symptoms" in Section "B" for items which can cause an unstable idle.

CODE 33

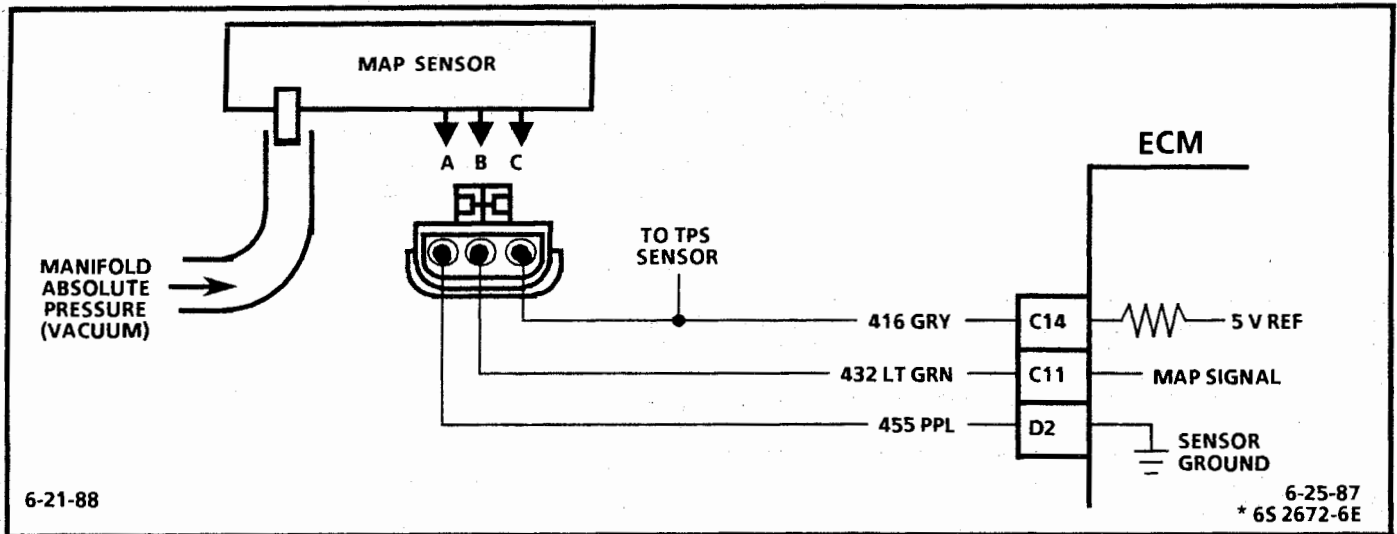
MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CIRCUIT (SIGNAL VOLTAGE HIGH - LOW VACUUM) 5.0L (VIN E) "F" CARLINE (TBI)



**MAP SENSOR VOLTAGE VS. ALTITUDE WITH
IGNITION "ON" AND ENGINE "OFF"**

ALTITUDE		VOLTAGE RANGE
Meters	Feet	
Below 305	Below 1,000	3.8---5.5V
305--- 610	1,000--2,000	3.6---5.3V
610--- 914	2,000--3,000	3.5---5.1V
914---1219	3,000--4,000	3.3---5.0V
1219--1524	4,000--5,000	3.2---4.8V
1524--1829	5,000--6,000	3.0---4.6V
1829--2133	6,000--7,000	2.9---4.5V
2133--2438	7,000--8,000	2.8---4.3V
2438--2743	8,000--9,000	2.6---4.2V
2743--3048	9,000--10,000	2.5---4.0V

LOW ALTITUDE = HIGH PRESSURE = HIGH VOLTAGE



CODE 34

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CIRCUIT (SIGNAL VOLTAGE LOW - HIGH VACUUM) 5.0L (VIN E) "F" CARLINE (TBI)

Circuit Description:

The manifold absolute pressure sensor (MAP) responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1-1.5 volts at idle to 4-4.5 volts at wide open throttle.

A "Scan" displays manifold pressure in volts. Low pressure (high vacuum) reads a low voltage while a high pressure (low vacuum) reads a high voltage.

If the MAP sensor fails the ECM will substitute a fixed MAP value and use the throttle position sensor (TPS) to control fuel delivery.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 34 will set when:
 - Signal is too low, (less than 14 kPa or greater than 28" HG) and engine running less than 1200 rpm

OR

 - Engine running greater than 1200 rpm
 - Throttle position greater than 21% (over 1.5 volts)
2. If the ECM recognizes the high MAP signal, the ECM and wiring are OK.
3. The "Scan" tool may not display 12 volts. The important thing is that the ECM recognizes the voltage as more than 4 volts, indicating that the ECM and CKT 432 are OK.

Diagnostic Aids:

An intermittent open in CKTs 432 or 416 will result in a Code 34.

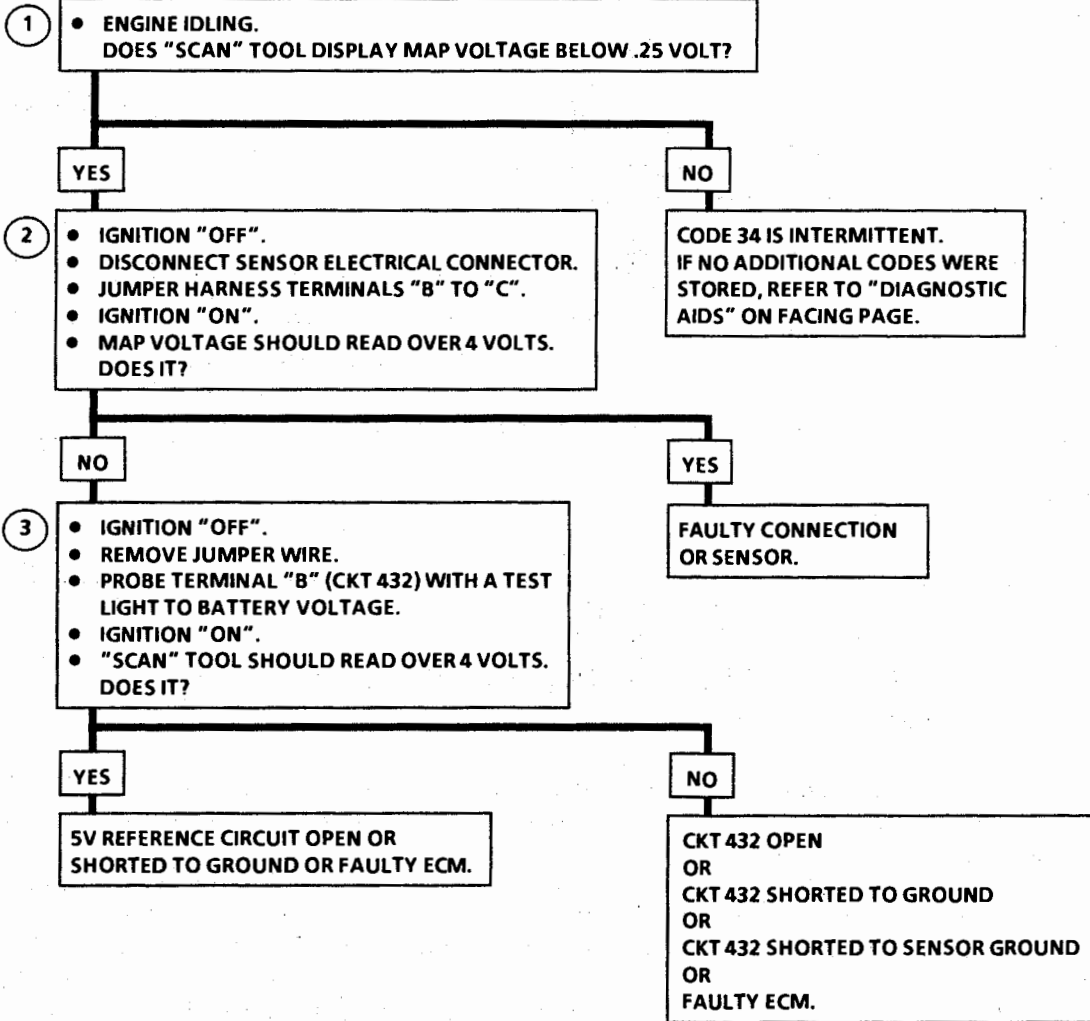
With the ignition "ON" and engine stopped, the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of vehicle altitude and is referred to as BARO. Comparison of this BARO reading with a known good vehicle with the same sensor is a good way to check accuracy of a "suspect" sensor. Reading should be the same, $\pm .4$ volts.

