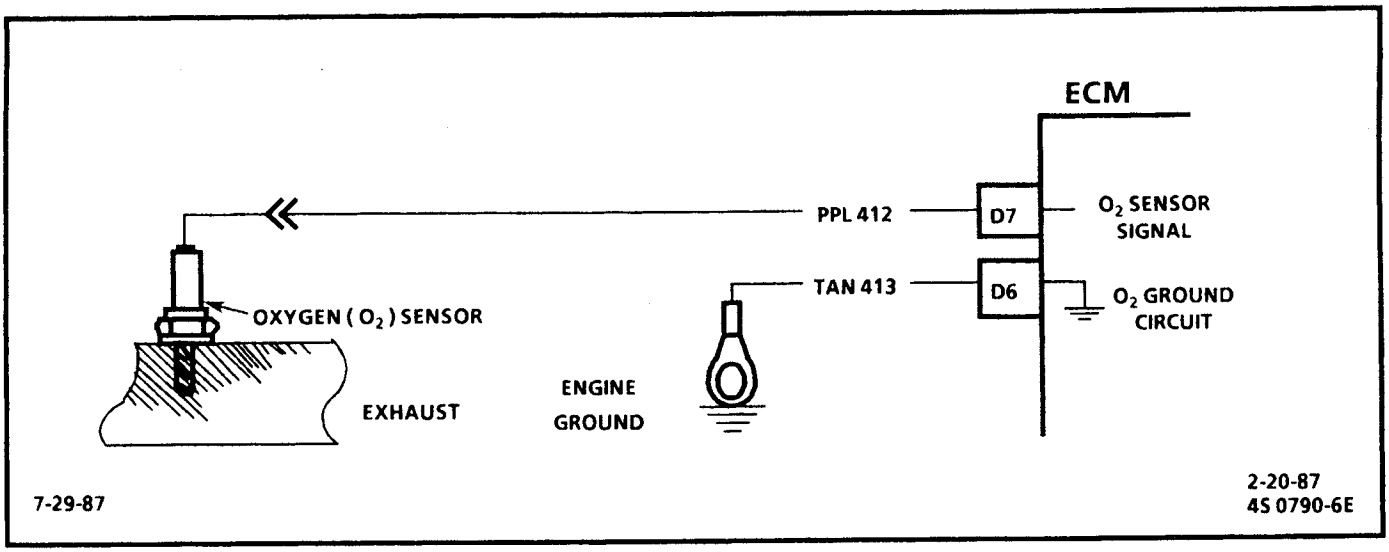


CODE 13

OXYGEN SENSOR CIRCUIT (OPEN CIRCUIT) 2.8L (VIN S) "F" CARLINE (PORT)

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 volts.) The O_2 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 315° 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.
   - O_2 signal voltage steady between .35 and .55 volts.
   - Throttle position sensor signal above 4%.
   - All conditions must be met for about 60 seconds.

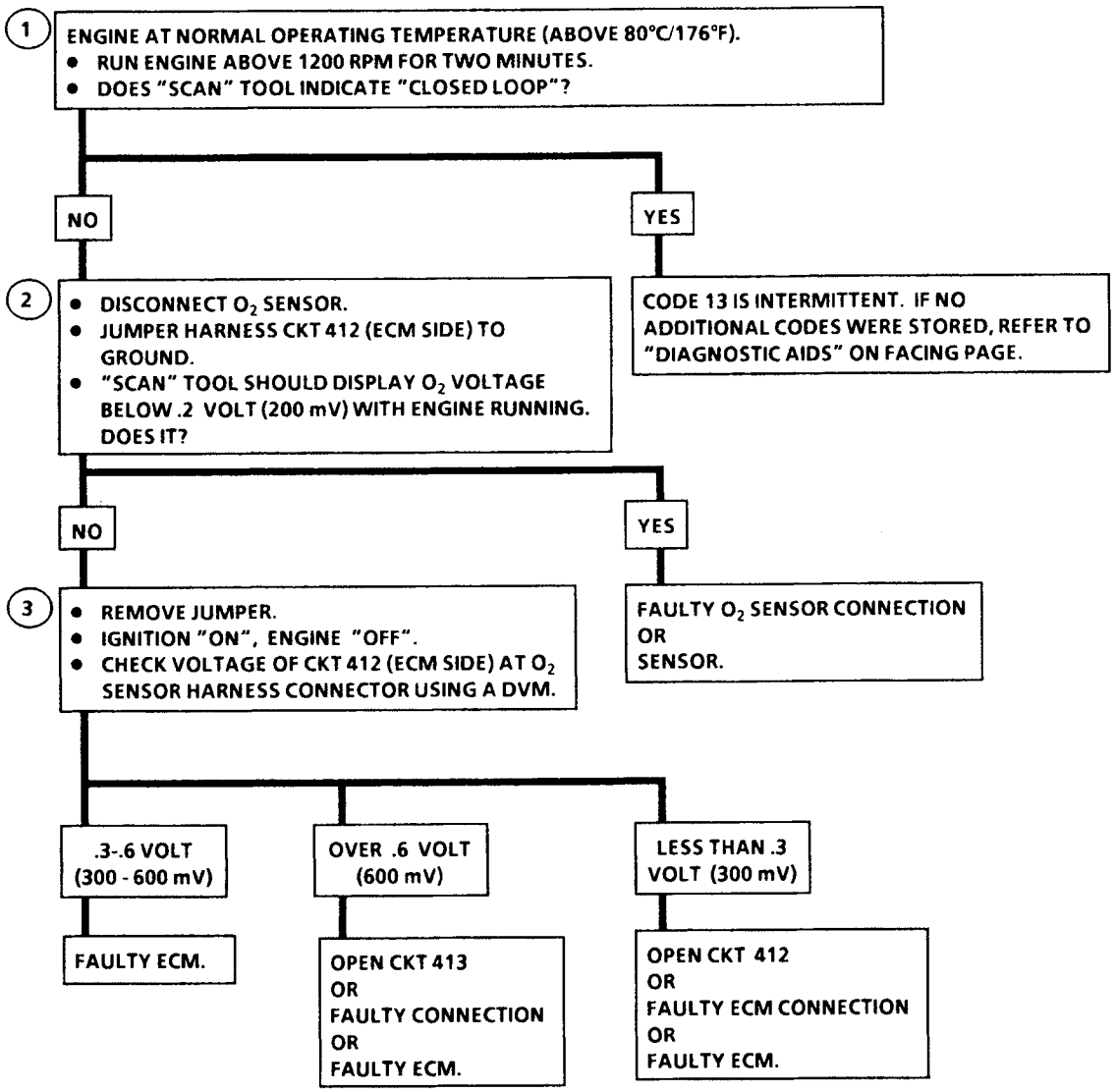
   If the conditions for a Code 13 exist the system will not go "Closed Loop".
2. This will determine if the sensor is at fault or the wiring or ECM is the cause of the Code 13.
3. In doing this test use only a high impedence digital volt ohmmeter. This test checks the continuity of CKTs 412 and 413 because 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 100mV to 999mV (.1 and 1.0 volt) while in "Closed Loop". Code 13 sets in one minute if voltage remains between .35 and .55 volts, but the system will go "Open Loop" in about 15 seconds. Refer to "Intermittents" in Section "B".

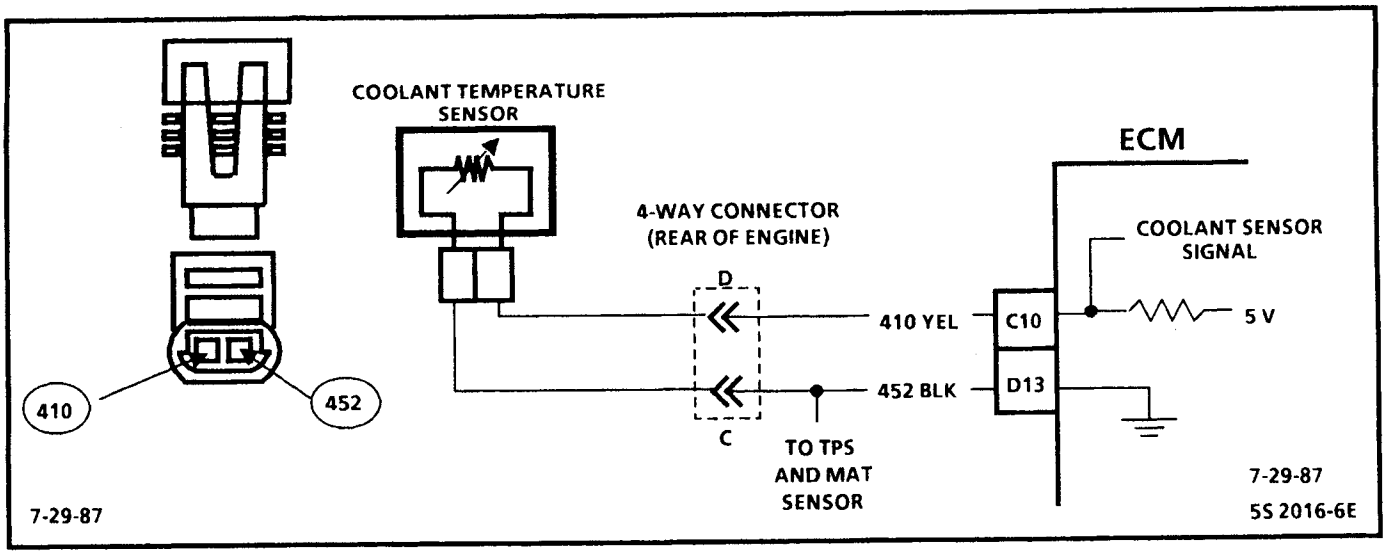
CODE 13

OXYGEN SENSOR CIRCUIT (OPEN CIRCUIT) 2.8L (VIN S) "F" CARLINE (PORT)



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

5-3-88
• 7S 3054-6E



CODE 14

COOLANT TEMPERATURE SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
2.8L (VIN S) "F" CARLINE (PORT)

Circuit Description:

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

As the engine warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature (85°C to 95°C) the voltage will measure about 1.5 to 2.0 volts.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

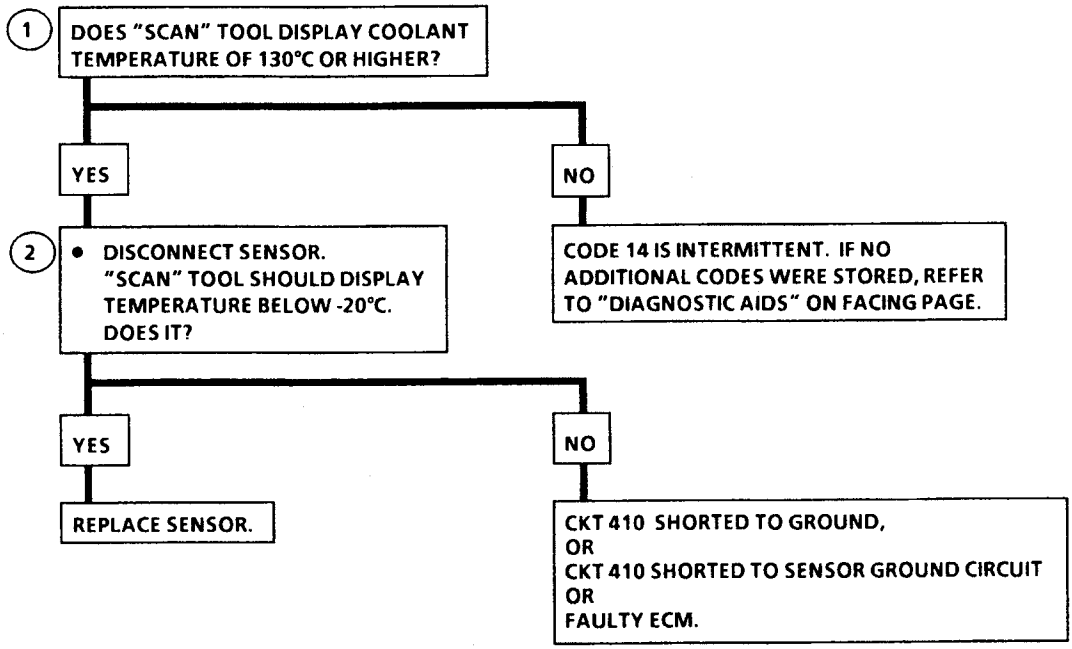
1. Code 14 will set if:
   - Signal voltage indicates a coolant temperature above 135°C (275°F) for 3 seconds.
2. This test will determine if CKT 410 is shorted to ground, which will cause the conditions for Code 14.

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 then stabilize when thermostat opens. Refer to "Intermittents" in Section "B".

