

# 1981 Computerized Engine Controls 1a-73

## GENERAL MOTORS COMPUTER COMMAND CONTROL

Buick  
Cadillac  
Chevrolet  
Oldsmobile  
Pontiac

The CCC system is primarily an emission control system. Primary objective of CCC system is to maintain an ideal air/fuel ratio of 14.7:1 under all operating conditions. When an ideal ratio is maintained, the catalytic converter can effectively control nitrogen oxides (NO<sub>x</sub>), hydrocarbons (HC) and carbon monoxide (CO).

### DESCRIPTION

The Computer Command Control (CCC) system is an electronically controlled system that monitors up to 15 engine/vehicle functions to control engine operation and lower exhaust emissions while maintaining good fuel economy and driveability. The Electronic Control Module (ECM) is the "brain" of the CCC system. The ECM can control as many as 9 engine-related systems to constantly adjust engine operation to maintain good vehicle performance under all normal driving conditions.

### OPERATION

The CCC system consists of 9 sub-systems: Fuel control, data sensors, Electronic Control Module (ECM), spark timing, Idle Speed Control (ISC), emission control, Torque Converter Clutch (TCC), diagnostic system and catalytic converter.

### FUEL CONTROL

All models are equipped with "feedback" carburetors which contain an electrically operated Mixture Control (M/C) solenoid. The M/C solenoid operates single or dual metering

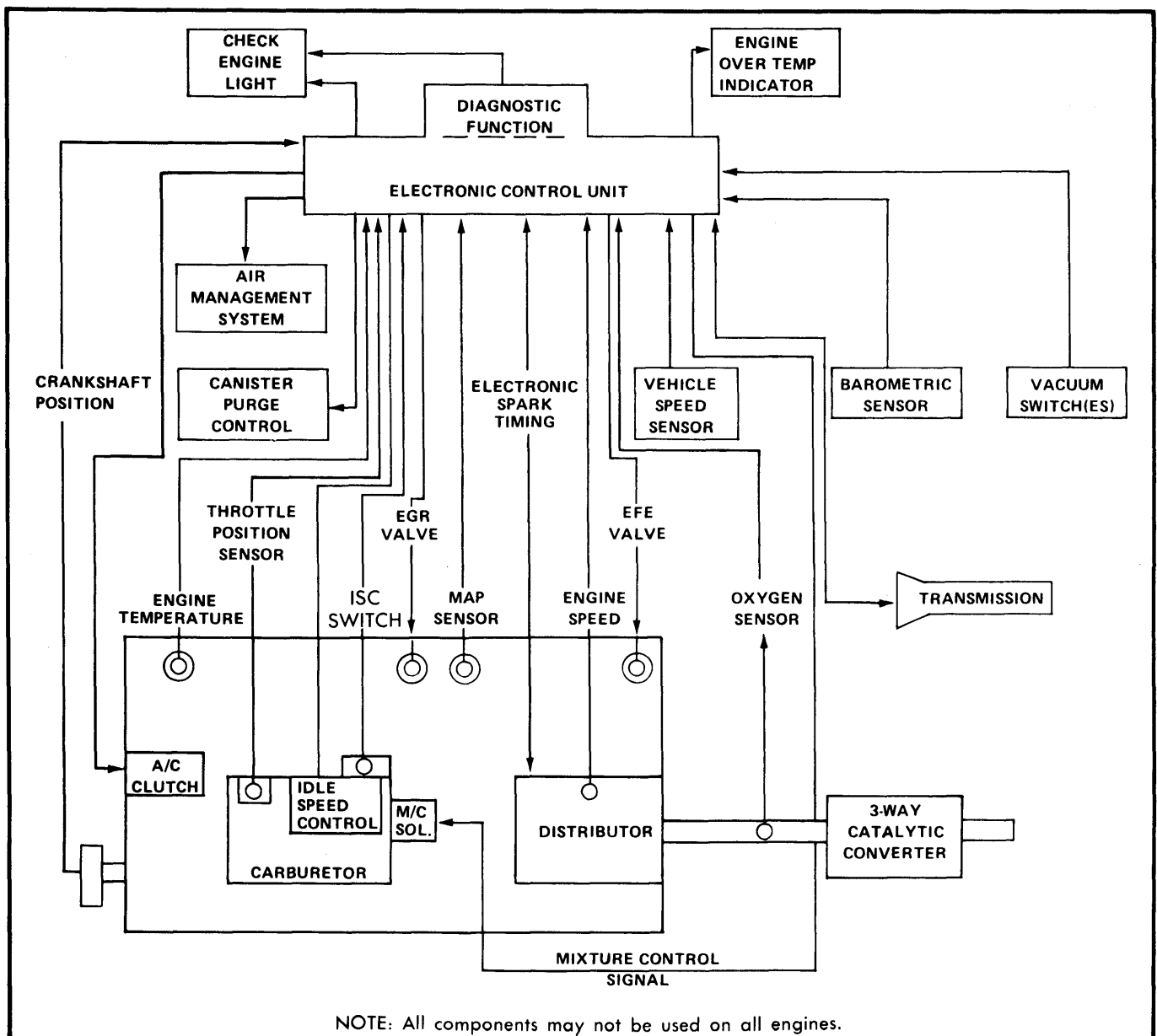
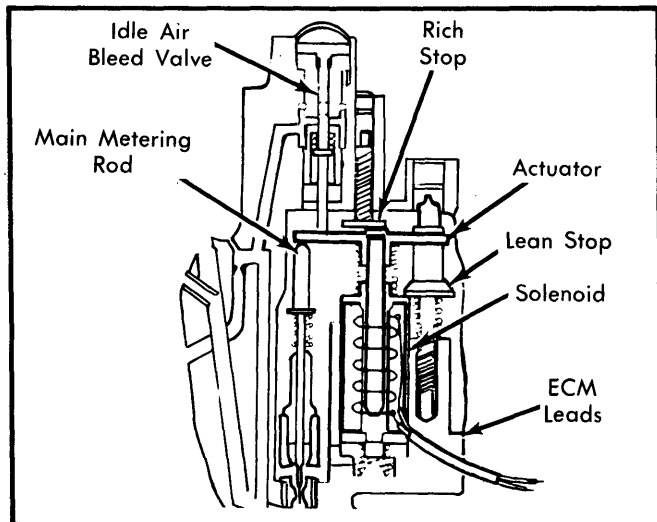


Fig. 1 Schematic of Computer Command Control System

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rods in float bowl. Metering rod(s) supplement fuel supplied to idle and main systems, varying air/fuel ratio within a pre-calibrated range. The M/C solenoid also controls air/fuel ratio through use of an idle air bleed circuit that operates in conjunction with metering rod(s).



**Fig. 2 Sectional View of Mixture Control Solenoid (Model E2ME and E4ME Carburetors Shown)**

The ECM, responding to inputs from data sensors, constantly adjusts air/fuel mixture to maintain engine performance. The ECM controls M/C solenoid by providing a ground for solenoid. When solenoid is energized, fuel flow through carburetor is reduced, providing a leaner mixture. When solenoid is de-energized, fuel flow through carburetor is increased, providing a richer mixture. The solenoid is cycled (turned on and off) at a rate of 10 times per second.

When ECM responds to signals received from oxygen sensor to adjust fuel mixture, the CCC system is in closed loop operation. Under certain operating conditions, the ECM may ignore inputs from various sensors and use a pre-programmed calibration control to operate the engine under that particular condition. During cold engine starts (engine speed below 200 RPM), M/C solenoid is turned off by ECM to provide rich mixture. Operating conditions which cause ECM to ignore oxygen sensor signals cause the CCC system to operate in open loop mode.

#### DATA SENSORS

Each sensor furnishes electronic impulses to ECM. The ECM computes spark timing and fuel mixture ratio necessary to maintain proper engine operation. The function of each sensor is closely related to each of the other sensors. Operation of each sensor is as follows:

**Oxygen Sensor** — This sensor is mounted in engine exhaust stream. It supplies a low voltage (under ½ volt) when fuel mixture is lean (too much oxygen) and a higher voltage (up to 1 volt) when fuel mixture is rich (not enough oxygen). Oxygen sensor must be hot (over 600°F) to function properly. The oxygen sensor measures quantity of oxygen only. On some models, oxygen sensor may cool off during idle, causing CCC system to go into open loop mode. Running the engine at fast idle will warm up oxygen sensor.

**NOTE** — No attempt should be made to measure oxygen sensor voltage output. Current drain of conventional voltmeter

could permanently damage sensor, shift sensor calibration range and/or render sensor unusable. Do not connect jumper wire, test leads or other electrical connectors to sensor. Use these devices only on ECM side of harness after disconnecting from sensor.

**Coolant Temperature Sensor (CTS)** — The CTS is located in the engine coolant stream to supply coolant temperature information to ECM. This information affects the following engine systems: Air/fuel ratio control (as engine coolant temperature varies with time during a cold start), switching functions for emission controls and torque converter clutch, spark timing, and engine temperature lamp operation.

**Manifold Absolute Pressure Sensor (MAP)** — This sensor is mounted in engine compartment or under instrument panel. It measures changes in manifold pressure (vacuum). The MAP sensor sends electrical signals to ECM, reflecting need for adjustment in air/fuel mixture and spark timing under various operating conditions.

**NOTE** — The MAP sensor is only used on 3.8L (VIN Code A) and 4.1L engines. Turbo engines (3.8L and 4.9L) use a special MAP sensor that detects altitude changes.

**Vacuum Sensor** — Vehicles not equipped with MAP sensors may be equipped with vacuum sensors which are located on right fender panel. Vacuum sensor performs same function as MAP sensor.

**NOTE** — The 3.8L (VIN Code K) engine does not use a MAP sensor or vacuum sensor.

**Barometric Pressure Sensor (BARO)** — This sensor is mounted on MAP sensor bracket. This sensor measures ambient or barometric pressures and signals ECM of pressure changes due to altitude and/or weather. This sensor is used only on engines equipped with MAP sensor.

**Throttle Position Sensor (TPS)** — This sensor is mounted inside carburetor and is operated by accelerator pump lever. The sensor, a variable resistor similar to fuel tank sending unit, signals ECM of change in throttle blade position from closed to wide open throttle.

**NOTE** — The throttle position sensor is not used on 2.5L engines.

**Vehicle Speed Sensor (VSS)** — This sensor is mounted behind the speedometer in instrument cluster. It provides a series of 8 volt pulses to ECM to indicate vehicle speed. The VSS is not used on all vehicles.

**High Gear Switch** — The high gear switch is mounted on 4-speed automatic transmission (Model 200-4R). This switch opens when transmission has shifted into high gear and closes under any other condition. High gear switch information is used for emission controls.

**Park/Neutral Switch (P/N Switch)** — This switch is connected to transmission gear selector. It is closed when selector is in "P" or "N" positions and open when selector is in gear. This switch is used for ISC on some vehicles.

**Air Conditioner "ON" Switch (A/C "ON")** — This switch is mounted in air conditioner compressor of some vehicles to signal ECM that air conditioner is operating. This switch supplies 12 volts when compressor is engaged and 0 volts when disengaged.

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### ELECTRONIC CONTROL MODULE (ECM)

The ECM is located in passenger compartment and controls all CCC system functions. The ECM consists of input/output devices, Central Processing Unit (CPU), power supply and memories. A brief description and operation of each component is as follows:

**Input/Output Devices** — These integral devices of ECM convert electrical signals received by data sensors and switches to digital signals for use by CPU.

**Central Processing Unit (CPU)** — Digital signals received by CPU are used to perform all mathematical computations and logic functions necessary to deliver proper air/fuel mixture. The CPU also calculates spark timing and idle speed information. The CPU commands operation of emission control, closed loop fuel control and diagnostic system.

**Power Supply** — Main source of power for the ECM is from the battery, through the No. 1 ignition circuit.

**Memories** — The 3 types of memories in the ECM are: Read Only Memory (ROM), Random Access Memory (RAM) and Programmable Read Only Memory (PROM). Function of each memory is as follows:

- **Read Only Memory (ROM)** — The ROM is programmed information that can only be read by ECM. The ROM program cannot be changed. If battery voltage is removed, ROM information will be retained.

- **Random Access Memory (RAM)** — This memory is the scratch pad for the CPU. Information can be read into or out of RAM memory; similar to a calculator. Data sensor information, diagnostic codes and results of calculations are temporarily stored in RAM memory. If battery voltage is removed, all information stored in this memory is lost.

- **Programmable Read Only Memory (PROM)** — This memory is factory-programmed information containing engine calibration data for each engine, transmission, body and rear axle ratio application. The PROM is easily removed from ECM. If battery voltage is removed, PROM information will be retained.

### SPARK TIMING

Spark timing is controlled by 1 of 3 different systems: Electronic Spark Timing (EST), Electronic Spark Timing with Electronic Spark Control (EST/ESC) and Electronic Module Retard (EMR). Operation and application of each system is as follows:

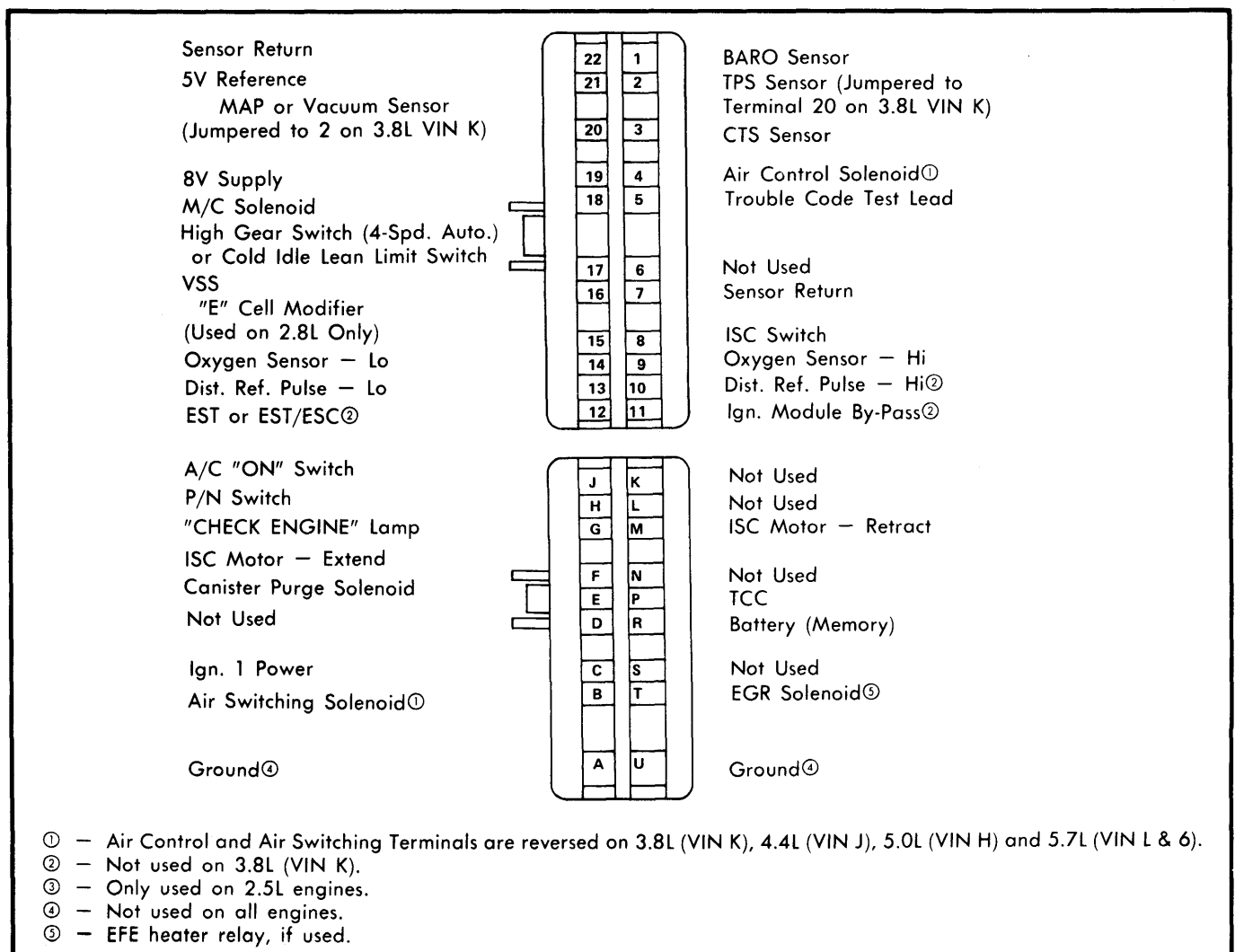


Fig. 3 Electronic Control Module Terminal Identification

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**Electronic Spark Timing (EST)** — The EST system consists of ECM and modified HEI distributor with 7 terminal HEI module. The EST distributor contains no vacuum or centrifugal advance. The HEI distributor communicates to ECM through a 4-terminal connector which contains 4 circuits: Distributor reference circuit, by-pass circuit, EST circuit and ground circuit.