Also CHART C-1D can be used to test the MAP sensor.

Refer to "Intermittents" in Section "B".

CODE 34

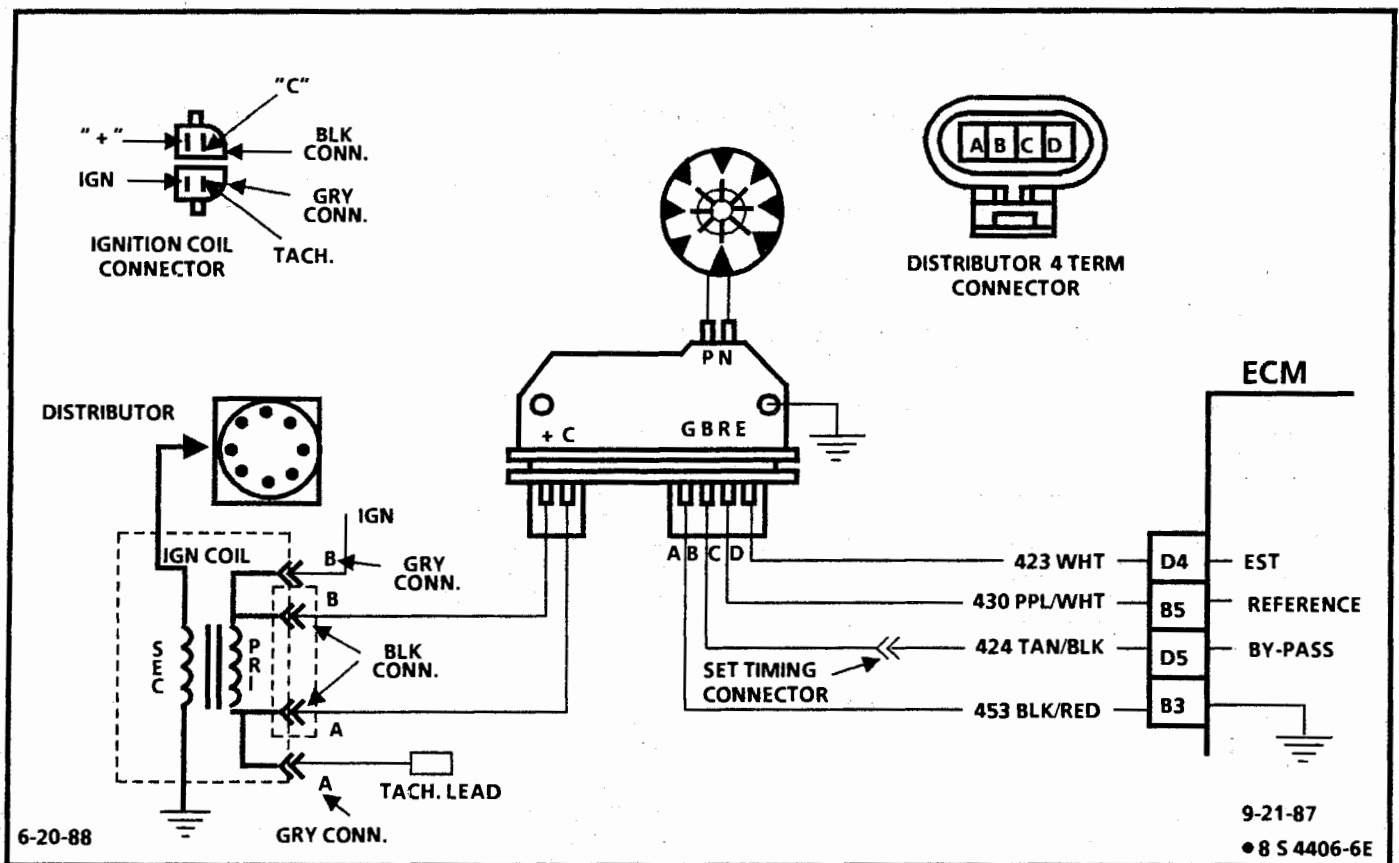
MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CIRCUIT (SIGNAL VOLTAGE LOW - HIGH VACUUM) 5.0L (VIN E) "F" CARLINE (TBI)



MAP SENSOR VOLTAGE VS. ALTITUDE WITH IGNITION "ON" AND ENGINE "OFF"

ALTITUDE		VOLTAGE RANGE
Meters	Feet	
Below 305	Below 1,000	3.8---5.5V
305--- 610	1,000--2,000	3.6---5.3V
610--- 914	2,000--3,000	3.5---5.1V
914--1219	3,000--4,000	3.3---5.0V
1219--1524	4,000--5,000	3.2---4.8V
1524--1829	5,000--6,000	3.0---4.6V
1829--2133	6,000--7,000	2.9---4.5V
2133--2438	7,000--8,000	2.8---4.3V
2438--2743	8,000--9,000	2.6---4.2V
2743--3048	9,000--10,000	2.5---4.0V

LOW ALTITUDE = HIGH PRESSURE = HIGH VOLTAGE



CODE 42

ELECTRONIC SPARK TIMING (EST) CIRCUIT 5.0L (VIN E) "F" CARLINE (TBI)

Circuit Description:

When the system is running on the ignition module, that is, no voltage on the bypass line, the ignition module grounds the EST signal. The ECM expects to see no voltage on the EST line during this condition. If it sees a voltage, it sets Code 42 and will not go into the EST mode.