CODE 14

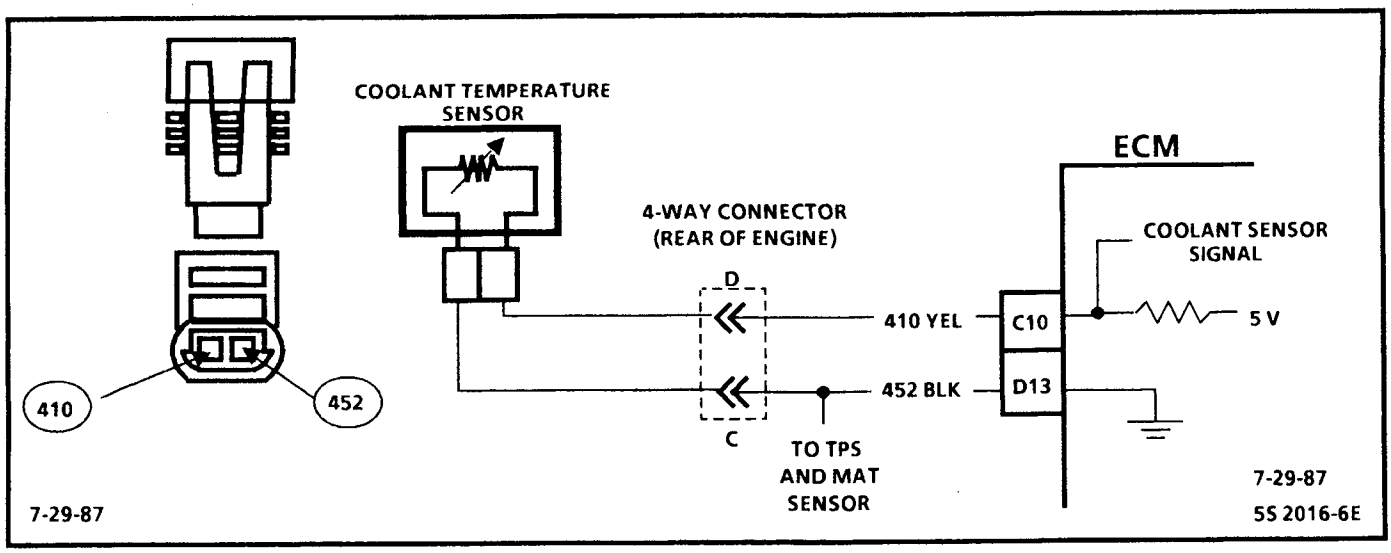
COOLANT TEMPERATURE SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
2.8L (VIN S) "F" CARLINE (PORT)



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) 2.8L (VIN S) "F" CARLINE (PORT)

Circuit Description:

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

As the engine warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature (85°C to 95°C) the voltage will measure about 1.5 to 2.0 volts at the ECM.

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

1. Code 15 will set if:
   - Signal voltage indicates a coolant temperature less than -44° C (-47° F) for 3 seconds.
2. This test simulates a Code 14. If the ECM recognizes the low signal voltage, (high temperature) and the "Scan" reads 130°C, the ECM and wiring are OK.
3. 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:

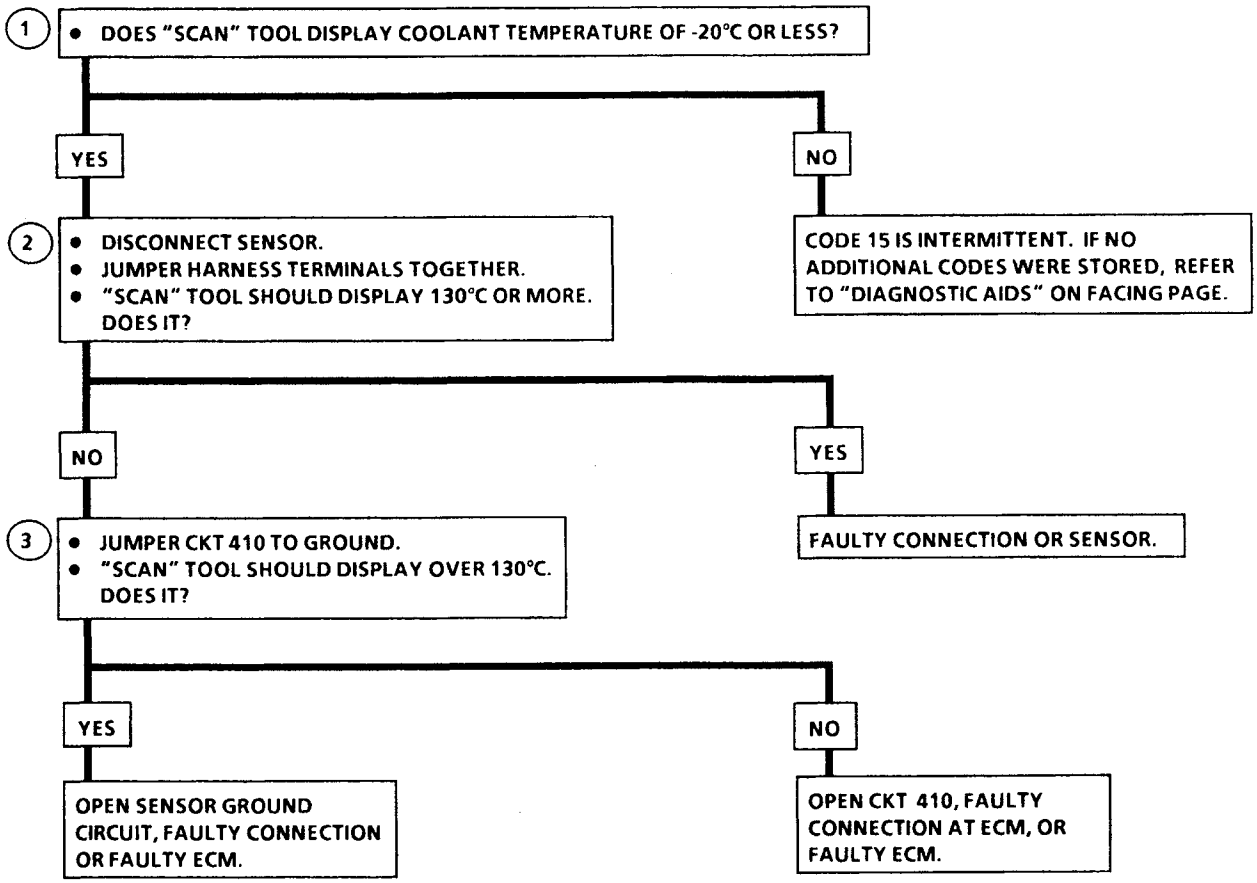
A "SCAN" tool reads engine temperature in degrees centigrade. After engine is started the temperature should rise steadily to about 90°C then stabilize when thermostat opens.

A faulty connection, or an open in CKT 410 or 452 will result in a Code 15.

If Code 23 or 63 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) 2.8L (VIN S) "F" CARLINE (PORT)

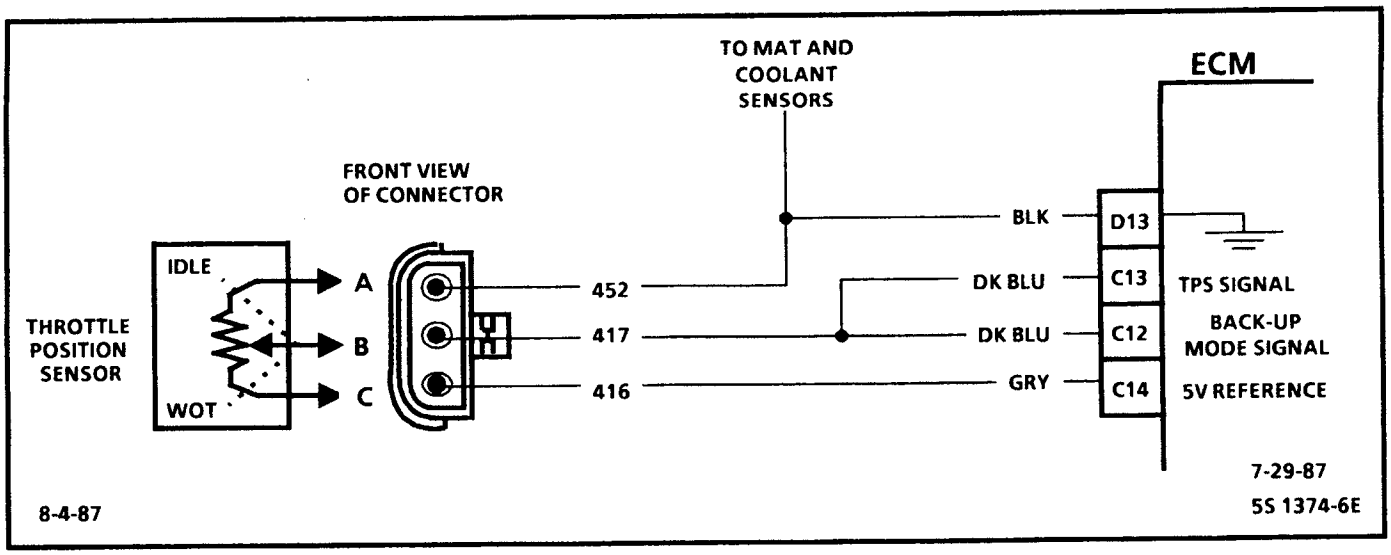


DIAGNOSTIC AID

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.

4-20-88
• 7S 3261-6E



CODE 21

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE HIGH)
2.8L (VIN S) "F" CARLINE (PORT)

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 control outputs.

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

1. Code 21 will set if:
   - Engine is running
   - TPS signal voltage is greater than 2.5 volts
   - Air flow is less than 12 gm/sec.
   - All conditions met for 5 seconds.

   OR

   - TPS signal voltage over 4.5 volts with ignition "ON".

   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, refer to "TPS Adjustment" in Section "6E3-C1".
2. With the TPS sensor disconnected, the TPS voltage should go low if the ECM and wiring is OK.
3. Probing CKT 452 with a test light checks the 5 volt return circuit, because a faulty 5 volt return will cause a Code 21.

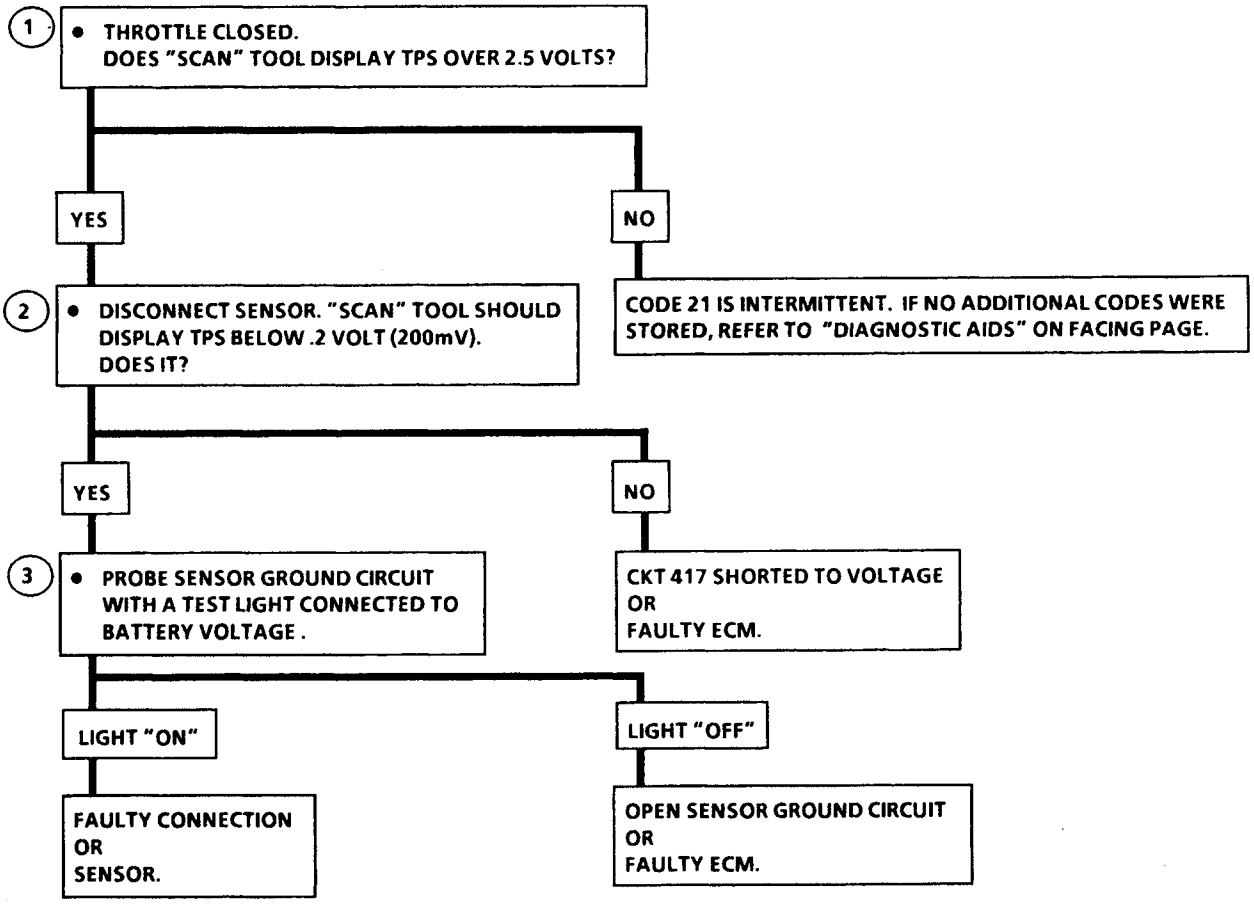
Diagnostic Aids:

A "SCAN" tool reads throttle position in volts. 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".