Whenever pick-up coil signals HEI module to open primary circuit, it also sends spark timing signals to ECM through reference line. When voltage on HEI by-pass line is 0 volts (engine cranking), HEI module switches to by-pass circuit. In by-pass circuit, HEI module provides spark advance at base timing and disregards spark advance signal from ECM. When voltage on HEI by-pass circuit is 5 volts (engine running), HEI module accepts spark timing signal provided by ECM.

The ECM monitors engine speed through HEI reference line and engine operating conditions through data sensors and switches. From these parameters, ECM calculates proper spark advance and supplies signal to HEI distributor through EST line. The EST system is used on all engines except 3.8L (VIN Codes K and 3), 4.1L and 4.9L (VIN Codes W and T).

**Electronic Spark Timing With Electronic Spark Control (EST/ESC)** — This is a closed loop system that controls engine detonation by adjusting spark timing. This system consists of EST system, detonation sensor, modified electronic control module in HEI distributor and a controller.

The detonation sensor is mounted in engine block (behind intake manifold) and it detects presence (or absence) and intensity of detonation by vibration characteristics of engine. Sensor sends electrical signal to controller. If sensor fails, no retard will occur. The controller constantly processes sensor signal into command signal to distributor to adjust spark timing. Controller failure would cause either no ignition, no retard or full retard.

The distributor receives commands from controller, and spark firing is delayed while detonation is occurring, thus providing required retard. The amount of retard is a function of degree of detonation. The EST/ESC system is used on 3.8L (VIN Code 3), 4.1L and 4.9L (VIN CODES W and T) engines.

**Electronic Module Retard (EMR)** — This is a spark control system which uses an HEI module with a timing retard feature. When retard circuit is grounded, firing of spark plugs is delayed for a calibrated number of crankshaft degrees. The grounding circuit is controlled by ECM. When retard circuit is open, there is no delay and distributor fires spark plugs as controlled by engine speed and vacuum. The EMR system is only used on 3.8L (VIN Code K) engines.

**NOTE** — If EMR/HEI module is removed and/or replaced, ignition timing must be checked and set to specifications.

### IDLE SPEED CONTROL (ISC)

The ISC is an electrically driven actuator which changes throttle valve angle (in idle position), according to commands from ECM. The ISC maintains low idle speeds while preventing stalls due to engine load changes.

The ECM monitors engine load to determine proper idle speed. To prevent stalling, the ECM monitors A/C "ON" switch, Park-Neutral switch and ISC throttle switch. With this information, the ECM will control idle speed by operating the ISC motor.

When engine is cold, ECM holds throttle valve open for longer period of time to provide faster warm-up. This function is bypassed when throttle is opened enough to bring TPS off its idle circuit. The ISC is located on side of carburetor.

**NOTE** — Not all engines are equipped with ISC system. Some may use an Idle Speed Solenoid (ISS) or an Idle Load Compensator (ILC) to control engine idle speed without ECM commands.

### EMISSION CONTROL

The ECM electrically controls the following emission systems: AIR Management (AIR), Pulse AIR Injection (PAIR), Early Fuel Evaporation (EFE), Exhaust Gas Recirculation (EGR) and Evaporative Emission Control System (EECS). A brief description of each system follows:

**AIR Management System** — This system helps to reduce HC and CO content in exhaust gases and to quickly heat up catalytic converter and oxygen sensor during cold engine operation. This is accomplished by injecting air into exhaust port of each cylinder. The ECM energizes an air control solenoid which allows air to flow to air switching valve, directing air to exhaust ports. During warm engine (closed loop) operation, the ECM de-energizes air switching valve, directing air to dual-bed converter, which lowers HC and CO emissions.

If air control valve detects rapid increase in manifold vacuum (deceleration condition), or ECM detects any failure in CCC system, air is diverted to air cleaner or dumped to atmosphere.

**Pulse AIR Management (PAIR)** — This system is used on 1.6L engines and is controlled in same manner as AIR management system.

**NOTE** — Vehicles may use separate air switching and air control valves, integral control valves or an air diverter valve.

**Early Fuel Evaporation (EFE)** — The ECM controls EFE system by either of the following methods: Vacuum operated valve and actuator, or ceramic heater grid located underneath carburetor primary bore. The vacuum operated valve and actuator is opened by a control solenoid mounted on valve cover. This solenoid controls vacuum to EFE valve from an electrical signal supplied by ECM.

The ceramic heater grid system is part of carburetor insulator. When ignition is turned on and engine coolant temperature is low, voltage is applied to EFE relay through ECM, energizing EFE heater. When coolant temperature increases, ECM de-energizes EFE relay, which shuts off voltage to EFE heater. This system is used on 1.6L, 2.8L and 3.8L (VIN Code 3) engines.

**NOTE** — Some vehicles incorporate EFE control through EGR or AIR system.

**Exhaust Gas Recirculation (EGR)** — The ECM controls ported vacuum to EGR valve with an electrically operated solenoid valve. When engine is cold, solenoid is energized, blocking vacuum to EGR valve. When engine is warm, solenoid is de-energized and EGR operation is allowed.

**NOTE** — Vehicles may use an integral EFE/EGR valve, TCC/EGR valve or an EFE/EGR/Canister Purge Valve.

**Evaporative Emission Control System (EECS)** — This is canister purge control. The ECM controls vacuum to purge valve in charcoal canister through a solenoid valve. When engine is operating in open loop mode, solenoid valve is energized and blocks vacuum to purge valve. When engine is operating in closed loop mode above prescribed RPM, solenoid valve is de-energized and vacuum is applied to purge valve. This draws collected vapors into intake manifold.

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**NOTE** — Some vehicles control canister purge operation through an integral EFE/EGR/Canister Purge Valve.

### TORQUE CONVERTER CLUTCH (TCC)

The ECM controls a solenoid (mounted on automatic transmission) to allow torque converter to directly connect engine to transmission, providing direct drive. When vehicle speed is high enough, ECM energizes TCC solenoid and engine is mechanically coupled to transmission. When operating conditions indicate that transmission should operate as normal (during rapid acceleration or deceleration), solenoid is de-energized. The transmission also returns to normal automatic operation when brake pedal is depressed.

### DIAGNOSTIC SYSTEM

The ECM of the CCC system is equipped with a self-diagnostic system which detects system failures or abnormalities. When a malfunction occurs, ECM will light the amber "CHECK ENGINE" lamp located on instrument panel. When malfunction is detected and lamp is turned on, a corresponding trouble code is stored in ECM memory. Malfunctions are recorded as "hard failures" or "intermittent failures".

- "Hard failures" cause "CHECK ENGINE" lamp to glow and remain on until malfunction is repaired. If the "CHECK ENGINE" lamp comes on and remains on during vehicle operation, cause of malfunction MUST be determined.
- "Intermittent failures" cause lamp to flicker or go out after 10 seconds when fault goes away. However, the associated trouble code will be retained in ECM memory. "Intermittent failures" may be sensor related. If a sensor fails, ECM will use a substitute value in its calculations to continue engine operation. In this condition, service is not mandatory; but loss of driveability may be encountered. If the related fault does not recur within 50 ignition cycles, related trouble code will be erased from ECM memory.

As a bulb and system check, the "CHECK ENGINE" lamp will glow when ignition switch is turned on and engine is not running. When engine is started, the lamp should go out after 1-4 seconds. If not, a malfunction has been detected in CCC system.

**NOTE** — Trouble codes will be recorded at various operating times. Some codes require operation of that sensor or switch for 5 seconds; others require operation for 5 minutes.

### CATALYTIC CONVERTER

Proper emission control is accomplished with a special 3-way catalytic converter which converts all 3 major pollutants (HC, CO and NO<sub>x</sub>). The converter is a dual-bed converter. The "upstream" section of the converter contains a reducing/oxidizing bed to reduce NO<sub>x</sub> while at the same time oxidizing HC and CO. An air supply pipe from the AIR or PAIR system introduces an extra amount of air between the dual beds (during closed loop mode), so second bed can oxidize any remaining HC and CO with a high conversion efficiency to minimize overall emissions.

## DIAGNOSIS & TESTING

### CCC DIAGNOSIS

The ECM stores component failure information for CCC system under a related trouble code which can be recalled for diagnosis and repair. When recalled, these codes will be dis-

played by flashes of "CHECK ENGINE" lamp. Codes are displayed starting with lowest numbered code. Only codes in which a related malfunction has occurred will be displayed.

**NOTE** — Example of trouble codes is as follows: "FLASH", "FLASH", "FLASH", pause, "FLASH", "FLASH", "FLASH". First series of flashes indicates first digit of trouble code; second series of flashes indicates second digit of trouble code.

**Entering Diagnostic Mode** — 1) Turn ignition on (engine off). "CHECK ENGINE" lamp should glow. Locate Assembly Line Data Link (ALDL) connector attached to ECM wiring harness under instrument panel. Insert spade lug terminal across terminals "D" ("TEST" lead) and "E" (Ground). See Fig. 4.



**Fig. 4 Exploded View of ALDL Connector**

2) "CHECK ENGINE" lamp should flash code "12". Code "12" consists of "FLASH", pause, "FLASH", "FLASH" followed by a longer pause. Trouble code "12" will be repeated 2 more times, then if any trouble codes are stored in ECM memory, they will be displayed in same manner.

3) Trouble codes will be displayed from lowest to highest numbered code (3 times each) and be repeated as long as the "TEST" terminal of ALDL connector is grounded.

**CAUTION** — Inserting lug in terminals of ALDL connector grounds "TEST" terminal lead. Do not ground ALDL connector before ignition is turned on or engine is started.

### ECM TROUBLE CODE IDENTIFICATION

Code	Circuit Affected
12	No reference pulses to ECM.
13	Oxygen sensor circuit.
14	Shorted coolant sensor circuit.
15	Open coolant sensor circuit.
21	Throttle position sensor circuit.
23	Open or grounded M/C solenoid circuit.
24	Vehicle speed sensor circuit.
32	BARO sensor circuit low.
34	MAP or vacuum sensor circuit.
35	ISC switch circuit shorted.
42	EST by-pass circuit grounded.
44	Lean oxygen sensor indication.
44 & 55	At same time, faulty oxygen sensor circuit.
45	Rich oxygen sensor indication.
51	Faulty PROM or improper PROM installation.
52 & 53	Faulty ECM.
54	Shorted M/C solenoid or faulty ECM.
55	Grounded +8 volts, voltage reference, faulty oxygen sensor or ECM.

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**Clearing Trouble Codes** — To clear memory of trouble codes, turn ignition on and ground "TEST" lead at ALDL connector. Turn ignition off and remove ECM fuse from fuse block for 10 seconds. Remove "TEST" lead ground.

**Exiting Diagnostic Mode** — To exit diagnostic mode, turn ignition off and remove spade lug terminal from ALDL connector.

**NOTE** — The terms "enter diagnostics" and "exit diagnostics" will be used periodically throughout this section. Follow the procedure for entering diagnostic mode when instructed to "enter diagnostics". Follow the procedure for exiting diagnostic mode when instructed to "exit diagnostics".

## FAILURE CODE DETERMINATION

During any diagnostic procedure, "hard failure" codes MUST be distinguished from "intermittent failure" codes. Diagnostic charts CANNOT be used to analyze "intermittent failure" codes, except as noted under Diagnostic Procedure. To determine "hard failure" codes and "intermittent failure" codes, proceed as follows:

1) Turn ignition on and enter diagnostics. Read and record all stored trouble codes. Exit diagnostics and clear trouble codes.

2) Apply parking brake and place transmission in neutral (manual) or park (automatic). Block drive wheels. Start engine. "CHECK ENGINE" lamp should go out. Run warm engine at specified curb idle for 2 minutes and note "CHECK ENGINE" light.

**NOTE** — Grounding "TEST" terminal with engine running will force engine to operate in closed loop mode if engine is warm and oxygen sensor is hot. If "CHECK ENGINE" lamp does not glow while in closed loop, CCC system is operating properly.

3) If "CHECK ENGINE" lamp comes on, enter diagnostics, read and record trouble codes. This will reveal "hard failure" codes. Codes "13", "15", "24", "44", "45" and "55" may require road test to reset "hard failure" after trouble codes were cleared.

4) If "CHECK ENGINE" lamp does not come on, all stored trouble codes were "intermittent failures", except as noted under Diagnostic Procedure.

**NOTE** — Trouble code "15" malfunction will only display after 5 minutes of engine operation. Trouble code "12" will display only during time of no reference pulses received by ECM; it will never be stored as a malfunction.

## DIAGNOSTIC PROCEDURE

**NOTE** — If vehicle exhibits performance problems and no codes are set, refer to System Performance Chart. Components recorded by trouble codes generally do not cause performance problems when no codes are stored in ECM memory.

The CCC system should be considered as a possible source of trouble on engine performance, fuel economy and exhaust emission complaints ONLY after normal checks (which apply to a vehicle without CCC) have been performed. Diagnosis of CCC system consists of 3 types of check sheets: Diagnostic Circuit Check, Driver Complaint and System Performance Check. Any of these check sheets may lead to a chart for locating source of problem or indicate no problem on that sheet and

refer to another sheet. If there is no trouble in CCC system, all 3 check sheets will result in that conclusion. The check sheets and their procedures are as follows:

**Diagnostic Circuit Check** — 1) If complaint is "CHECK ENGINE" lamp related, this check will lead to most likely problem area, if malfunction exists. Enter diagnostics and record stored trouble codes. Begin diagnosis with lowest numbered code which is displayed and refer to appropriate trouble code chart.

2) If code "51" is displayed, refer to PROM removal and installation in this article for diagnosis of this code.

3) If code "52" or "53" is displayed, check PROM installation before replacing ECM. Refer to ECM removal and installation.

4) If codes "54" or "55" are displayed with another code, always refer to diagnostic chart for code "54" or "55" first, then proceed to next lowest numbered code.

**NOTE** — Any time codes "51", "52", "53", "54" or "55" are displayed with another code, start with "50-series" code first, then proceed to next lowest numbered code.