When the rpm for EST is reached (about 400 rpm), and bypass voltage applied, the EST should no longer be grounded in the ignition module so the EST voltage should be varying.

If the bypass line is open or grounded, the ignition module will not switch to EST mode so the EST voltage will be low and Code 42 will be set.

If the EST line is grounded, the ignition module will switch to EST, but because the line is grounded there will be no EST signal. A Code 42 will be set.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

- Code 42 means the ECM has seen an open or short to ground in the EST or bypass circuits. This test confirms Code 42 and that the fault causing the code is present.
- Checks for a normal EST ground path through the ignition module. An EST CKT 423 shorted to ground will also read less than 500 ohms; however, this will be checked later.
- As the test light voltage touches CKT 424, the module should switch causing the ohmmeter to "overrange" if the meter is in the 1000-2000 ohms position. Selecting the 10-20,000 ohms position will indicate above 5000 ohms. The important thing is that the module "switched."

- The module did not switch and this step checks for:
 - EST CKT 423 shorted to ground
 - Bypass CKT 424 open
 - Faulty ignition module connection or module
- Confirms that Code 42 is a faulty ECM and not an intermittent in CKTs 423 or 424.

Diagnostic Aids:

If a Code 42 was stored and the customer complains of a "Hard Start", the problem is most likely a grounded EST line (CKT 423).

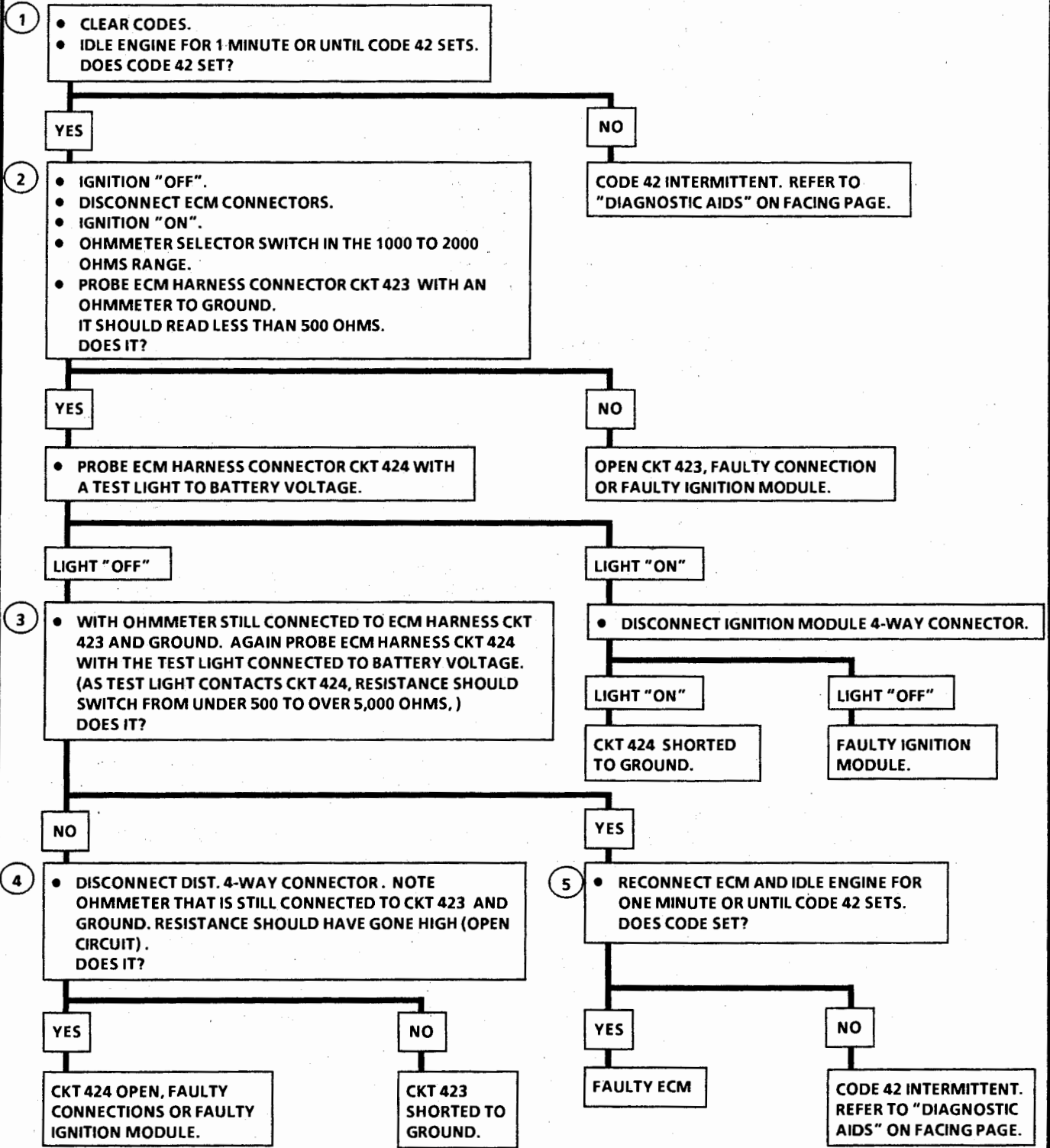
The "Scan" tool does not have any ability to help diagnose a Code 42 problem.

A PROM not fully seated in the ECM can result in a Code 42.

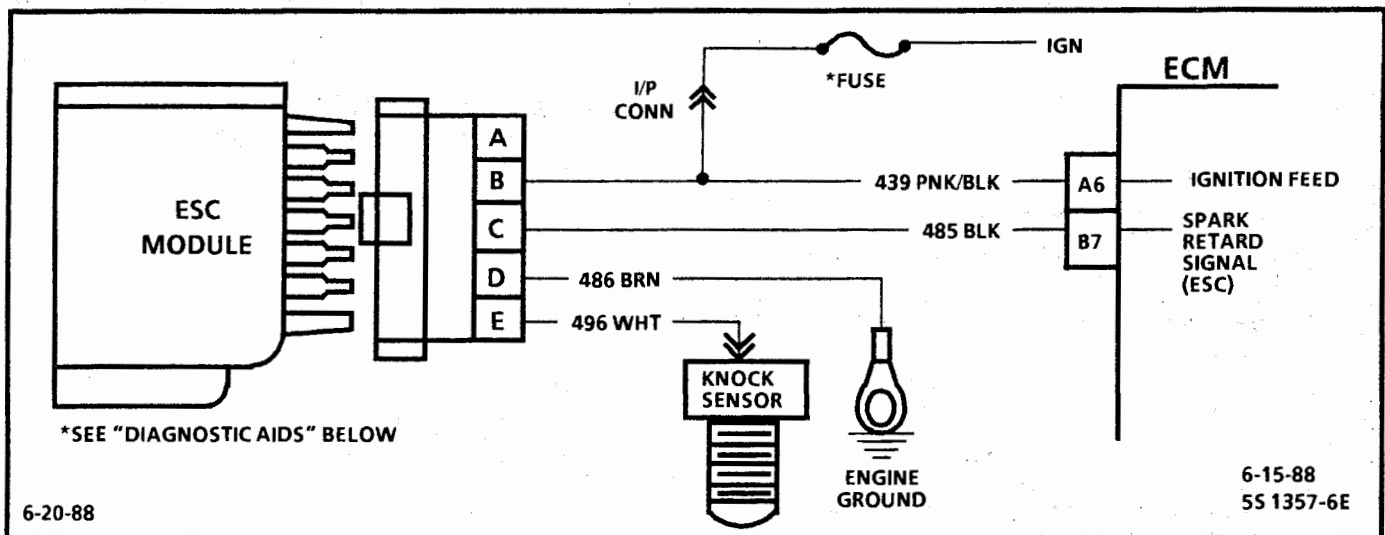
Refer to "Intermittents" in Section "B".