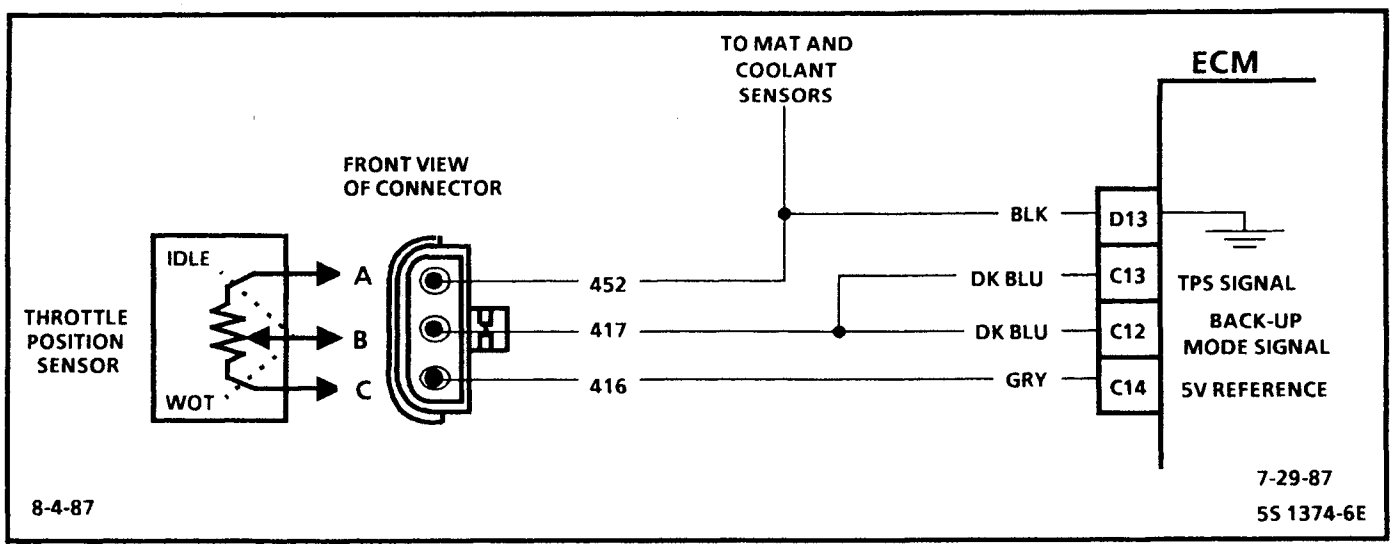
CODE 21

THROTTLE POSITION SENSOR (TPS) CIRCUIT (SIGNAL VOLTAGE HIGH) 2.8L (VIN S) "F" CARLINE (PORT)



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

3-9-88
• 7S 3057-6E



CODE 22

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE LOW)
2.8L (VIN S) "F" CARLINE (PORT)

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 control 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, refer to "TPS Adjustment" in Section "6E3-C1".
4. This simulates a high signal voltage to check for an open in CKT 417.

Diagnostic Aids:

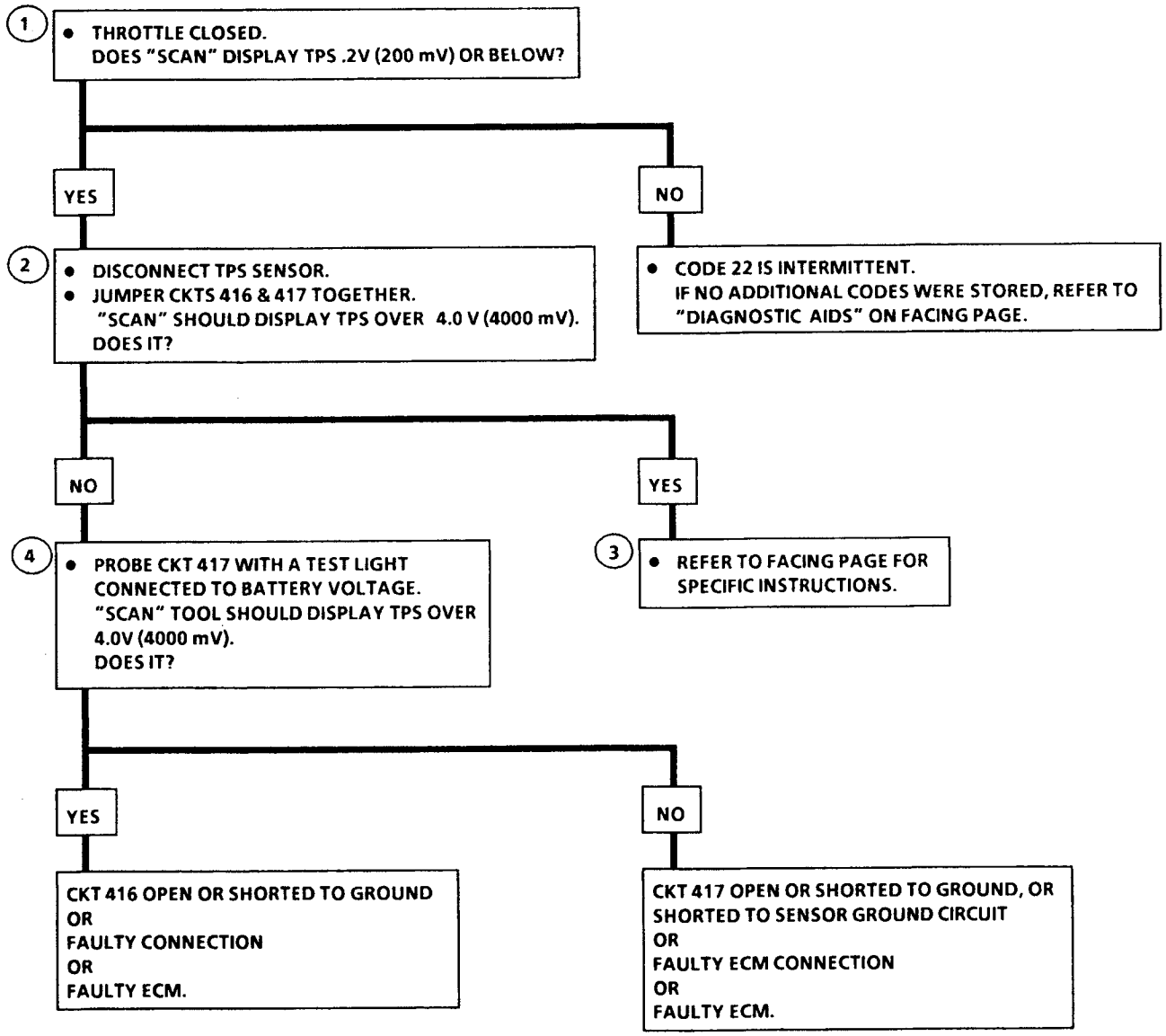
A "Scan" tool reads throttle position in volts. Voltage should increase at a steady rate as throttle is moved toward WOT.

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

Refer to "Intermittents" in Section "B".

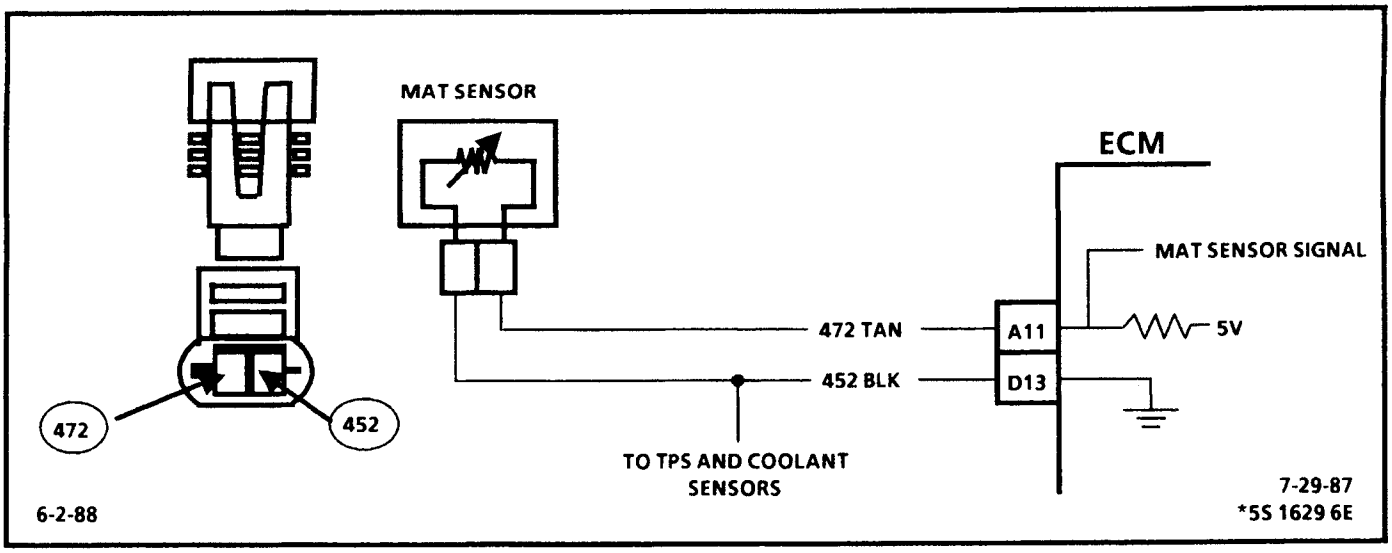
CODE 22

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE LOW)
2.8L (VIN S) "F" CARLINE (PORT)



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

3-10-88
• 7S 3365-6E



CODE 23

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
2.8L (VIN S) "F" CARLINE (PORT)

Circuit Description:

The 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 air is cold the sensor (thermistor) resistance is high, therefore the ECM will see a high signal voltage. If the air is warm the sensor 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 −35°C (-31°F) for 3 seconds.
   - Time since engine start is 8 minutes or longer.
   - No VSS.
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 signal CKT 472 or the 5V return CKT 452 is open.

Diagnostic Aids:

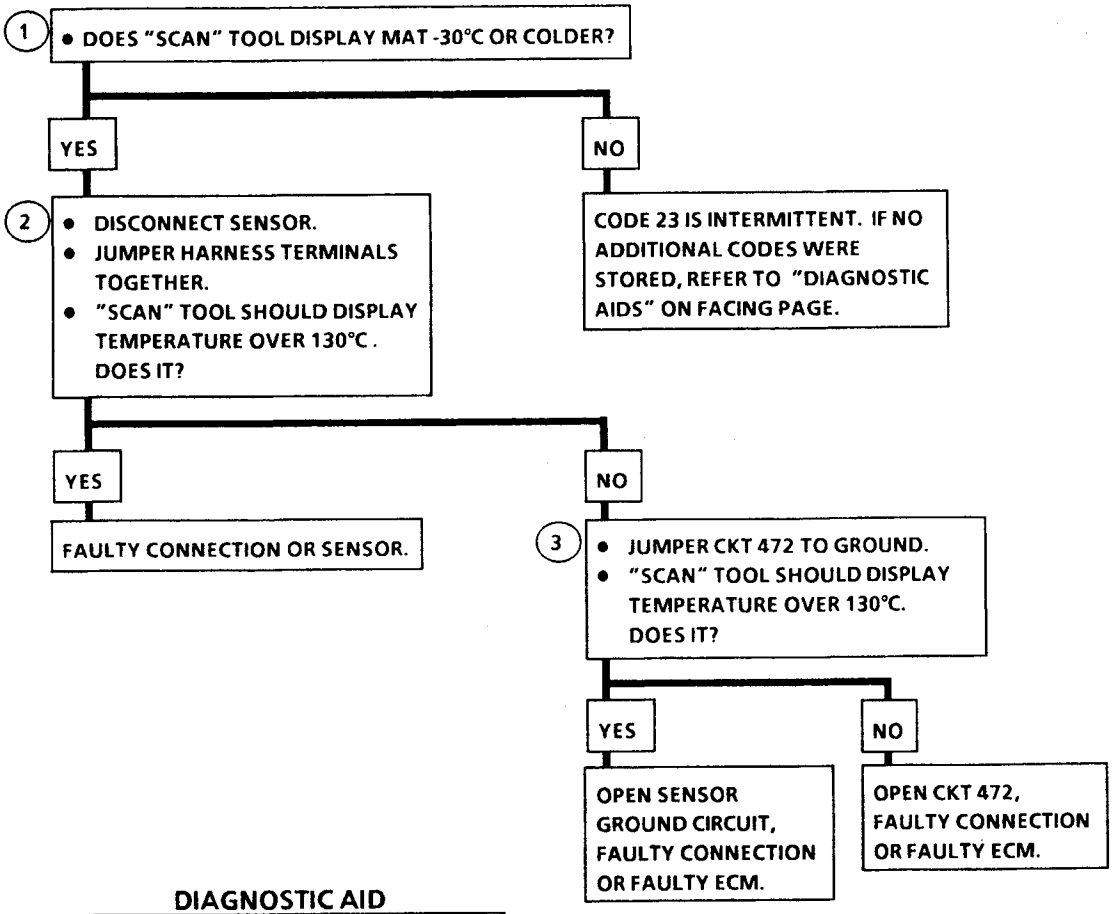
A "SCAN" tool reads temperature of the air entering the engine and should read close to ambient air temperature when engine is cold, and rises as underhood temperature increases.

A faulty connection, or an open in CKT 472 or 452 will result in a Code 23.

Refer to "Intermittents" in Section "B".