5) If codes "14" and "21" or "15" and "21" are displayed, start with code "21" first, then proceed to code "14" or "15".

6) On 2.5L engines only, if codes "13" and "34" are displayed, start with code "34" first, then proceed to code "13".

7) If "intermittent failure" codes "13", "15", "24", "44", "45" or "55" are displayed, use diagnostic chart for corresponding "hard failure" code.

**Driver Complaint Sheet** — 1) If complaint is not "CHECK ENGINE" lamp related, this check will lead to most likely problem area, if malfunction exists. Make checks that would normally be made for the complaint on a vehicle without CCC system.

2) Follow diagnostic chart and repair malfunction. After repair, perform System Performance Check.

**System Performance Check** — 1) This check verifies that CCC system is functioning correctly. This check should always be made after any repair on CCC system.

2) When performing this check, always engage parking brake and block DRIVE wheels. Parking brake on front-wheel drive models does not hold drive wheels. On engines equipped with Varajet carburetors (E2SE Model), remove bowl vent line at carburetor and plug hose at carburetor during check and reconnect it after the check is complete.

3) On some engines, the oxygen sensor will cool off after only a short period of time while engine is idling. This will cause engine to go into open loop. To restore closed loop mode, run engine at part throttle several minutes and accelerate from idle to part throttle several times.

**NOTE** — Although there are many charts connected with CCC diagnosis, only 2 charts are needed to prove the system is operating properly. Normally, only 3 charts are necessary to find a problem, if one exists.

## GENERAL MOTORS COMPUTER COMMAND CONTROL (Cont.)

**Diagnostic Tools** — 1) The CCC system does not require special tools for diagnosis. A dwell meter, tachometer, test light, ohmmeter, digital voltmeter with 10 megohms impedance (minimum), vacuum pump, vacuum gauge and 6 jumper wires 6" long (1 wire with female connectors at both ends; 1 wire with male connectors at both ends; 4 wires with male and female connectors at opposite ends) are only tools necessary for diagnosis.

**NOTE** — If dwell meter causes a change in engine operation when connected to M/C solenoid "DWELL" lead (green connector near carburetor), it CANNOT be used. The following tach/dwell models should not be used: G, GA, TDT 1, 2 or 5, 216 and 216/1.

2) A test light, rather than a voltmeter, must be used when indicated by diagnostic chart.

**Connecting Dwell Meter** — 1) A dwell meter set on "6-cylinder" scale for all engines is used to measure ECM output

and M/C dwell (duty cycle). A green connector located in wiring harness near carburetor is the dwell meter connection point.

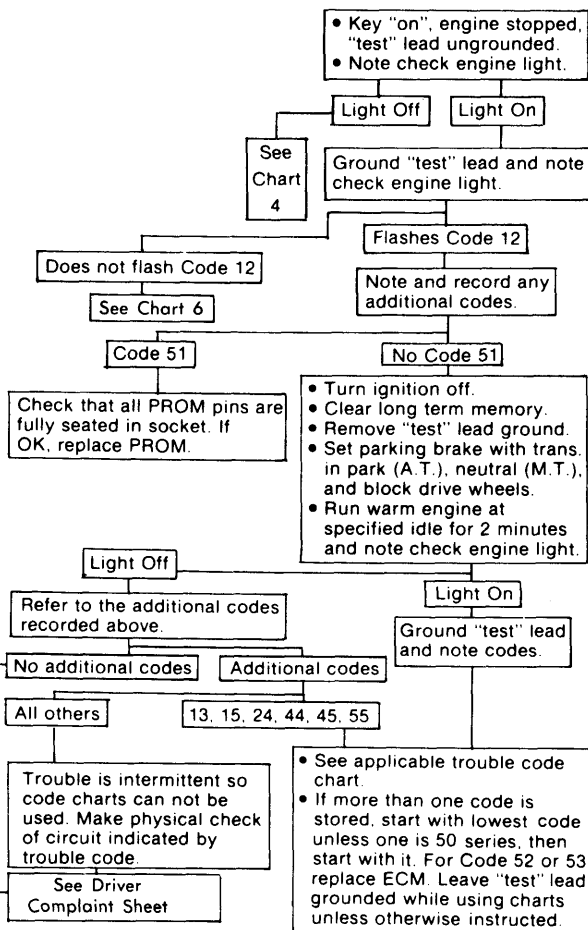
2) When dwell meter is connected, do not allow terminal to touch any ground source, including hoses. This could damage ECM. On a normal operating engine, dwell at both idle and part throttle should read between 10-50° and will be varying. "Varying" means needle will continually move up and down the scale. The amount of variation does not matter, only fact that it does move.

3) This variation of needle indicates system is in closed loop and ECM is responding to signals from oxygen sensor. At wide open throttle or cold engine operation, dwell will be fixed (needle steady). This indicates open loop and that ECM is ignoring oxygen sensor signals.

4) If there is doubt whether engine is in closed loop or open loop, richen or lean mixture (choke carburetor or cause air leak). This action will cause dwell to change if engine is in closed loop.

### DIAGNOSTIC CIRCUIT CHECK

Always check PROM for correct application before replacing ECM.



The system performance check should be performed after any repairs to the CCC system have been made.

### DRIVER COMPLAINT SHEET

**Engine performance problem (odor, surge, fuel economy...)**

**Emission problem**

If the "check engine" light is not on, normal checks that would be performed on cars without CCC should be done first.

If generator or coolant light is on with the check engine light, they should be diagnosed first.

Inspect for poor connections at coolant sensor, M/C solenoid, etc., and poor or loose vacuum hoses and connections. Repair as necessary.

- Intermittent check engine light but no trouble code stored —
  - Check for intermittent connection in circuit from:
    - Distributor module terminal R to ECM terminal 10.
    - Battery to ECM terminals C and R.
    - ECM terminal U to engine ground.
  - Loss of long terminal memory
    - Grounding dwell lead for 10 seconds with "test" lead ungrounded should give code 23. It should be retained after engine is stopped and ignition turned to run position. If it is not, ECM is defective.
- Stalling, Rough Idle or Improper Idle Speed — See idle speed control.
- Poor Performance and/or Fuel Economy — See EST diagnosis.
- Poor Full Throttle Performance — See Chart 5 (if equipped with TPS)
- All Other Complaints — Make system performance check on warm engine (upper radiator hose hot)

The system performance check should be performed after any repairs to the CCC system have been made.

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### SYSTEM PERFORMANCE CHECK

1. Start engine.
2. Ground trouble code "test" lead. (Must not be grounded before engine is started.)
3. Disconnect purge hose from cannister and plug it. On Varajet carburetors, disconnect bowl vent at carburetor and plug the hose to the cannister.
4. Connect tachometer (distributor side of tach. filter if used.)
5. Disconnect mixture control (M/C) solenoid and ground M/C solenoid dwell lead.
6. Run engine at 3,000 RPM and while keeping throttle constant, reconnect M/C solenoid and note RPM. If car is equipped with an electric cooling fan, it may lower RPM when it engages.
7. Remove ground from dwell lead before returning to idle.

Less than 100 RPM drop

More than 100 RPM drop

Check that pink wire is attached to right hand terminal of M/C solenoid connector (viewed from harness end). If OK, check carburetor.

- Connect dwell (duty cycle) meter to M/C sol. dwell lead (6-cyl. scale).
- Set carb. on high step of fast idle cam. and run for one minute or until dwell starts to vary, whichever happens first.
- Return engine to idle and note dwell (duty cycle).\*

Fixed under 10° (16%)

Fixed 10-50° (16-83%)

Fixed over 50° (83%)

Varying

See Chart 1

See Chart 2

See Chart 3

Check dwell (duty cycle) at 3,000 RPM (on 2.8L V-6 with AT disconnect and plug hose to vacuum sensor during check).

Between 10-50° (16-83%)

Not between 10-50° (16-83%)

Check air management system.

Check carburetor. Adjust TPS, if necessary.

- No trouble found in CCC System
- Clear long term memory.

\*Oxygen sensors may cool off at idle and the dwell (duty cycle) change from varying to fixed. If this happens running the engine at fast idle will warm it up again.

### CHART NO. 1 DWELL FIXED UNDER 10°

With engine idling, choke engine.

Dwell (duty cycle) increased

No dwell (duty cycle) change

- Check for air leak (including air management system).
- Check for exhaust leak ahead of oxygen sensor.
- Vacuum hose routing

- Disconnect oxygen sensor.
- Connect a digital voltmeter with 10 megohms input impedance, set on the 20 volt scale, from bat + to purple wire to ECM (not oxygen sensor).\*
- Note dwell (duty cycle)

No leak

Leak

Service or repair carburetor.

Repair

Increases

Under 10° (16%)

Check for open tan wire to ECM term. 14. If not open, replace oxygen sensor.

Check for an open or grounded purple wire to ECM term. "9". If not open or grounded, replace ECM.

\*Do Not use an ordinary voltmeter or jumper in place of the digital voltmeter because they have too little resistance. A voltage source of 1.0V to 1.7V (such as a flashlight battery) can be connected with the Pos. term. to the purple wire and the neg. term. to ground instead of using the digital voltmeter as a jumper. If the polarity is reversed, it won't work.

### CHART NO. 2 DWELL FIXED BETWEEN 10-50°

(Open Coolant or Oxygen sensor circuit)

Check for sticking TPS plunger and adjustment and low coolant.

- Run engine at part throttle for one minute
- With engine idling, note dwell (duty cycle), remove connector from Coolant Sensor, and jumper connector terms

Changes over 5° (8%) from what it was with sensor connected

No change

It is Coolant Sensor Connection or sensor.

- Reconnect Coolant Sensor
- Disconnect Oxygen Sensor and jumper connector terms on leads to ECM (not sensor) Leave jumpered for rest of checks

Under 10° (16%)

No change

It is faulty Oxygen sensor connections or sensor.

Connect jumper between terminals 9 and 14 at ECM.

Under 10° (16%)

No change

Repair open in wires to oxygen sensor

Jumper terminals 3 and 7 at ECM

Changes over 5° (16%)

No change

Repair open in wires to coolant sensor. Reconnect oxygen sensor.

It is faulty connection to ECM terms. 3, 7, 9, or 14 or faulty ECM. Reconnect oxygen sensor

### CHART NO. 3 DWELL FIXED OVER 50°

Run engine at fast idle, then with engine idling, remove large vacuum hose such as PCV source to cause air leak to engine. (But not enough to stall the engine.)

Dwell (duty cycle) changes

No dwell (duty cycle) change

Service or repair carburetor

- Disconnect oxygen sensor.
- Jumper connector, terminals on leads to ECM (not oxygen sensor).

Dwell (duty cycle) drops to under 10° (16%)

No dwell (duty cycle) change

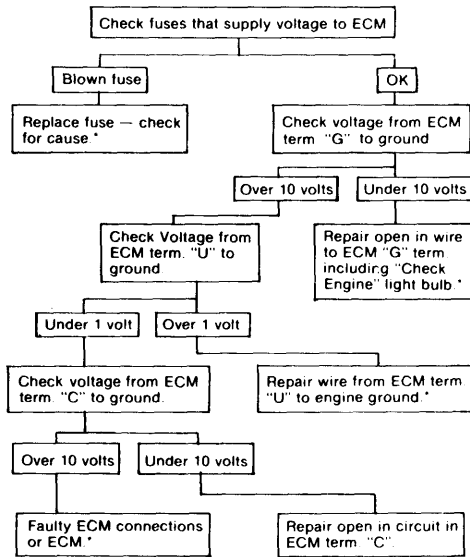
Replace oxygen sensor

Replace ECM.

## GENERAL MOTORS COMPUTER COMMAND CONTROL (Cont.)

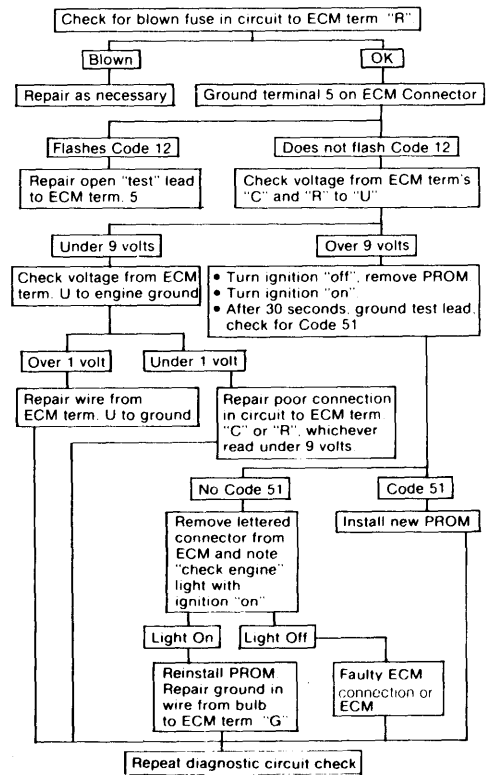
### CHART NO. 4 "CHECK ENGINE" LAMP INOPERATIVE

NOTE: Light will not come on steady if "test" lead is grounded and then the ignition is turned on, the solenoid will click and Code 12 will flash.



\*Continue diagnostic circuit check after repair

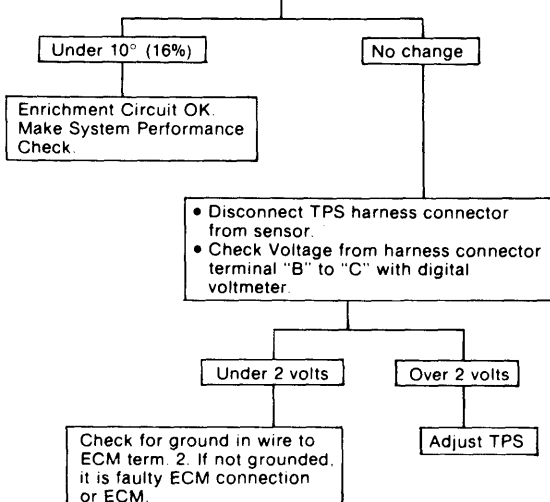
### CHART NO. 6 WON'T FLASH CODE 12



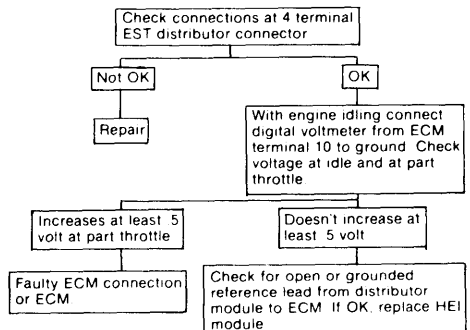
### CHART NO. 5 TPS SWITCH CIRCUIT CHECK

Except for 2.8L V6 with manual transmission. It uses vacuum sensor for enrichment.

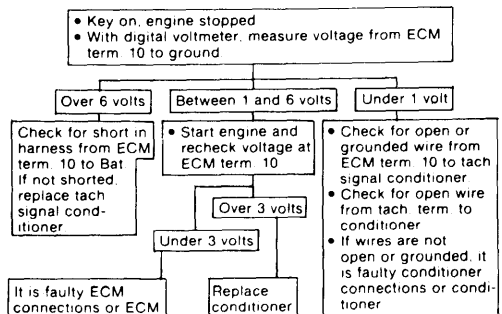
- Ground "test" lead with ignition "on", engine running, at part throttle.
- Connect dwell (duty cycle) meter to M/C solenoid (use 6 cycle scale).
- Depress TPS plunger completely and not dwell (duty cycle).