CODE 42

ELECTRONIC SPARK TIMING (EST) CIRCUIT 5.0L (VIN E) "F" CARLINE (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 43

ELECTRONIC SPARK CONTROL (ESC) CIRCUIT 5.0L (VIN E) "F" CARLINE (TBI)

Circuit Description:

Electronic spark control is accomplished with a module that sends a voltage signal to the ECM. As the knock sensor detects engine knock, the voltage from the ESC module to the ECM drops, and this signals the ECM to retard timing. The ECM will retard the timing when knock is detected and rpm is above about 900 rpm.

Code 43 means the ECM has read low voltage on CKT 485 for longer than 5 seconds with the engine running or the system has failed the functional check.

This system performs a functional check once per start up to check the ESC system. To perform this test the ECM will advance the spark when coolant is above 95°C (194°F) and at a high load condition (near WOT). The ECM then checks the signal at "B7" to see if a knock is detected. The functional check is performed once per start up, if knock is detected when coolant is below 95°C (194°F) the test has passed and the functional check will not be run. If the functional check fails, the "Service Engine Soon" light will remain "ON" until ignition is turned "OFF" or until a knock signal is detected.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. If the conditions for a Code 43 are present the "Scan" will always display "yes". There should not be a knock at idle unless an internal engine problem, or a system problem exists.
2. This test will determine if the system is functioning at this time. Usually a knock signal can be generated by tapping on the block close to the area of the sensor.
3. Because Code 43 sets when the signal voltage on CKT 485 remains low this test should cause the signal on CKT 485 to go high. The 12 volts signal should be seen by the ECM as "no knock" if the ECM and wiring are OK.
4. This test will determine if the knock signal is being detected on CKT 496 or if the ESC module is at fault.

5. If CKT 496 is routed to close to secondary ignition wires the ESC module may see the interference as a knock signal.
6. This checks the ground circuit to the module. An open ground will cause the voltage on CKT 485 to be about 12 volts which would cause the Code 43 functional test to fail.
7. Contacting CKT 496 with a test light to 12 volts should generate a knock signal. This will determine if the ESC module is operating correctly.

Diagnostic Aids:

* = ECM/IGN fuse

Code 43 can be caused by a faulty connection at the knock sensor at the ESC module or at the ECM. Also check CKT 485 for possible open or short to ground.

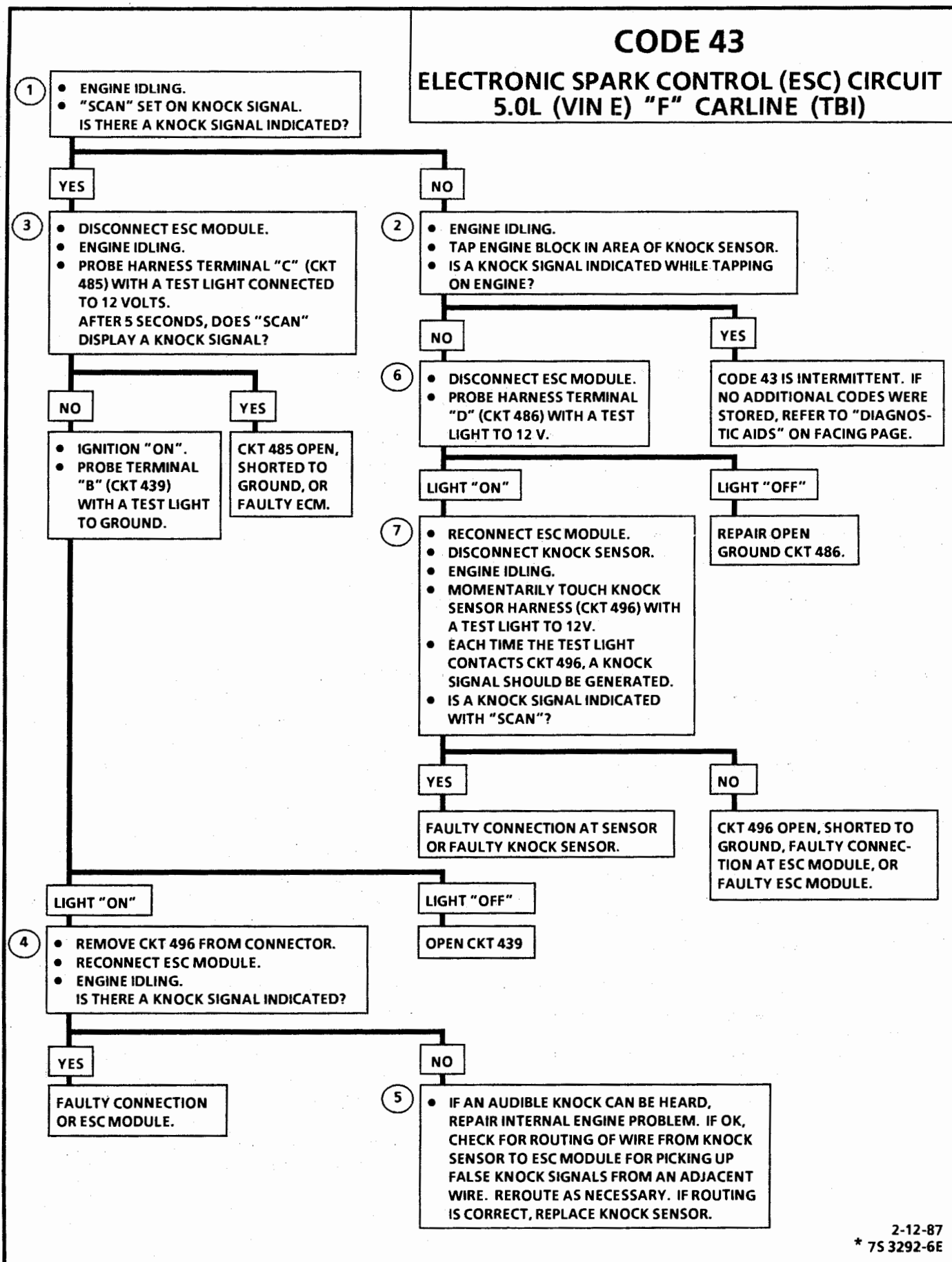
Refer to "Intermittents" in Section "B".