CODE 23

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
2.8L (VIN S) "F" CARLINE (PORT)

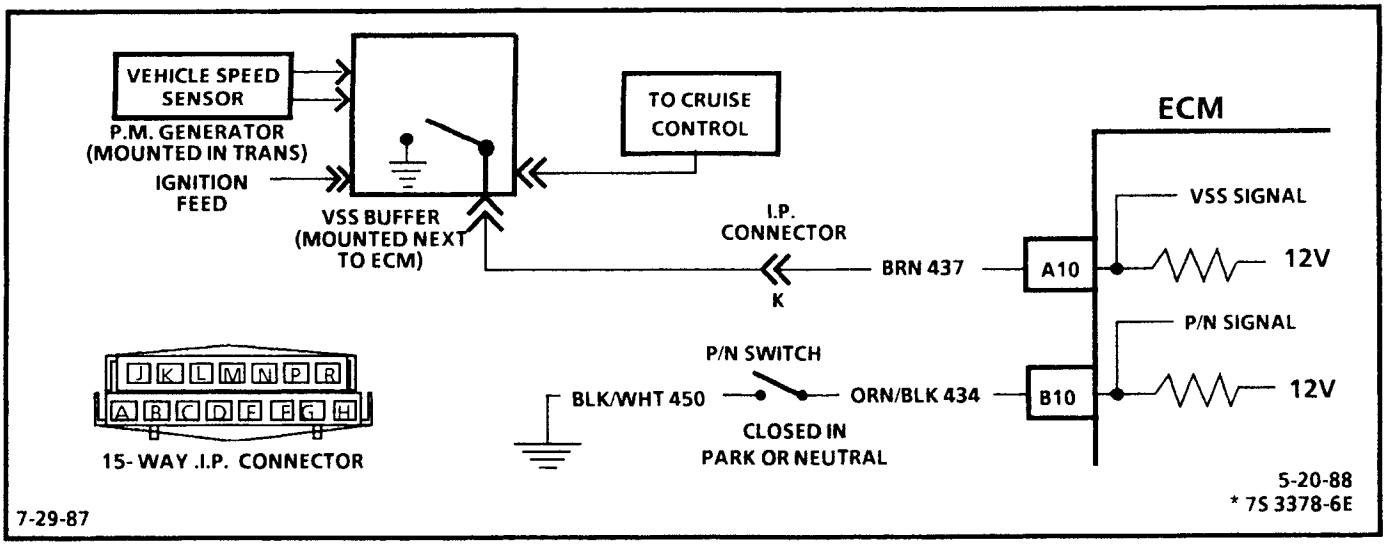


DIAGNOSTIC AID

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.

9-21-87
• 7S 3285-6E



CODE 24

VEHICLE SPEED SENSOR (VSS) CIRCUIT 2.8L (VIN S) "F" CARLINE (PORT)

Circuit Description:

The ECM applies and monitors 12 volts on CKT 437. CKT 437 connects to the vehicle speed sensor buffer 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" tool reading should closely match with speedometer reading with drive wheels turning.

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

1. Code 24 will set if:
   - CKT 437 voltage is constant.
   - Engine speed between 1400 and 3600 rpm.
   - Less than 2% throttle opening.
   - Low load condition (low air flow).
   - Not in park or neutral.
   - All conditions must be met for 3 seconds.

   These conditions are met during a road load deceleration.
2. A voltage of less than 1 volt at the 15-way connector indicates that the CKT 437 wire may be shorted to ground. Disconnect CKT 437 at the VSS buffer. If voltage now reads above 10 volts, the VSS buffer is faulty.

   If voltage remains less than 10 volt, 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:

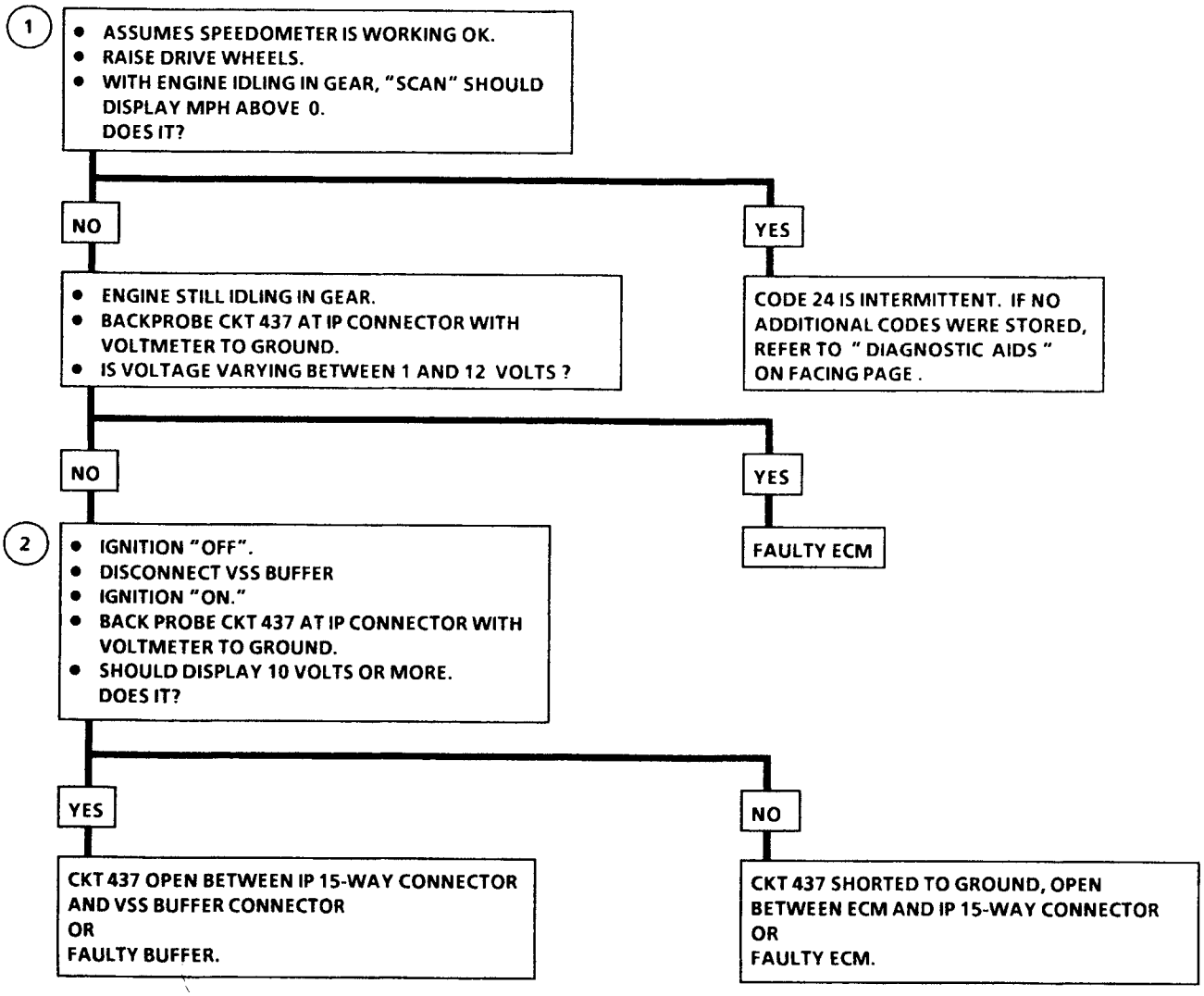
If "Scan" displays vehicle speed, check park/neutral switch CHART C-1A on vehicle with auto trans. If switch is OK, check for intermittent connections. An open or short to ground in CKT 437 will result in a Code 24. If the customer also complained about a loss of mph on the I.P., check the P.M. generator circuit. Refer to Section "8A" for complete wiring diagram.

Refer to "Intermittents" in Section "B".

CODE 24

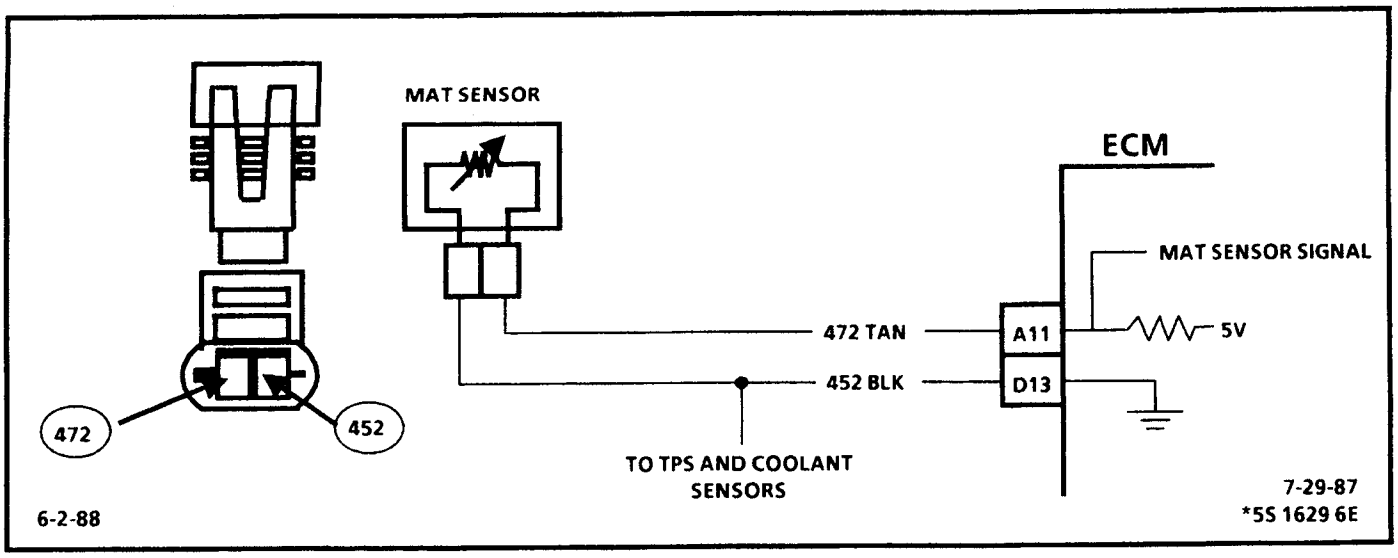
VEHICLE SPEED SENSOR (VSS) CIRCUIT 2.8L (VIN S) "F" CARLINE (PORT)

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.

1-6-88
• 85 4684-6E



CODE 25

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT (HIGH TEMPERATURE INDICATED) 2.8L (VIN S) "F" CARLINE (PORT)

Circuit Description:

The manifold air temperature 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. As the air warms, the sensor resistance becomes less, and the voltage drops.

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 145°C (293° F) for 3 seconds.
   - Time since engine start is 8 minutes or longer.
   - A vehicle speed is present.

Diagnostic Aids:

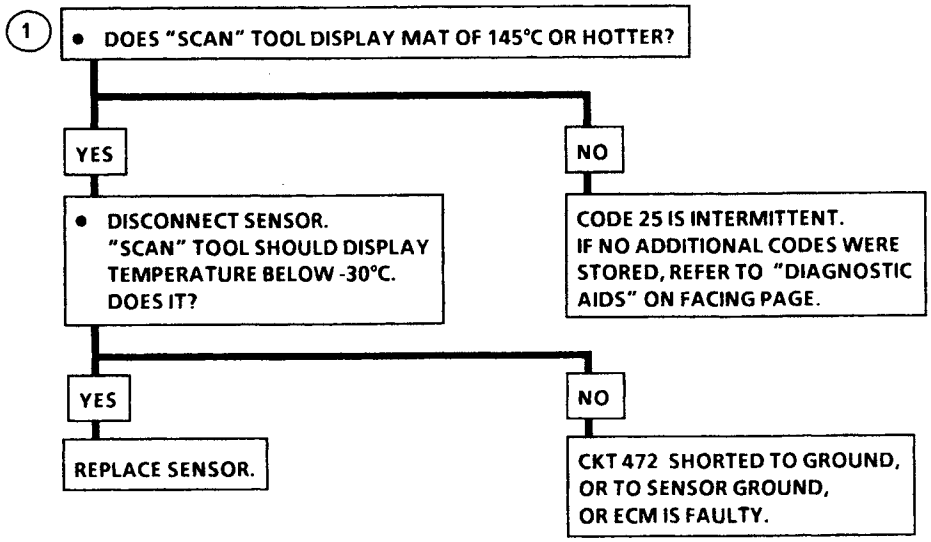
A "SCAN" tool reads temperature of the air entering the engine and should read close to ambient air temperature, when engine is cold, and rises as underhood temperature increases.

A short to ground in CKT 472 will result in a Code 25.

Refer to "Intermittents" in Section "B".

CODE 25

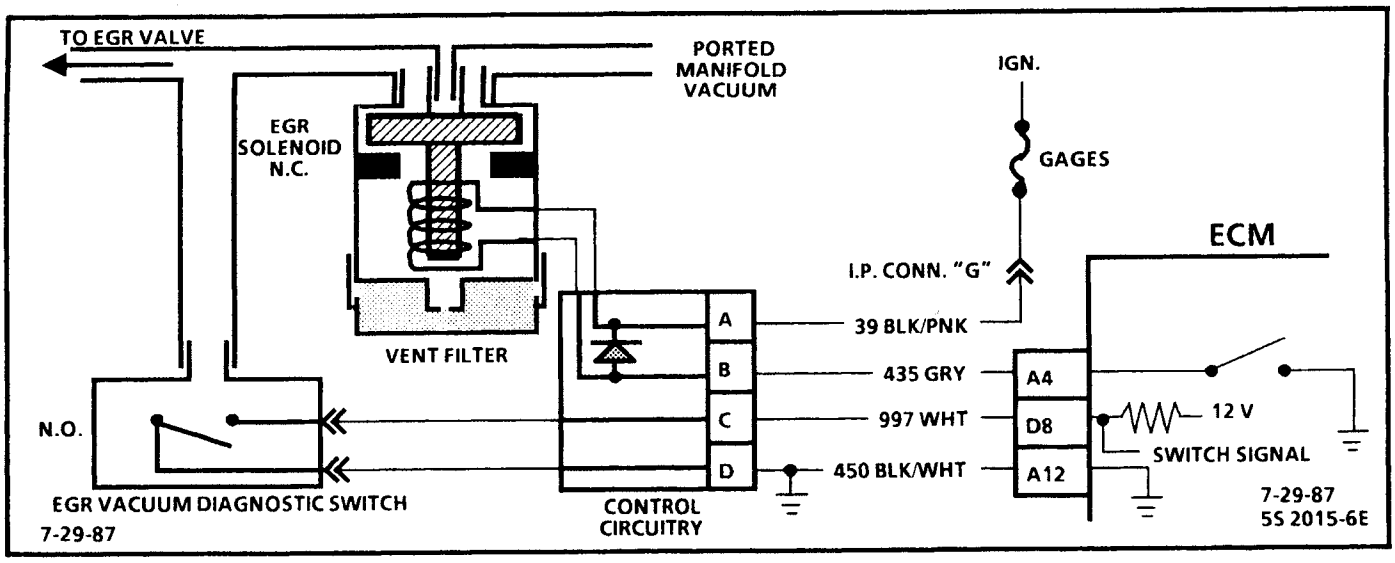
MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
2.8L (VIN S) "F" CARLINE (PORT)



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 2.8L (VIN S) "F" CARLINE (PORT)

Circuit Description:

The EGR vacuum control uses an ECM controlled solenoid. The solenoid is normally closed and the vacuum source is a ported signal. The ECM will turn the EGR "ON" and "OFF" (Duty Cycle) by grounding CKT 435. The duty cycle is calculated by the ECM based on information from the coolant and mass airflow sensor and engine rpm. The duty cycle should be 0% (no EGR) when in park or neutral, TPS input below a specified value, or TPS indicating WOT.