### TROUBLE CODE 12 ALL EXCEPT 3.8L VIN CODE K



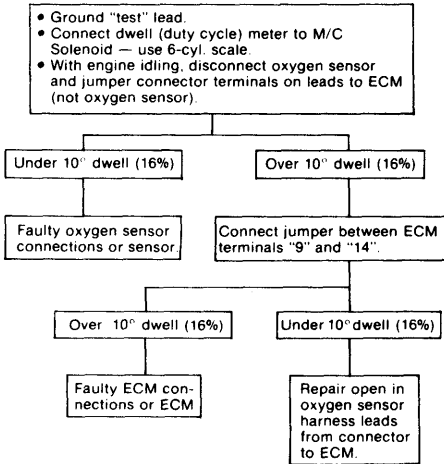
### TROUBLE CODE 12 3.8L VIN CODE K



## GENERAL MOTORS COMPUTER COMMAND CONTROL (Cont.)

### TROUBLE CODE 13

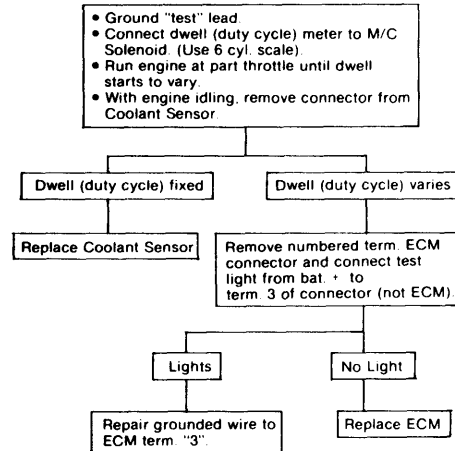
Check for sticking throttle position sensor.  
On 2.5L, if code 34 is also present, go to Chart 34 first.



### TROUBLE CODE 14

If 14 and 21 are displayed, go to Chart 21 first

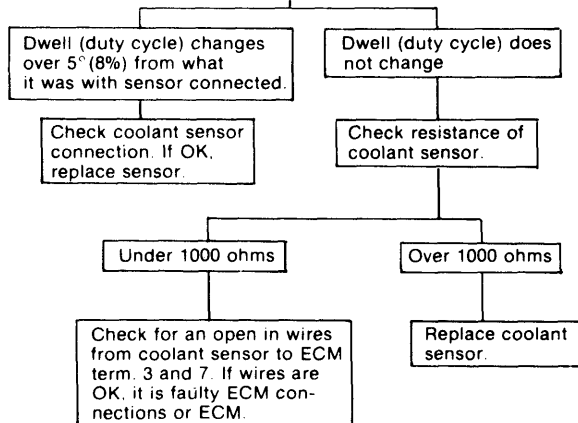
If the engine hot light is "on", check for overheating condition before making following test.



### TROUBLE CODE 15

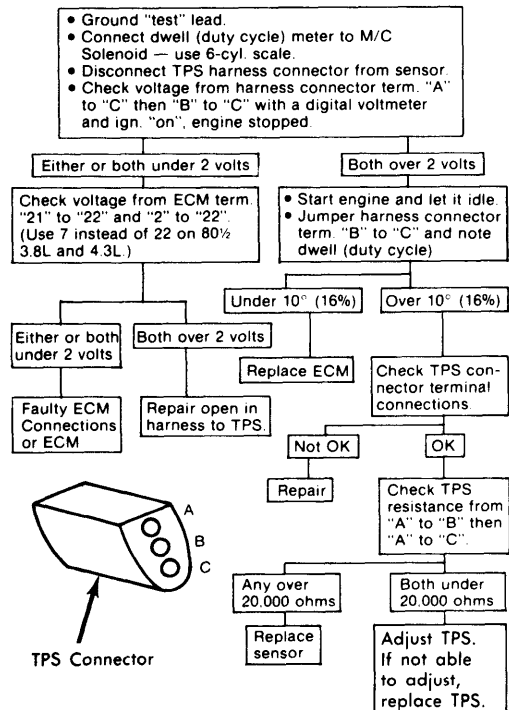
If 15 and 21 are displayed, go to Chart 21 first.

- Ground "test" lead.
- Connect dwell (duty cycle) meter to M/C Solenoid — use 6-cyl. scale.
- Run at part throttle for one minute.
- With engine idling, note dwell (duty cycle), remove connector from coolant sensor and jumper connector term.

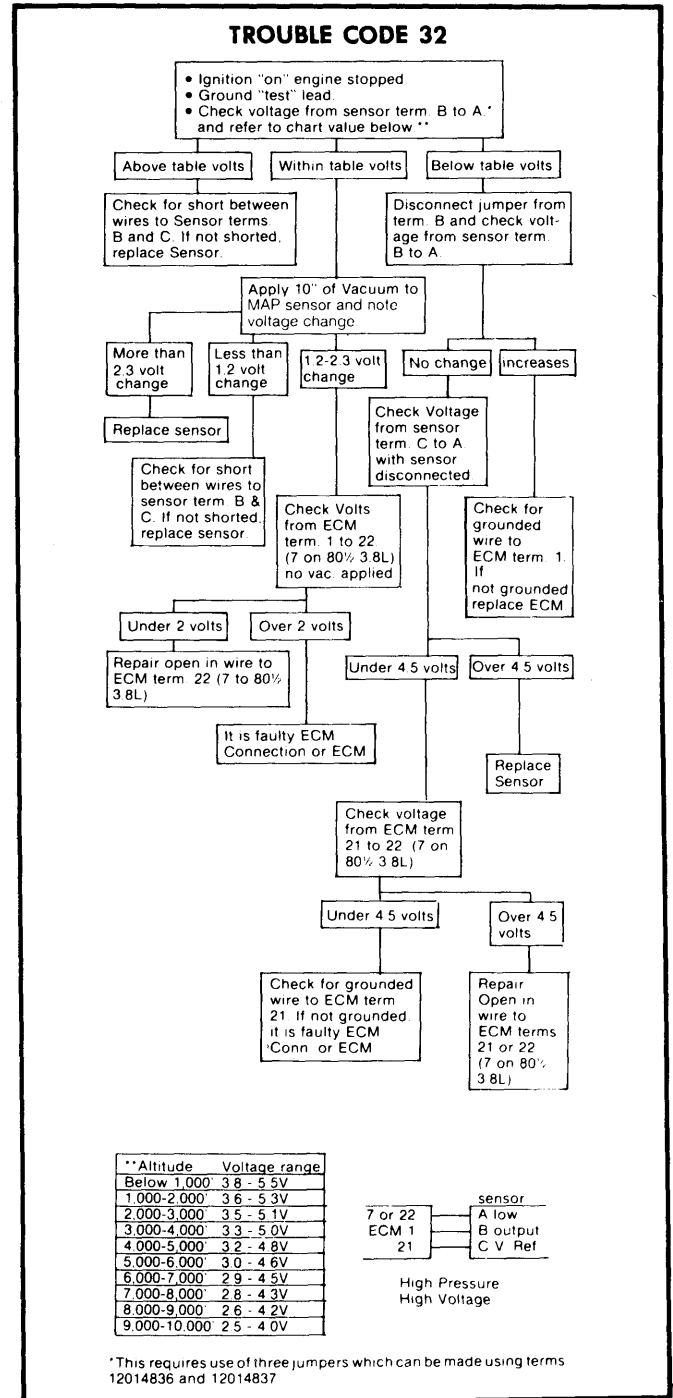
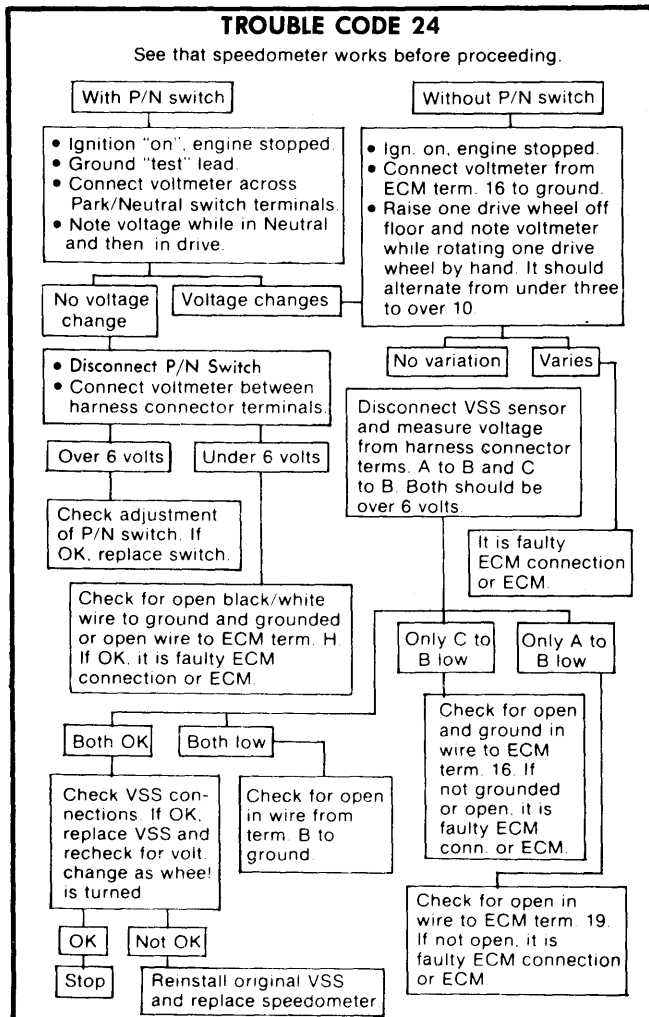
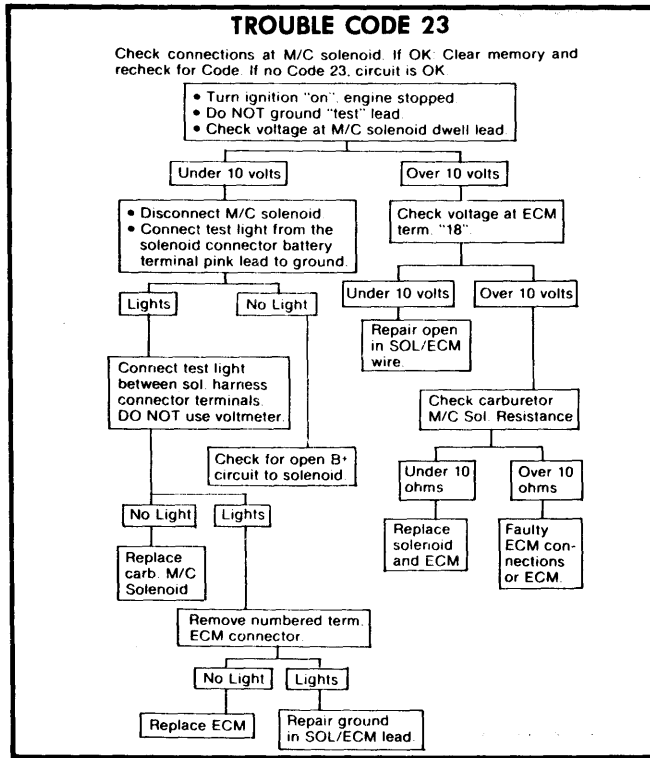


### TROUBLE CODE 21

Check for stuck or misadjusted TPS Plunger—Repair as necessary. If OK, proceed:



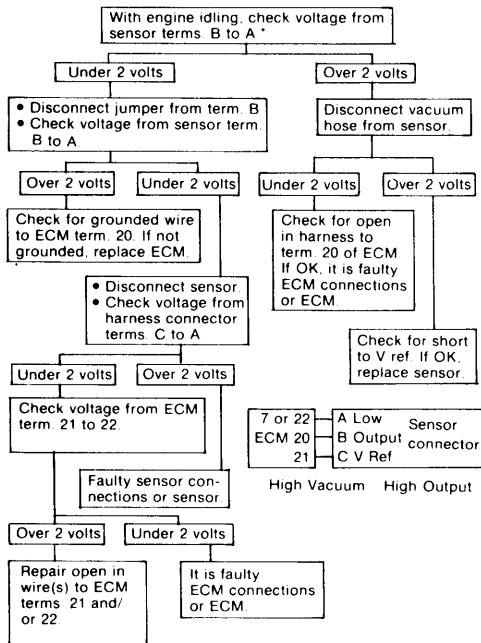
## GENERAL MOTORS COMPUTER COMMAND CONTROL (Cont.)



## GENERAL MOTORS COMPUTER COMMAND CONTROL (Cont.)

### TROUBLE CODE 34 VACUUM SENSOR CIRCUIT

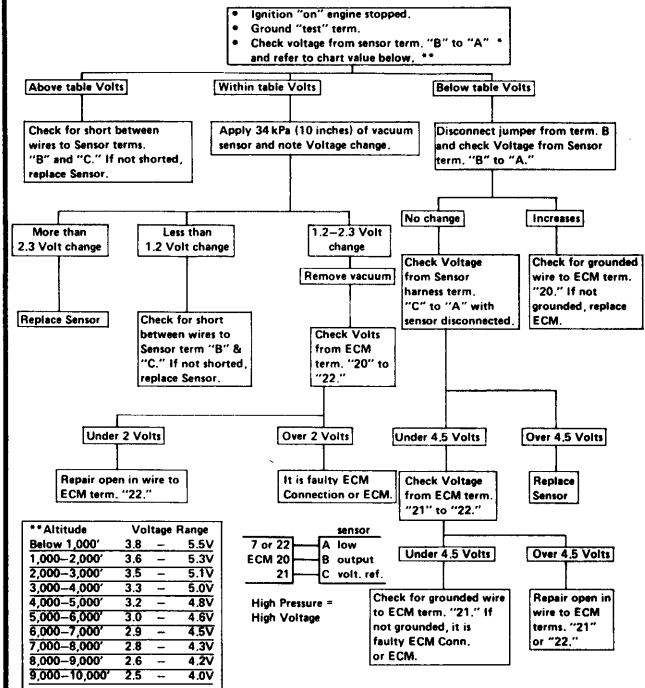
Check for over 10" of vacuum at sensor with engine idling. If not OK, repair.



\*This requires use of three jumpers between the sensor and the connector. They can be made using terminals 12014836 and 12014837.

### TROUBLE CODE 34 MAP SENSOR (NON-TURBO MODELS)

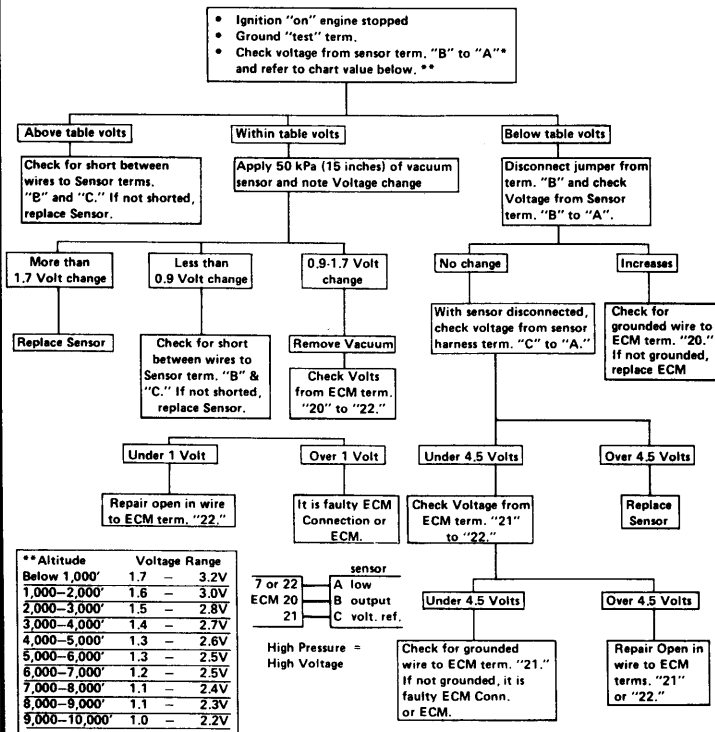
Check for over 34 kPa (10 inches) vacuum at MAP sensor with engine idling. If not OK, repair hoses or connections.



\*This requires use of three jumpers which can be made using terms, part numbers 12014836 and 12014837.

### TROUBLE CODE 34 MAP SENSOR (TURBO MODELS)

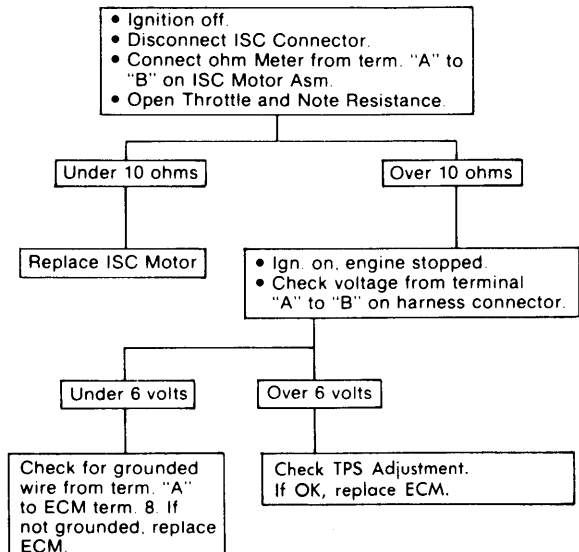
Check for over 34 kPa (10 inches) vacuum at MAP sensor with engine idling. If not OK, repair hoses or connections.



\*This requires use of three jumpers which can be made using terms, part number 12014836 and 12014837.

### TROUBLE CODE 35

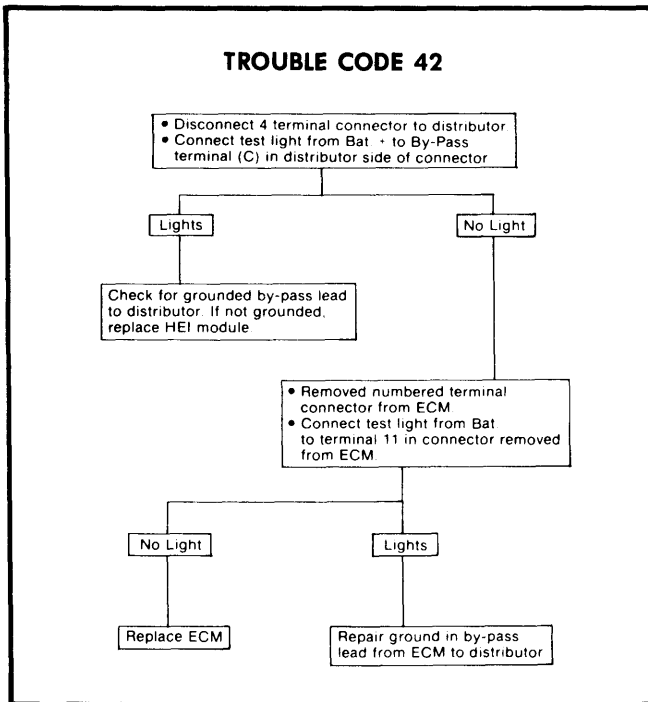
Check for sticking TPS Plunger — repair as necessary — on 4 cylinder check for leak in hose to vacuum sensor.



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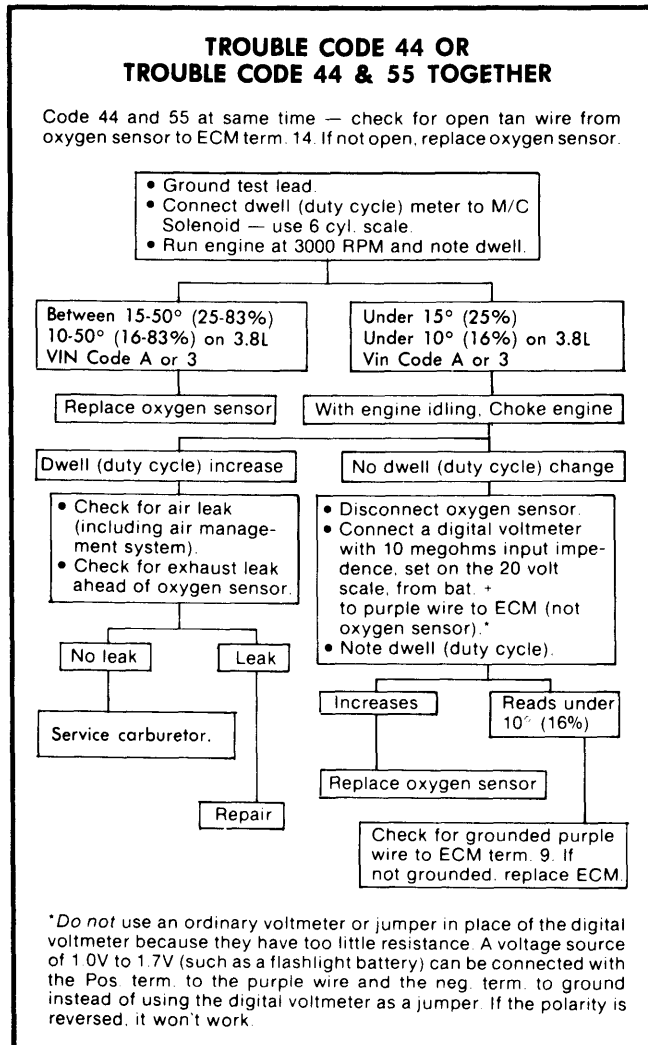
## GENERAL MOTORS COMPUTER COMMAND CONTROL (Cont.)

### TRUBLE CODE 42



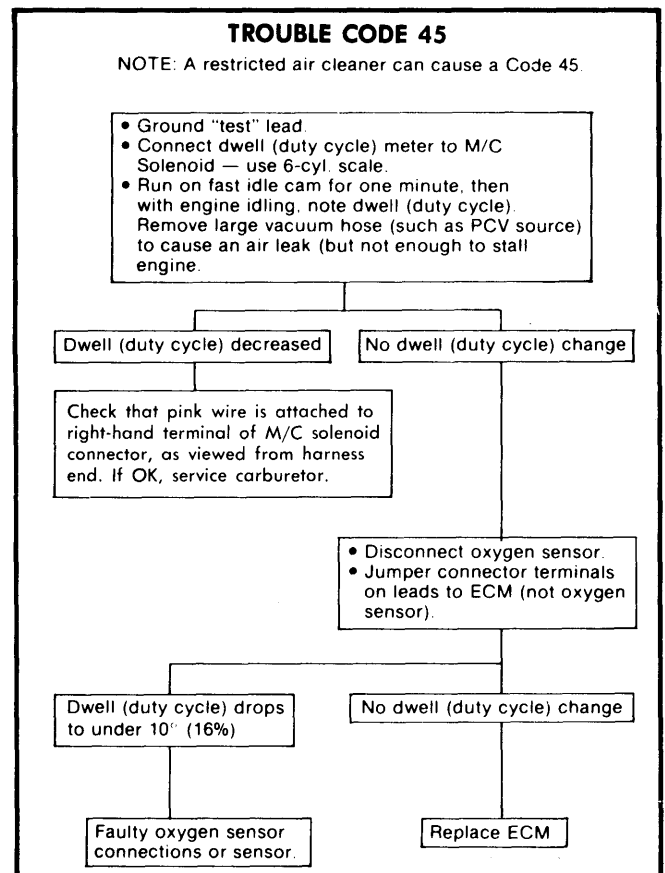
### TRUBLE CODE 44 OR TRUBLE CODE 44 & 55 TOGETHER

Code 44 and 55 at same time — check for open tan wire from oxygen sensor to ECM term. 14. If not open, replace oxygen sensor.



### TRUBLE CODE 45

NOTE: A restricted air cleaner can cause a Code 45.



### TRUBLE CODES 51-54

#### CODE 51

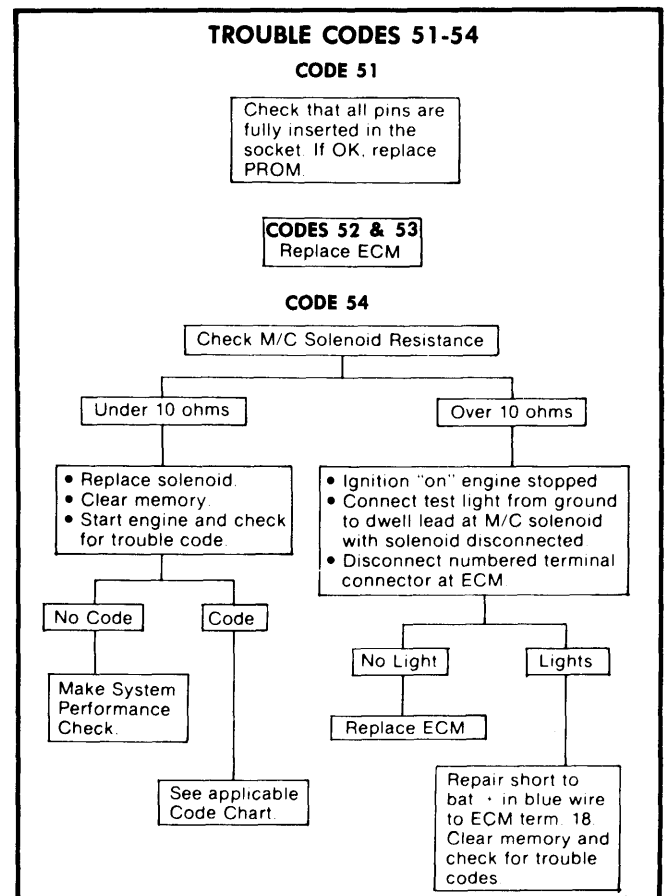
Check that all pins are fully inserted in the socket. If OK, replace PROM.

#### CODES 52 & 53

Replace ECM

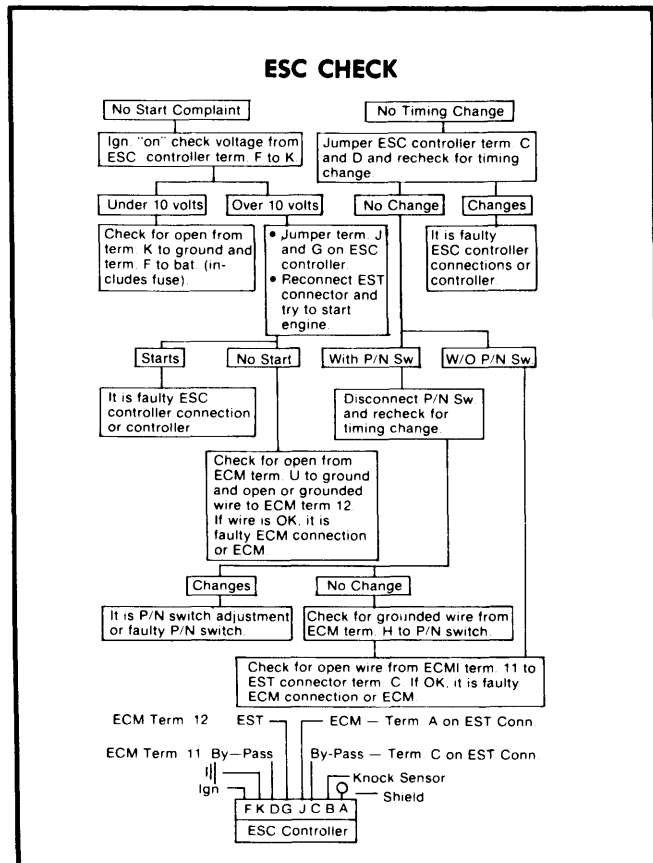
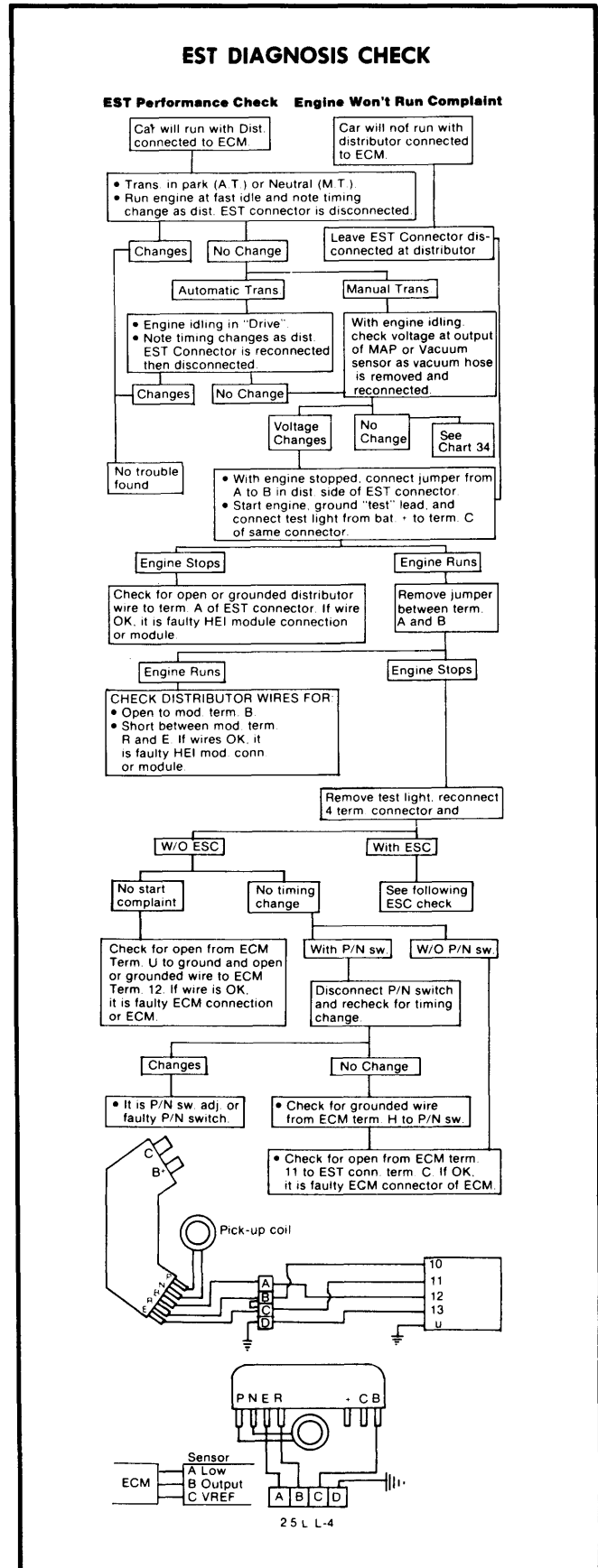
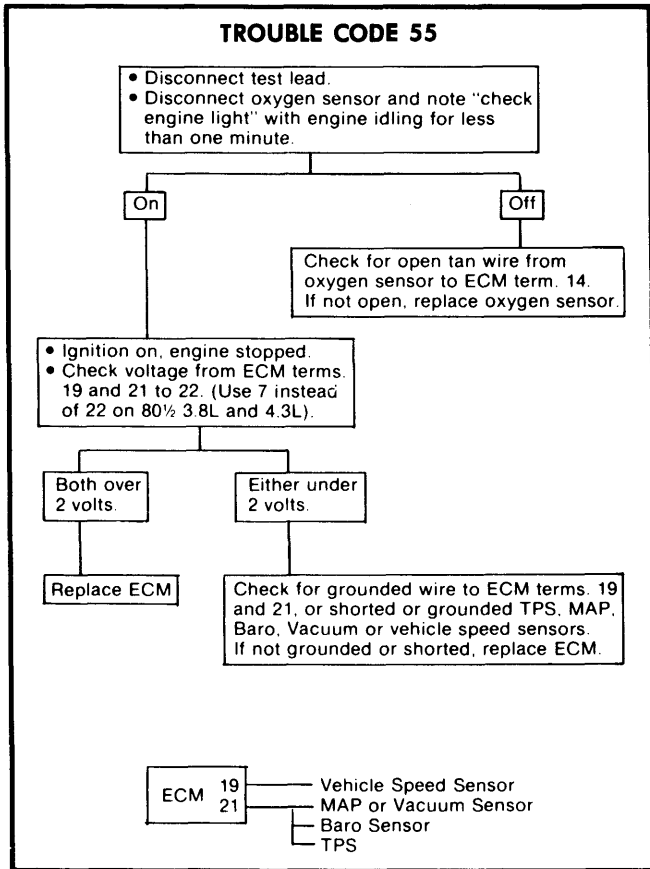
#### CODE 54

Check M/C Solenoid Resistance



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## GENERAL MOTORS COMPUTER COMMAND CONTROL (Cont.)