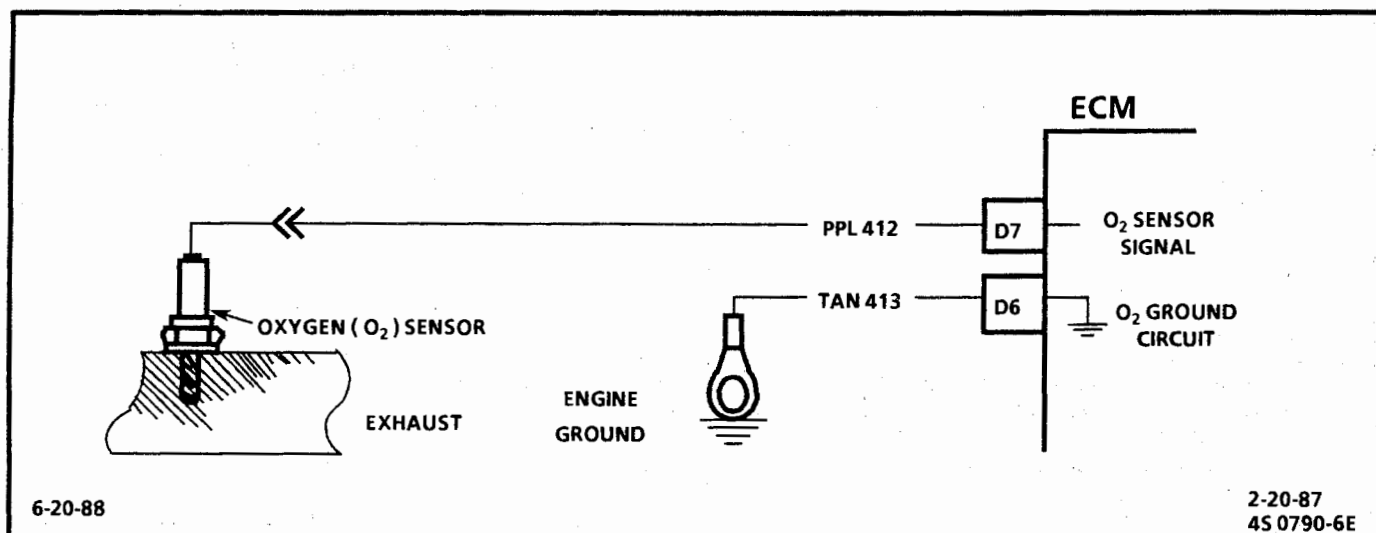
6-20-88

6-15-88
55 1357-6E

CODE 43

ELECTRONIC SPARK CONTROL (ESC) CIRCUIT 5.0L (VIN E) "F" CARLINE (TBI)





CODE 44

OXYGEN SENSOR CIRCUIT (LEAN EXHAUST INDICATED) 5.0L (VIN E) "F" CARLINE (TBI)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "D6" and "D7". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volt.) The O₂ sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down through about .10 volt if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below about 360°C (600°F). An open sensor circuit or cold sensor causes "Open Loop" operation.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

- Code 44 is set when the O₂ sensor signal voltage on CKT 412.
 - Remains below .2 volt for 50 seconds
 - And the system is operating in "Closed Loop"

Diagnostic Aids:

Using the "Scan", observe the block learn values at different rpm and air flow conditions to determine when the Code 44 may have been set. If the conditions for Code 44 exists the block learn values will be around 150.

- O₂ Sensor Wire** Sensor pigtail may be mispositioned and contacting the exhaust manifold.
- Check for intermittent ground in wire between connector and sensor.

- MAP Sensor** A manifold absolute pressure (MAP) sensor output that causes the ECM to sense a higher than normal vacuum will cause the system to go lean. Disconnect the MAP sensor and if the lean condition is gone, replace the sensor.
- Lean Injector(s)**
- Fuel Contamination** Water, even in small amounts, near the in-tank fuel pump inlet can be delivered to the injectors. The water causes a lean exhaust and can set a Code 44.
- Fuel Pressure** System will be lean if pressure is too low. It may be necessary to monitor fuel pressure while driving the car at various road speeds and/or loads to confirm. See "Fuel System Diagnosis", CHART A-7.
- Exhaust Leaks** If there is an exhaust leak, the engine can cause outside air to be pulled into the exhaust and past the sensor. Vacuum or crankcase leaks can cause a lean condition.
- AIR System.** Be sure air is not being directed to the exhaust ports while in "Closed Loop." If the block learn value goes down while squeezing air hose to left side exhaust ports, refer to CHART C-6.
- If the above are OK, it is a faulty oxygen sensor.

CODE 44
OXYGEN SENSOR CIRCUIT
(LEAN EXHAUST INDICATED)
5.0L (VIN E) "F" CARLINE (TBI)

① • RUN WARM ENGINE (75°C/167°F TO 95°C/203°F) AT 1200 RPM.
 • DOES "SCAN" TOOL INDICATE O₂ SENSOR VOLTAGE FIXED BELOW .35 VOLT (350 mV)?

YES

NO

• DISCONNECT O₂ SENSOR.
 • WITH ENGINE IDLING, "SCAN" TOOL SHOULD DISPLAY O₂ SENSOR VOLTAGE BETWEEN .35 VOLT AND .55 VOLT (350 mV AND 550 mV). DOES IT?