With the ignition "ON", engine stopped, the EGR solenoid is de-energized unless the diagnostic terminal is grounded.

Code 32 means that the EGR vacuum diagnostic switch was closed during start-up, or that the switch was not detected closed under the following conditions.

- Coolant temperature greater than 80° C (176°F).
- EGR duty cycle commanded by the ECM is greater than 55%.
- TPS less than half throttle, but not at idle.
- All conditions above must be met for 5 seconds.

If the switch is detected closed during start-up, or , if the switch is detected open when the above conditions are met, the "Service Engine Soon" light will remain "ON" unless the switch changes state.

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

1. If the first step caused Code 32 to set, then the ECM has recognized a closed vacuum switch on start-up. This test will determine whether the EGR vacuum diagnostic switch is the cause or if the wiring or the ECM is the cause.
2. With the ignition "ON", the solenoid should not be energized and vacuum should not pass to the EGR valve.
3. To this point the EGR solenoid and valve are OK and the following check will check the diagnostic vacuum switch portion of the system.
4. The diagnostic switch should close at about 2" of vacuum. With vacuum applied, the switch should close and resistance go to near zero ohms and the vacuum should hold.

CODE 32

EXHAUST GAS RECIRCULATION (EGR) CIRCUIT 2.8L (VIN S) "F" CARLINE (PORT)

BEFORE USING THIS CHART, CHECK FOR PORTED VACUUM TO EGR SOLENOID, ALSO CHECK HOSES FOR LEAKS OR RESTRICTIONS. SHOULD BE AT LEAST 23.64 kPa (7") HG VACUUM AT 2000 RPM.

- IGNITION "OFF", CLEAR CODES.
- START ENGINE. AND IDLE FOR 30 SECONDS OR UNTIL CODE 32 SETS.

NO CODE 32

(2)
- DISCONNECT EGR SOLENOID VACUUM HARNESS.
- ROTATE HARNESS AND REINSTALL ONLY THE EGR VALVE SIDE.
- IGNITION "ON", ENGINE STOPPED.
- INSTALL A HAND HELD VACUUM PUMP WITH GAGE TO MANIFOLD SIDE OF EGR SOLENOID.
- APPLY VACUUM AND OBSERVE EGR VALVE.
- VALVE SHOULD NOT MOVE.

VALVE DOES NOT MOVE
- GROUND DIAGNOSTIC TERMINAL.
- REPEAT TEST.

VALVE MOVES

VALVE MOVES

(3)
- DISCONNECT EGR 4-WAY CONNECTOR.
- CONNECT VOLTMETER BETWEEN "C" & "D".
- IGNITION "ON".

OVER 10 VOLTS

(4)
- CONNECT OHMMETER ACROSS TERMINALS "C" & "D" OF SOLENOID.
- APPLY 23.64 kPa (7") VACUUM TO VACUUM DIAGNOSTIC SWITCH.
- NOTE RESISTANCE.

LOW RESISTANCE (SWITCH CLOSED)

PROBLEM IS INTERMITTENT, CHECK ALL CONNECTIONS AND TERMINALS.

HIGH RESISTANCE (SWITCH OPEN)

FAULTY SWITCH, WIRING OR CONNECTIONS.

VALVE DOES NOT MOVE
- DISCONNECT EGR SOLENOID ELECTRICAL CONNECTOR.
- REPEAT TEST.

VALVE DOES NOT MOVE
- DISCONNECT EGR 4-WAY CONNECTOR
- CONNECT TEST LIGHT BETWEEN HARNESS TERMINALS "A" & "B".

LIGHT "ON"
- CONNECT VACUUM PUMP TO EGR VALVE.
- APPLY VACUUM AND OBSERVE VALVE.

UNDER 10 VOLTS

CONNECT VOLTMETER BETWEEN TERMINAL "C" AND CHASSIS GROUND.

OVER 10 VOLTS

REPAIR OPEN GROUND CKT 450.

UNDER 10 VOLTS

CHECK CKT 997 FOR OPEN. IF NOT OPEN, IT IS A FAULTY ECM. SEE ECM QUAD DRIVER CHECK (CHART C-1).

VALVE MOVES

FAULTY HOSE OR CONNECTION BETWEEN EGR SOLENOID AND EGR VALVE OR FAULTY EGR SOLENOID.

VALVE DOES NOT MOVE

REPLACE EGR VALVE

LIGHT "OFF"

CONNECT TEST LIGHT BETWEEN "A" AND GROUND.

NO LIGHT

REPAIR OPEN CKT 39.

LIGHT

REPAIR OPEN CKT 435. IF NOT OPEN, IT IS A FAULTY ECM. SEE ECM QUAD DRIVER CHECK (CHART C-1).

CODE 32

(1)
- CLEAR CODES.
- DISCONNECT EGR SOLENOID 4-WAY CONNECTOR.
- REPEAT TEST.

NO CODE 32

CHECK FOR A STUCK CLOSED SWITCH. IF NOT CLOSED, IT IS FAULTY WIRING OR CONNECTIONS.

CODE 32

CHECK CKT 997 FOR SHORT TO GROUND. IF NOT SHORTED IT IS A FAULTY ECM.

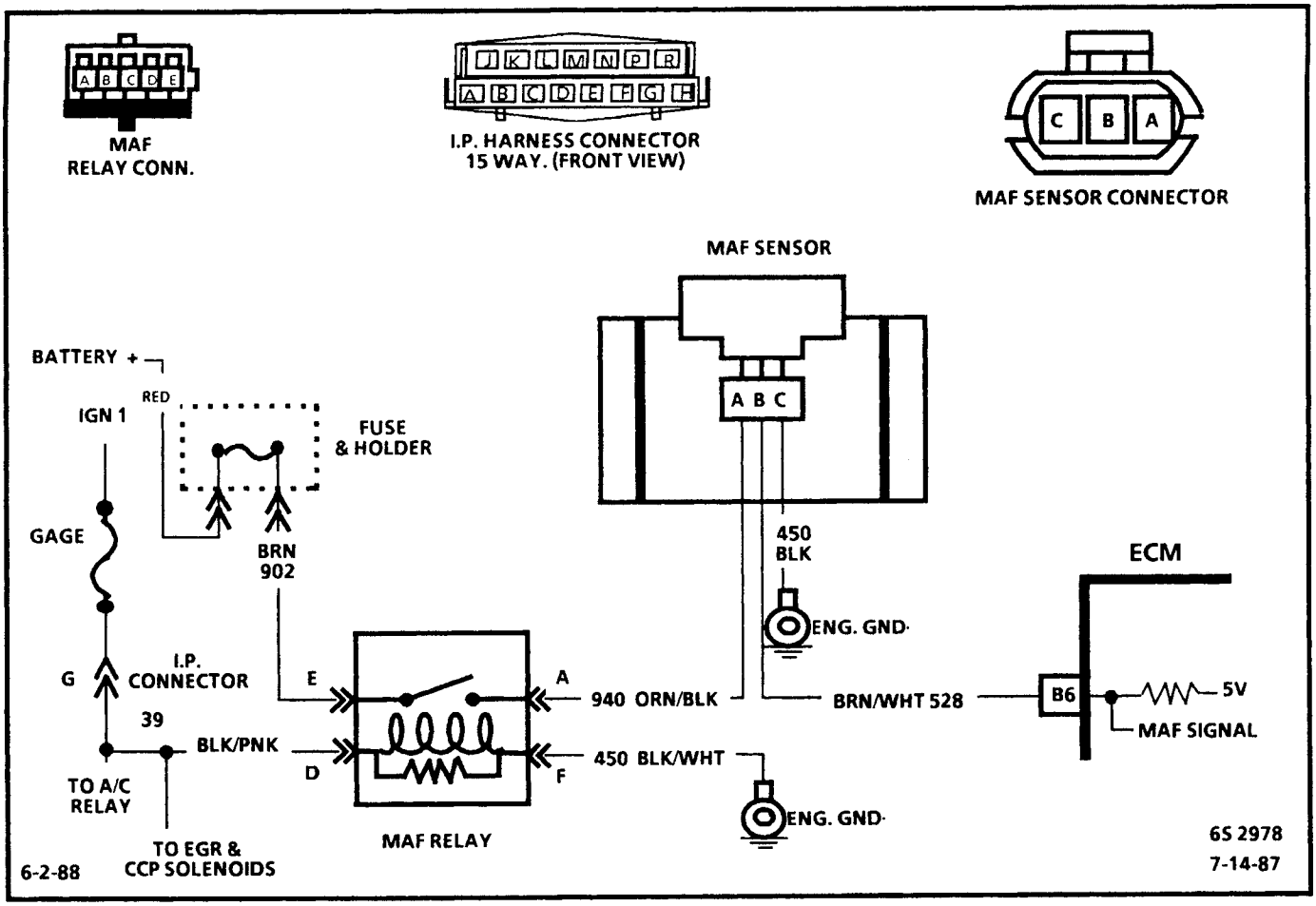
VALVE MOVES

FAULTY EGR SOLENOID

VALVE DOES NOT MOVE

CHECK CKT 435 FOR SHORT TO GROUND. IF OK, IT IS A FAULTY ECM. SEE ECM QUAD DRIVER CHECK (CHART C-1).

7-29-87
5S 1602-6E



CODE 33

MASS AIR FLOW (MAF) SENSOR CIRCUIT
(GM/SEC HIGH)
2.8L (VIN S) "F" CARLINE (PORT)

Circuit Description:

The MAF sensor measures the flow of air entering the engine. The sensor produces a frequency output between 32 and 150 hertz (3gm/sec to 150gm/sec). A large quantity (high frequency) indicates acceleration, and a small quantity (low frequency) indicates deceleration or idle. This information is used by the ECM for fuel control and is converted by a "Scan" tool to read out the air flow in grams per second. A normal reading is about 4-7 grams per second at idle and increases with rpm.

The MAF sensor is powered up by the MAF sensor relay and the sensor should have power supplied to it anytime the ignition is "ON". The MAF sensor is located in the air duct.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. Code 33 will set if:
   - Ign "ON" and air flow exceeds 20gm/sec.
     OR
   - Engine is running less than 1300 rpm.
   - TPS is 8% or less.
   - Air flow greater than 20 grams per second (high frequency).
   - All of the above are met for 2 seconds.

Diagnostic Aids:

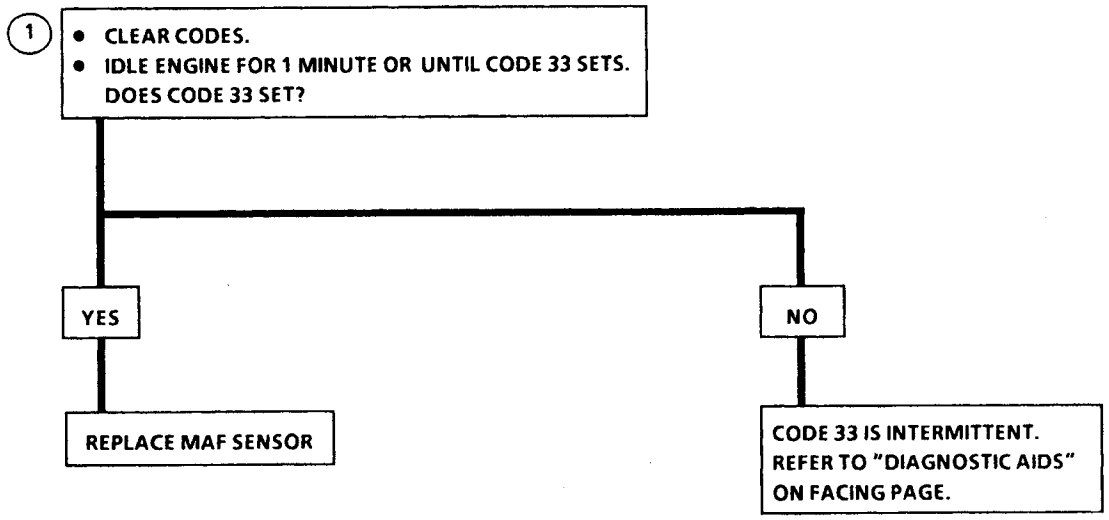
The "Scan" tool is not of much use in diagnosing this code because when the code sets gm/sec will be displaying the default value. However, the "Scan" may be useful in comparing the signal of a problem vehicle with that of a known good running one.

Refer to "Intermittents" in Section "B".