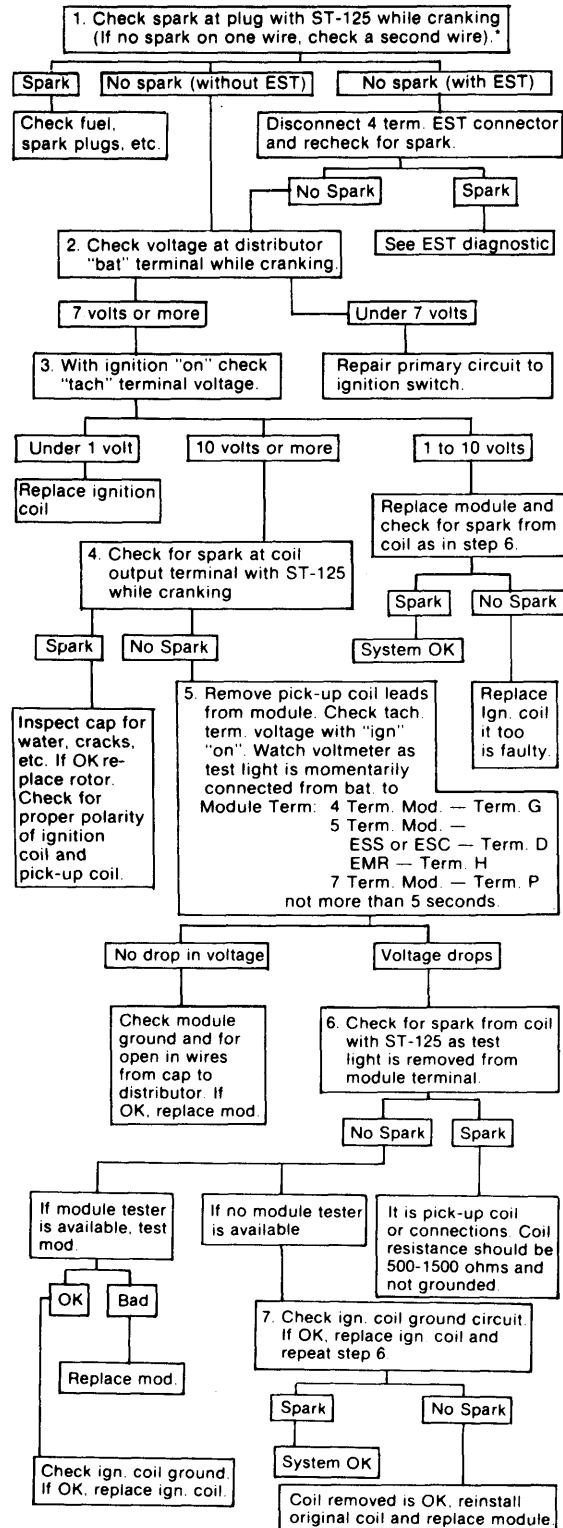


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## GENERAL MOTORS COMPUTER COMMAND CONTROL (Cont.)

### ENGINE CRANKS, BUT WILL NOT START

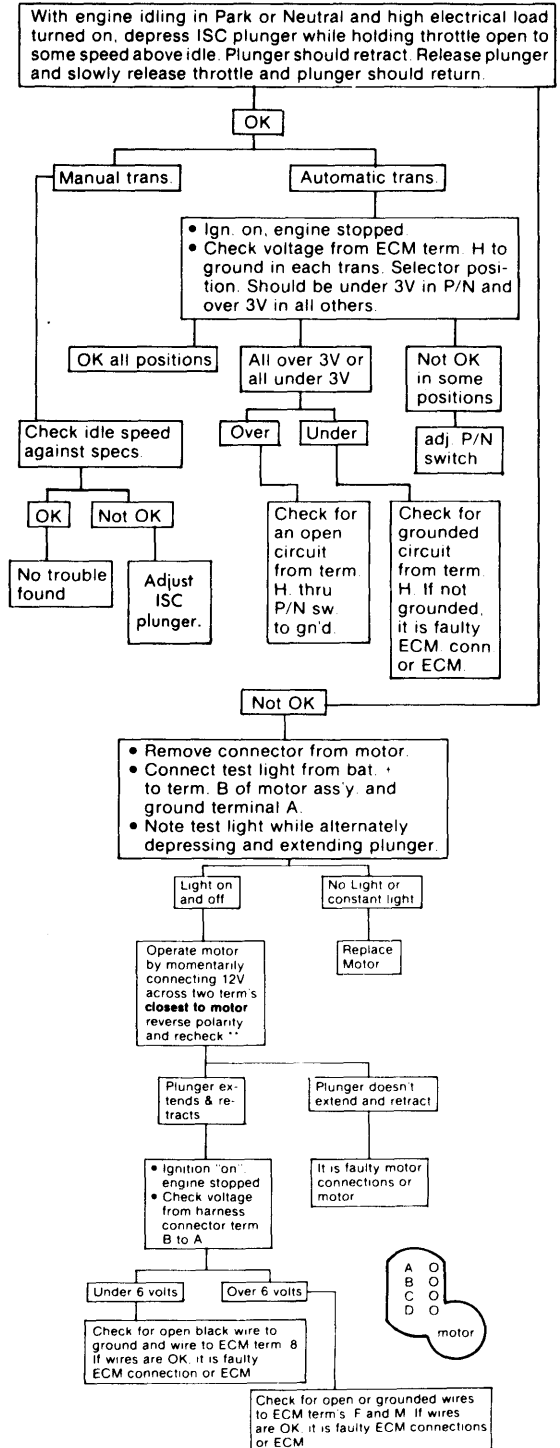
NOTE: If a tachometer is connected to the tachometer terminal disconnect it before proceeding with the test.



\*Some EST problems will result in one or two sparks when cranking is started, then spark will stop. This is considered a "no spark" condition.

### IDLE SPEED CONTROL CHECK\*

NOTICE: The ISC motor plunger is not used to adjust idle speed. Do not disconnect or connect ISC motor with Ign. on, to do so may damage the ECM.



\*\*Do not leave battery voltage applied longer than necessary to retract plunger (not over 10 seconds)

\*Stalling or rough idle only with A/C "on": there should be over 10 volts to ECM term. J with A/C clutch engaged. If there isn't, check for an open in the wire from the A/C clutch to ECM terminal J

The P/N switch grounds the circuit in P/N

## GENERAL MOTORS COMPUTER COMMAND CONTROL (Cont.)

### AIR MANAGEMENT CHECK (EXC. 3.8L VIN K, 4.1L, 4.4L VIN J, 5.0L VIN H & 5.7L VIN L, 6 & 8)

Make visual inspection of hoses and connectors for leaks and proper connections. Repair as necessary.

Converter hose goes to control valve and air cleaner hose to switching valve on these application.

#### Check Control Valve Operation

- Disconnect coolant sensor, start engine and ground "test" lead
- Quickly accelerate and decelerate engine. Valve should divert air to converter outlet on deceleration only.

OK

Not OK

#### Check Switching Valve Operation

- Run engine at idle
- Pulsations should be felt in outlet to exhaust ports
- With coolant sensor reconnected air should switch to converter outlet

OK

No Port or no Port and no conv air

No conv air

Ignition "on" engine stopped, check for a click at switching valve as "test" lead is grounded.

Clicks

No click

With engine idling, and test lead ungrounded, disconnect M/C sol and check air discharge.

To converter

To air cleaner

Check for open in wires to relay points term. A & D. If OK, it is faulty relay connections or relay.

No trouble found

Re-connect M/C solenoid. Clear codes.

Check for grounded wire to ECM term. B for control valve or 4 or switching valve. If not grounded, replace ECM.

Ground "test" lead

No light

Light

Connect test light from each term of connector to ground.

No light

Light on both term

Light on one term

Repair open in Pink Black wire circuit to T Sig fuse.

Repair short from Bat - to wire to ECM and replace ECM.

Check for open in wire to ECM term B for control valve or 4 for switching valve. If OK, check resistance of switching valve sol and air control relay coil. If under 30 ohms, replace sol or relay, whichever is low, and ECM. If not, it is faulty ECM connection or ECM.

Reconnect control relay if it was disconnected

### AIR MANAGEMENT CHECK (3.8L VIN K, 4.4L VIN J, 5.0L VIN H & 5.7L VIN L, 6 & 8)

Make visual inspection of hoses and connectors for leaks and proper connections. Repair as necessary.

#### Check Control Valve Operation

- Disconnect coolant sensor, start engine and ground "test" lead
- Quickly accelerate and decelerate engine. Valve should divert air to air cleaner outlet on deceleration only.

OK

Not OK

#### CHECK SWITCHING VALVE OPERATION

- Run engine at idle
- Pulsations should be felt in outlet to exhaust ports until coolant sensor is reconnected then switch to converter outlet

OK

Not OK

Check control valve solenoid control circuit as follows:

OK

Not OK

Ignition "on" engine stopped, check for a click at air control solenoid as "test" lead is grounded.

Clicks

No click

Check for grounded wire to ECM term 4 for control valve or B for switching valve. If not grounded, replace ECM.

No trouble found

Ground trouble code "test" lead

Connect test light from each term of connector to ground.

No Light

Light

Check for open in wire to ECM term 4 for control valve or B for switching valve. If under 30 ohms, replace sol and ECM. If not, it is faulty connection to ECM or ECM.

No Light

Light on both term

Light on one term

Check for open in wire to ECM term B for control valve or 4 for switching valve. If OK, check resistance of switching valve sol and air control relay coil. If under 30 ohms, replace sol or relay, whichever is low, and ECM. If not, it is faulty ECM connection or ECM.

Repair open in Pink Black wire circuit to T Sig fuse.

Repair short from bat - to wire to ECM

\*Some solenoids are remote from the valve

### TCC ELECTRICAL DIAGNOSIS (WITHOUT EGR BLEED)

Mechanical checks such as linkage, oil level, etc. should be performed prior to using this chart. Also, check for code 24. If present, see Chart 24.

- Connect test light from TCC test point in fuse block to ground
- With drive wheels off floor, trans in gear, increase speed to 25 MPH and note light

Light On

Light Off

Hold throttle position. Test light should go out as brake pedal is momentarily depressed.

Not OK

OK

It is faulty brake sw or adj.

Light On

Light Off

Check for blown fuse. If OK, disconnect connector at trans and connect test light from harness connector A to B terms on two term connector (A to D on 4 term connector) with Ign on, engine stopped, note test light.

Check volt from ECM term 2 to ground with digital V M with Ign on, eng stopped, throttle wide open.

Under 6 volts

Over 6 volts

Check TPS adj. If OK, repair trans.

Light Off

Light On

Repair open in TCC brake sw circuit or adjust switch.

Connect test light between harness connector term's again. Ground trans test point and note light.

Check for ground in wire to ECM term P. If not grounded, replace ECM.

Check volt from ECM term 17 to ground.

Under 1 volt

Over 1 volt

Check for ground in wire to ECM term 2.

Check TPS adj. If OK, it is faulty trans conn or trans.

Repair open in wire to trans term B.

It is faulty ECM conn or ECM.

Repair open in wire from trans to test point.

Stop engine. Ign on, check voltage from ECM term 16 to ground while turning one drive wheel by hand with the other on the floor. It should alternate from under 3 to over 10 volts.

OK

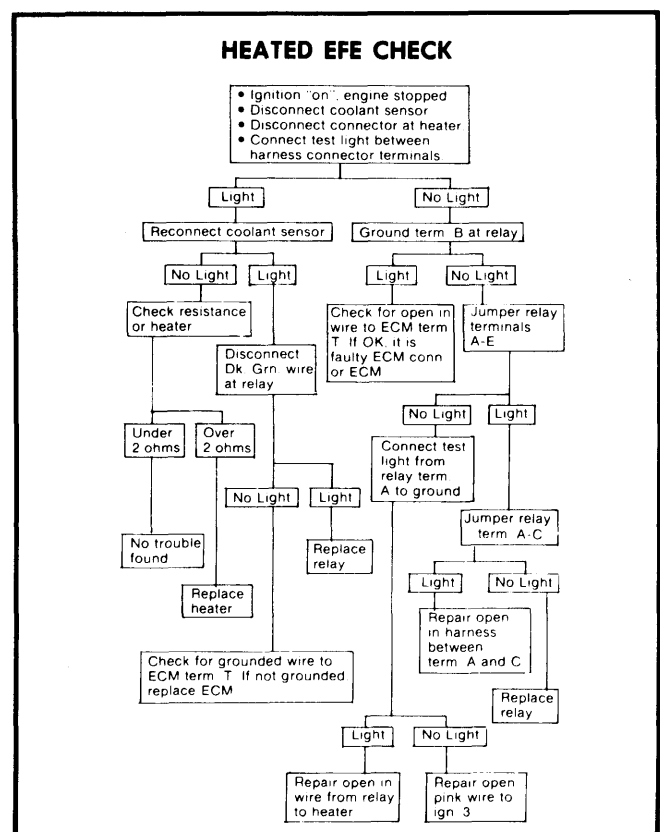
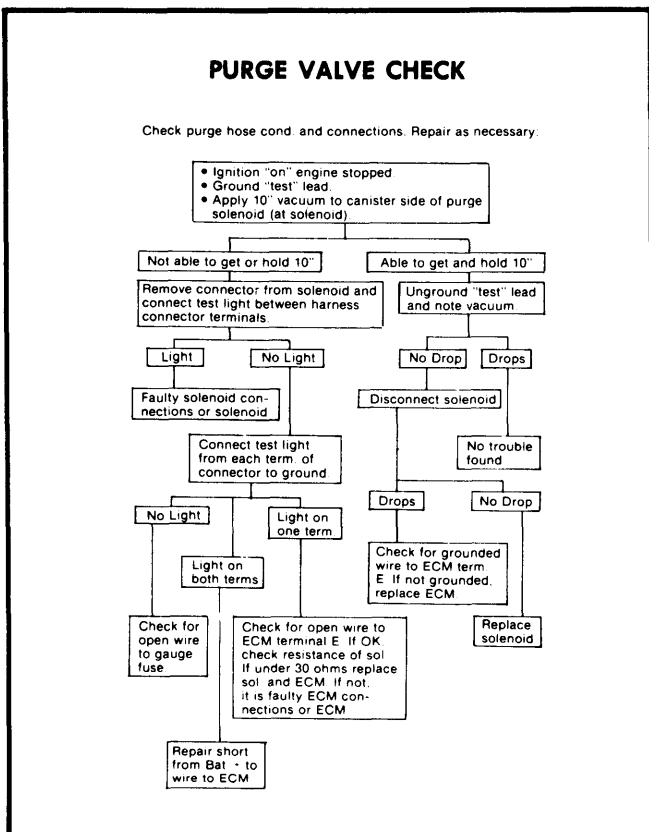
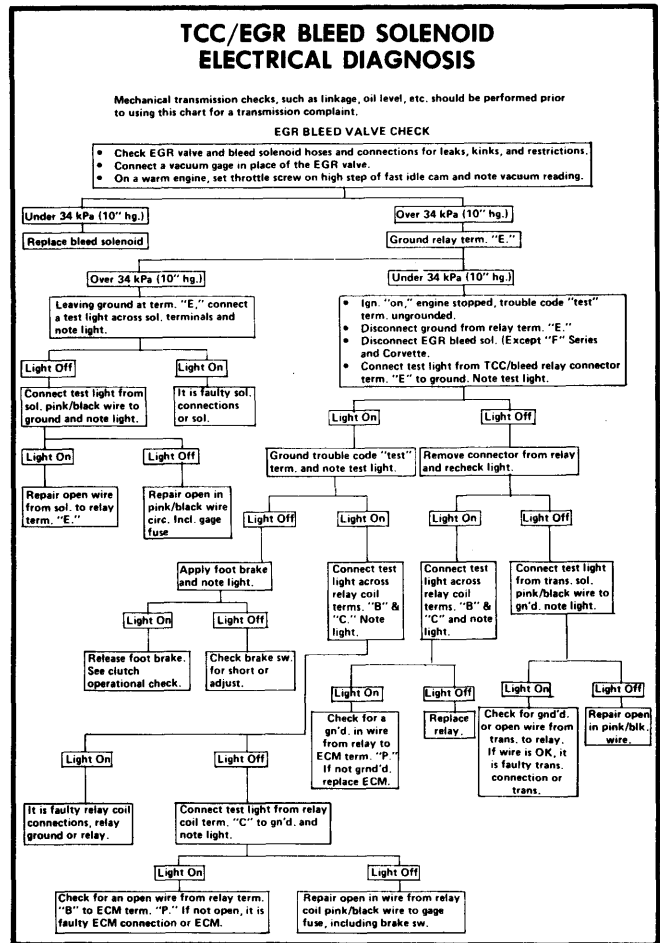
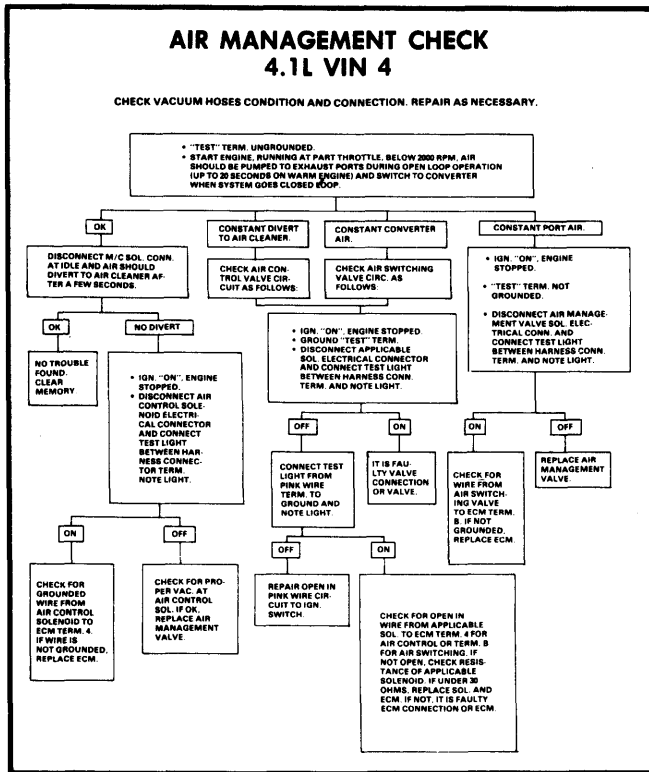
Not OK

It is faulty ECM conn or ECM.

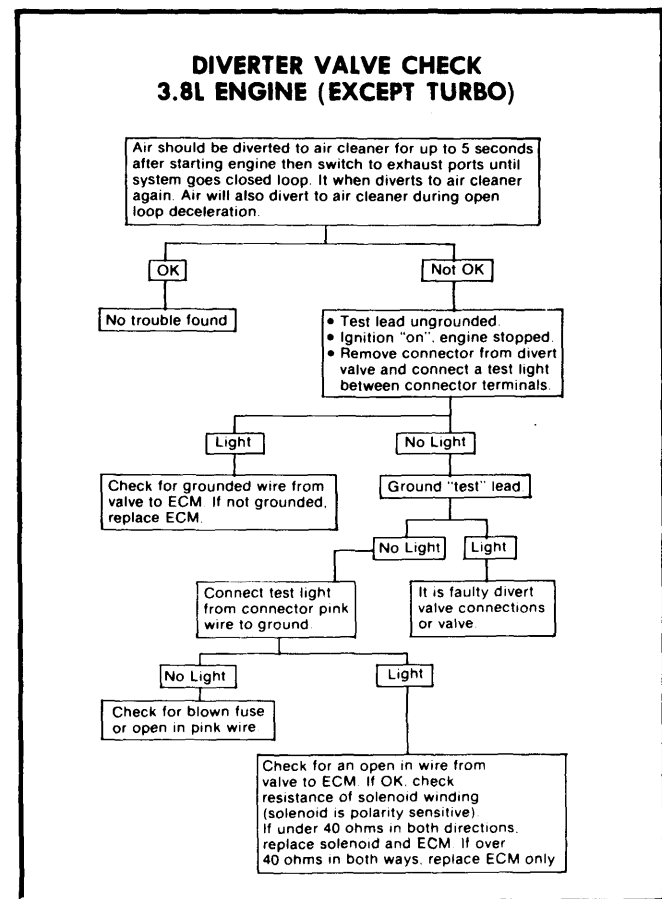
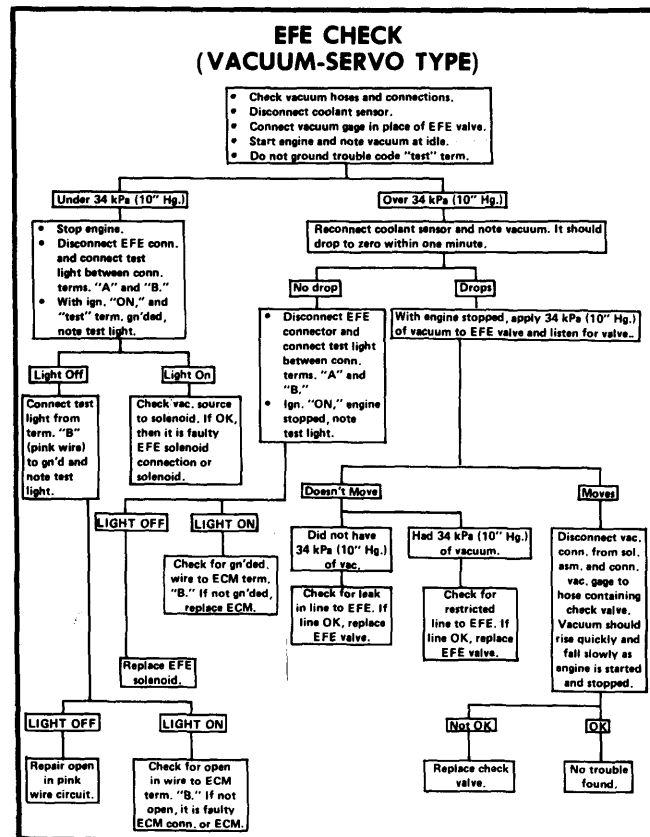
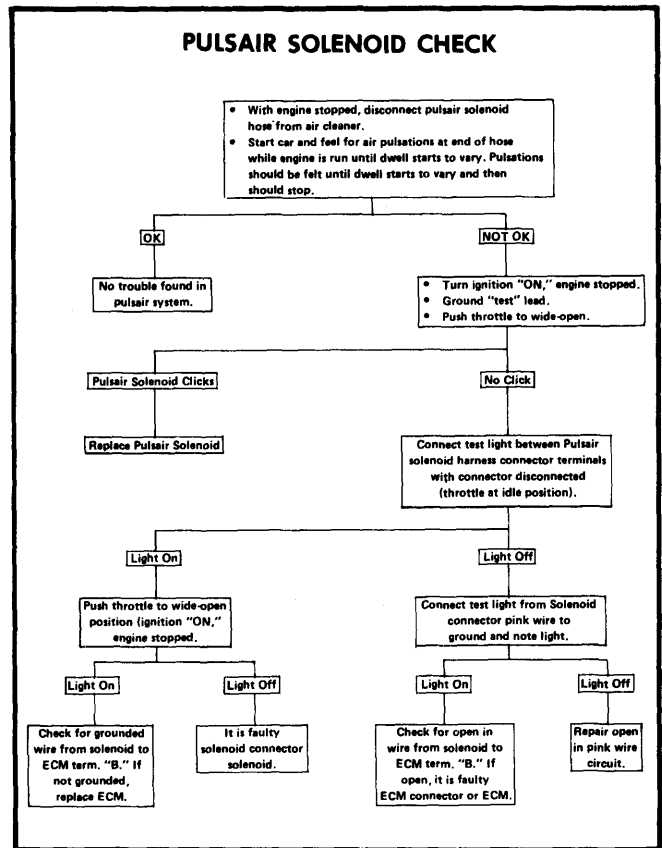
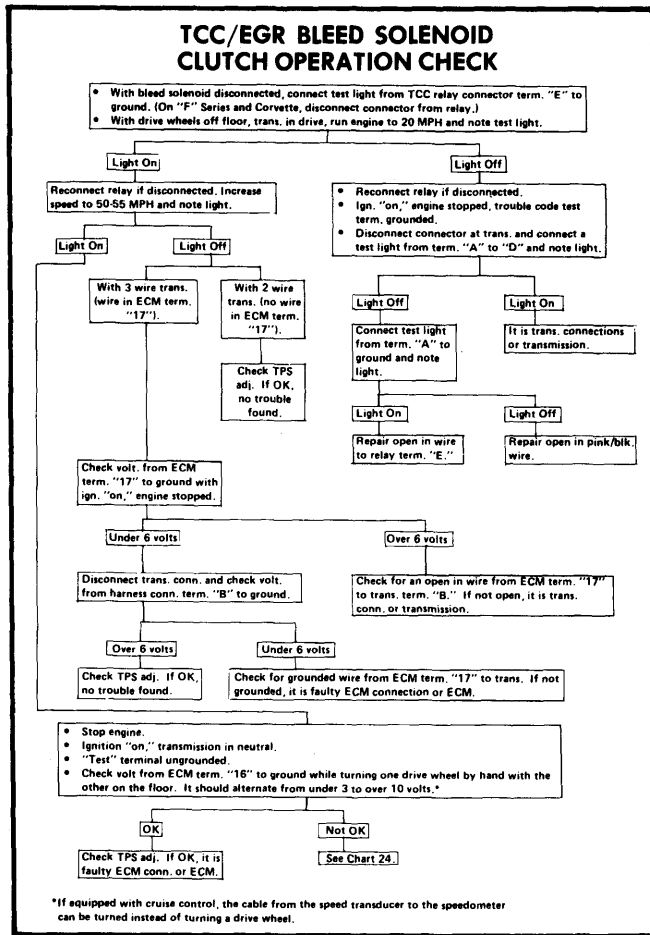
See Chart 24

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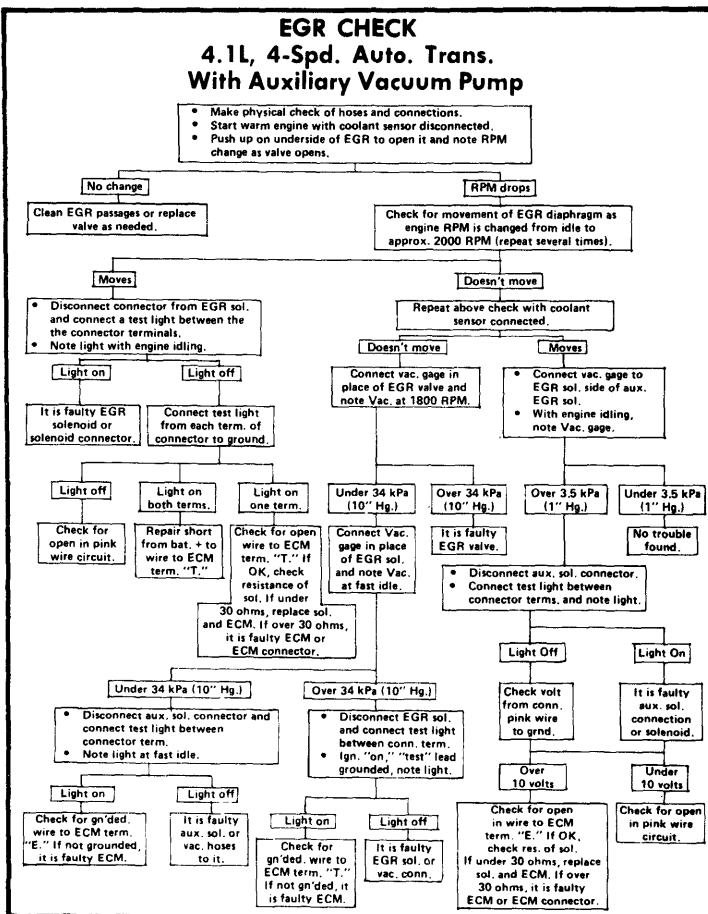
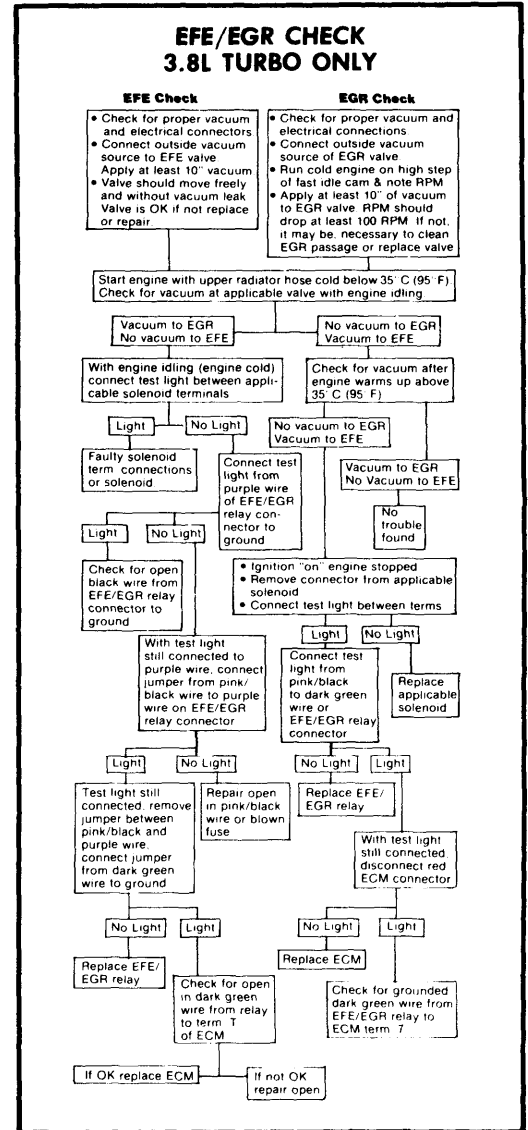
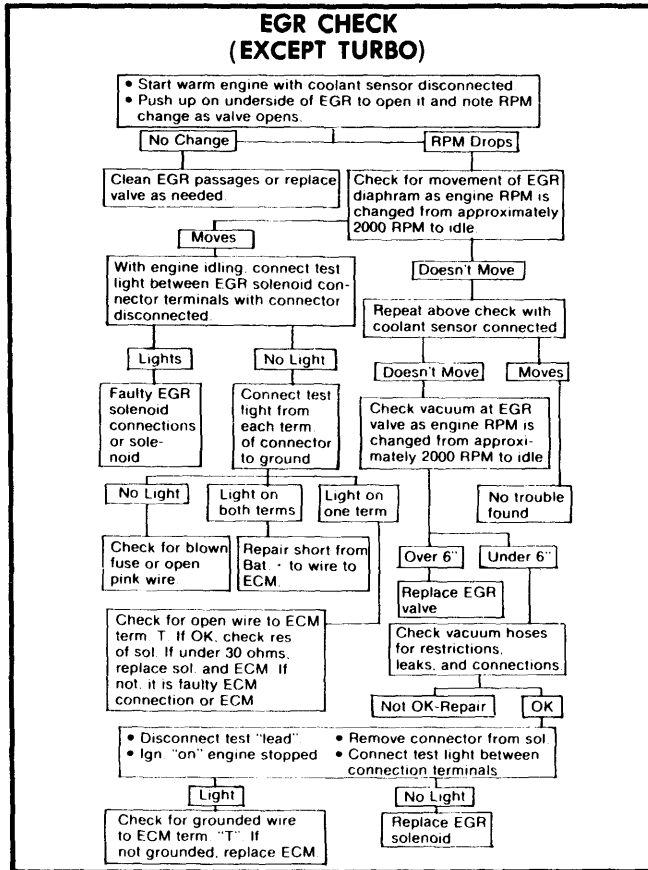
## GENERAL MOTORS COMPUTER COMMAND CONTROL (Cont.)



## GENERAL MOTORS COMPUTER COMMAND CONTROL (Cont.)



## GENERAL MOTORS COMPUTER COMMAND CONTROL (Cont.)









# 1981 Computerized Engine Controls<sup>1a-95</sup>

## GENERAL MOTORS COMPUTER COMMAND CONTROL (Cont.)

### MAINTENANCE

#### OXYGEN SENSOR REPLACEMENT

**Chevette (Suffix "Z" Engine Only)** — Every 30,000 miles, a maintenance reminder labeled "EMISSIONS" appears in speedometer face, indicating need for oxygen sensor replacement. Replace oxygen sensor as described under Removal & Installation in this article. Reset maintenance reminder.

**All Other Models** — The CCC system does not require periodic maintenance. The ECM signals need for repair or replacement of oxygen sensor. However, if the vehicle is raised for other services, check the general condition of catalytic converter and exhaust system.

#### MAINTENANCE REMINDER RESET

**Chevette (Suffix "Z" Engine Only)** — Remove instrument panel trim plate. Remove instrument cluster lens. Using pointed tool, apply light downward pressure on notches of flag until it is reset. An alignment mark will appear in left center of odometer window when label is reset.

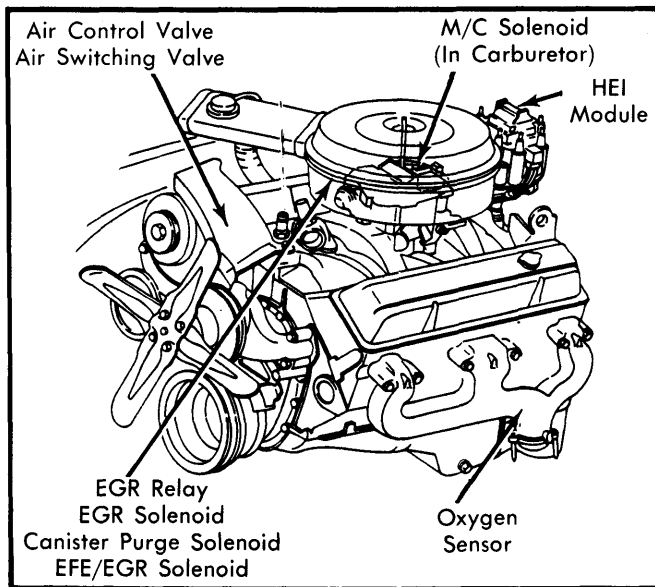


Fig. 8 Location of CCC System Components

### REMOVAL & INSTALLATION

#### ELECTRONIC CONTROL MODULE (ECM) ELECTRONIC SPARK CONTROL UNIT (ESC)

**Removal & Installation** — Remove ECM mounting hardware. Disconnect electrical connectors and ground strap. Remove ECM. To install ECM, reverse removal procedure and ensure ground strap is securely attached.

**NOTE** — The ECM may be located at right side kick panel, glove compartment area or center console area.

#### PROGRAMMABLE READ ONLY MEMORY (PROM)

**Removal** — 1) Remove ECM as previously described. Remove sheet metal screw holding access cover closed and remove access cover. Using a small flat tip screwdriver, place blade at PROM carrier reference end between edge of opening in case

and underside of protruding lip of carrier. Apply prying force and force side of carrier up as far as possible. Repeat procedure on other reference end lip.

2) Using prying force explained in step 1), force opposite end of carrier up as far as possible. Grasp carrier with thumb and forefinger. Gently rock carrier from side to side while applying upward force and remove PROM.

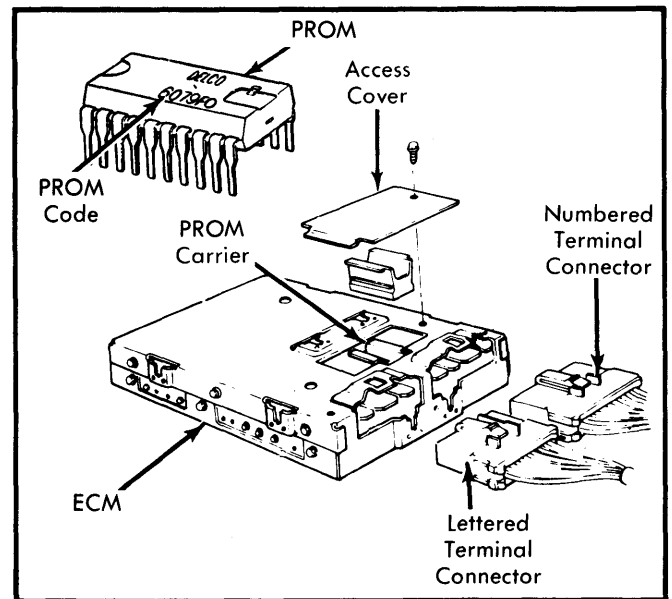


Fig. 9 Replacement of PROM in ECM

**Installation** — 1) Before installing new PROM, ensure that part number agrees with removed PROM. Ensure that molded "half-round" depression of PROM is at same end as "squared-off" symmetrical end of carrier and that PROM is centered in carrier.

**NOTE** — Any time PROM is installed backwards and ignition is turned on, PROM is destroyed and must be replaced.

2) Position carrier squarely over PROM socket with "squared-off" symmetrical end of carrier aligned with small notch in socket. Press down firmly on top of carrier and press down on body of PROM with narrow blunt tool. Squarely seat PROM in socket by alternately pressing down on either end of PROM.

3) Replace access cover and reinstall ECM. Reconnect electrical connectors and start engine. Enter diagnostics and check for trouble code "51". If trouble code "51" does not appear, PROM is correctly installed.

4) If code "51" does appear, PROM is not fully seated, is installed backwards, has bent pins, or is defective. Remove ECM and fully seat PROM. If pins are bent, remove PROM, straighten pins and reinstall PROM. If pins break or crack during straightening process, replace PROM. If PROM is installed backwards, replace PROM.

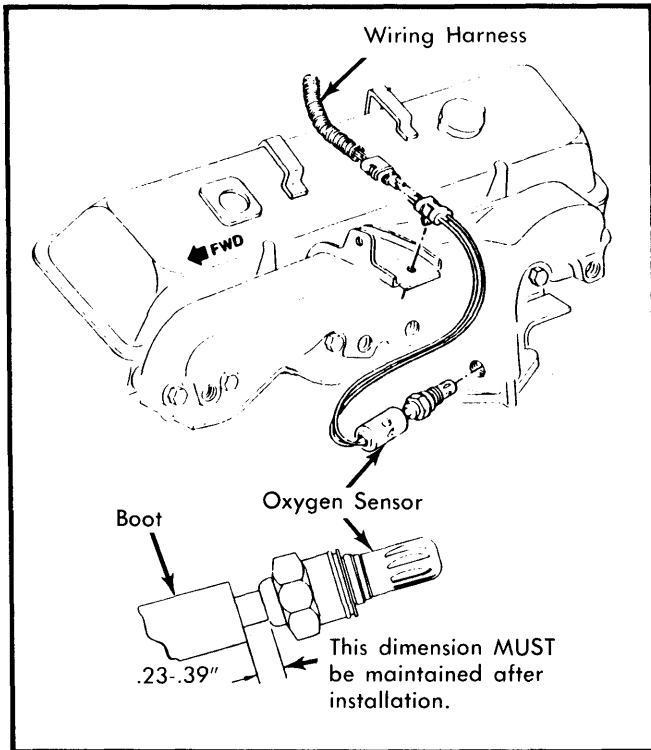
#### OXYGEN SENSOR

**Removal** — Raise and support vehicle (if required). Disconnect electrical connector at harness. Spray threads of oxygen sensor with penetrating oil and allow to soak for 5 minutes. Carefully remove oxygen sensor.

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## GENERAL MOTORS COMPUTER COMMAND CONTROL (Cont.)

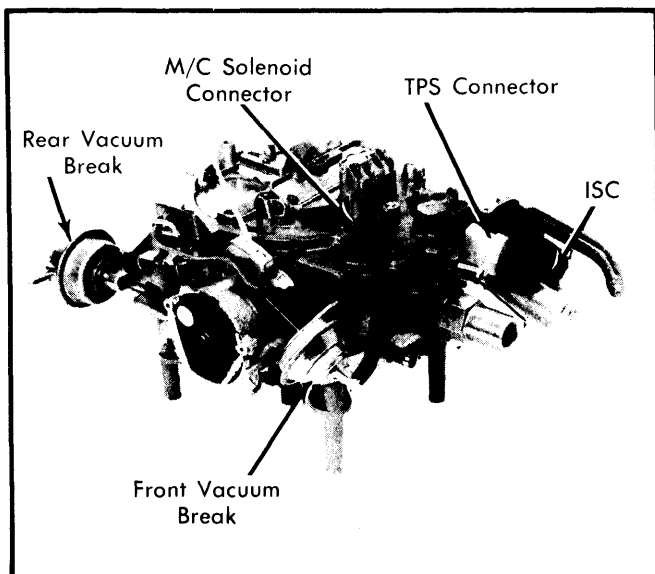
**NOTE** — Oxygen sensor may be difficult to remove when engine temperature is below 120°F. Excessive force may damage threads in exhaust manifold or pipe.



**Fig. 10** View Showing Oxygen Sensor Location

**Installation** — Install new oxygen sensor and torque to 30 ft. lbs. When installing new oxygen sensor, do not remove glass bead coating (anti-seize compound) from threads or install with any type of sealant. Reconnect electrical connector. Ensure oxygen sensor boot is  $\frac{5}{16}$ " away from wrench fitting of oxygen sensor.

**NOTE** — DO NOT attempt to reinstall an oxygen sensor. Reinstallation of a sensor without special glass bead thread coating may require complete replacement of exhaust system.



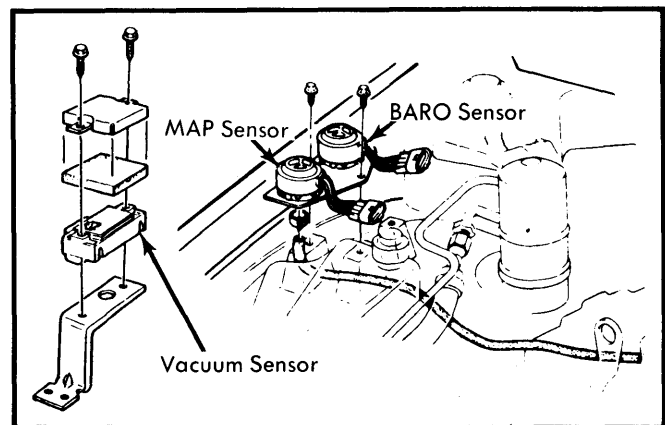
**Fig. 11** Location of CCC Components on Carburetor

### IDLE SPEED CONTROL ACTUATOR (ISC), IDLE SPEED SOLENOID (ISS), IDLE LOAD COMPENSATOR (ILC)

**Removal & Installation** — Disconnect electrical harness connector, if equipped. Remove mounting screws and idle control device. To install, reverse removal procedure and adjust idle control device.

### MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP), BAROMETRIC PRESSURE SENSOR (BARO), VACUUM SENSOR

**Removal & Installation** — These sensors may be located in engine compartment or instrument panel. Locate sensor and remove electrical connector. Remove mounting screws and remove sensor. To install sensor, reverse removal procedure and reconnect ground strap (if equipped).



**Fig. 12** MAP/BARO Sensor or Vacuum Sensor Location

### COOLANT TEMPERATURE SENSOR (CTS)

**Removal** — Drain radiator until coolant level is below sensor. Remove alternator (if required) to gain access to sensor. Disconnect harness connector from sensor and remove sensor from block.

**Installation** — Apply non-hardening sealer to threads of sensor and install sensor. Reconnect harness connector and install alternator (if removed). Refill radiator.

### Vehicle Speed Sensor (VSS)

**Removal & Installation** — Remove speedometer cluster and disconnect VSS electrical harness. Remove mounting hardware and remove sensor. To install, reverse removal procedure.

### EMISSION CONTROL SOLENOIDS

**Removal & Installation** — Remove electrical connector and hoses (if equipped). Remove solenoid. To install, reverse removal procedure.

### TORQUE CONVERTER CLUTCH SOLENOID (TCC), HIGH GEAR SWITCH

*Removal and installation requires disassembly of transmission.*

### DETONATION SENSOR, (ESC EQUIPPED ENGINES)

**Removal & Installation** — Remove electrical harness and remove sensor. To install, coat threads of sensor with anti-seize compound and install sensor.