CODE 44 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

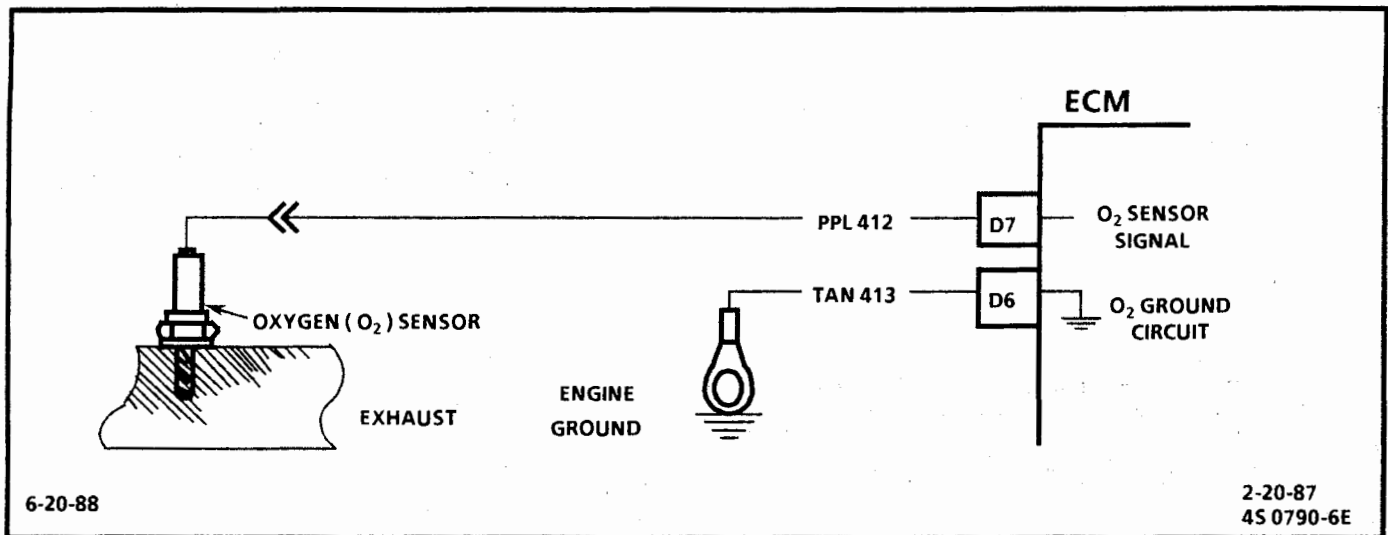
YES

NO

REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

CKT 412 SHORTED TO GROUND OR FAULTY ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 45

OXYGEN SENSOR CIRCUIT (RICH EXHAUST INDICATED) 5.0L (VIN E) "F" CARLINE (TBI)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "D6" and "D7". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volt.) The O₂ sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down through about .10 volt if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below about 360°C (600°F). An open sensor circuit or cold sensor causes "Open Loop" operation.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

- Code 45 is set when the O₂ sensor signal voltage on CKT 412.
 - Remains above .7 volt for 50 seconds; and in "Closed Loop"
 - Engine time after start is 1 minute or more
 - Throttle angle greater than 2% (about .2 volt above idle voltage) but less than 25%

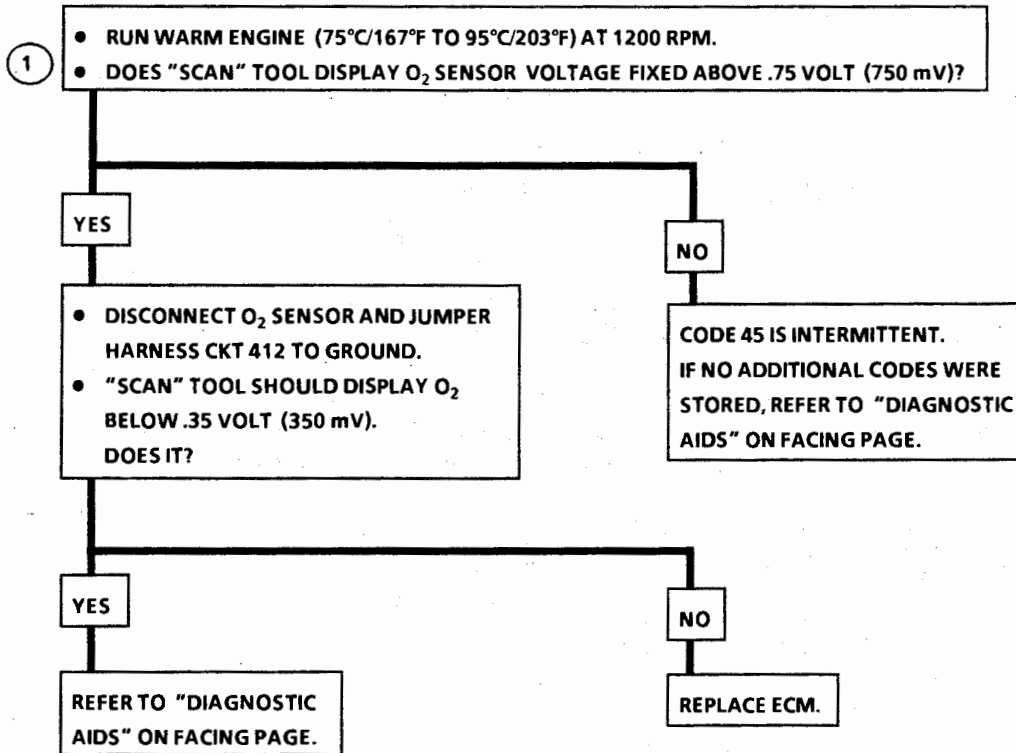
Diagnostic Aids:

Using the "Scan", observe the block learn values at different rpm conditions to determine when the Code 45 may have been set. If the conditions for Code 45 exists, The block learn values will be around 115.

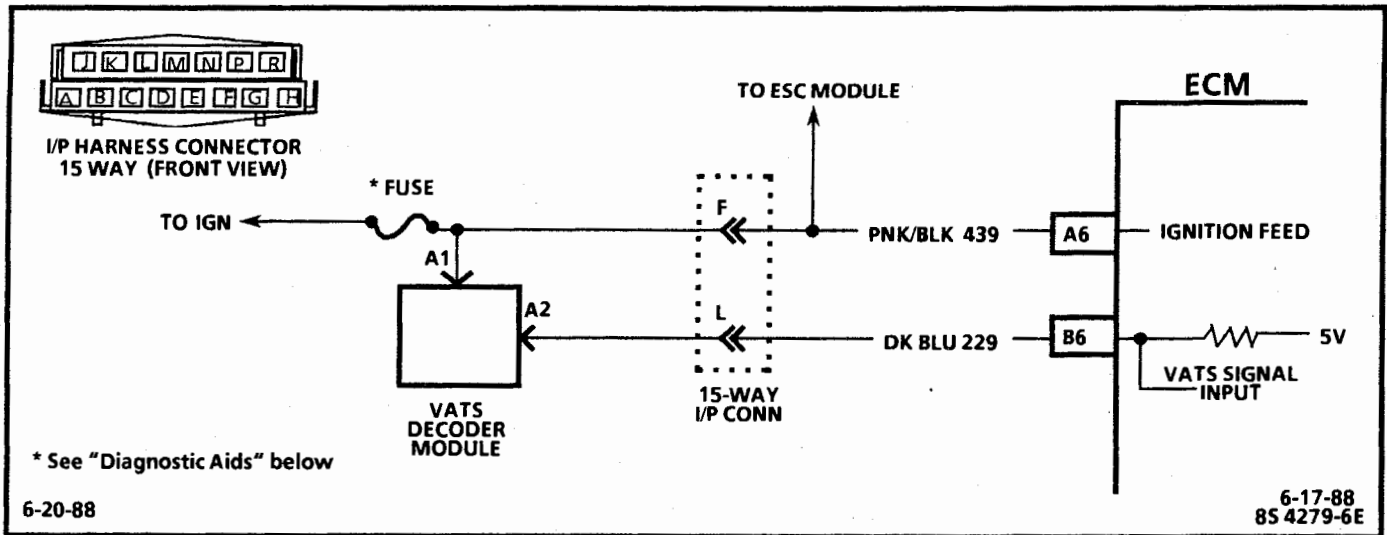
- Fuel Pressure** System will go rich if pressure is too high. The ECM can compensate for some increase. However, if it gets too high, a Code 45 may be set. See "Fuel System Diagnosis", CHART A-7.
- Leaking injector** See CHART A-7
- Check for fuel contaminated oil