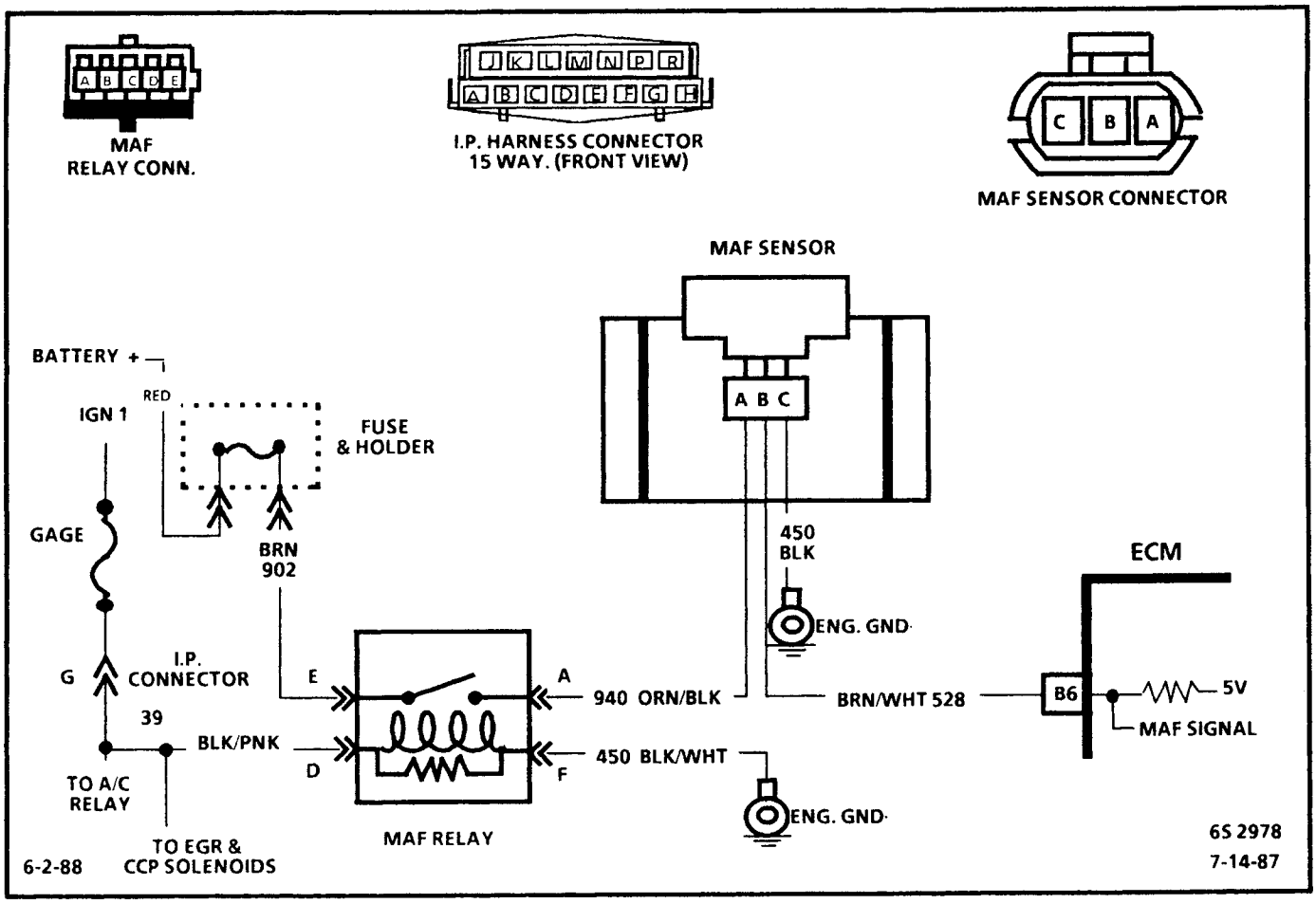
CODE 33

MASS AIR FLOW (MAF) SENSOR CIRCUIT (GM/SEC HIGH)

2.8L (VIN S) "F" CARLINE (PORT)



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



CODE 34

MASS AIR FLOW (MAF) SENSOR CIRCUIT
(GM/SEC LOW)
2.8L (VIN S) "F" CARLINE (PORT)

Circuit Description:

The MAF sensor measures the flow of air entering the engine. The sensor produces a frequency output between 32 and 150 hertz (3gm/sec to 150gm/sec). A large quantity (high frequency) indicates acceleration, and a small quantity (low frequency) indicates deceleration or idle. This information is used by the ECM for fuel control and is converted by a "SCAN" tool to read out the air flow in grams per second. A normal reading is about 4-7 grams per second at idle and increase with rpm.

The MAF sensor is powered up by the MAF sensor relay and the sensor should have power supplied to it anytime the ignition is "ON". The MAF sensor is located in the air duct.

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

1. Code 34 will set if:
   - Engine running
   - MAF sensor disconnected, faulty relay, or MAF signal circuit shorted to ground.

   OR
   - Air flow less than 2 grams per second (low frequency).

   A loose or damaged air duct can set Code 34.
   This test checks to see if ECM recognizes a problem. A light "OFF" at this point indicates an intermittent problem.
2. Checks to see if 5 volt reference signal from ECM is at MAF sensor harness connector.
3. Checks for 12 volt supply to MAF sensor.
4. Checks for open in 12 volt supply to relay.

Diagnostic Aids:

The "Scan" tool is not of much use in diagnosing this code because when the code sets gm/sec will be displaying the default value. However, the "Scan" may be useful in comparing the signal of a problem vehicle with that of a known good running one.

Check for loose or damaged air duct.

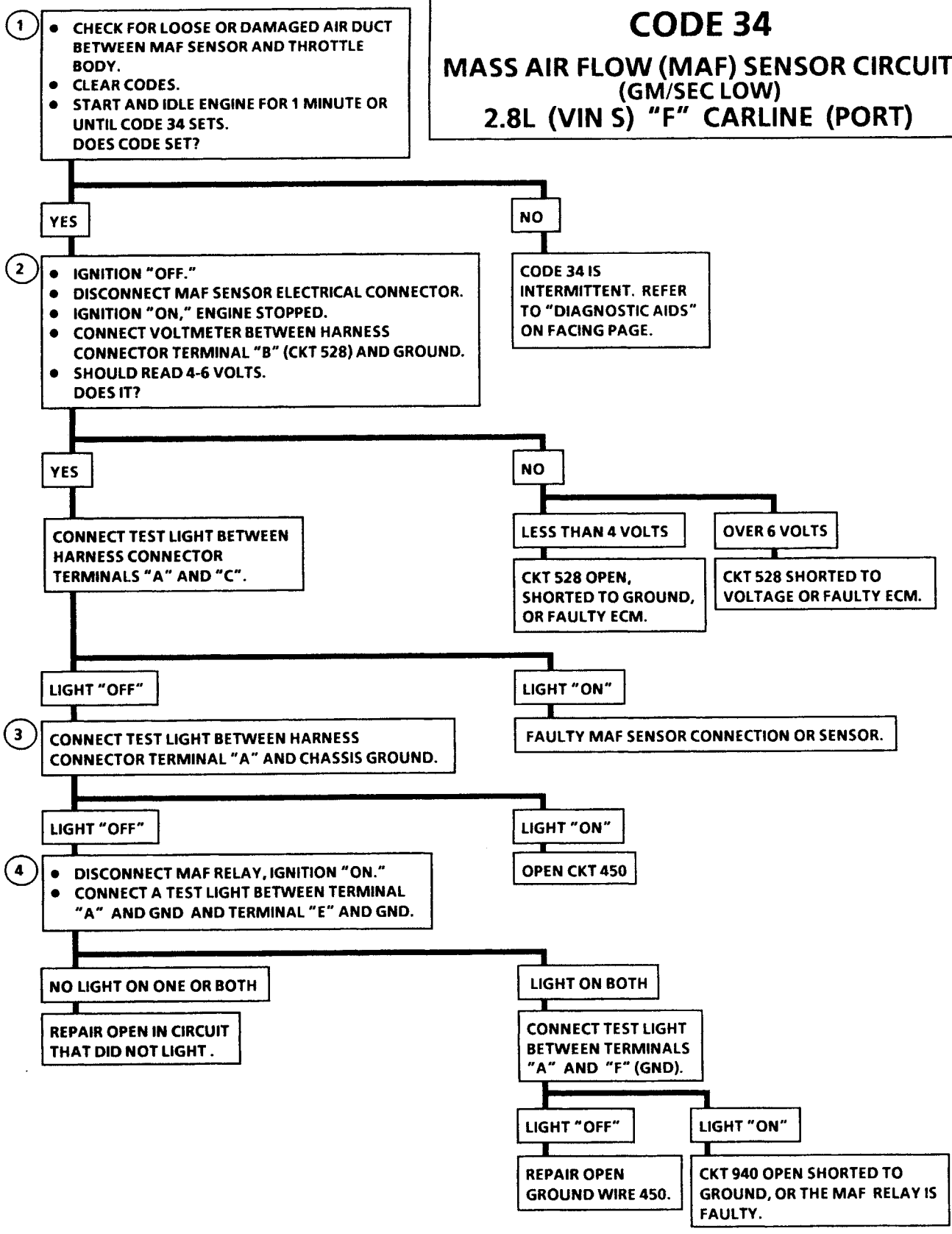
Inspect sensor and relay connections as an open will result in a Code 34.

Refer to "Intermittents" in Section "B".

CODE 34

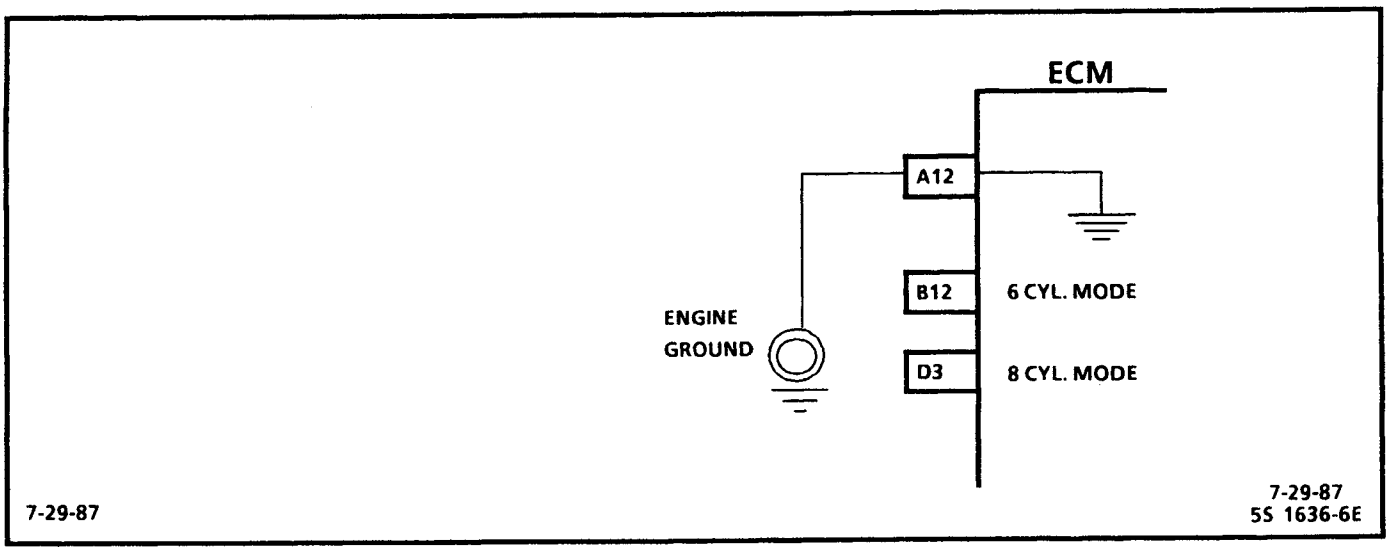
MASS AIR FLOW (MAF) SENSOR CIRCUIT (GM/SEC LOW)

2.8L (VIN S) "F" CARLINE (PORT)



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

5-26-88
5S 1635-6E



CODE 41

CYLINDER SELECT ERROR
(FAULTY OR INCORRECT MEM-CAL)
2.8L (VIN S) "F" CARLINE (PORT)

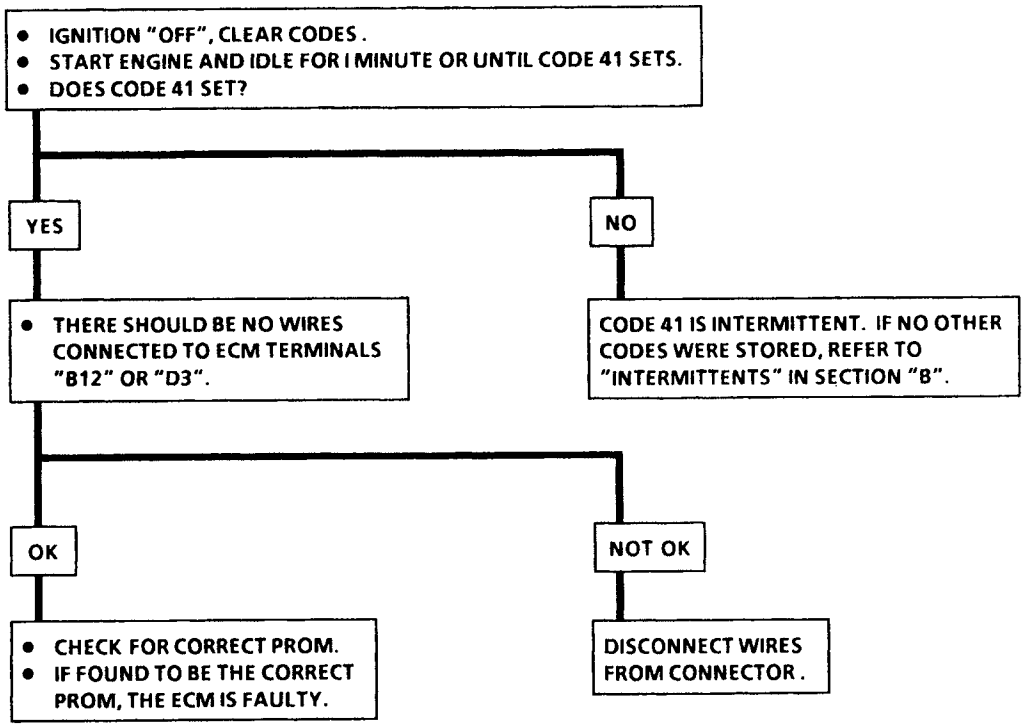
Circuit Description:

Due to the ECM being used for different engines, it is necessary for the engine application to be selected. This is done by leaving "B12" and "D3" open for a six cylinder engine.

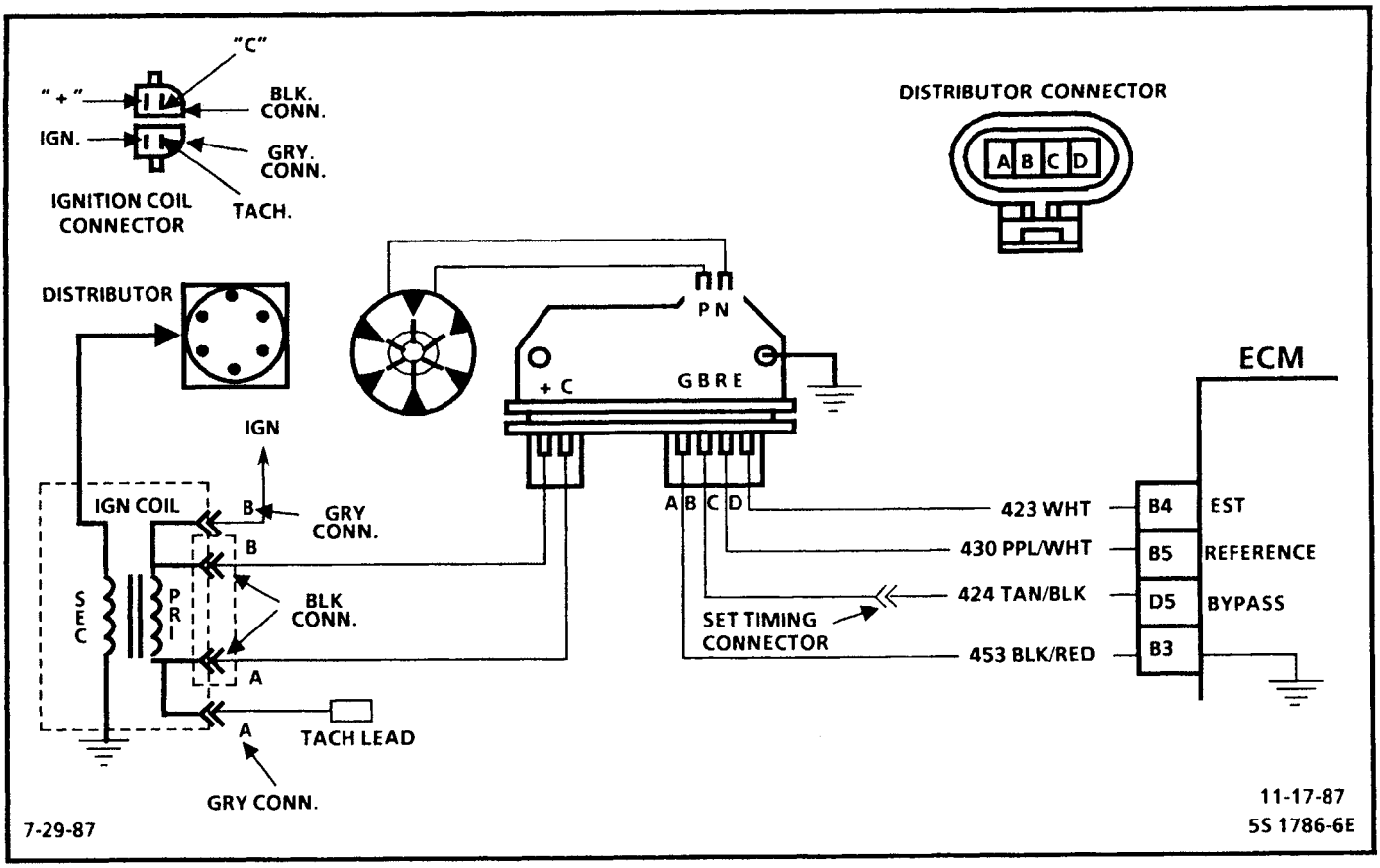
A Code 41 will set if the reference pulses are not equal to a value selected within the PROM when engine rpm's are below 2000. This code may set if the incorrect PROM is installed into the ECM.

CODE 41

CYLINDER SELECT ERROR (FAULTY OR INCORRECT MEM-CAL) 2.8L (VIN S) "F" CARLINE (PORT)



7-29-87
5S 1637-6E



CODE 42

ELECTRONIC SPARK TIMING (EST) CIRCUIT 2.8L (VIN S) "F" CARLINE (PORT)

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 on 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.

1. 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.
2. 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.
3. 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".
4. 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.
5. Confirms that Code 42 is a faulty ECM and not an intermittent in CKTs 423 or 424.

Diagnostic Aids:

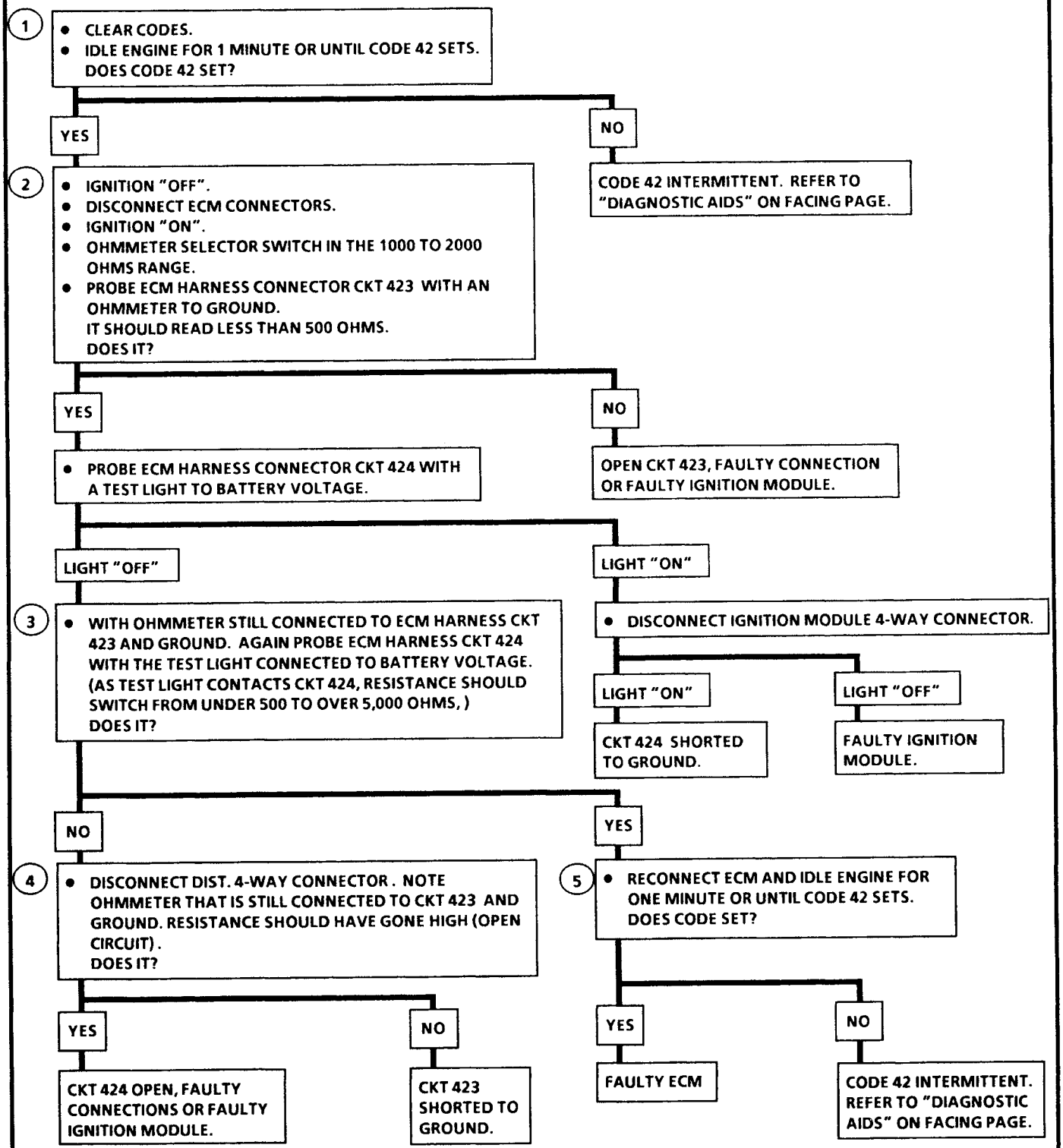
The "Scan" tool does not have any ability to help diagnose a Code 42 problem.

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

Refer to "Intermittents" in Section "B".

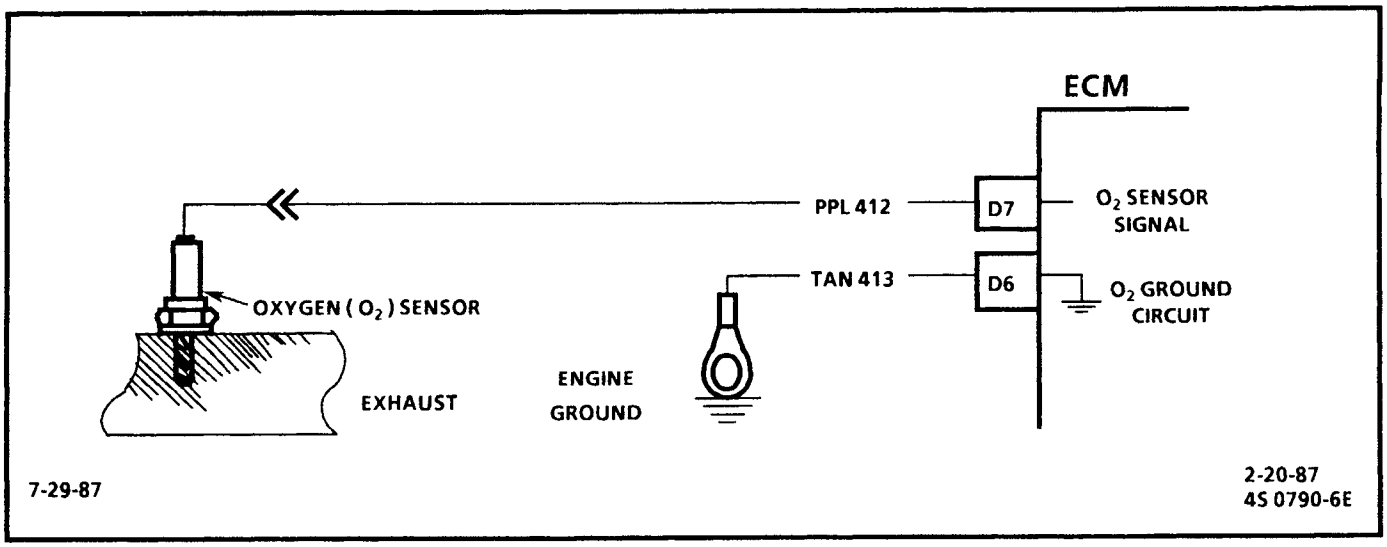
CODE 42

ELECTRONIC SPARK TIMING (EST) CIRCUIT 2.8L (VIN S) "F" CARLINE (PORT)



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

3-7-88
• 7S 3291-6E



CODE 44

OXYGEN SENSOR CIRCUIT
(LEAN EXHAUST INDICATED)
2.8L (VIN S) "F" CARLINE (PORT)

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 O_2 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.

1. Code 44 is set when the O_2 sensor signal voltage on CKT 412.
   - Remains below .2 volt for 60 seconds or more:
   - And the system is operating in "Closed Loop".

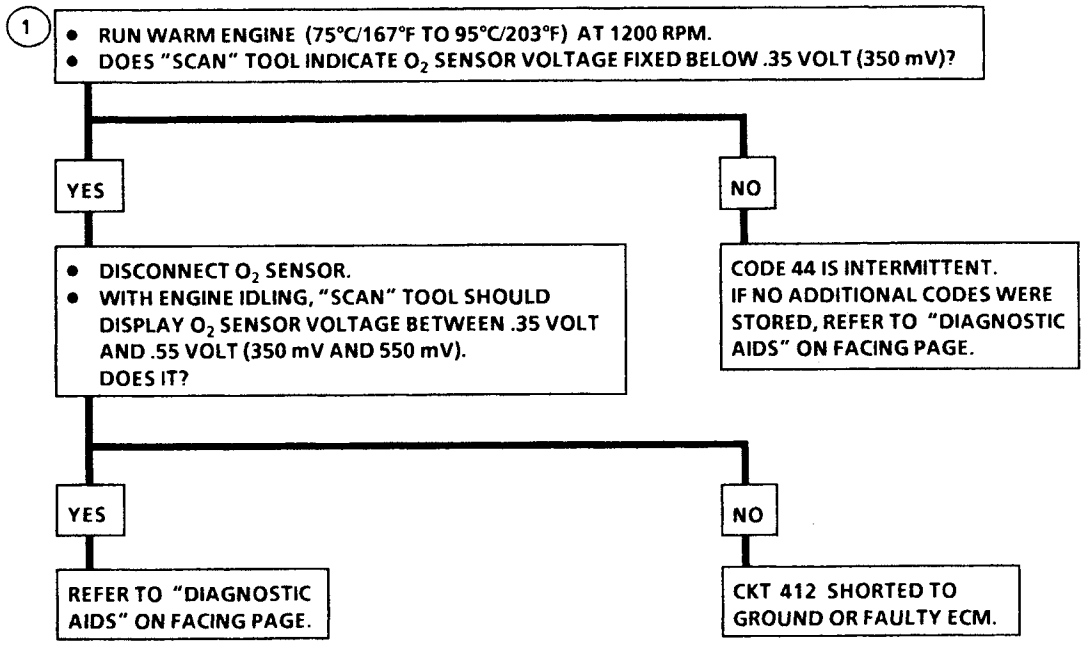
Diagnostic Aids:

Using the "Scan", observe the block learn values at different rpm and air flow conditions. If the conditions for Code 44 exists the block learn values will be around 150.

- O_2 Sensor Wire Sensor pigtail may be mispositioned and contacting the exhaust manifold.
- Check for intermittent ground in wire between connector and sensor.
- MAF Sensor A mass air flow (MAF) sensor output that causes the ECM to sense a lower than normal air flow will cause the system to go lean. Disconnect the MAF sensor and if the lean condition is gone, check for a Code 34.
- Lean Injector(s) Perform injector balance test, CHART C-2A.
- 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 (manual trans only)
  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 exhaust ports, refer to CHART C-6.
- If the above are OK, it is a faulty oxygen sensor.

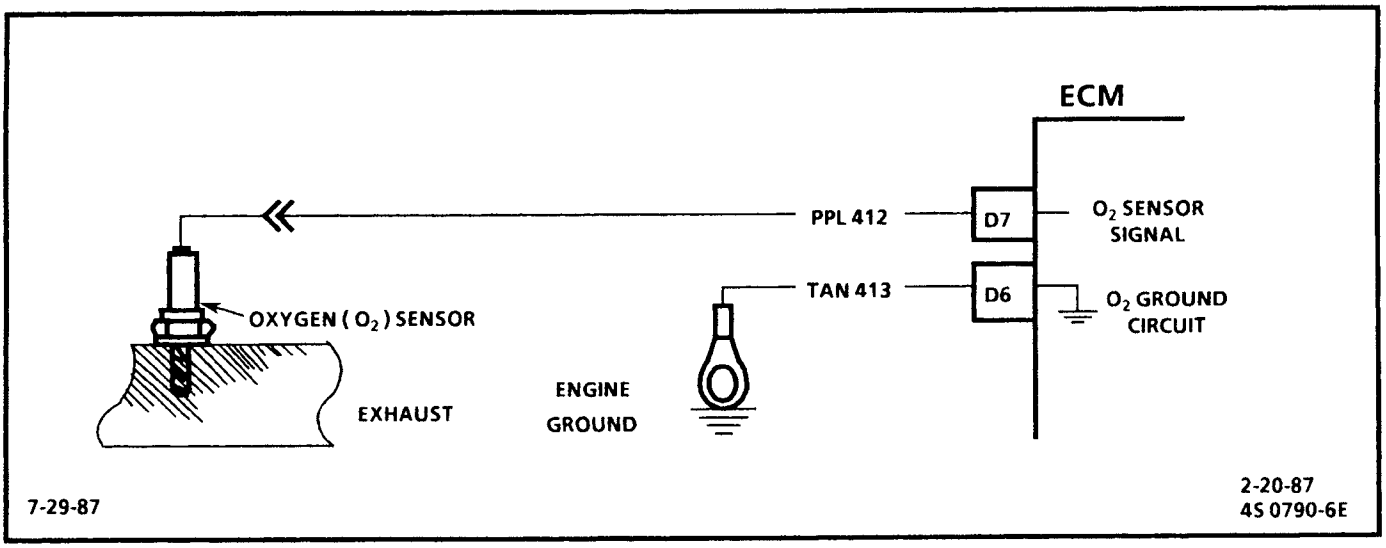
CODE 44

OXYGEN SENSOR CIRCUIT
(LEAN EXHAUST INDICATED)
2.8L (VIN S) "F" CARLINE (PORT)



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

5-3-88
• 7S 3191-6E



CODE 45

OXYGEN SENSOR CIRCUIT
(RICH EXHAUST INDICATED)
2.8L (VIN S) "F" CARLINE (PORT)

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 O_2 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 315°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 45 is set when the O_2 sensor signal voltage or CKT 412.
   - Remains above .7 volt for 30 seconds; and in "Closed Loop".
   - Engine time after start is 1 minute or more.
   - Throttle less than 1/2 open but not at idle.

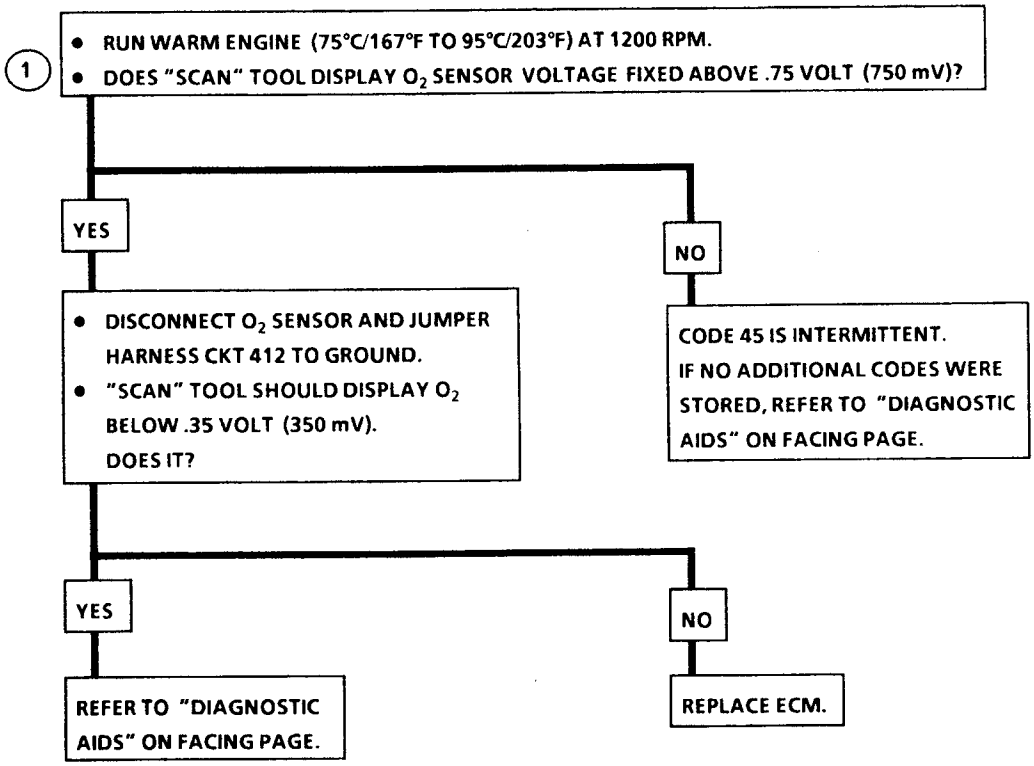
Diagnostic Aids:

Using the "Scan", observe the block learn values at different rpm and air flow conditions. 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.
- Rich Injector Perform injector balance test CHART C-2A.
- Leaking Injector See CHART A-7.
- Check for fuel contaminated oil.
- HEI Shielding An open ground CKT 453 (ignition system reflow) 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".
- MAF Sensor An output that causes the ECM to sense a higher than normal airflow can cause the system to go rich. Disconnecting the MAF sensor will allow the ECM to set a fixed value for the sensor. Substitute a different MAF sensor if the the rich condition is gone while the sensor is disconnected. Check for a Code 34.
- Check for leaking fuel pressure regulator diaphragm by checking vacuum line to regulator for fuel.
- TPS An intermittent TPS output will cause the system to go rich, due to a false indication of the engine accelerating.
- EGR An EGR staying open (especially at idle) will cause the O_2 sensor to indicate a rich exhaust.

CODE 45

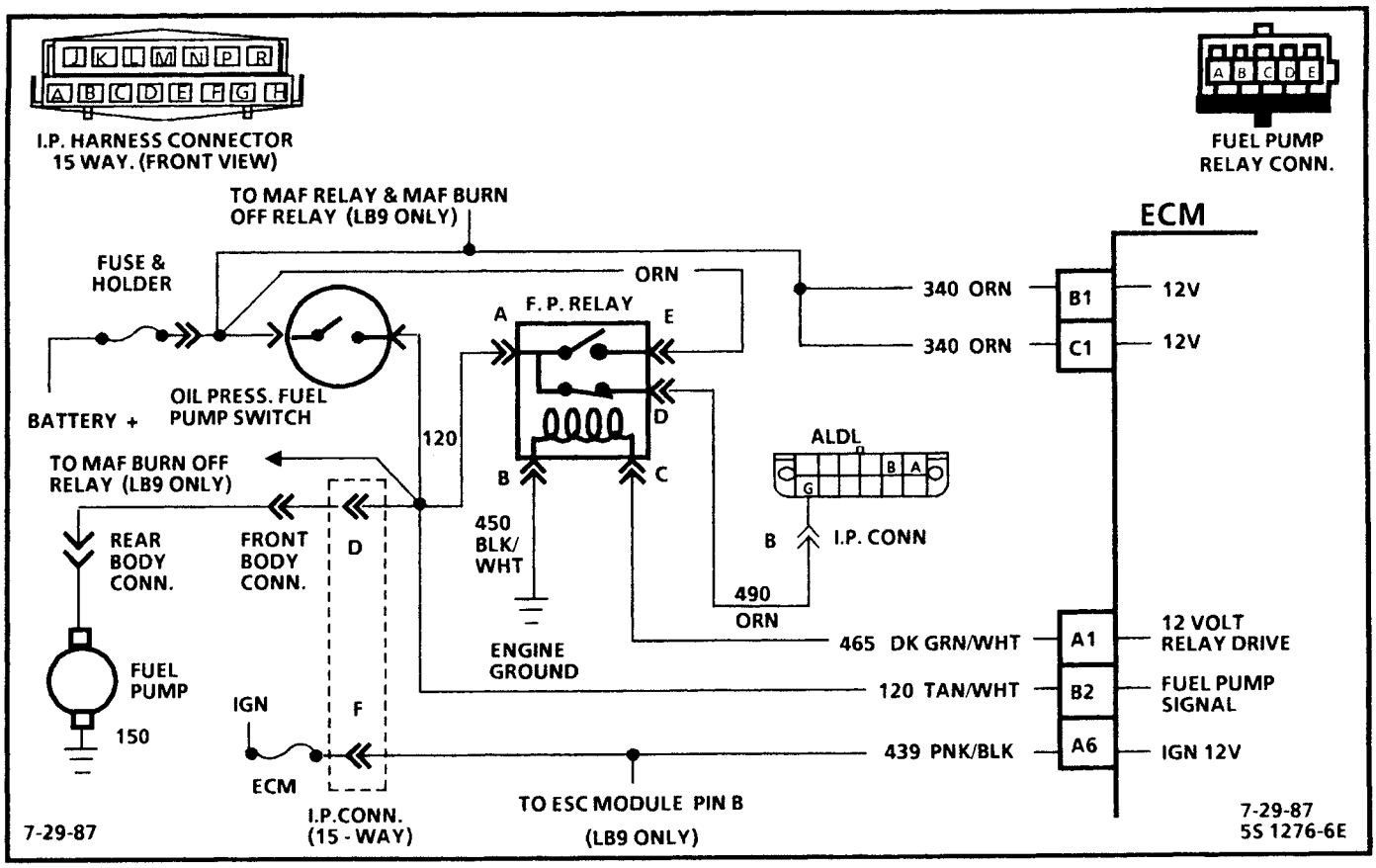
OXYGEN SENSOR CIRCUIT
(RICH EXHAUST INDICATED)
2.8L (VIN S) "F" CARLINE (PORT)



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

5-3-88

• 7S 3192-6E



CODE 54

FUEL PUMP CIRCUIT
(LOW VOLTAGE)
2.8L (VIN S) "F" CARLINE (PORT)

Circuit Description:

The status of the fuel pump CKT 120 is monitored by the ECM at terminal "B2", and is used to compensate fuel delivery based on system voltage. This signal is also used to store a trouble code if the fuel pump relay is defective or fuel pump voltage is lost while the engine is running. There should be about 12 volts on CKT 120 for 2 seconds after the ignition is turned or any time references pulses are being received by the ECM.

Diagnostic Aids:

Code 54 will set if the voltage at terminal "B2" is less than 2 volts for 1.5 seconds since the last reference pulse was received. This will help in detecting a faulty relay, causing extended crank time and the code will help the diagnosis of an engine that "CRANKS BUT WILL NOT RUN".

If a fault is detected during start-up the "Service Engine Soon" light will stay "ON" until the ignition is cycled off. However, if the voltage is detected below 2 volts with the engine running the light will only remain on while the condition exists.

CODE 54

FUEL PUMP CIRCUIT (LOW VOLTAGE)

2.8L (VIN S) "F" CARLINE (PORT)

- 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?

NO

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

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.

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"

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

LIGHT "OFF"

REPAIR OPEN CKT 450.

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

2-10-88
●7S 3155-6E

CODE 51
CODE 52
CODE 53
CODE 55
2.8L (VIN S) "F" CARLINE (PORT)

CODE 51

PROM ERROR
(FAULTY OR INCORRECT PROM)

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

CODE 53

SYSTEM OVER VOLTAGE

THIS CODE INDICATES THERE IS A BASIC GENERATOR PROBLEM.

- CODE 53 WILL SET IF VOLTAGE AT ECM TERMINAL "B2" IS GREATER THAN 17.1 VOLTS FOR 2 SECONDS.
- CHECK AND REPAIR CHARGING SYSTEM. SEE SECTION "6D".

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

CODE 55

ECM ERROR

BE SURE ECM GROUNDS ARE OK. IF OK
REPLACE ELECTRONIC CONTROL MODULE (ECM)

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