- HEI Shielding** An open ground CKT 453 (ignition system reference low) may result in EMI, or induced electrical "noise". The ECM looks at this "noise" as reference pulses. The additional pulses result in a higher than actual engine speed signal. The ECM then delivers too much fuel, causing system to go rich. Engine tachometer will also show higher than actual engine speed, which can help in diagnosing this problem.
- Canister Purge** Check for fuel saturation. If full of fuel, check canister control and hoses. See "Canister Purge", Section "C3".
- MAP Sensor** An output that causes the ECM to sense a lower than normal vacuum can cause the system to go rich. Disconnecting the MAP sensor will allow the ECM to set a fixed value for the sensor. Substitute a different MAP sensor if the rich condition is gone while the sensor is disconnected.
- TPS** An intermittent TPS output will cause the system to go rich, due to a false indication of the engine accelerating.

CODE 45
OXYGEN SENSOR CIRCUIT
(RICH EXHAUST INDICATED)
5.0L (VIN E) "F" CARLINE (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 53

VEHICLE ANTI-THEFT SYSTEM (VATS) CIRCUIT 5.0L (VIN E) "F" CARLINE (TBI)

Circuit Description:

The VATS system is designed to disable vehicle operation if the incorrect key or starting procedure is used. The VATS decoder module sends a signal to the ECM if the correct key is being used. If the proper signal does not reach the ECM on CKT 229, the ECM will not pulse the injectors "ON" and thus not allow the vehicle to be started.

Code 53 will set, if the proper signal is not being received on CKT 229 ECM when the ignition is turned "ON." Code 53 does not store in the ECM memory but is only present when the conditions stated above are met.

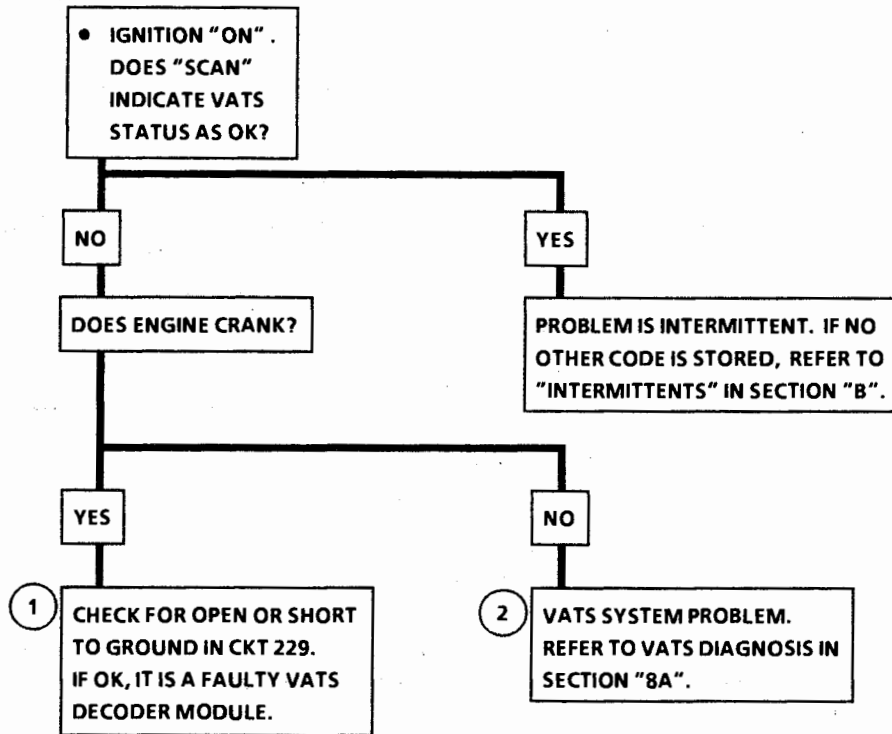
Test Description: Numbers below refer to circled numbers on the diagnostic chart.

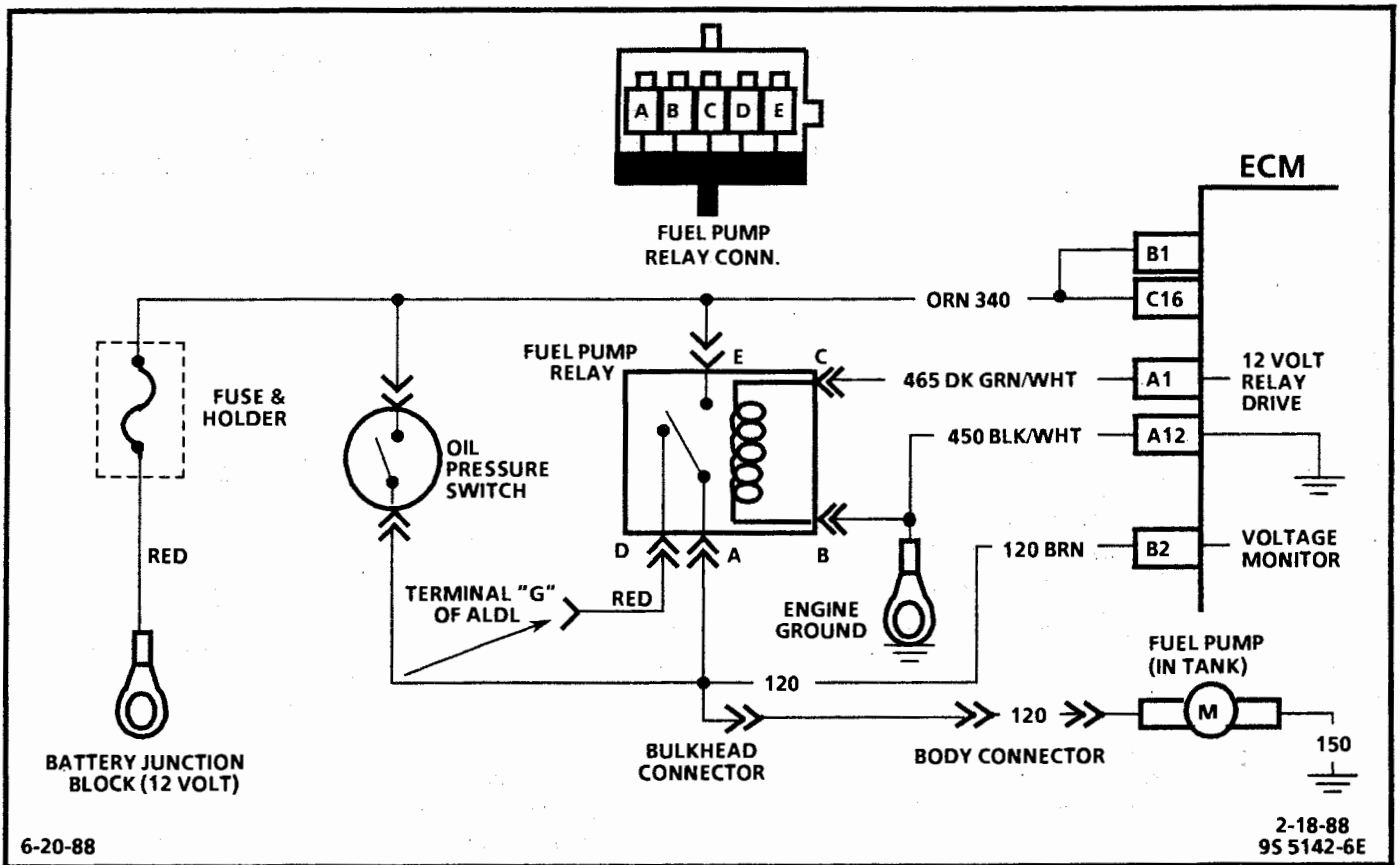
1. If the engine cranks, and a Code 53 is stored, it indicates that the portion of the module which generates the signal to the ECM is not operating or CKT 229 is open or shorted to ground. If the decoder module is found to be OK, as determined from Section "8A", the ECM may be at fault, but this is not a likely condition.
2. If Code 53 is stored, and the engine will not crank, it indicates that there is a VATS problem or an incorrect key or starting procedure is being used.

Diagnostic Aids:

* = ECM/IGN fuse

CODE 53
VEHICLE ANTI-THEFT SYSTEM (VATS) CIRCUIT
5.0L (VIN E) "F" CARLINE (TBI)





CODE 54

FUEL PUMP CIRCUIT (LOW VOLTAGE) 5.0L (VIN E) "F" CARLINE (TBI)

Circuit Description:

When the ignition switch is turned "ON", the electronic control module (ECM) will activate the fuel pump relay and run the in-tank fuel pump. The fuel pump will operate as long as the engine is cranking or running, and the ECM is receiving ignition reference pulses.

If there are no reference pulses, the ECM will shut "OFF" the fuel pump within 2 seconds after ignition "ON," or engine stops.

Should the fuel pump relay, or the 12 volt relay drive from the ECM fail, the fuel pump will be run through an oil pressure switch back-up circuit.

Code 54 will set if the ECM does not see the 12 volts signal at terminal "B2" during the 2 seconds that the ECM is energizing the fuel pump relay.

Diagnostic Aids:

An inoperative fuel pump relay can result in long cranking times, particularly if the engine is cold or engine oil pressure is low. The extended crank period is caused by the time necessary for oil pressure to build enough to close the oil pressure switch and turn "ON" the fuel pump.

CODE 54
FUEL PUMP CIRCUIT
(LOW VOLTAGE)
5.0L (VIN E) "F" CARLINE (TBI)

• IGNITION "OFF" FOR 10 SECONDS.
 • IGNITION "ON".
 • LISTEN FOR IN-TANK FUEL PUMP.
 • PUMP SHOULD RUN FOR 2 SECONDS AFTER IGNITION "ON".
 DOES IT?

NO

• IGNITION "OFF".
 • USING A FUSED JUMPER WIRE, CONNECT FUEL PUMP TEST CONNECTOR TO 12 VOLTS.
 • DOES PUMP RUN?

YES

• IGNITION "OFF".
 • DISCONNECT FUEL PUMP RELAY.
 • PROBE CKT 340 WITH A TEST LIGHT TO GROUND.

LIGHT "ON"

CONNECT TEST LIGHT BETWEEN CKTS 340 & 450.

LIGHT "OFF"

REPAIR OPEN IN CKT 340.

NO

• DISCONNECT FUEL PUMP RELAY.
 • USING THE FUSED JUMPER WIRE, CONNECT CKT 120 TO 12 VOLTS.
 DOES PUMP RUN?

YES

FAULTY RELAY.

NO

OPEN CKT 120, FAULTY IN-TANK PUMP OR FAULTY PUMP GROUND.

YES

• CLEAR CODES.
 • START AND RUN ENGINE FOR 30 SECONDS OR UNTIL CODE 54 SETS.
 DOES CODE SET?

YES

• AT THE ECM, BACK PROBE CKT 120 WITH A TEST LIGHT TO GROUND.
 • IGNITION "OFF" FOR 10 SECONDS.
 • NOTE LIGHT WITHIN 2 SECONDS AFTER IGNITION "ON".

LIGHT "ON"

FAULTY CONNECTION AT ECM OR FAULTY ECM.

NO

CODE 54 IS INTERMITTENT. REFER TO "INTERMITTENTS" IN SECTION "B".

LIGHT "OFF"

OPEN CKT 120 TO ECM.

LIGHT "ON"

• CONNECT TEST LIGHT BETWEEN HARNESS CKT 465 AND GROUND.
 • IGNITION "OFF" FOR 10 SECONDS.
 • NOTE TEST LIGHT WITHIN 2 SECONDS AFTER IGNITION "ON".

LIGHT "ON"

• FAULTY RELAY.

LIGHT "OFF"

REPAIR OPEN CKT 450.

LIGHT "OFF"

CKT 465 OPEN, SHORTED TO GROUND, OR FAULTY ECM.

NOTE: IF ORIGINAL COMPLAINT WAS "CRANKS BUT WILL NOT RUN" MAKE THE FOLLOWING ADDITIONAL CHECKS:

• ENGINE IDLING AT NORMAL OPERATING TEMPERATURE.
 • OIL PRESSURE NORMAL.
 • DISCONNECT FUEL PUMP RELAY.
 • ENGINE SHOULD CONTINUE TO RUN.
 • DOES IT?

YES

• RECONNECT FUEL PUMP RELAY.
 • IGNITION "OFF".
 • PROBE FUEL PUMP TEST TERMINAL WITH A TEST TERMINAL WITH A TEST LIGHT TO GROUND.

LIGHT "OFF"

FUEL PUMP CIRCUIT OK

NO

FAULTY OIL PRESSURE SWITCH.

LIGHT "ON"

FAULTY OIL PRESSURE SWITCH

CODE 51

**PROM ERROR
(FAULTY OR INCORRECT PROM)
5.0L (VIN E) "F" CARLINE (TBI)**

CHECK THAT ALL PINS ARE FULLY INSERTED IN THE SOCKET. IF OK, REPLACE PROM, CLEAR MEMORY AND RECHECK. IF CODE 51 REAPPEARS, REPLACE ECM.

CLEAR ALL CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT

CODE 52

**CALPAK ERROR
(FAULTY OR INCORRECT CALPAK)**

CHECK THAT ALL PINS ARE FULLY INSERTED IN THE SOCKET. IF OK, REPLACE CALPAK, CLEAR MEMORY AND RECHECK. IF CODE 52 REAPPEARS, REPLACE ECM.

CLEAR ALL CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT

CODE 55

ECM ERROR

REPLACE ELECTRONIC CONTROL MODULE (ECM).

CLEAR ALL CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT