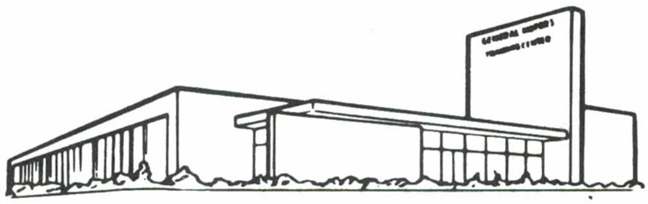
DIGITAL FUEL INJECTION

AND MODULATED DISPLACEMENT ENGINE



GM

Product Service Training

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FOREWORD

This booklet is supplied by GM Product Service Training to GM dealer service personnel upon their completion of the subject course conducted at GM Training Centers.

While this booklet will serve as an excellent review of the extensive program presented in the training center session, it is not intended to substitute for the various service manuals normally used on the job. The range of specifications and variation in procedures between carlines and models requires that the division service publications be referred to, as necessary, when performing these operations.

All information contained in this booklet is based on the latest data available at the time of publication approval. The right is reserved to make product or publication changes, at any time, without notice.

1981 DIGITAL FUEL INJECTION - MODULATED DISPLACEMENT

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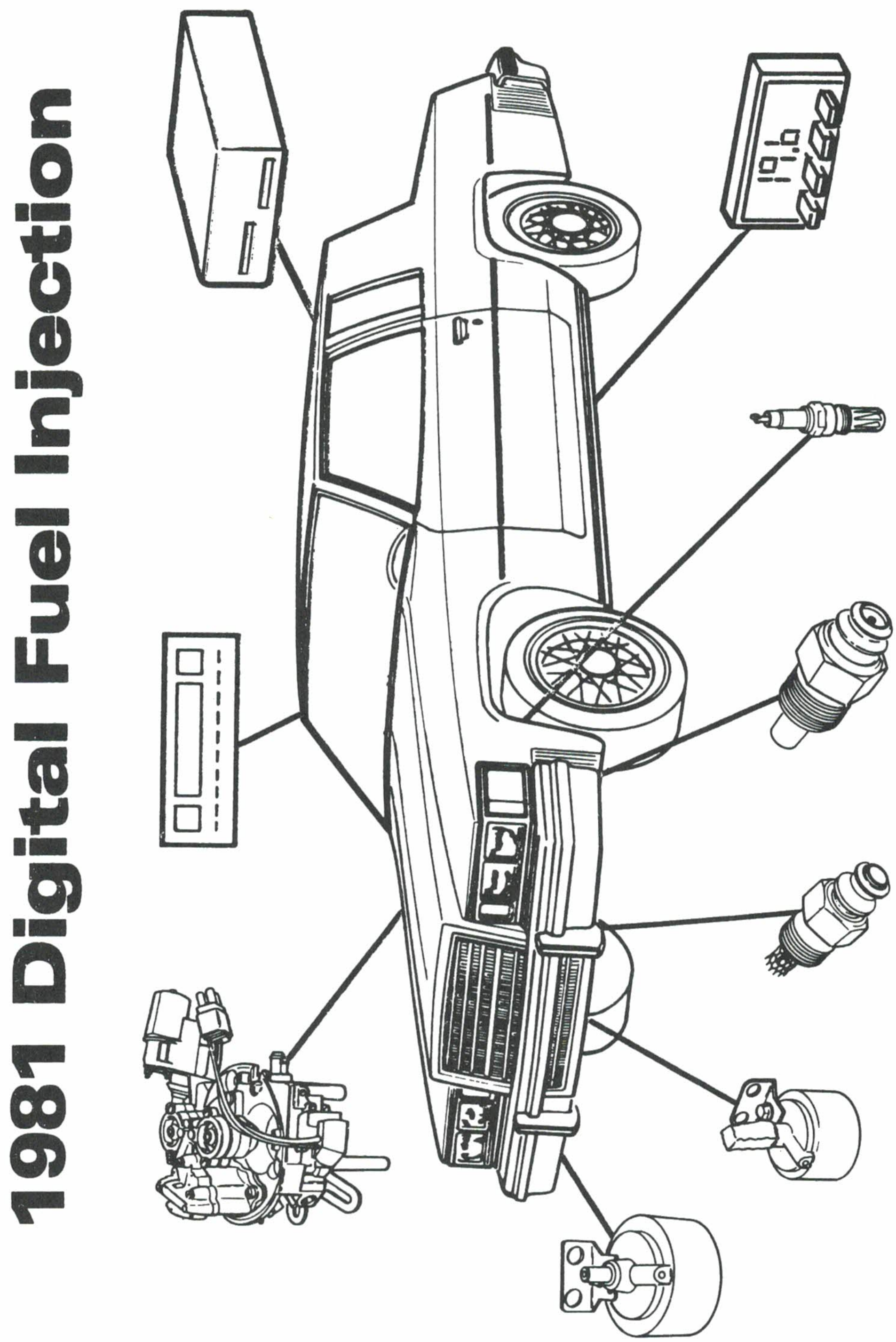


Figure 1 1981 D.F.I. Components

SECTION 1

GENERAL DESCRIPTION

INTRODUCTION

In the 1981 model year, Cadillac will introduce Digital Fuel Injection coupled with Modulated Displacement. These two systems will be combined on the 6.0L engines.

These new systems are based on the Digital Electronic Fuel Injection introduced in the 1980 model year.

DFI is a fuel delivery system which controls tail pipe emissions while maintaining or improving fuel economy and engine performance by precisely controlling air/fuel mixtures under all operating conditions. This system can also self-diagnose and store this diagnosis information in memory which can be called out and read through a digital display in the instrument panel. Modulated Displacement, which is coupled with DFI, has the ability to stop operation of as many as 4 cylinders. The object of this is to reduce the consumption of gasoline through more efficient use of the capacity of the engine. 4-cylinder operation takes place after the car has reached operating temperature in third gear and usually above 30mph.

COMPONENT DESCRIPTION

The DFI systems and components are listed below. Each system is described in the following paragraphs.

- Fuel Supply System & Injectors
- Air Induction System
- Sensors
- Electronic Control Module (ECM)
- Electronic Spark Timing (EST)
- Idle Speed Control (ISC) System
- Emission Control Systems
- Closed Loop Fuel Control (1981)
- System Diagnostics

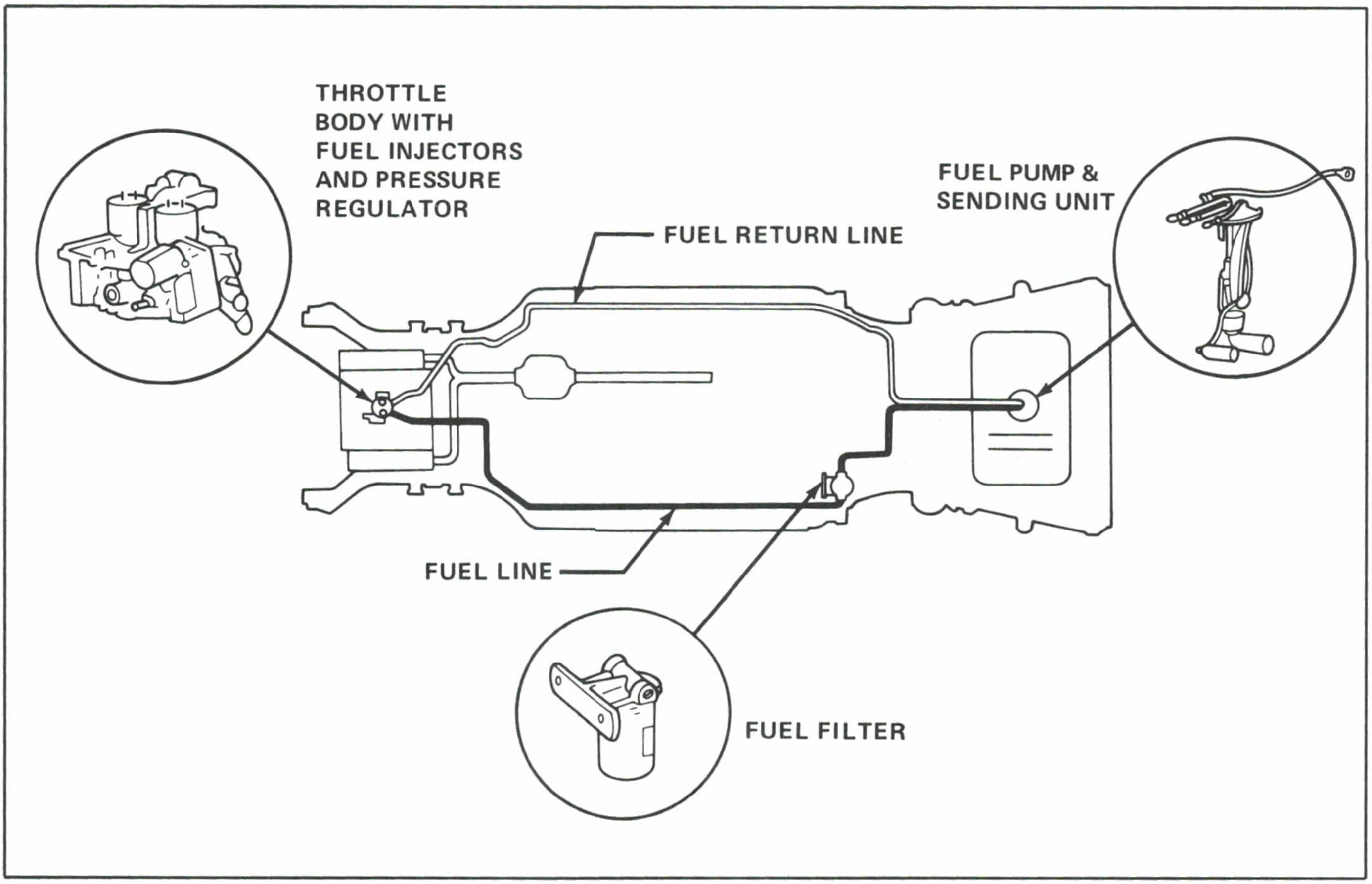


Figure 2 Fuel System

1. FUEL SUPPLY SYSTEM & INJECTORS

The fuel supply system provides fuel at 10 p.s.i. for injection into the throttle body. The fuel supply system consists of a fuel tank-mounted electric pump, a full-flow fuel filter mounted on the vehicle frame, a fuel pressure regulator built into the throttle body, fuel pressure and fuel return lines, and two fuel injectors. The timing and amount of fuel supplied is controlled by the ECM.

a. Fuel Pump

An electric motor-driven twin turbine type pump is integral with the fuel tank float unit and provides fuel under pressure to the throttle body and fuel pressure regulator. The pump is specific for the DFI application and is not repairable; however, the pump as well as the filter may be replaced separately from the fuel gage unit.

Fuel Pump operation is controlled by the fuel pump relay, located in the relay center. Operation of the relay depends upon a signal from the ECM.

The fuel pump circuit is protected by a 10 amp fuse located in the mini fuse block. The ECM turns the pump on with the ignition in ON or START. However, if the engine is not cranked within one second after the ignition is turned on, the ECM signal is removed and the pump turns off.

b. Fuel Tank

The fuel tank includes a reservoir directly below the sending unit/in-tank pump assembly. The "bath tub" shaped reservoir is used to insure a constant supply of fuel for the in-tank pump even at low fuel·level and under very severe maneuvering. The fuel returned to the tank by the fuel pressure regulator is directed into the reservoir as an additional means of keeping the pump intake below the fuel level.

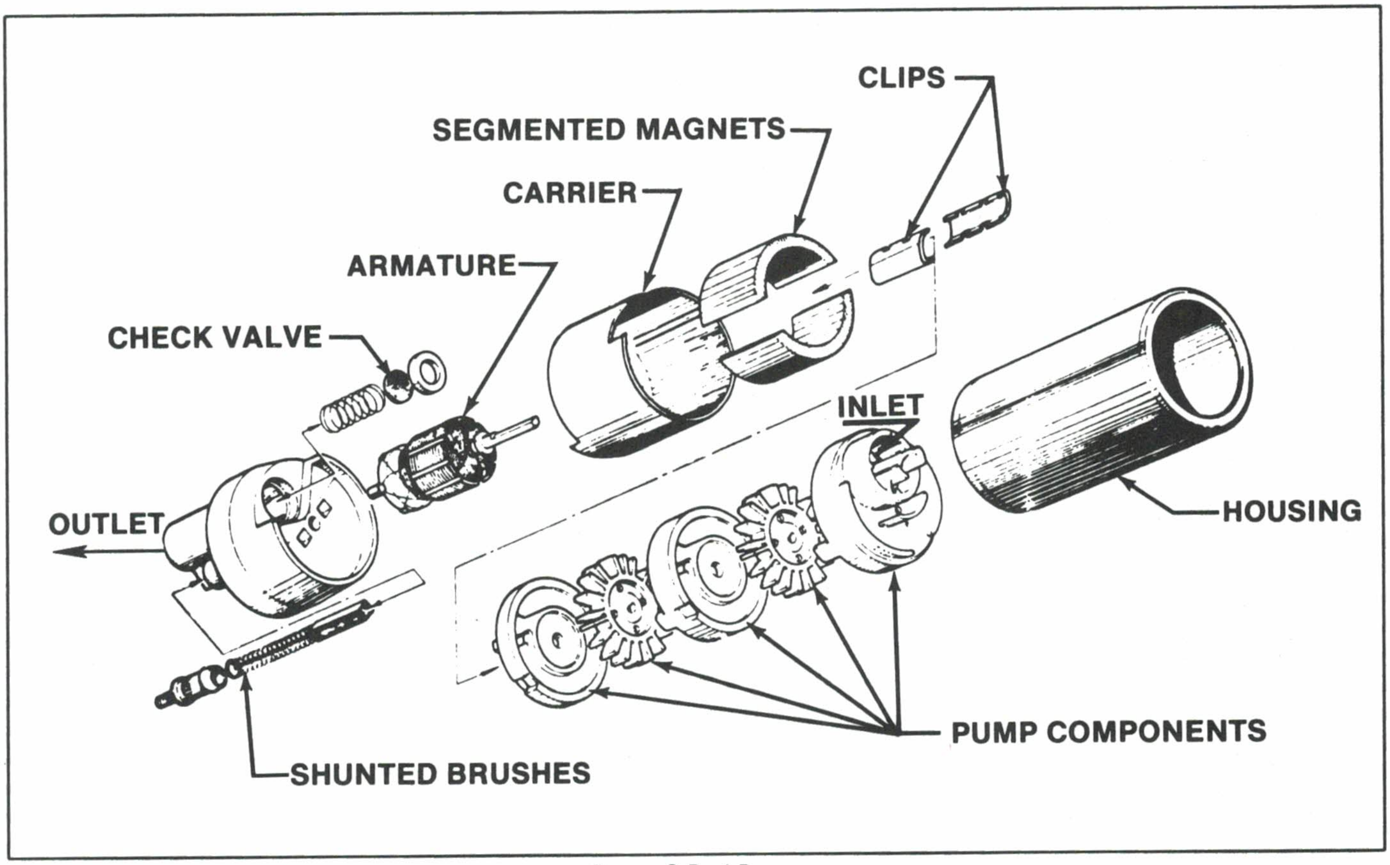


Figure 3 Fuel Pump

c. Fuel Filter

The fuel filter, consists of a casing with an internal paper filter element capable of filtering foreign particles down to the 10 micron (.0004″) size. The filter element is serviceable and should be replaced (AC type GF-157 or equivalent) as described in the Vehicle Maintenance Schedule. The filter is mounted to the frame near the left rear wheel.

d. Fuel Pressure Regulator

The fuel pressure regulator, **Figure 4**, is contained in the throttle body. This valve, which regulates pressure, is a diaphragm-operated relief valve in which one side of the valve is exposed to fuel pressure and the other side to atmospheric pressure. Normal pressure is established by a pre-load spring. Constant pressure across the injector inlets is held at 10 psi above atmospheric pressure by the pressure regulator. Fuel in excess of that used is returned through the fuel return line to the fuel tank.

e. Fuel Injectors

The two fuel injectors, **Figure 5**, are energized alternately by the ECM and meter and direct the atomized fuel into the throttle body above the throttle blades.

The injector body contains a solenoid whose plunger or core piece is pulled upward by the energized solenoid allowing the spring-loaded ball valve to come off its seat. This allows fuel through to the atomizer/spray nozzle. Injectors may be replaced individually.

Since the pressure regulator maintains a constant pressure across the injectors, the amount of fuel injected is determined by how long the valves are held open.

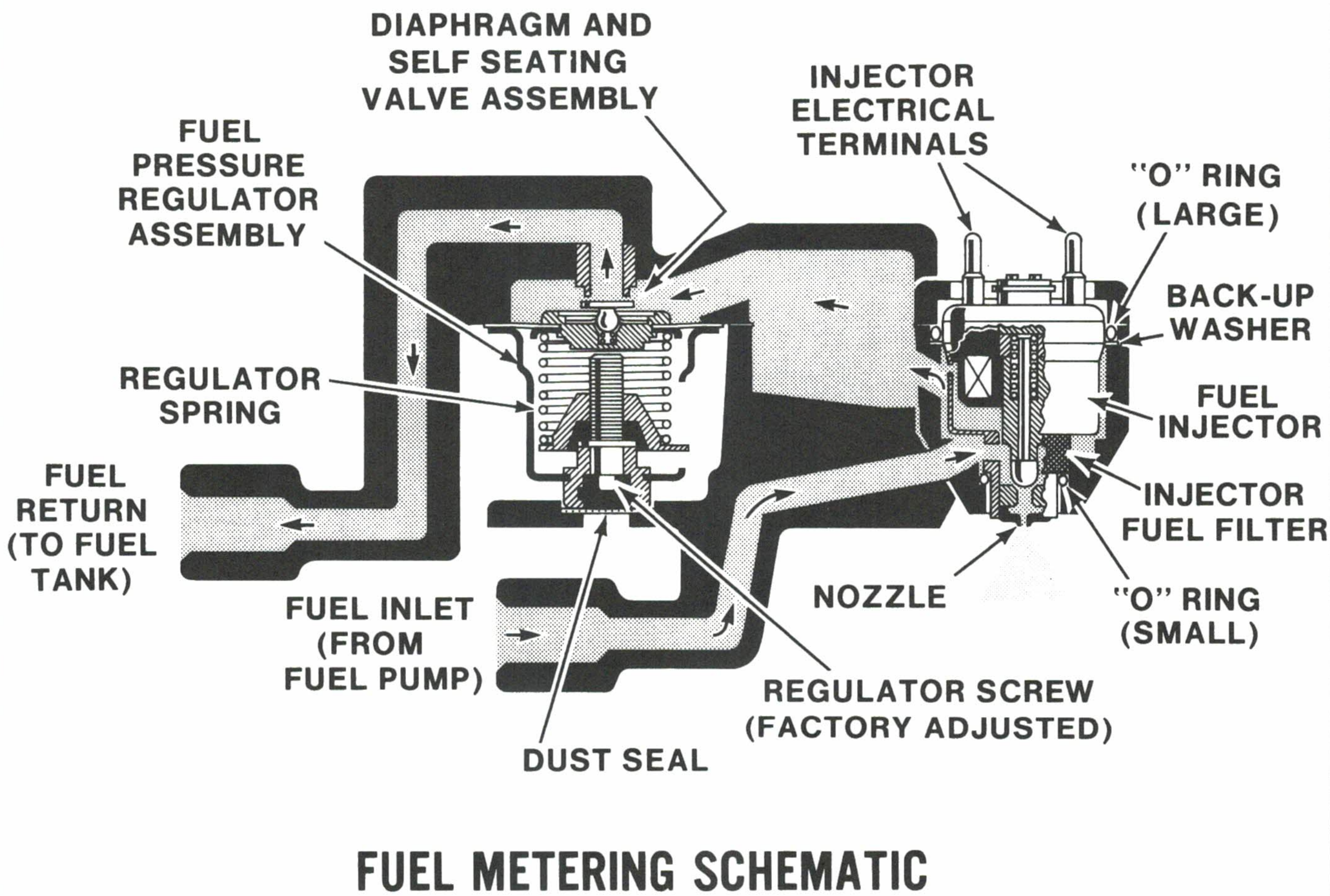


Figure 4 Fuel Pressure Regulator and Injector

f. Fuel Lines

A 3/8" fuel delivery line is routed along the left frame side rail between the fuel pump/sending unit assembly and the throttle body. A braided stainless steel covered teflon hose connects the metal fuel line to another fuel line on the engine to provide durability and to protect against damage.

The 5/16" fuel return line is routed along the right frame side rail. Flexible connection in this line is also by a braided stainless covered teflon hose at the engine to frame connection.

2. AIR INDUCTION SYSTEM

The air induction system consists of the throttle body assembly, idle speed control and intake manifold. Air for combustion enters the throttle body and is distributed to each cylinder through the intake manifold. The air flow rate is controlled by the throttle valve opening.

Idle speed is determined by the position of the throttle valves and is controlled by the ISC actuator.

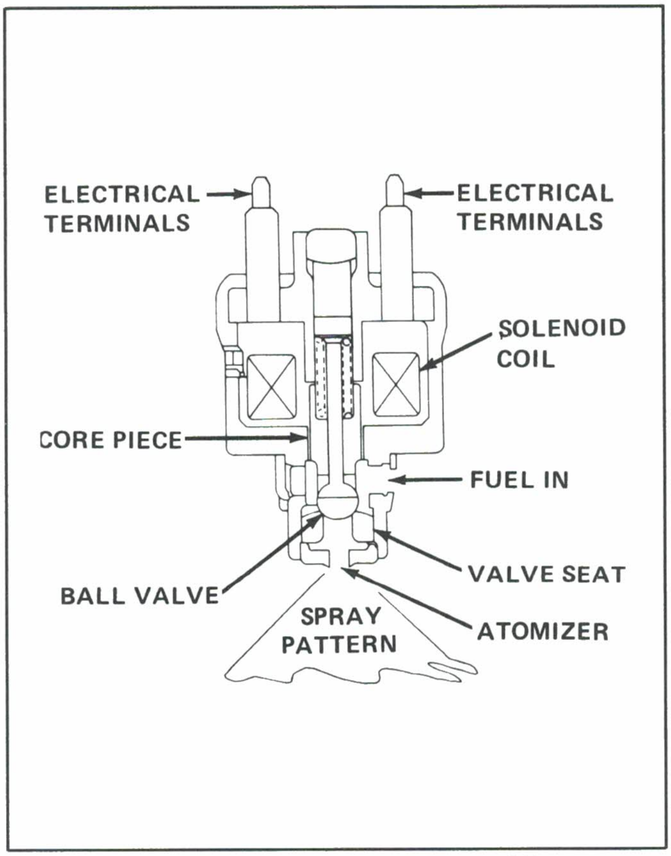


Figure 5 Injector Cutaway Reduce 56%

Additional air flow for cold starts and warm-up is provided by opening the throttle valves further. This is accomplished by the ISC actuator moving out further in response to commands from the ECM. The air induction system components are as follows:

a. Throttle Body

The throttle body, **Figure 6**, consists of a housing with two bores and two shaft-mounted throttle valves connected to the vehicle accelerator pedal by mechanical linkage. The end of the throttle shaft opposite the accelerator lever controls the throttle position sensor (described under Sensors).

b. Idle Speed Control (ISC)

At closed throttle, the idle speed control sets the idle speed of the engine. Operation of the ISC is discussed under the "Electronic Control Module" heading. It consists of a reversible motor which moves a shaft in and out to control throttle position.

c. Intake Manifold

The aluminum intake manifold used with the DFI system is of the dual plane design, (1980) single plane (1981). It contains a heat crossover passage as DFI uses an EFE system.

3. SENSORS

The sensors include the manifold air temperature sensor (MAT), engine coolant temperature sensor (CTS), manifold absolute pressure sensor (MAP), barometric pressure sensor (BARO), and throttle position sensor (TPS). The engine speed sensing function is performed by the EST distributor.

a. Manifold Air Temperature Sensor (MAT)

The manifold air temperature sensor is located in the intake manifold in front of the throttle body. This sensor measure the temperature of the air/fuel mixture in the intake manifold and provides this information to the ECM. The sensor is a thermister whose resistance changes as its temperature changes. At low temperatures the resistance is high (100,000 ohms @ -40°C) and as temperature increases sensor resistance decreases (70 ohms @ +130C).

B. Coolant Temperature Sensor (CTS)

The coolant temperature sensor is similar in function to the MAT sensor, and is installed in the right front corner

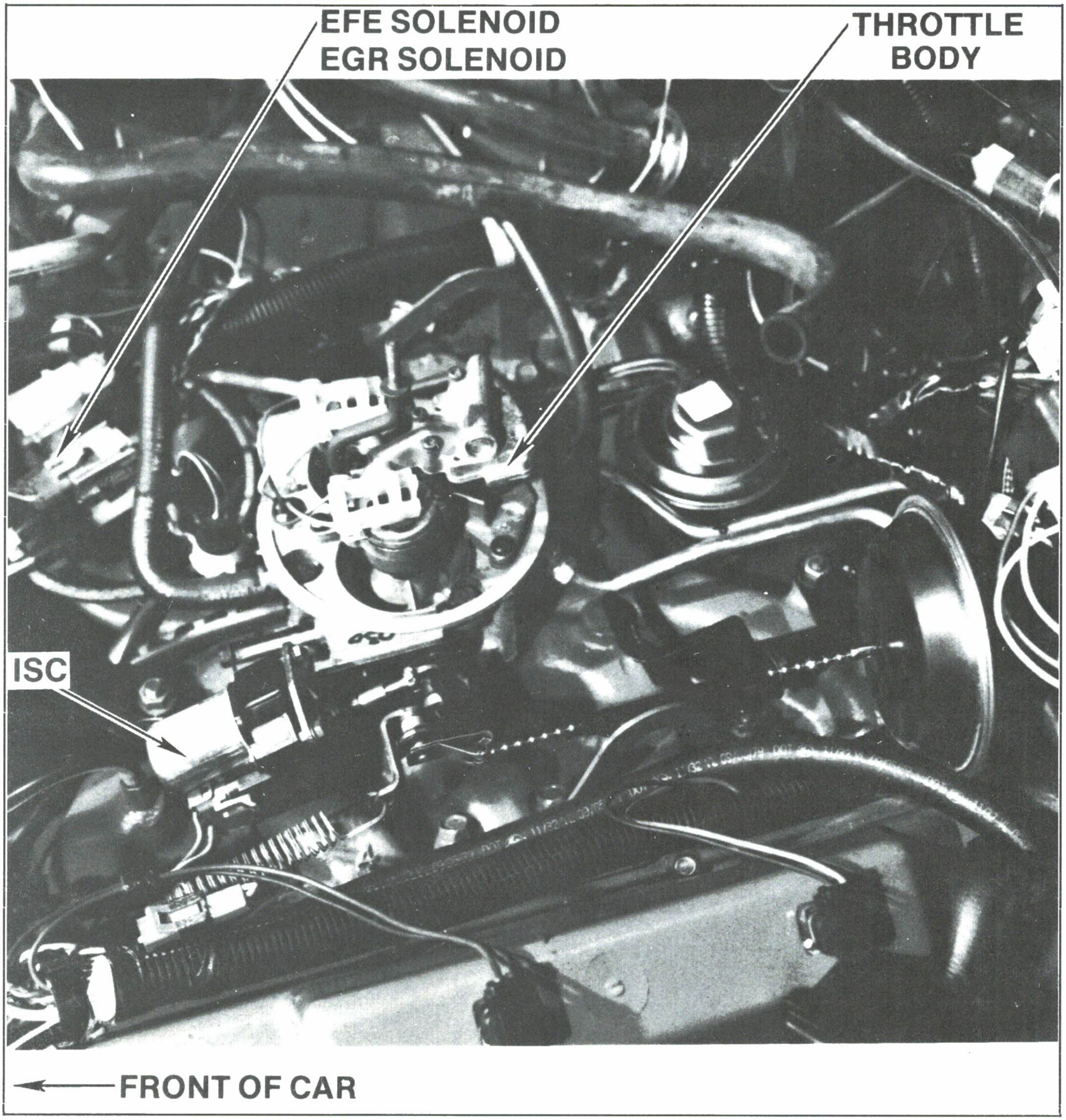


Figure 6 Throttle Body

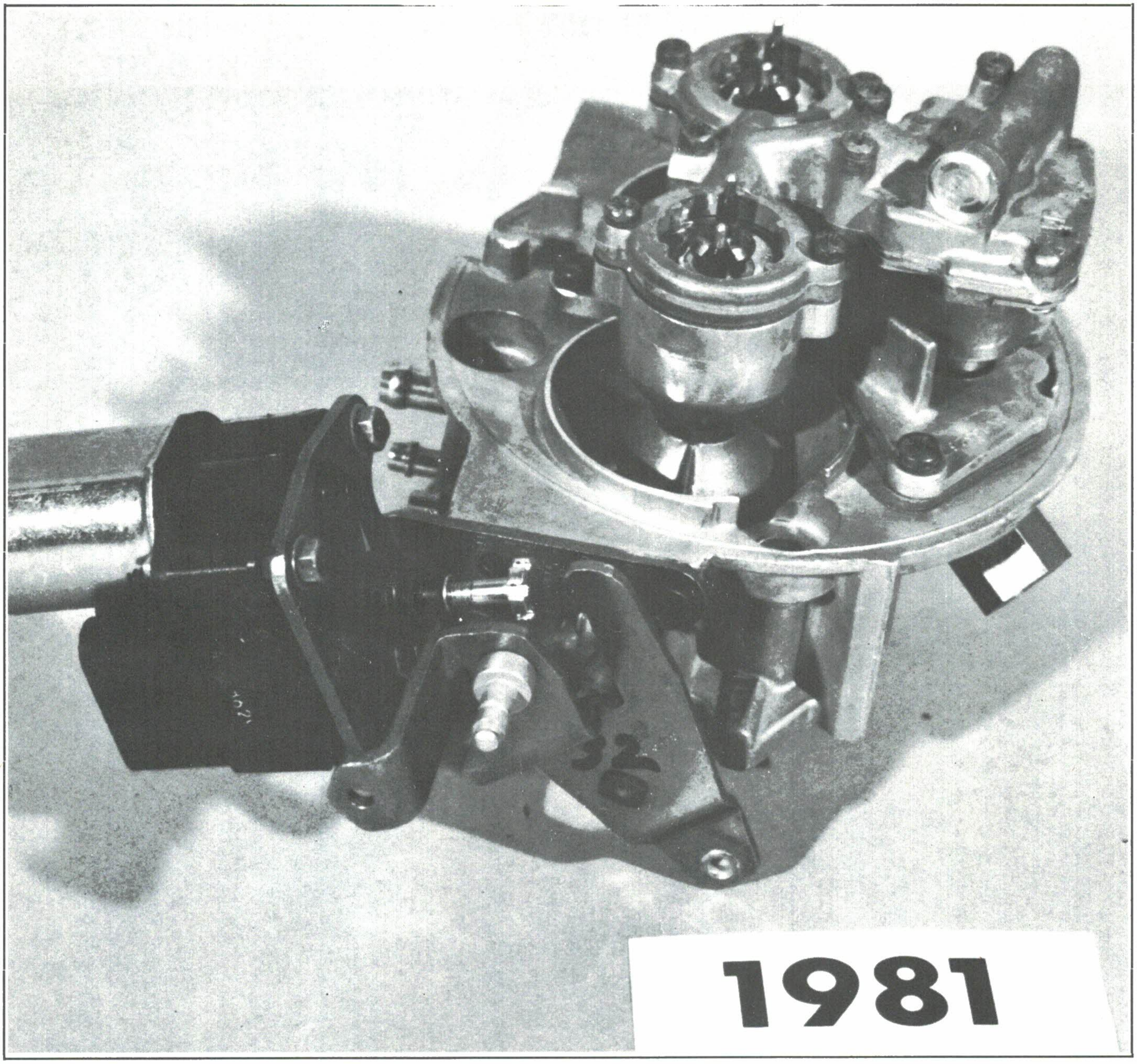


Figure 7 Throttle Body with I.S.C.

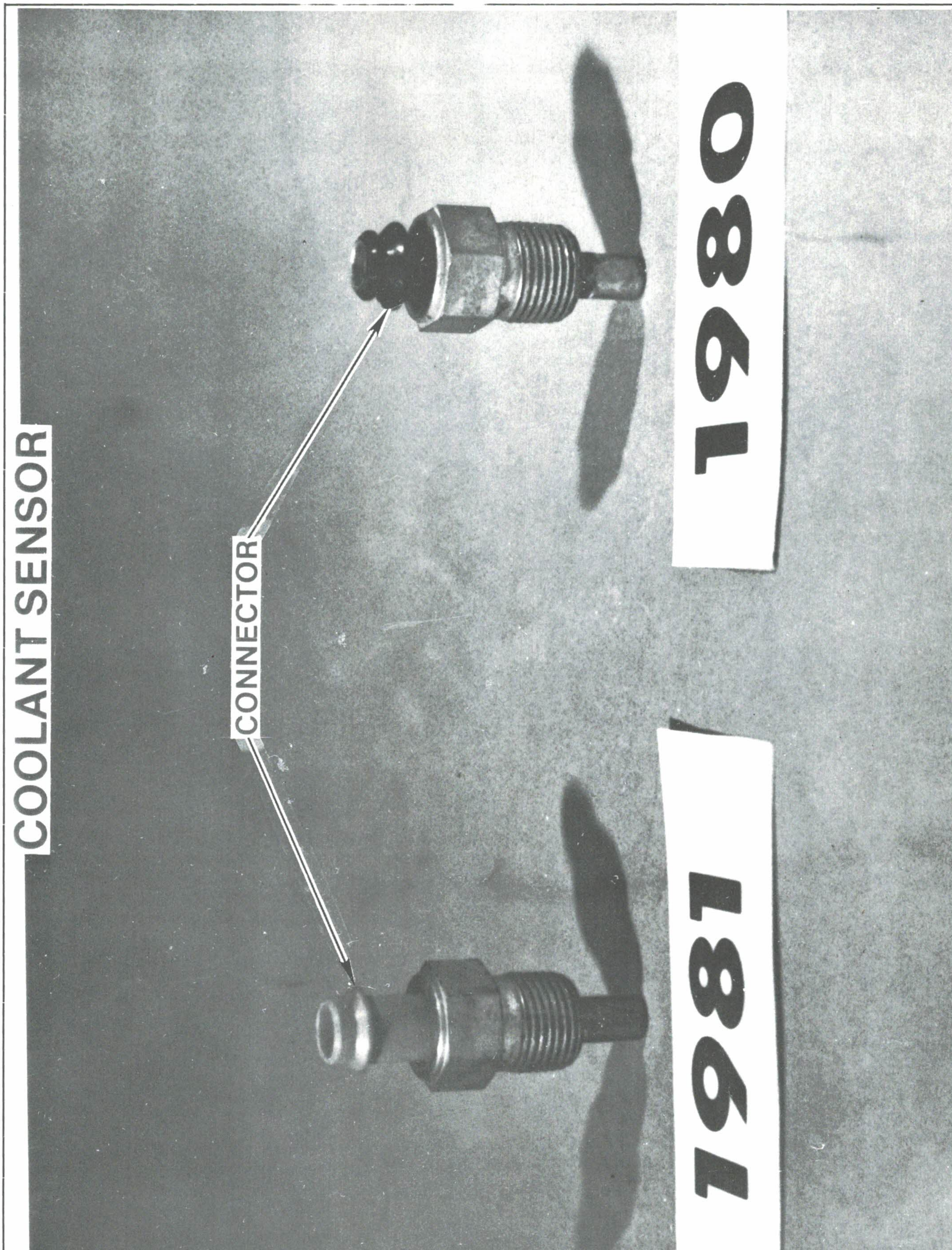


Figure 8 Coolant Temperature Sensor

MAP SENSOR

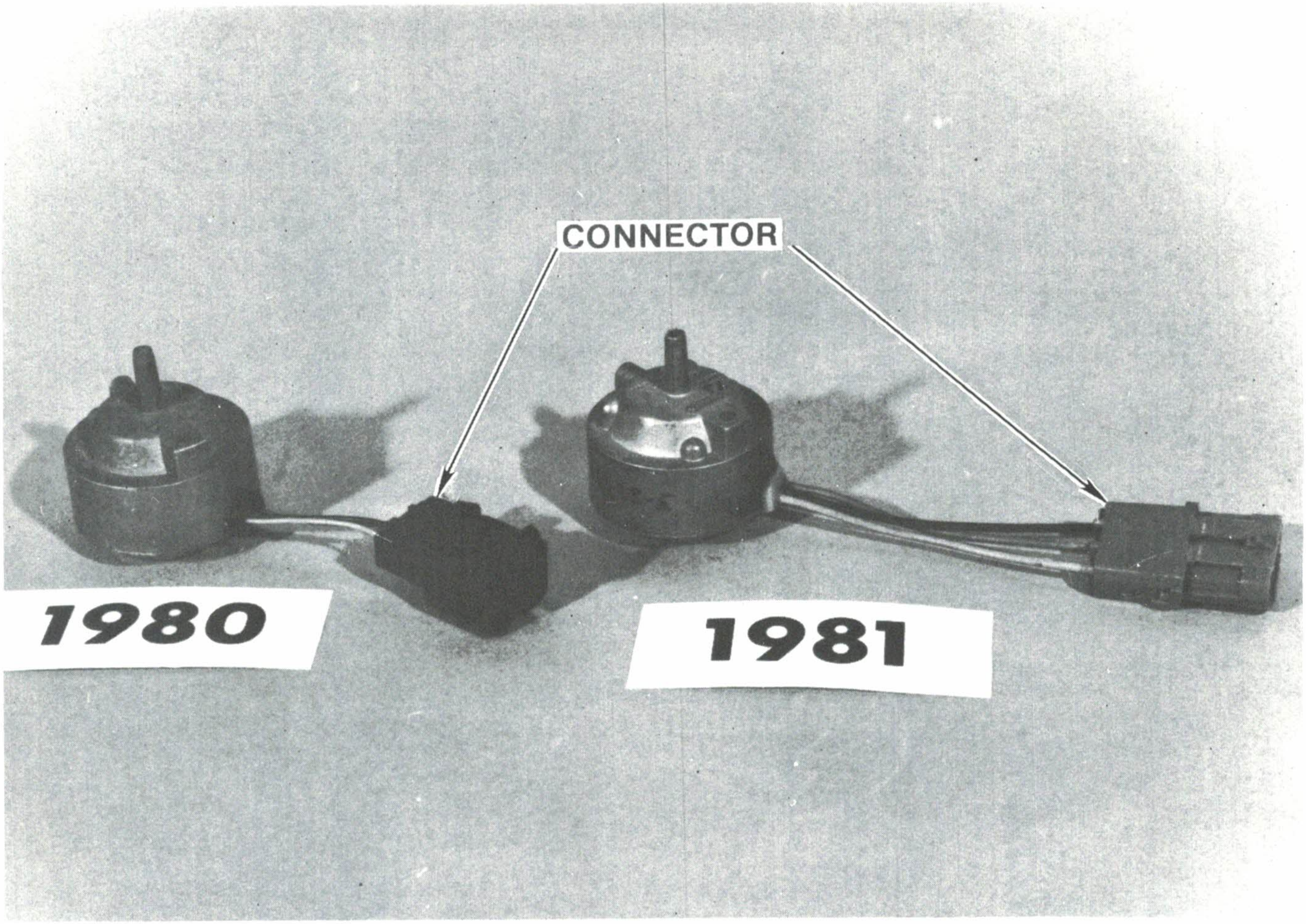


Figure 9 M.A.P. Sensor

of the engine directly below the thermostat. This sensor provides temperature information to the ECM for fuel enrichment during cold operation, for idle speed control, ignition timing and EGR operation. For 1981, canister purge, air management and modulated displacement are also controlled.

c. Manifold Absolute Pressure Sensor (MAP)

The manifold absolute pressure (MAP) sensor monitors the changes in intake manifold pressure (engine vacuum) which result from engine load and speed changes. Under heavier loads, the intake manifold pressure increases, (vacuum signal is weaker), additional fuel is required. The MAP sensor sends this information to the ECM so that the injector on time (pulse width) will be increased.

As manifold pressure decreases, (vacuum signal is stronger), the pulse width will be shortened. The MAP sensor is mounted under the instrument panel near the right-hand A/C outlet and is connected electrically to the ECM. A hose from the throttle body provides its input signal.

d. Barometric Pressure Sensor (BARO)

This unit senses ambient barometric (atmospheric) pressure and provides information to the ECM on ambient pressure changes due to weather and/or altitude. The sensor is mounted under the instrument panel near the right-hand A/C outlet and is connected electrically to the ECM. The sensor's atmospheric opening is covered by a foam filter.

e. Throttle Position Sensor (TPS)

The throttle position sensor is a variable resistor mounted to the throttle body and connected to the throttle valve shaft. Movement of the accelerator pedal causes the throttle shaft to rotate, thus opening or closing the throttle blades. The sensor determines shaft position, and signals this to the ECM. The ECM processes this signal and determines conditions for the idle speed control. and injector pulse width.

BARO SENSOR

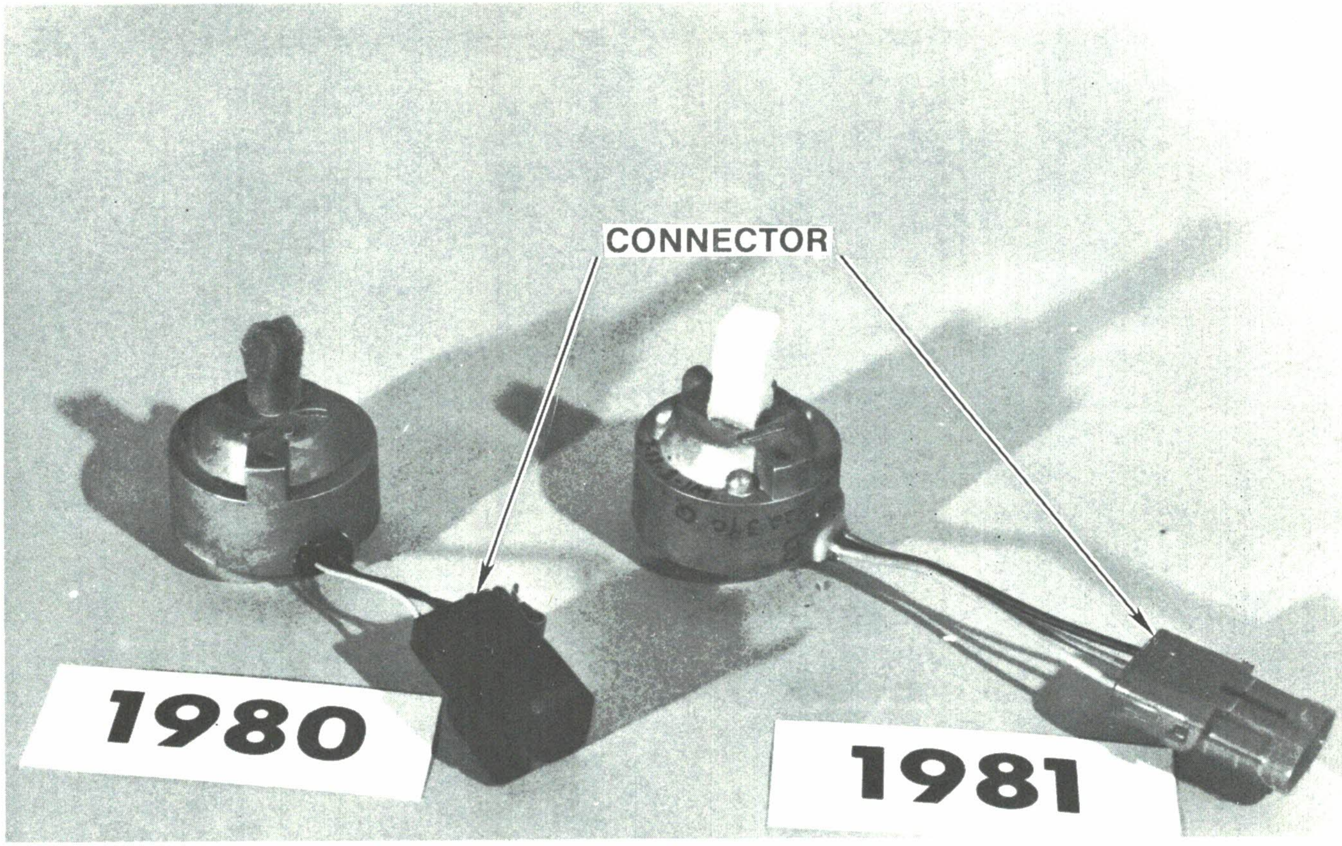


Figure 10 Sensor Baro

THROTTLE POSITION SENSOR (TPS)

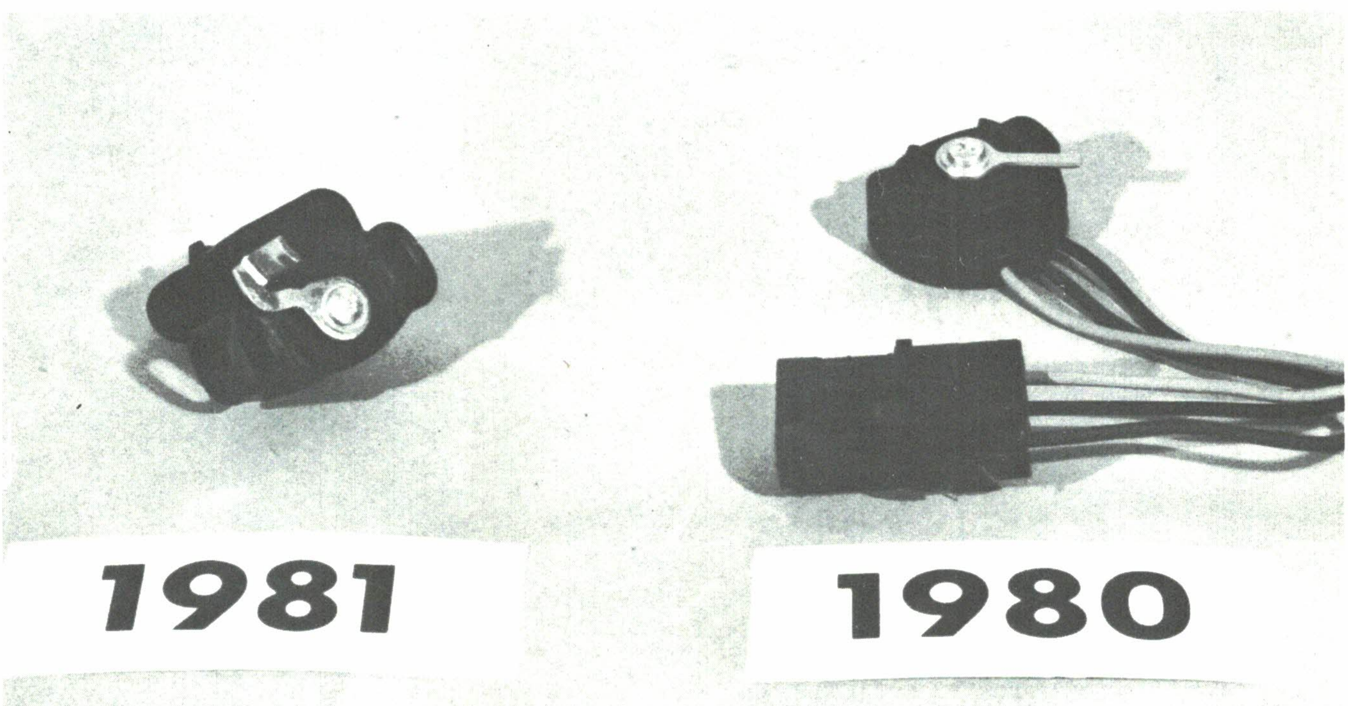


Figure 11 Throttle Position Sensor

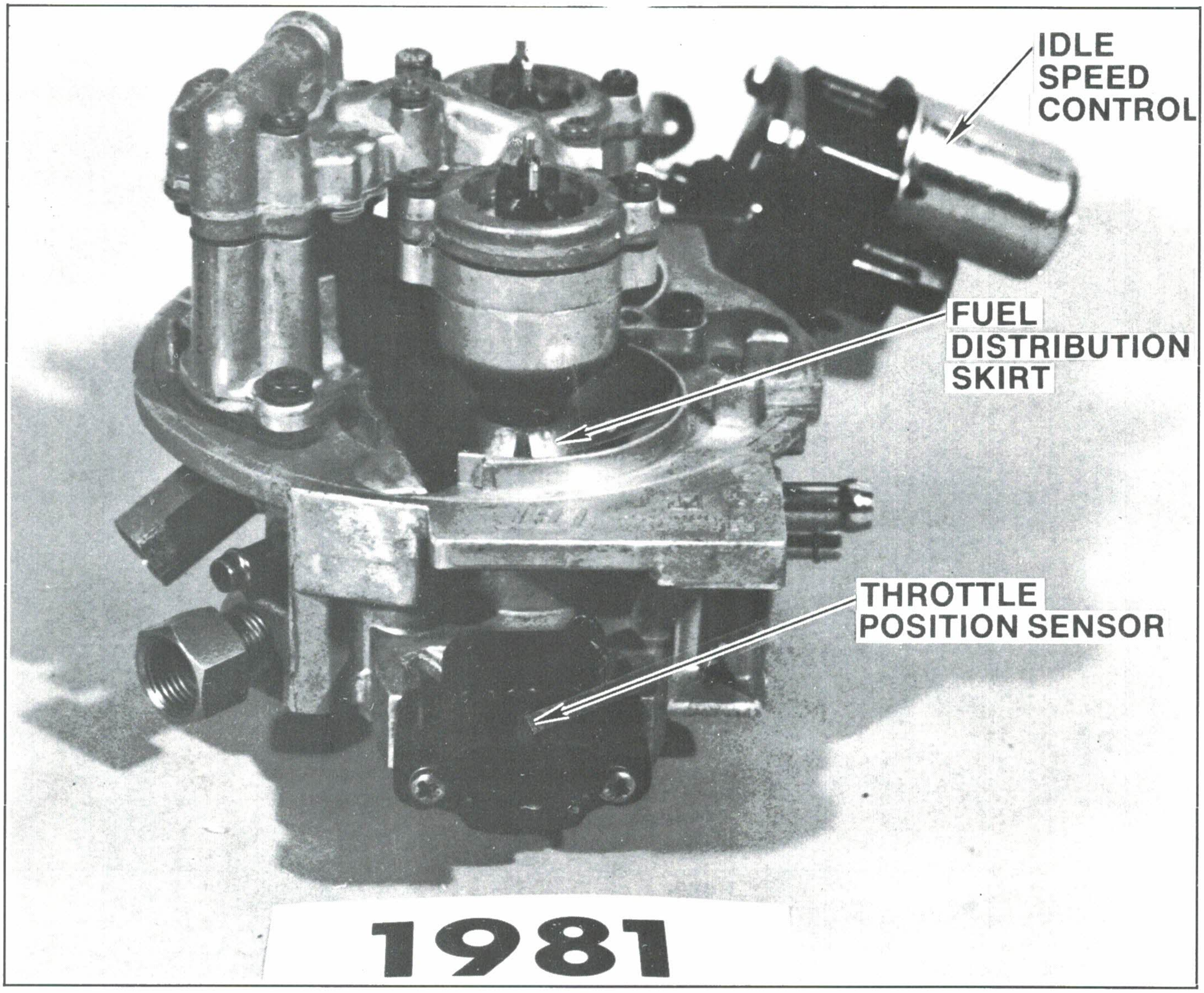


Figure 12 TPS Installation

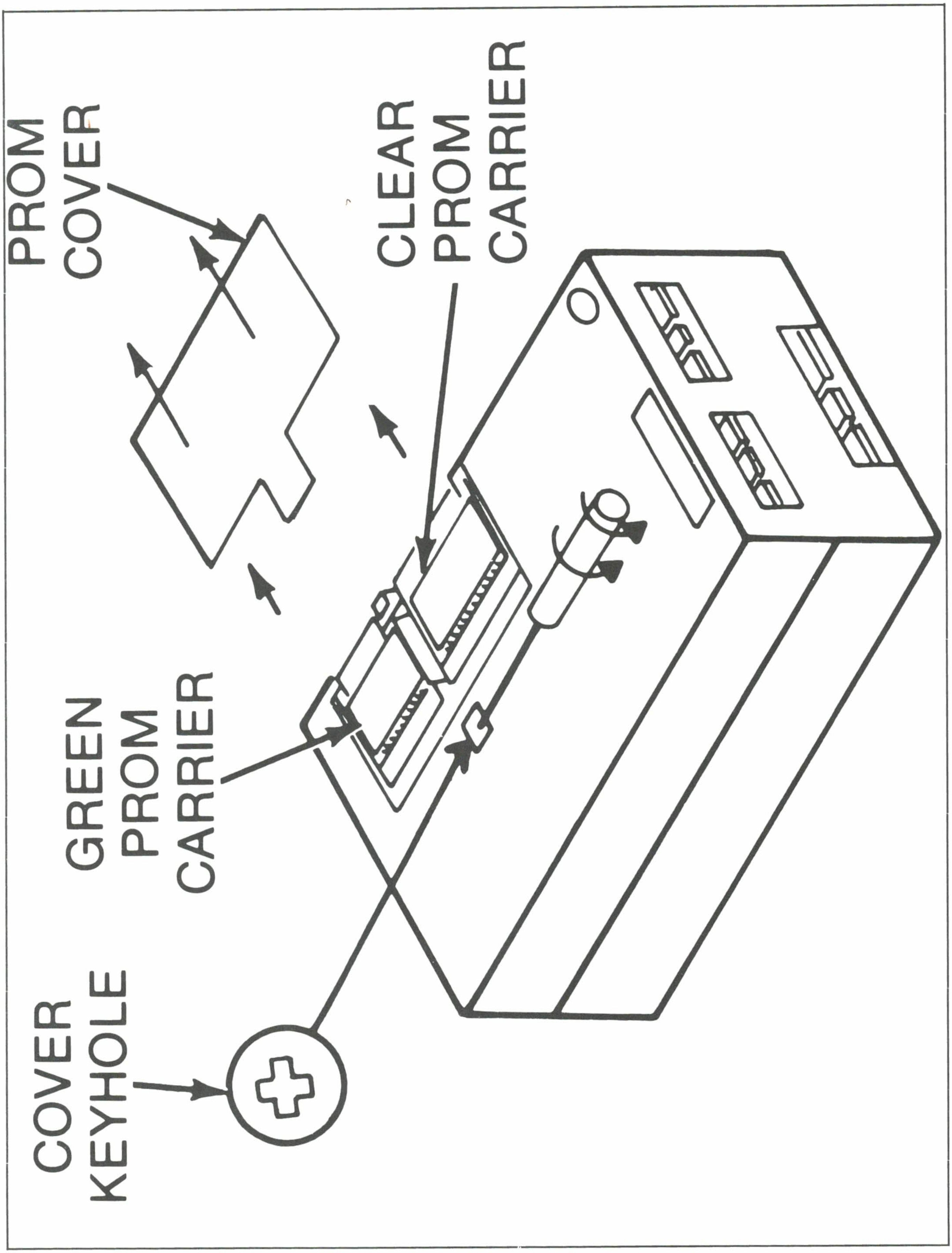


Figure 13 ECM with Prom Cover Removed

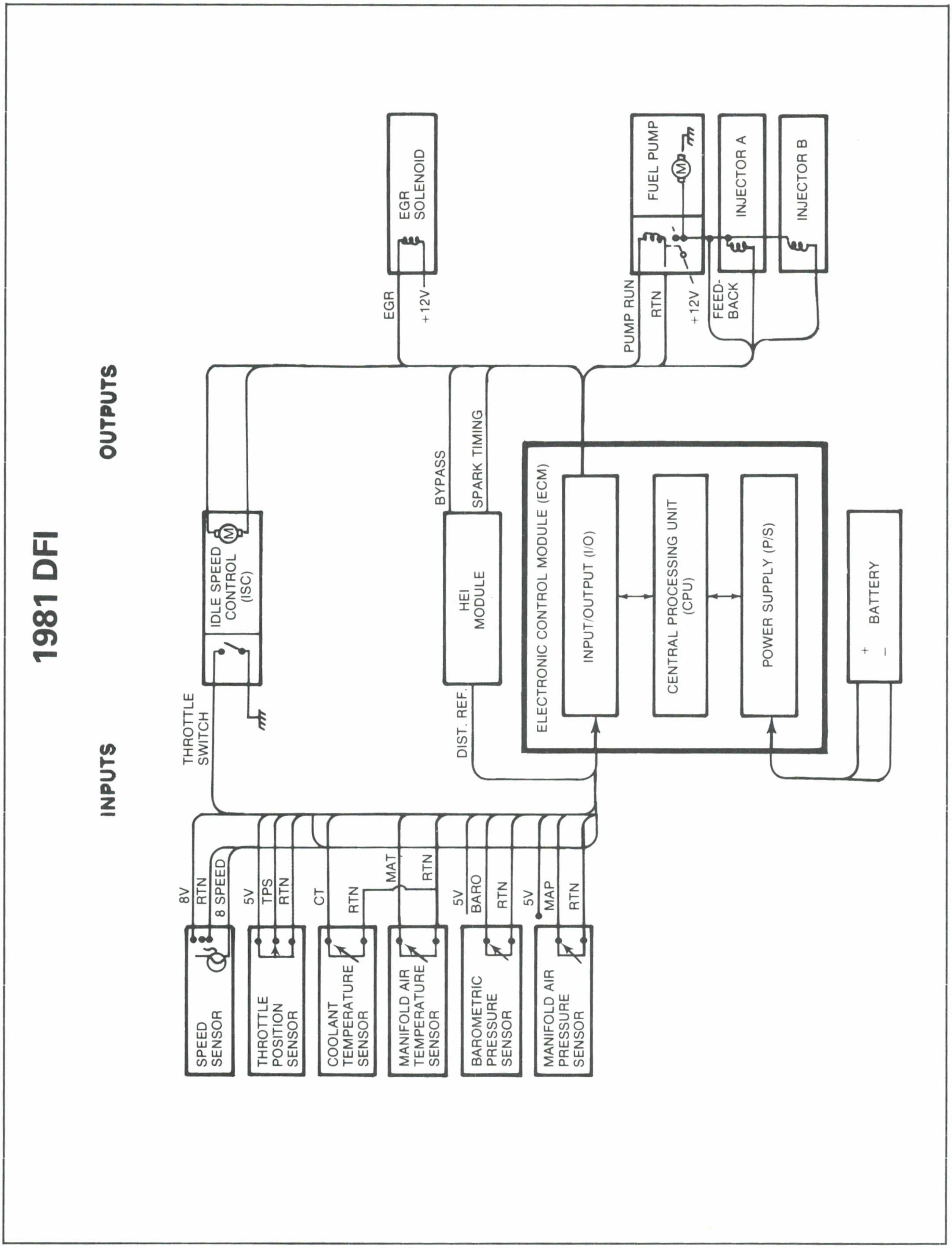


Figure 14 ECM Inputs/Outputs

f. Oxygen Sensor (02 Sensor) (1981)

The oxygen sensor, located in the left manifold, and exposed to the exhaust gases, is a device which generates a weak electrical voltage that varies with the oxygen content of the exhaust gases. As the amount of oxygen increases, as compared to the surrounding air, the voltage output falls, indicating a lean mixture. As the oxygen content decreases, a rich mixture is indicated. Signal range is 100-900 milivolts as a sensor temperature of 315°C. This signal is sent to the ECM where the information is used to calculate corrections in the air/fuel mixture (injector open time). Usable signals are generated when the sensor is heated to above 200°C.

g. Vehicle Speed Sensor (VSS) (1981)

The vehicle speed sensor, located in the speedometer head, provides a signal which is used as input for several functions. These include the cruise control, modulated displacement, miles per gallon calculations and idle speed. The speed signal is fed through a buffer amplifier to the ECM.

4. ELECTRONIC CONTROL MODULE (ECM)

The electronic control module makes all computations for the DFI system. Sensor signals are fed into the ECM from the various sensors and processed to produce the correct ON time for the injectors, the correct idle speed for the particular operating condition, and the proper spark advance. The ECM is mounted under the instrument panel and consists of various printed circuit boards mounted in a protective metal box.

The ECM receives power from the vehicle battery and when the ignition is in on the ON or CRANK position, the following information is received from the sensors:

Engine coolant temperature

Intake manifold air temperature

Intake manifold absolute pressure

Barometric pressure

Engine speed

Throttle position

The following commands are sent by the ECM:

Electric fuel pump-turned on

ISC motor control

Spark advance control

Fuel injector activation

EGR solenoid activation

The desired air/fuel mixtures for various driving and atmospheric conditions are programmed into the ECM. As the signals are received from the sensors, the ECM processes the signals and determines the engine's fuel requirements. The ECM issues commands to the injectors to open for a specific length of time. The length of the command pulses varies as the operating conditions change.

The DFI system is turned on when the igntion switch is turned on.

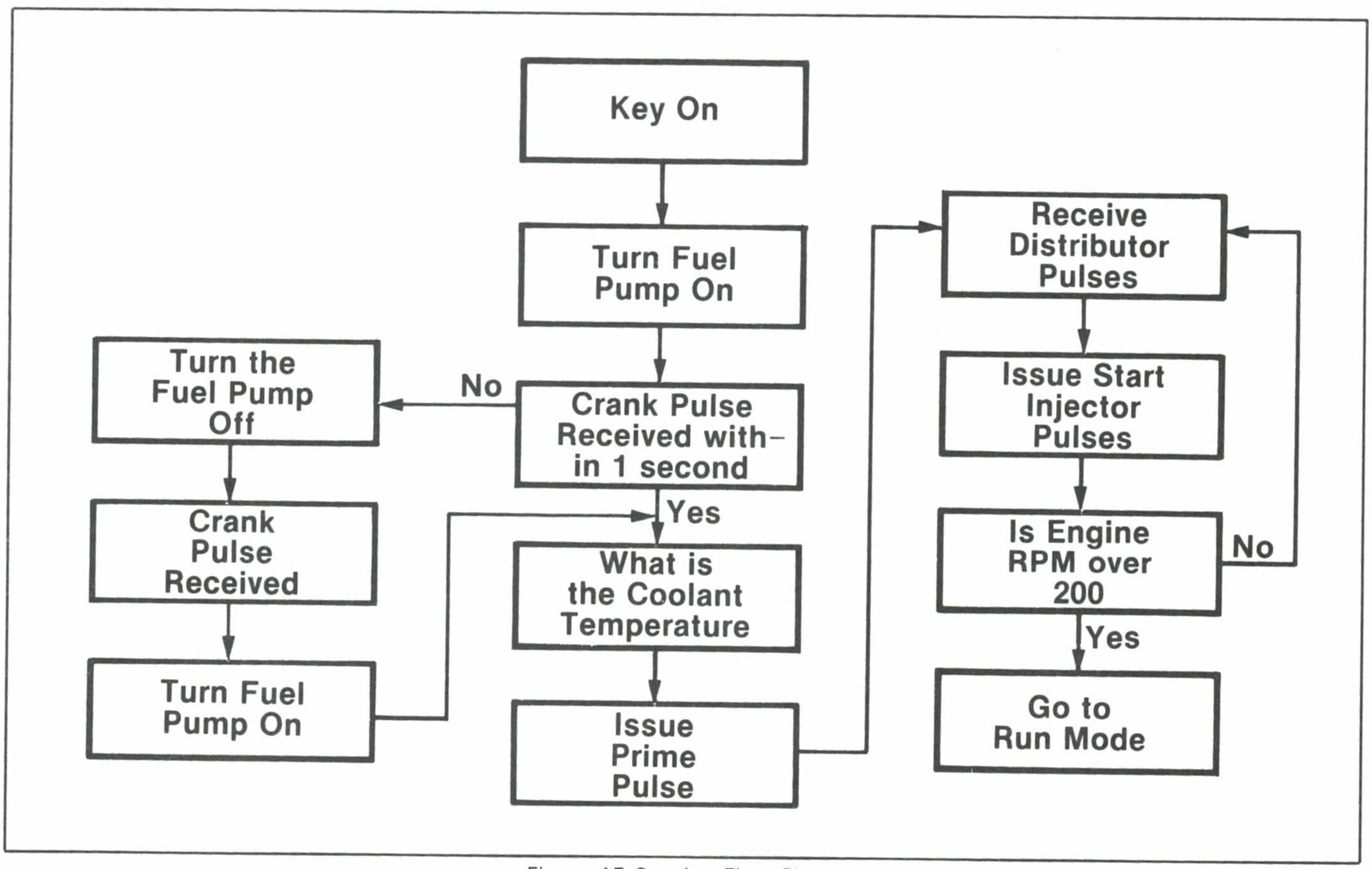


Figure 15 Starting Flow Chart

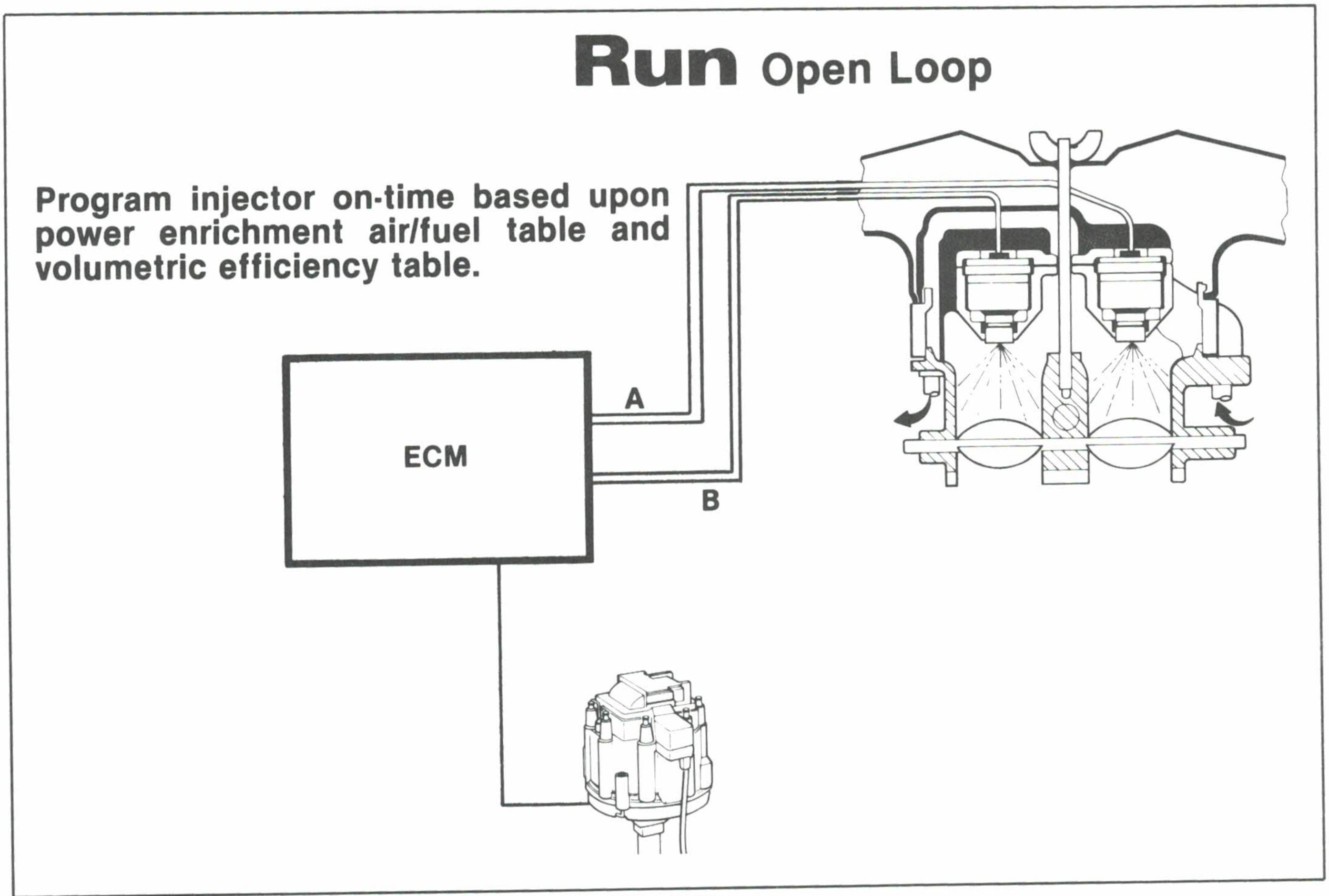


Figure 16

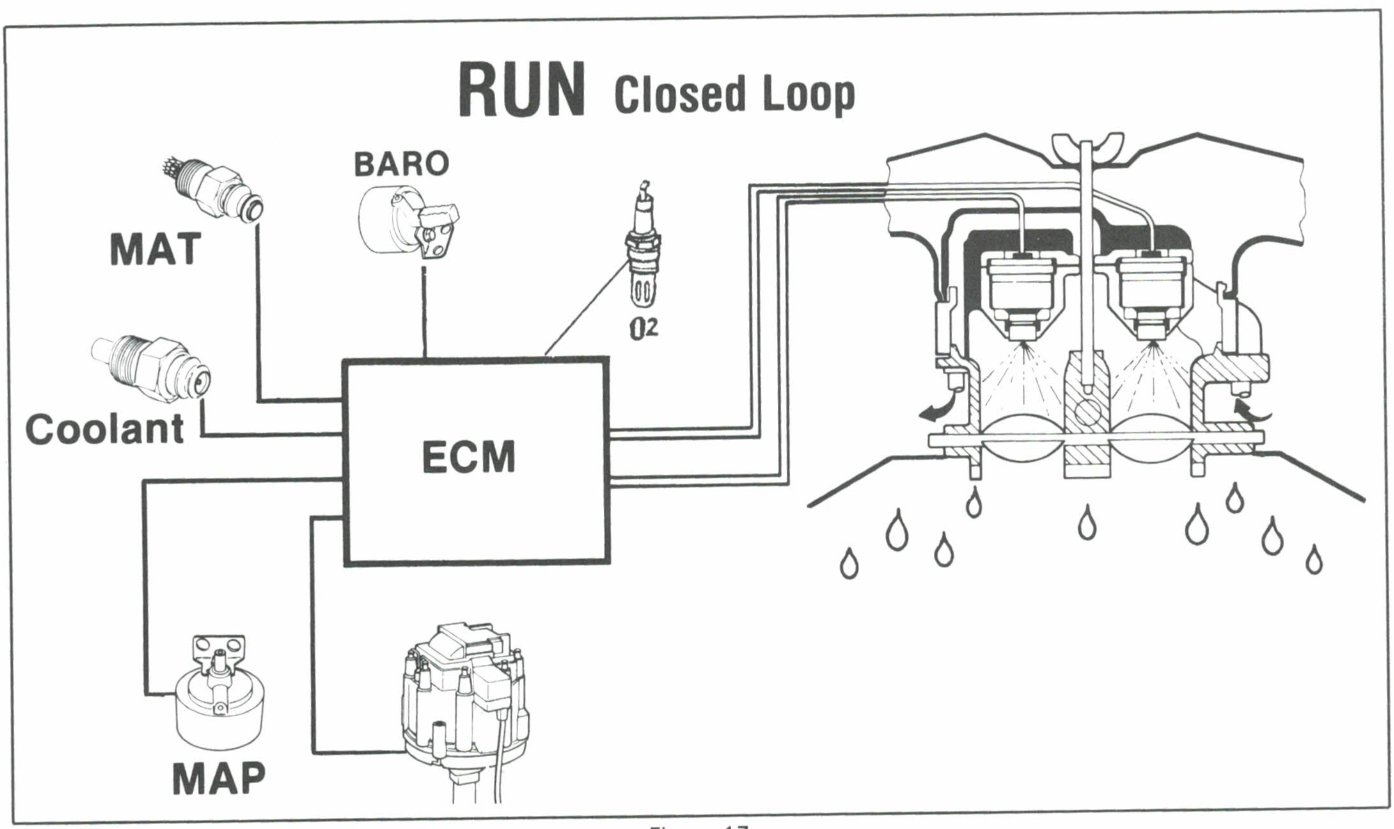


Figure 17

When the system is turned on:

1. The ECM receives the ignition ON signal.
2. The fuel pump is turned on by the ECM. (The pump will operate for approximately one second only, unless the engine is cranking or running.)
3. All engine sensors are turned on and begin sending signals to the ECM.
4. The EGR solenoid is energized to block the vacuum signal to the EGR valve at coolant temperatures below 110°F. (1980) or 150°F (1981).
5. The "Check Engine" and "Coolant" lights are illuminated as a functional check of the bulb and circuit.
6. Operation of the fuel economy lights begins.

The following events occur when the engine is started:

1. The fuel pump is activated for continuous operation.
2. The ISC motor begins controlling idle speed (including fast idle speed) if the throttle switch is closed.
3. The spark advance shifts from base (bypass) timing to the ECM programmed spark curve.
4. The fuel pressure regulator maintains the fuel pressure at 10 psi by returning excess fuel to the fuel tank.
5. The following sensor signals are continuously received and processed by the ECM.
   a. Engine Coolant Temperature
   b. Intake Manifold Air Temperature
   c. Barometric Pressure
   d. Intake Manifold Air Pressure
   e. Engine Speed
   f. Throttle Position changes
   g. Oxygen Sensor (if sensor is above 600°F)
6. The ECM alternately grounds each injector, precisely controlling the opening and closing time to deliver the proper amount of fuel to the engine.

The ECM controls the following systems:

a. Fuel Delivery System-ECM Functions

The ECM's control of fuel delivery can be considered in three basic modes: cranking, part throttle, and wide open throttle. A voltage signal in the cranking signal wire from the ignition switch tells the ECM that the engine is being cranked. If the engine is determined to be in the cranking mode, the starting fuel delivery consists of one long "prime" pulse from both injectors followed by a series of "starting" pulses until the cranking mode signal is no longer present.

In addition, there is a "clear flood" (unloader) condition where smaller alternating fuel pulses are delivered if the throttle is held wide open and cranking exceeds five seconds.

Once the engine is running injector open time is then adjusted to account for operating conditions such as idle, part throttle, acceleration, deceleration, altitude, air and coolant temperature and engine loading.

For wide open throttle (W.O.T.) conditions, which are sensed by comparing the MAP and BARO sensor signals, additional enrichment is provided. When the difference between their readings becomes small enough, the ECM recognizes a W.O.T. signal.

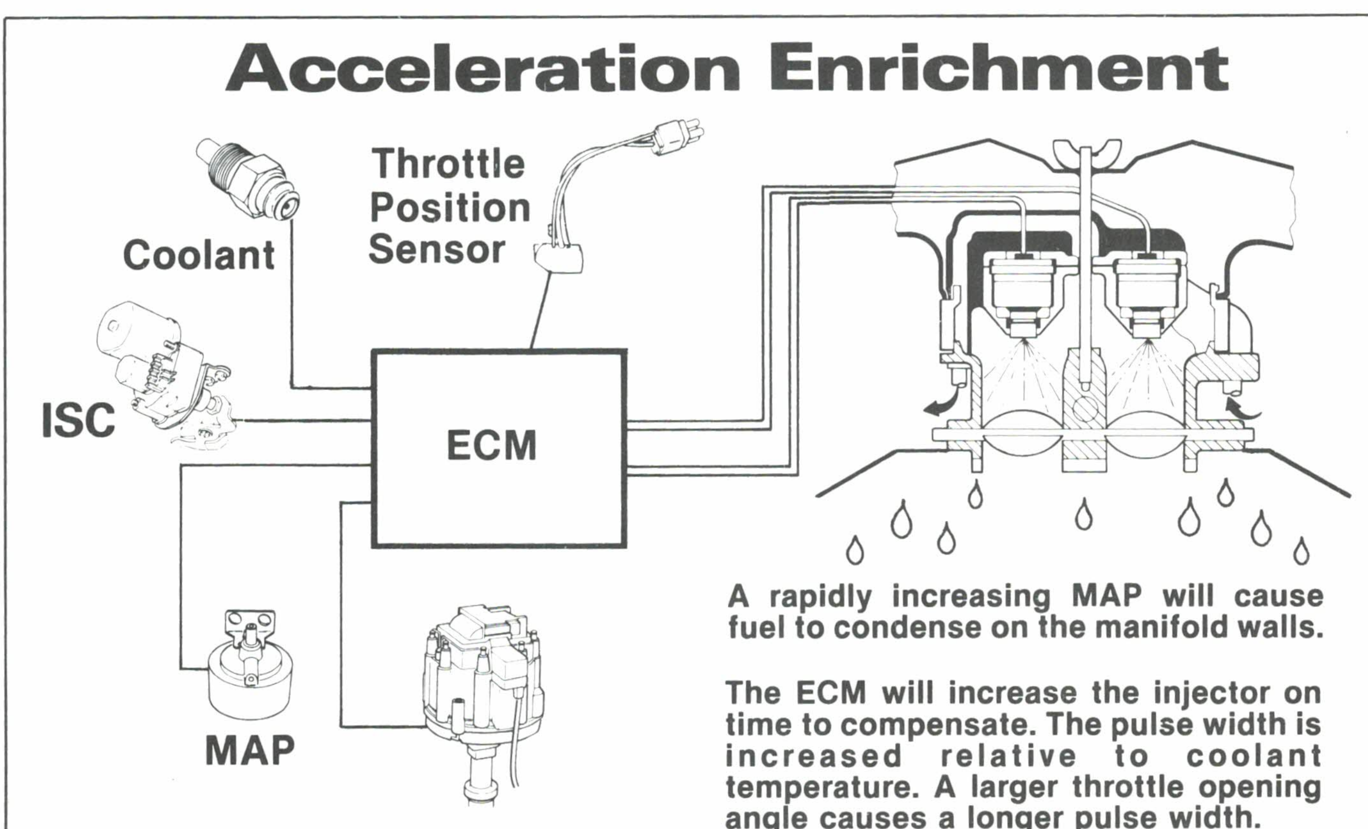


Figure 18

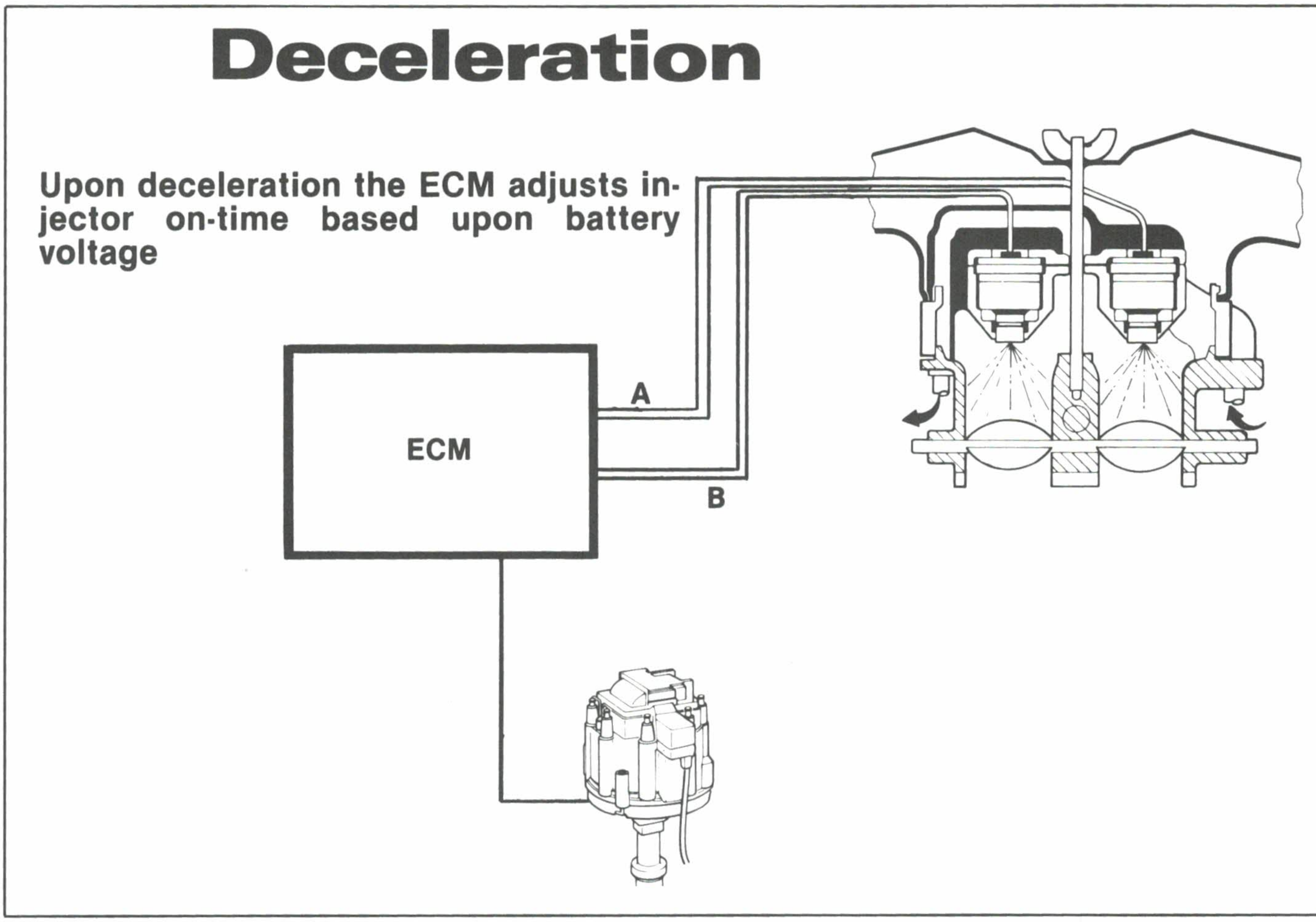


Figure 19

b. Idle Speed Control System - ECM Functions

The Idle Speed Control System is controlled by the ECM. The system controls engine idle speed in three ways:

1. Normal idle (RPM) control
2. As a fast idle device
3. As a "dashpot" on decelerations and throttle closing.

The normal engine idle speed is programmed into the ECM and no adjustments are possible. Under normal engine operating conditions idle speed is controlled in a "closed loop" fashion. To accomplish this, the ECM continually senses the engine idle speed and then issues commands to the ISC to move the throttle stop to maintain the designed speed.

For engine starting, the throttle is either held open by the ISC for a longer period (cold) or a shorter time (hot) to provide adequate engine warm-up prior to normal operation.

Signal inputs for transmission gear (from the ADL-automatic door lock switch), air conditioning compressor clutch (engaged or not engaged), and throttle open or closed are used to either increase or decrease throttle opening in response to these particular engine loadings.

As an example, as the transmission is shifted from neutral to reverse, the signal from the ADL switch allows the ECM to "anticipate" the higher load and raise the engine idle speed while the shift is actually being made. Thus, the idle speed stays virtually unchanged.

Another function of the ISC is to signal the ECM through the nose switch. When the accelerator is depressed the switch disconnects letting the ECM know the vehicle is under driver control. The ECM then drives the ISC full out to "catch" the accelerator when it returns for instance during deceleration.

On deceleration the ISC acts as a dashpot to hold the throttle open momentarily for improved emission control.

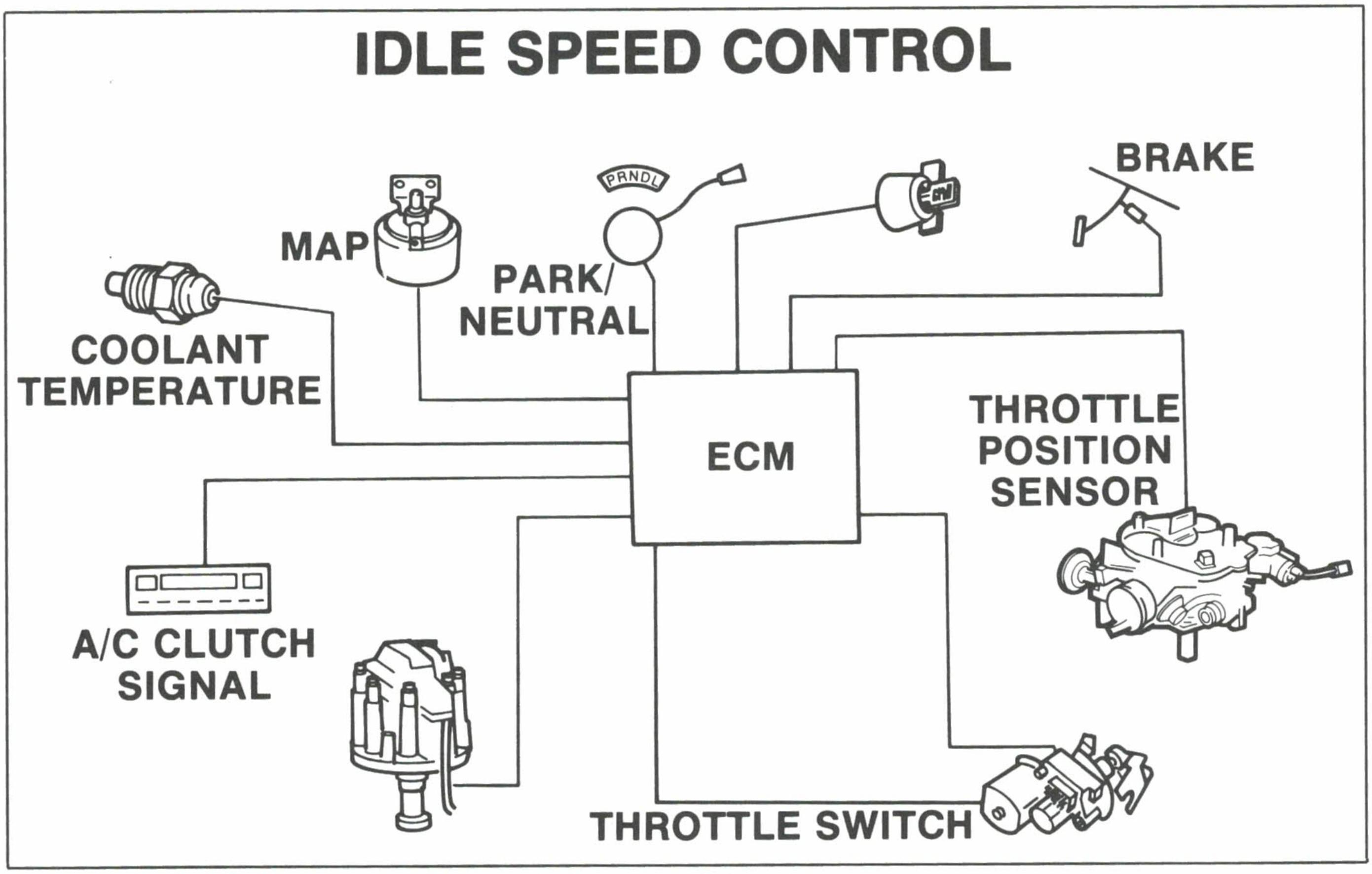


Figure 20

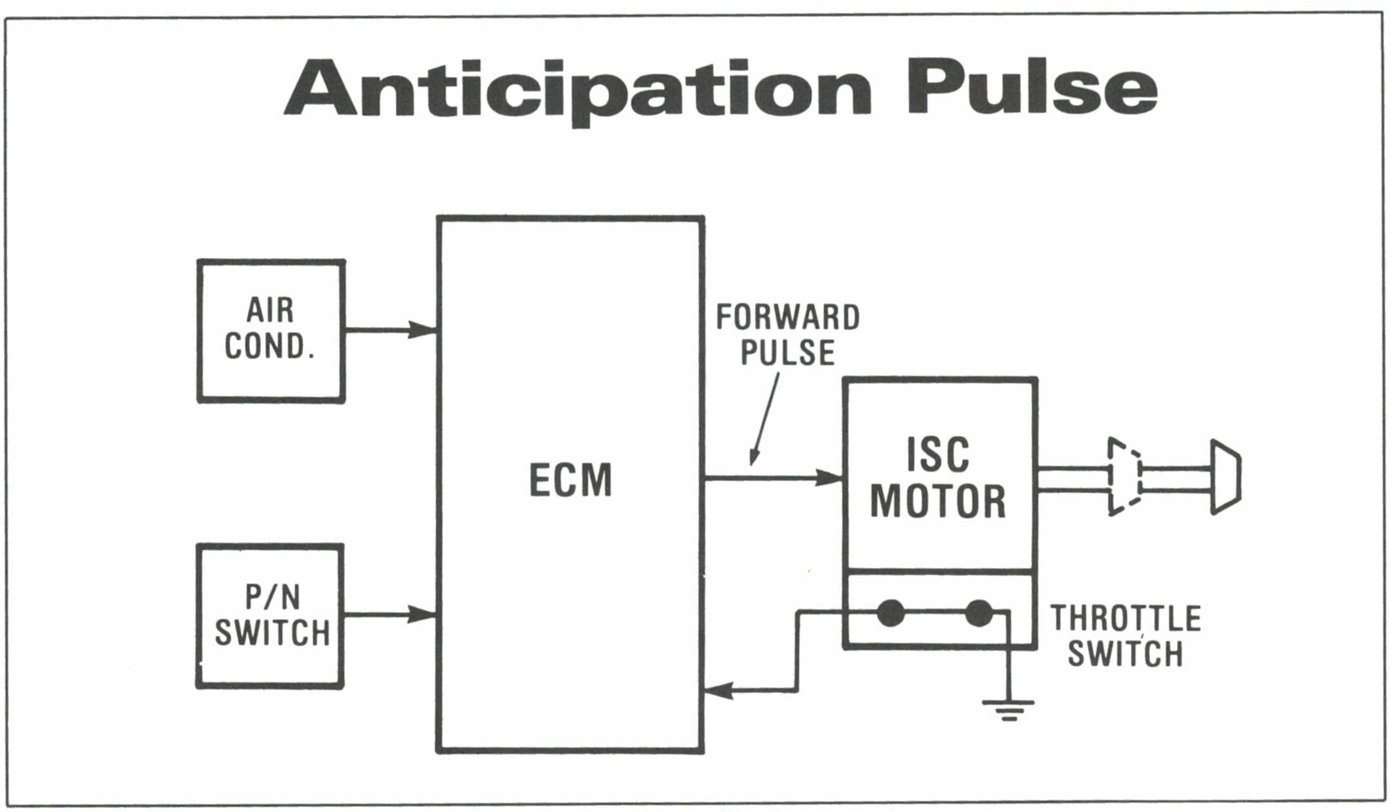


Figure 21

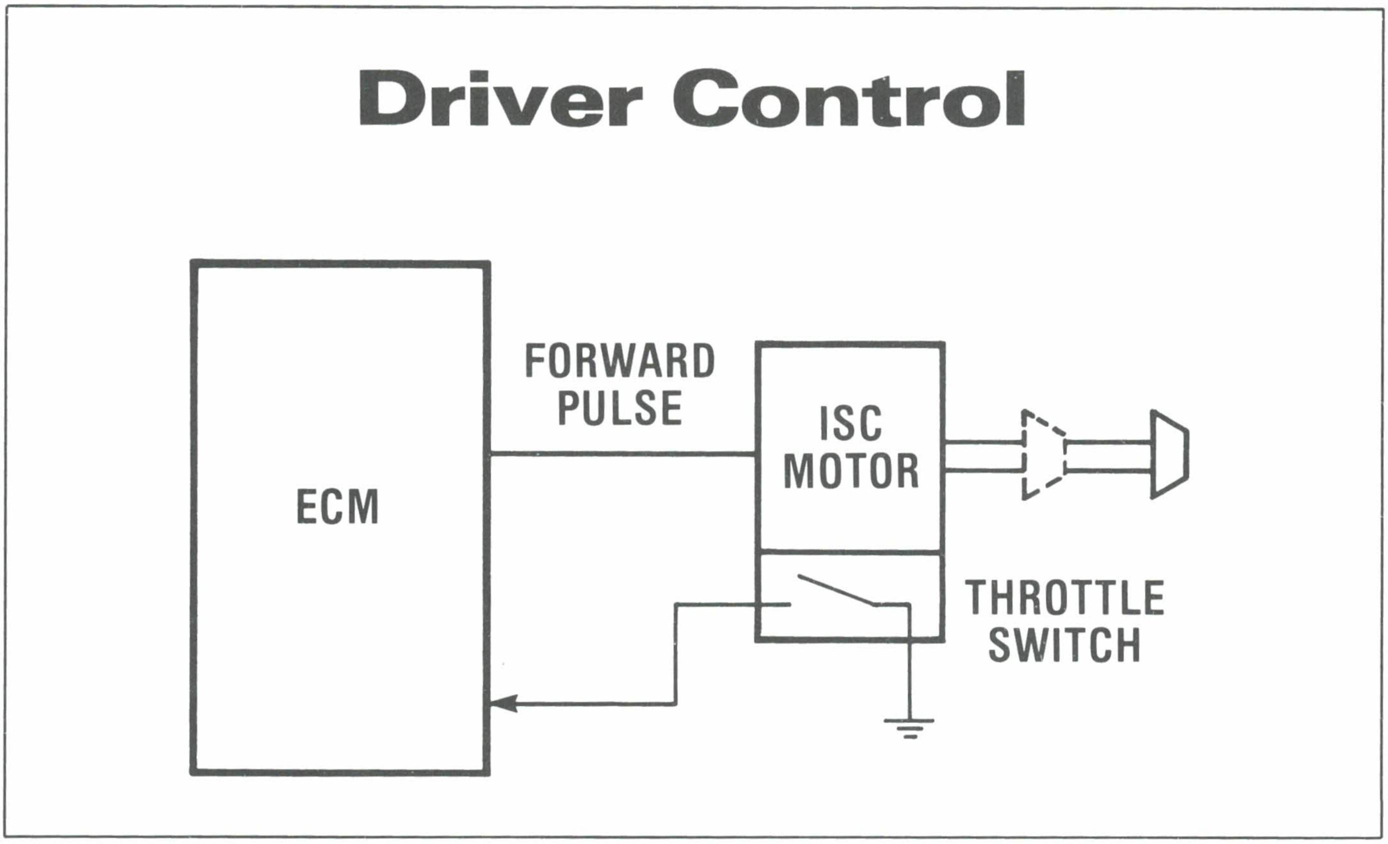


Figure 22

5. ELECTRONIC SPARK TIMING (EST)

The EST type HEI distributor receives all spark timing information from the ECM when the engine is running. The ECM provides spark plug firing pulses based on engine operating conditions. The electronic components for the EST system are contained in the ECM and in the 7 terminal HEI module.

The EST distributor is similar to the normal HEI distributor except that it has neither centrifugal nor vacuum advance mechanisms. Also, the HEI module has three terminals not found on a regular HEI module. These are Reference, EST, and Bypass. The Reference terminal sends RPM and crankshaft position information from the pickup coil to the ECM. The ECM (above 200 RPM) sends a signal on the bypass line back to the HEI module indicating that the reference signal has been received by the ECM.

Based on the signals from the sensors, the ECM determines proper spark timing for the operating conditions and sends that signal through the EST line to the HEI module. The module then causes the spark plugs to fire at the correct time.

If for any reason the bypass signal is not received by the HEI module, or if the reference output does not reach the ECM, the distributor will operate at base timing according to a program contained in the HEI module. This advance is somewhat retarded from normal operation, but will vary with engine speed. Sensor outputs are not used.

If, however, the EST signal fails to reach the HEI module, the engine will not run.

The distributor will operate at base timing during cranking (below 200 RPM) and when coolant temperatures are below a predetermined level. By remaining at base timing, with no advance, the engine starts more easily.

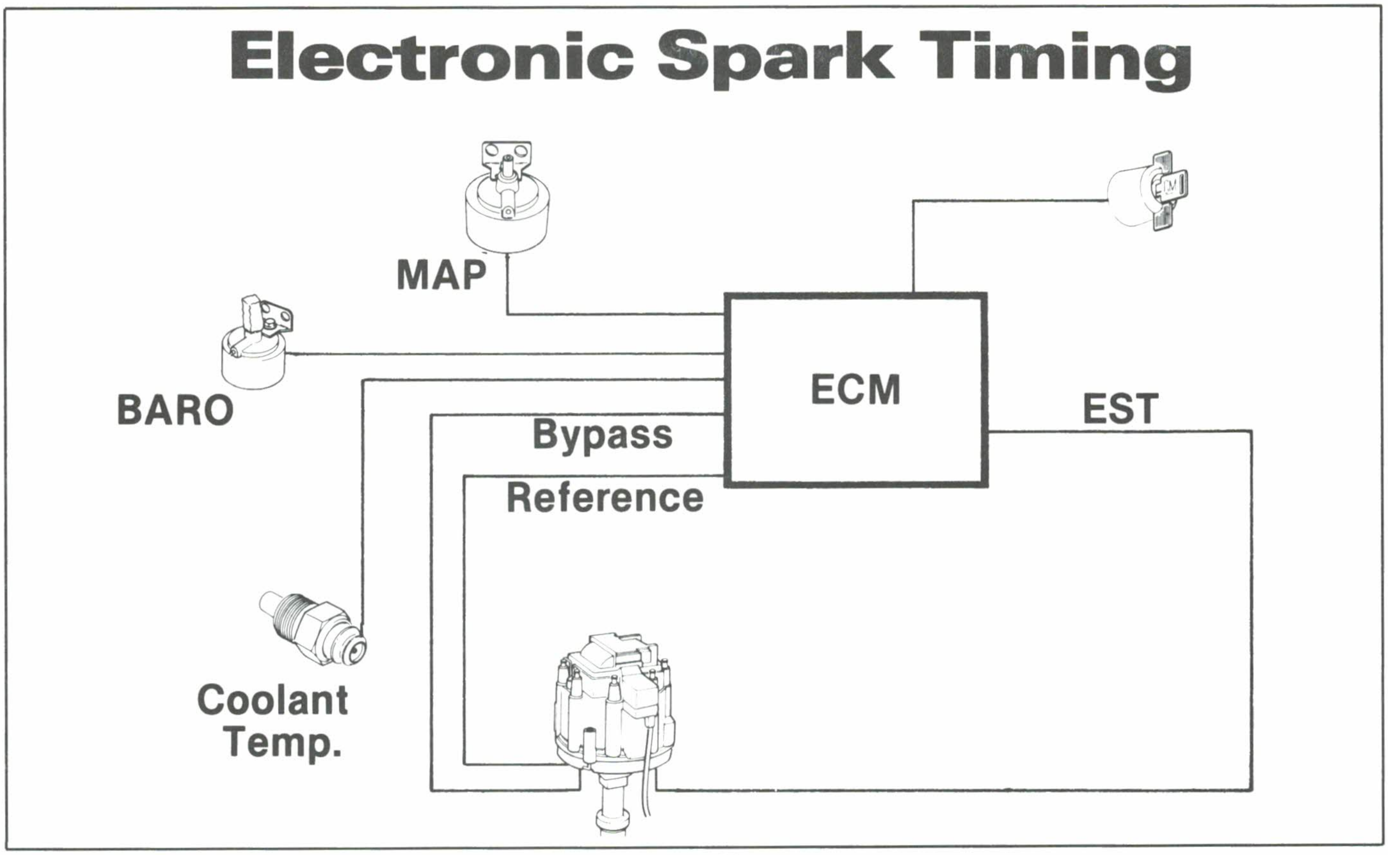


Figure 23

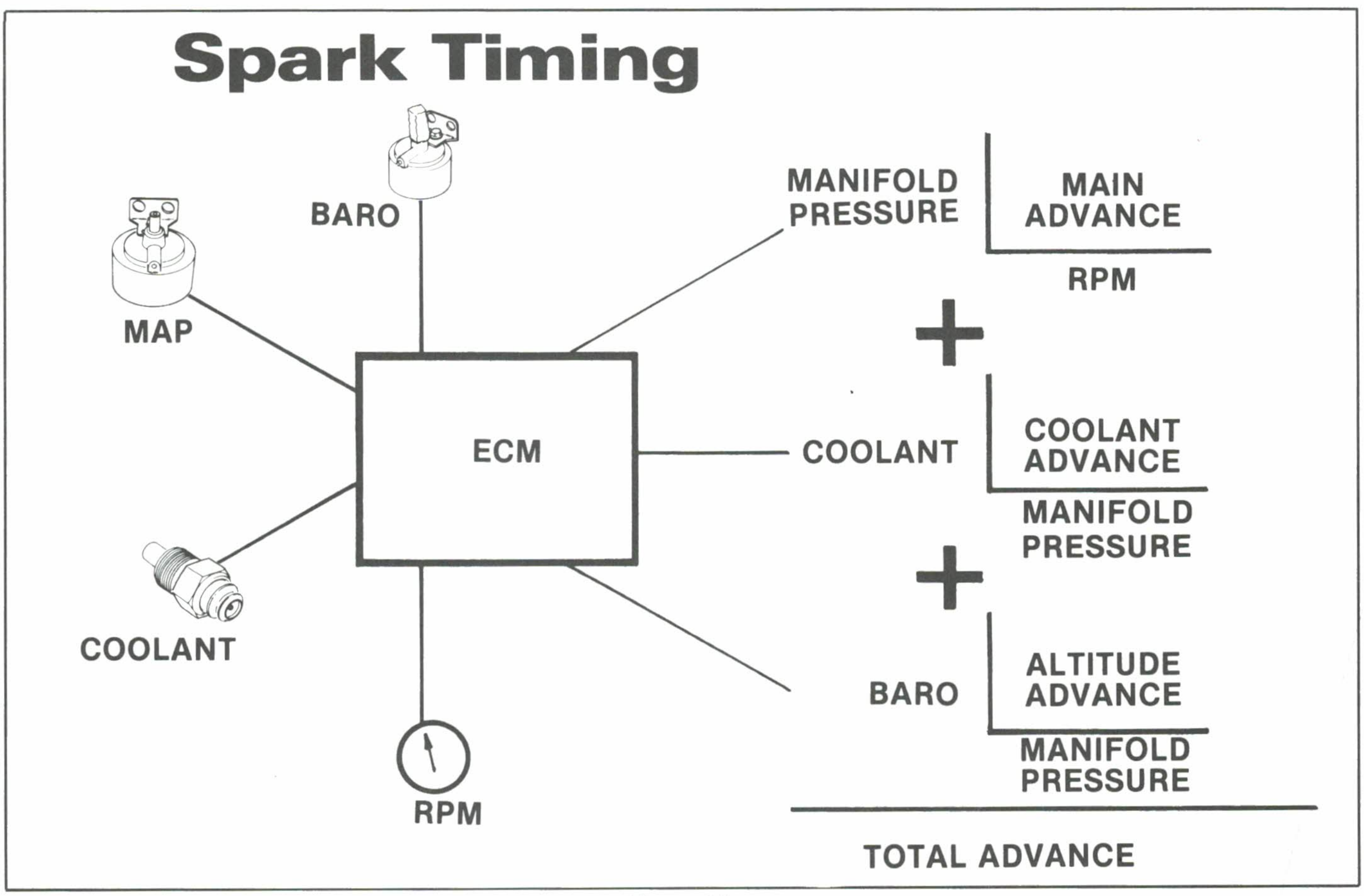


Figure 24

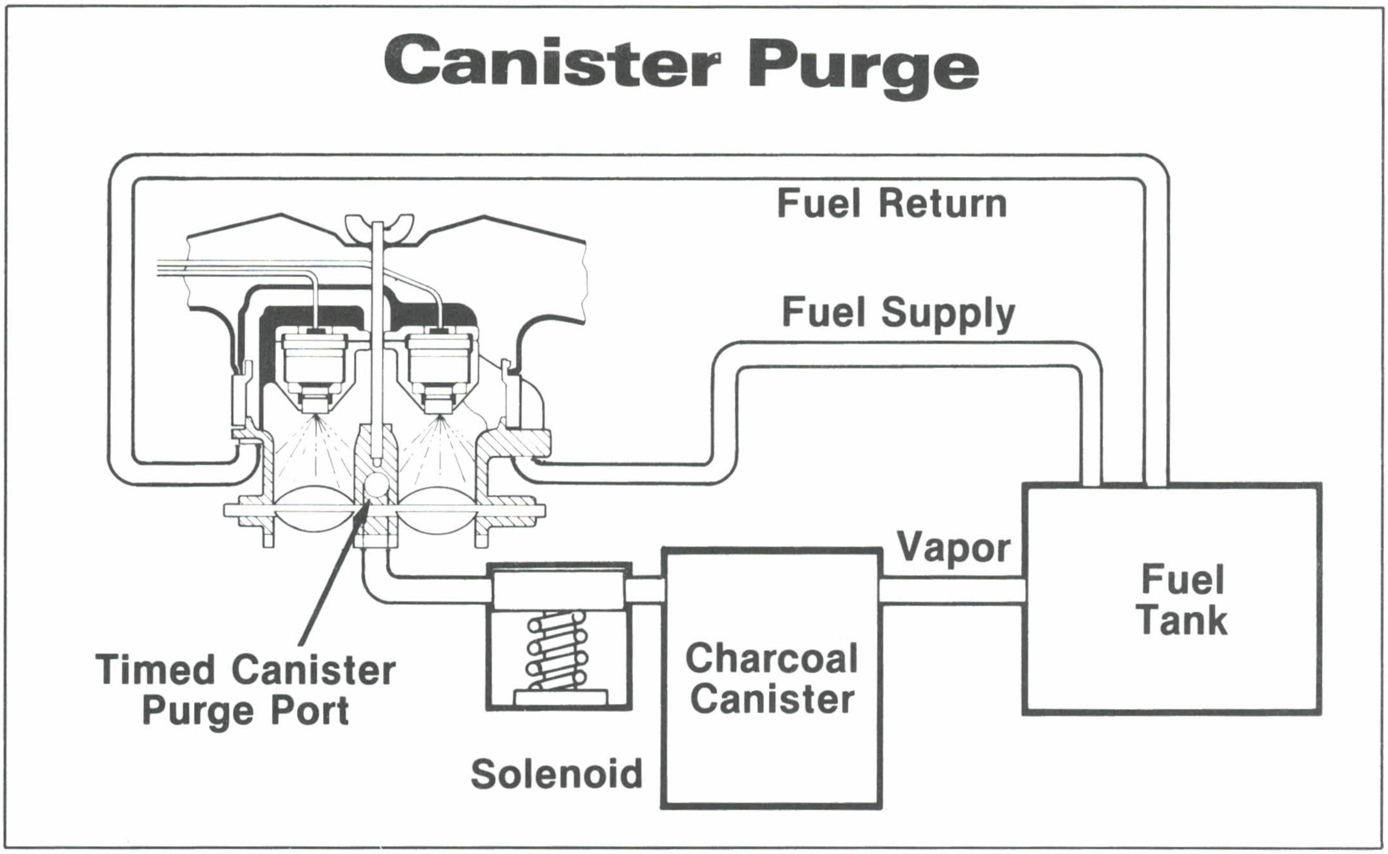


Figure 25

6. EMISSION CONTROL SYSTEMS (1981)

a. Evaporative Emission Control

To collect and hold fuel vapors from the fuel tank and intake manifold, a charcoal cannister is used. The ECM controls the purge on the cannister through the use of a solenoid. When the solenoid is de-energized, a vacuum valve at the cannister opens and allows the cannister to be purged of stored hydrocarbons. When the ECM turns the solenoid on, no purge is allowed. The purge signal at the throttle body is ported and does now allow purge at closed throttle except for a .030" bleed into the PCV port. To allow the ECM to turn the solenoid on the engine must be running and the coolant temperature must be above 80°C (178°F).

b. EGR (Exhaust Gas Recirculation)

EGR is a means of flowing a small amount of exhaust gas through a valve mounted on the intake manifold where it is fed back into the combustion chamber. In this process, combustion temperature is lowered by the introduction of inert gases thereby reducing the amount of oxides of nitrogen. The ECM controls, with a solenoid, the flow of vacuum to the valve. (also used in 1980)

The EGR is off when the coolant temperature is below 64°C (150°F), under high engine load, (below 32kpa), during power enrichment (wide open throttle-87kpa) and at idle. (120°F for 1980).

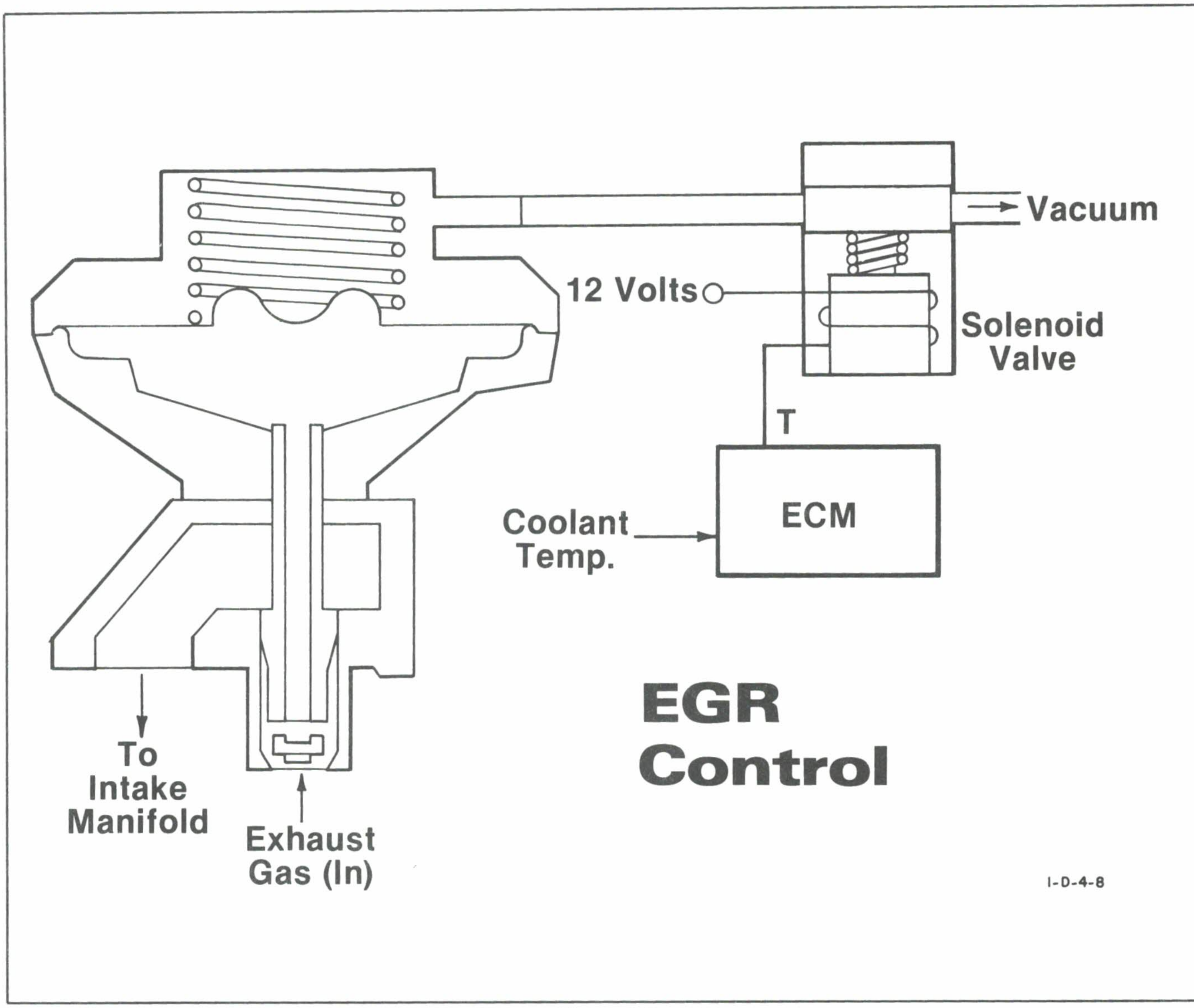
c. Air Management System

The A.I.R. control valve controls the flow of air from the air pump. Depending upon the operation, the ECM will either direct the air flow to the air cleaner, the exhaust ports in the cylinder head, or the catalytic converter.

The air control valve consists of two parts.

The air divert section, when energized, will send the air to the air switching valve. When deenergized, air flow will be to the air cleaner. The air switching valve, when energized will send air to the exhaust ports, and when deenergized, will be sent to the catalytic converter.

Upon initial start-up with the coolant temperature below 59°C (120°F) and the manifold pressure below 69kpa, the air divert and air switching valves are energized and air is sent to the exhaust ports. Once coolant temperature is above 59°C (120°F) and the minimum manifold air pressure is above 61kpa, the ECM will turn off the air switching valve and air will be sent to the catalytic converter. At any time, power enrichement is in process (manifold air pressure greater than 87kpa and engine rpm above 4,000 rpm) air will be diverted to the air cleaner. This is to prevent the catalytic converter from overheating.



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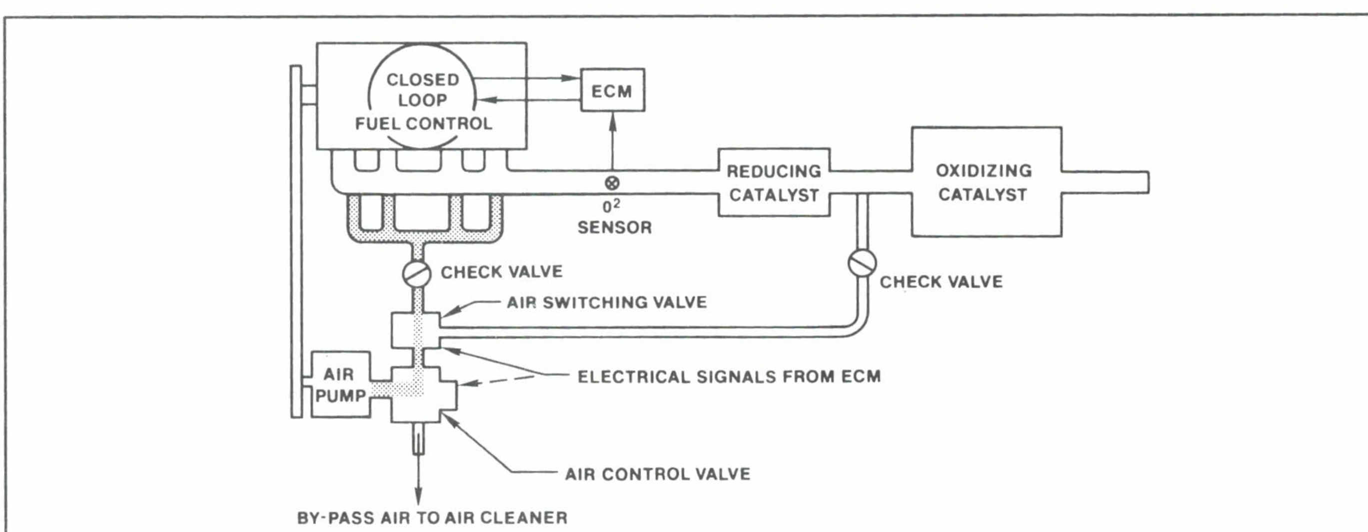

Figure 27

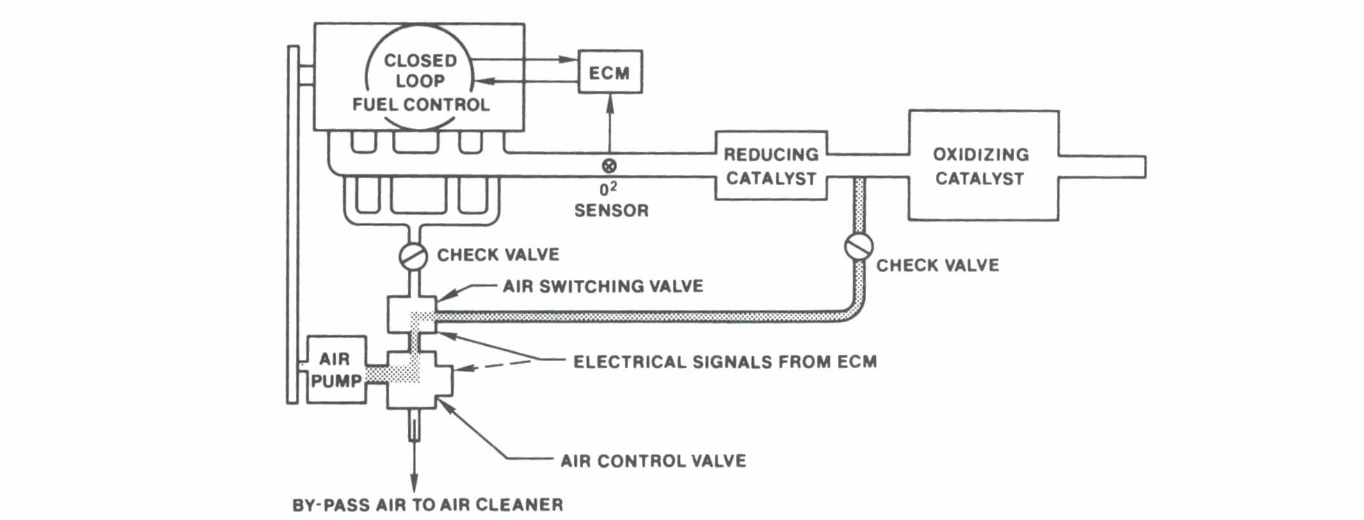

Figure 28

7. CLOSED-LOOP FUEL CONTROL (1981)

For proper conversion of HC and CO and the reduction of NOx in the catalytic converter, the air/fuel ratio must be controlled very close to 14.7 to 1. At 14.7 to 1 the converter efficiency is at maximum and this maintains low emission levels. Since the ECM controls the air/fuel ratio it needs to check its exhaust emission levels and make corrections as required. The 02 sensor provides this information resulting in improved emission levels while maintaining acceptable levels of driveability and fuel economy. The technician, while conducting the diagnostic checks, can read the 02 sensor voltage output and compare it with specifications. This, in many situations, eliminates the need to experiment with known good sensors and assures greater repair reliability.

8. SYSTEM DIAGNOSTICS

The DFI diagnostic routine for 1981 has four types of tests which may be utilized. These four tests are:

1. The engine malfunction tests
2. Switch tests
3. Engine data displays
4. Output cycling tests

Engine malfunction and switch tests were also used in 1980.

The engine malfunction tests detect system failures or abnormalities. When these malfunctions occur, the ECM will turn on the amber "Check Engine" light located in the right hand information center. The corresponding trouble codes will be stored in the ECM memory. If a sensor fails, the ECM substitutes a failsoft value into its calculations and continues to operate the engine using this value. In this mode, there may or may not be some loss of driveability. If the fault should clear up, then the "Check Engine" light turns off, but the trouble code remains. This condition is known as an intermittent failure. The digital display panel of the Electronic Climate Control will display any of the trouble codes which may have been stored in the ECM.

The switch tests check the operation of various switches which provide inputs to the ECM. During this test series the technician turns certain switches on and off. The ECM analyzes this action to determine if the switches are operating properly.

The engine data series displays important engine information. The technician then compares this information to specifications.

The output cycling series turns various ECM outputs on and off. During this test series, the technician can check the operation of the engine control solenoids and lamps by using command signals originating from the ECM.

MILES PER GALLON (MPG) SENTINEL

The mpg sentinal panel is a three-digit display with a three or four button keyboard. The standard is a four button panel. If the car is equipped with digital instrumentation, the sentinel will not have a range button and will therefore have only three buttons. This mpg feature is a part of the digital instrumentation package.

The DFI electronic control module (ECM) sends miles per gallon data to the ECC control head, which in turn operates the mpg sentinel display.

Normally, unless otherwise requested, the instantaneous miles per gallon is displayed in two digit form. The average mpg can be displayed by pressing the average button on the mpg sentinel panel. The average miles per gallon will appear as three digits, accurate to tenths of a gallon.

The DFI ECM will begin calculating the average mpg for a new time period whenever the reset button on the mpg panel is pressed. A range module, placed between the ECM and the ECC control head is used to compute the range. The range is calculated by multiplying remaining gallons of fuel in the tank by average miles per gallon economy.

By pressing the active cylinder button on the mpg panel, the number of active cylinders will be displayed. The readout will show a 4, 6 or 8 cylinder usage is dependent upon engine load and speed. The mpg panel is blank whenever the diagnostic codes are being displayed on the control head display.

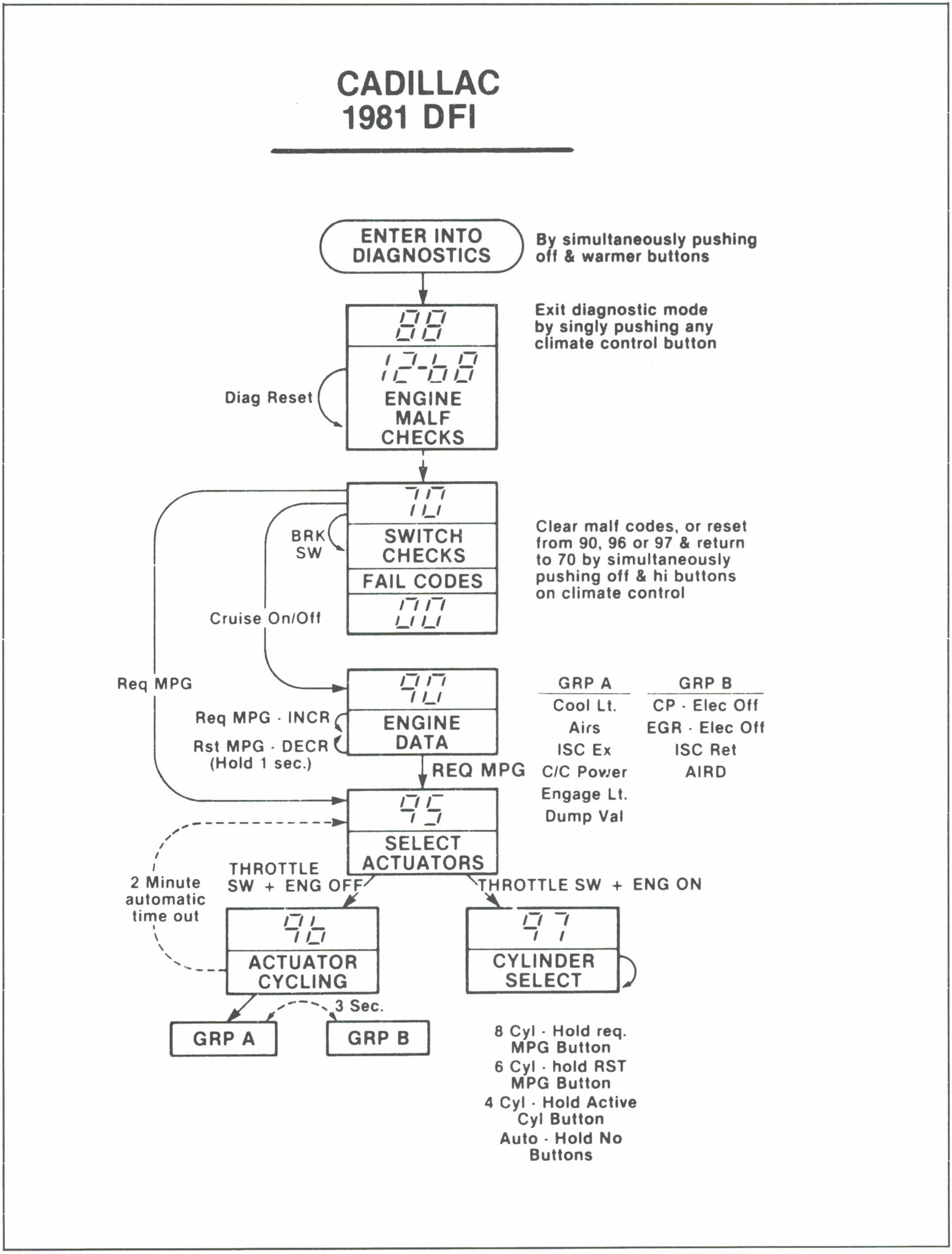
CADILLAC
1981 DFI
ENTER INTO DIAGNOSTICS
By simultaneously pushing off & warmer buttons
88
12-68
ENGINE MALF CHECKS
Diag Reset
Exit diagnostic mode by singly pushing any climate control button
70
SWITCH CHECKS
BRK SW
FAIL CODES
00
Cruise On/Off
Clear malf codes, or reset from 90, 96 or 97 & return to 70 by simultaneously pushing off & hi buttons on climate control
Req MPG
90
ENGINE DATA
Req MPG · INCR
Rst MPG · DECR
(Hold 1 sec.)
REQ MPG
GRP A
Cool Lt.
Airs
ISC Ex
C/C Power
Engage Lt.
Dump Val
GRP B
CP · Elec Off
EGR · Elec Off
ISC Ret
AIRD
95
SELECT ACTUATORS
THROTTLE SW + ENG OFF
THROTTLE SW + ENG ON
2 Minute automatic time out
96
ACTUATOR CYCLING
97
CYLINDER SELECT
3 Sec.
GRP A
GRP B
8 Cyl · Hold req. MPG Button
6 Cyl · hold RST MPG Button
4 Cyl · Hold Active Cyl Button
Auto · Hold No Buttons

Figure 29

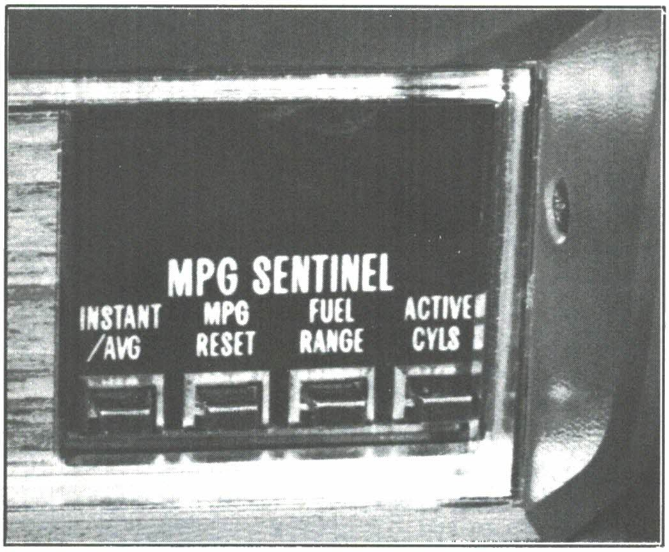

Figure 30

MDD CYLINDER SELECT MAP

CYL.	MAP (KPA)
8 to 6	79.5
6 to 4	75.0
8 to 4	66.5
4 to 6	92.0
6 to 8	97.5
4 to 8	96.0

Figure 32 Pressure Point of Cylinder Change

MODULATED DISPLACEMENT (MD) (1981)

Modulated displacement is an ECM controlled system that stops operation of certain cylinders while the engine is running. It can automatically shut off two or four cylinders by forcing both the intake and exhaust valves to remain closed, Figure --. This results in reduced pumping losses by the pistons, increased combustion efficiency and improved fuel economy, especially when full engine power is not required.

In six cylinder operation, cylinders one and four are inoperative. In 4 cylinder operation cylinder 1, 4, 6 and 7 are inoperative.

The valves are deactivated by an electromechanical solenoid.

When energized the solenoid causes a blocker plate to slide across the top of a spring-loaded valve selector body. The body is held in the down position by an internal spring which exerts approximately 60 psi of force. The body places pressure on the rocker arm pivot.

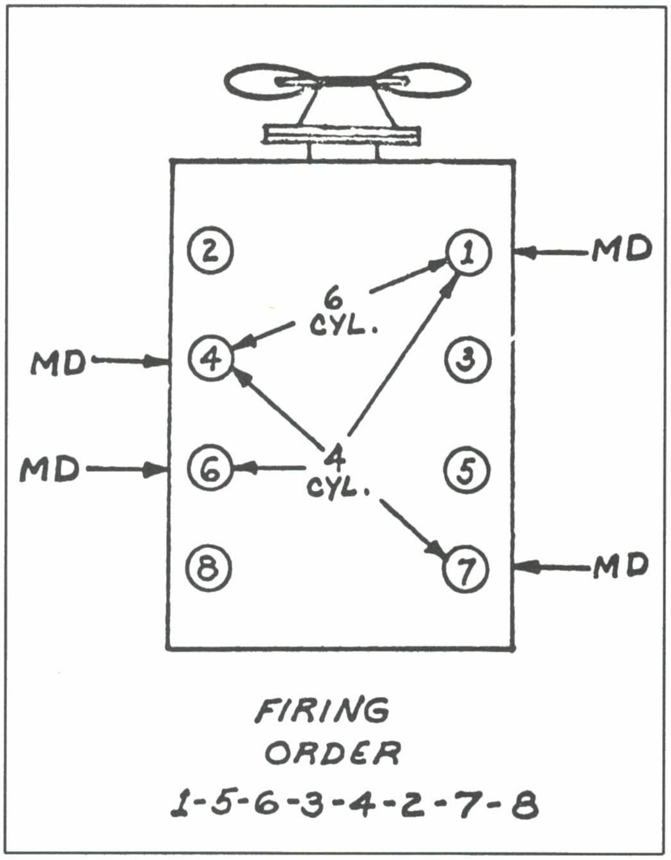

Figure 31 Modulated Displacement Cylinder Diagram

The pivot is positioned in the base of the rocker arm near the fulcrum point during normal valve operation. The entire mechanism is held in place by through bolts threaded into the cylinder head and pedestals.

Energizing the solenoid deactivates the cylinder by rotating a blocker plate, allowing projections on the selector body to move up and through windows in the blocker plate. This upward movement of the body allows the rocker arm to follow, compressing the body spring and shifting the fulcrum point to the top of the valve stem. The body spring is also necessary to keep the hydraulic lifters from pumping up.

Other changes were also made to the 6 liter engine in order to covert it to MD.

The cam lobe profiles on MD cylinders are slightly modified to allow for approximately .040" lash inherent in the selector assembly. The valve lifter will begin to move off the base circle of the cam earlier than a conventional cylinder. Due to the lash in the valve selector, the valve opening is delayed and is kept uniform with other cylinders. This assures consistent overlap and valve timing.

Rocker arm covers have been redesigned to fit over the valve selector mechanisms and are made of reinforced nylon.

Additionally, for a given engine speed and output torque, the fuel metering and ignition timing is continually changed when operating on 4 or 6 cylinders.

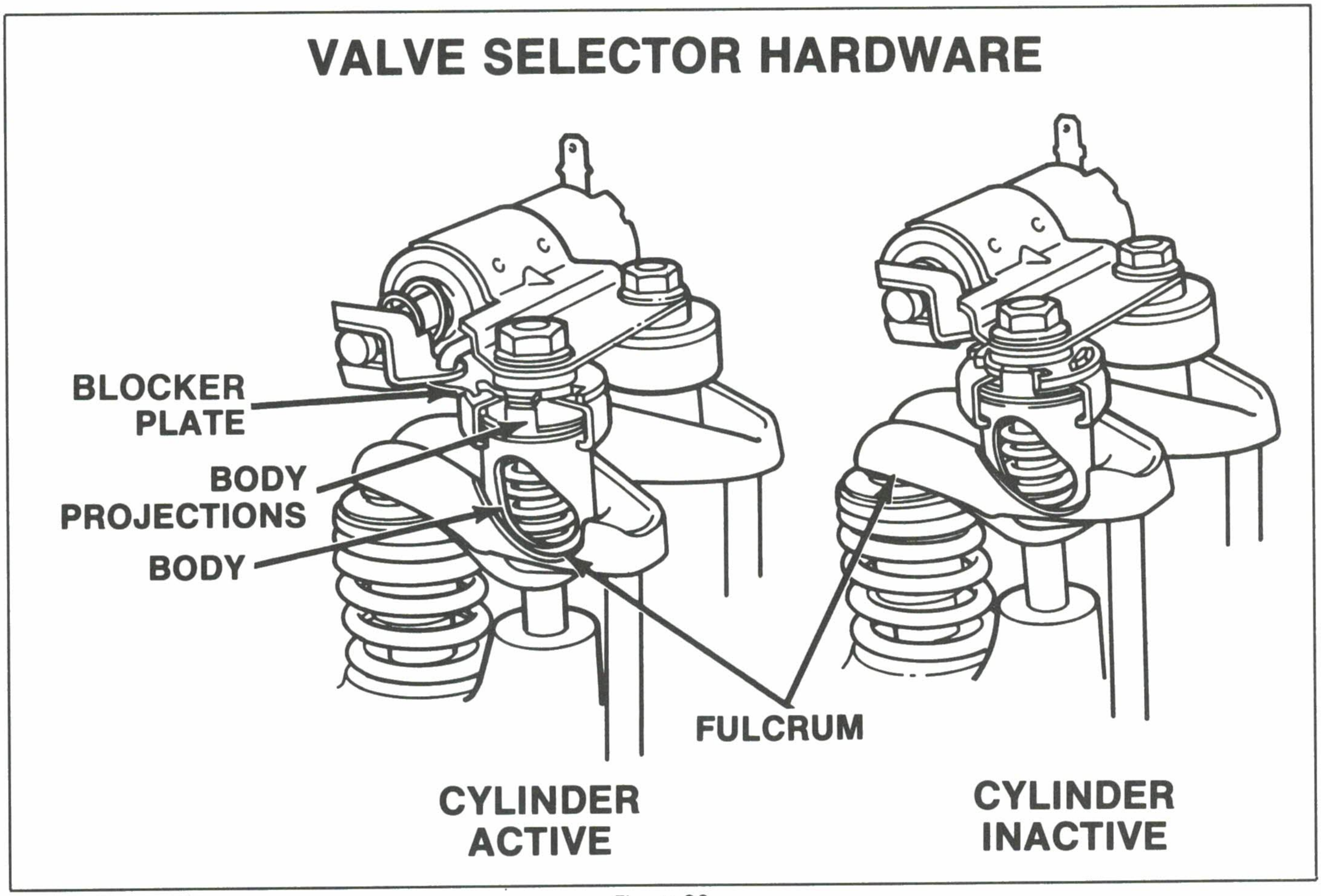

Figure 33

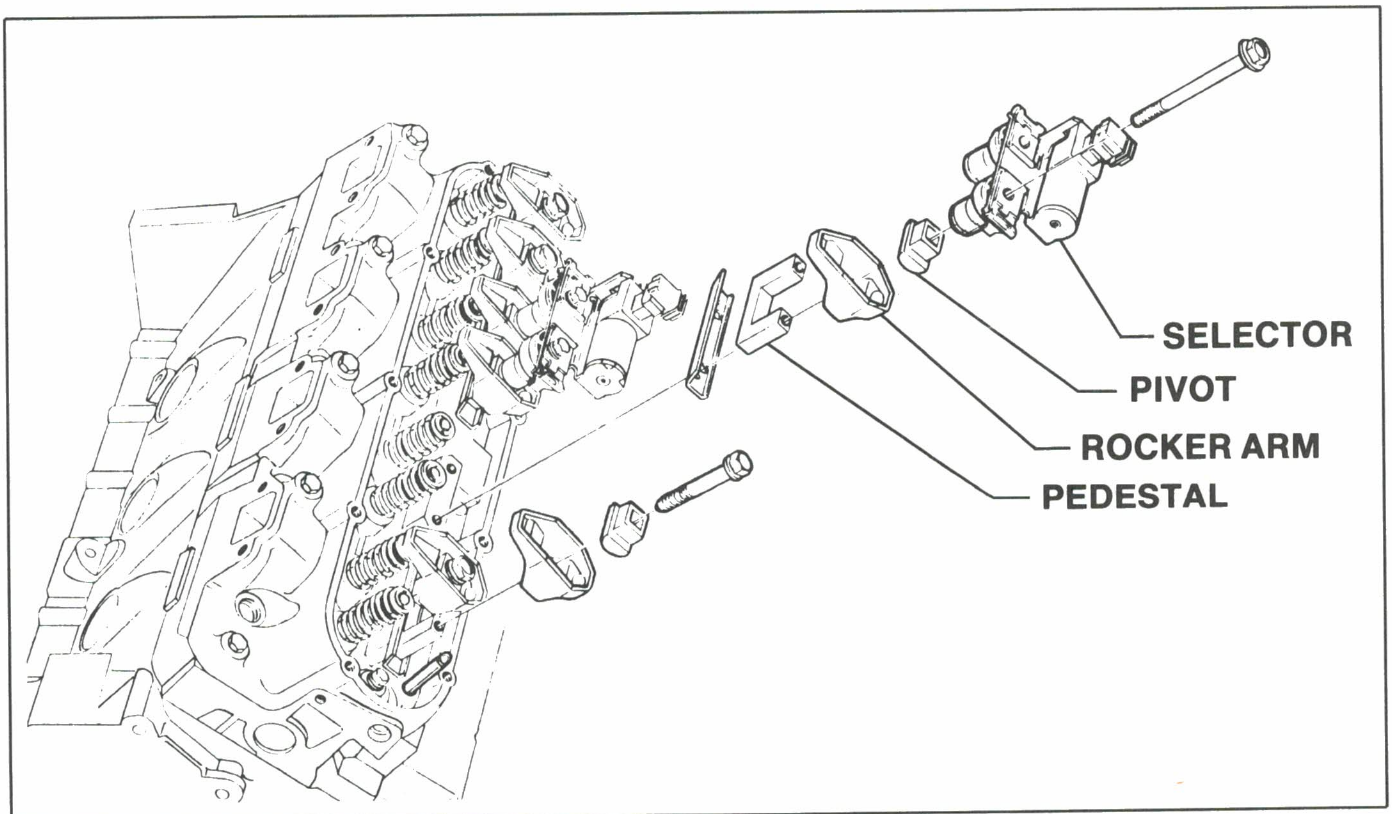

Figure 34 MD Head and Hardware

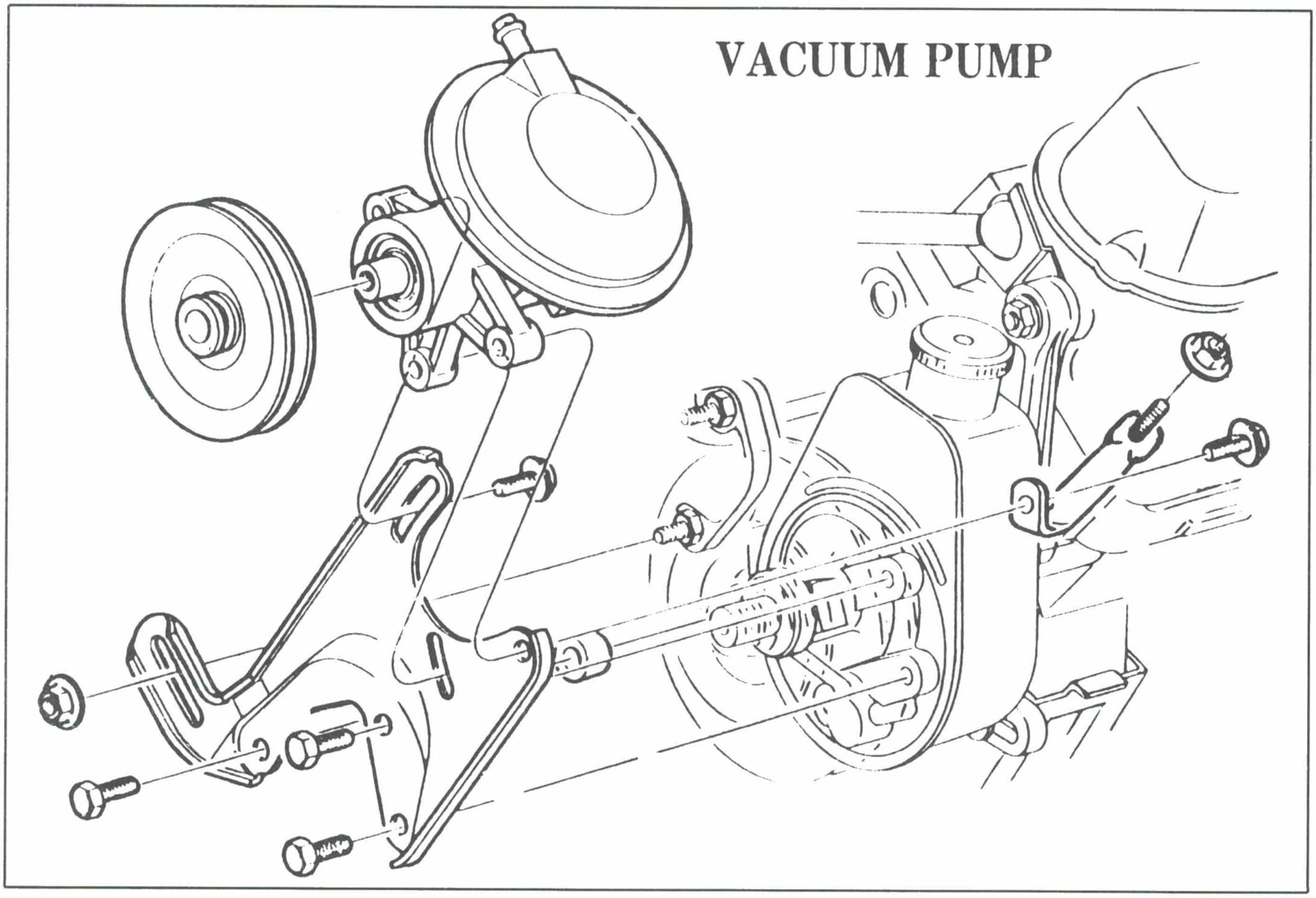

Figure 35

To insure a constant supply of vacuum for the operation of vacuum-operated accessories, a belt-driven vacuum pump is used.

The selector selenoids require an initial pull-in current of 4 amps at 13 volts dc for approximately one to two seconds. This later reduces to a hold-in current of one amp. This amperage requirement is more than the ECM can handle. It is accomplished by a remote relay installed between the solenoids and the ECM. This component, is called a modulated displacement driver assembly, (MDDA). It supplies the additional amperage required by the selector solenoids and also performs some functions with regard to switching from 8 to 6 or 4 cylinder operation.

This cutaway diagram illustrates cylinders in the active and deactivated modes. The body projections on the left, are pressing against the blocker plate on top and normal valve operation continues. The solenoid is not energized.

As shown, when the solenoid is energized, the blocker plates on top of both selectors rotate so the windows are in line with the body projections. Now when the push rod is raised by the cam action, the fulcrum point is moved from the middle of the rocker arm to the end contacting the valve stem.

Figure on the left, shows a cylinder activated normal operation. It shows the blocker plate obstructing the extension of the body projections. On the right side, with the cylinder deactivated, the blocker plate has rotated as a result of solenoid pull-in and now aligns itself so that the windows in the plate are properly lined up with the projections.

Operation in 6 or 4 cylinder modes occurs when coolant temperature is above 120°F, with engine in closed loop operation and the transmission in 3rd gear.

The ECM knows that the transmission is in third gear by the use of a third gear switch which senses direct clutch oil pressured on a 400 THM, the switch is installed on the valve body. On a 325 THM, the switch is external and is mounted on the intermediate servo.

When in third gear, shifts from 8 to 4 cylinder operation can occur above 24 mph. When in the 4 cylinder mode of operation, cylinders 1, 4, 6 and 7 are deactivated. The shift into 6 cylinder mode of operation cannot occur below speeds of 47 mph. This is due to uneven firing impulses delivered to the crankshaft. At speeds above 47 mph this uneveness is not noticeable and 6 cylinder operation is allowed.

The transition from 8 to either 4 or 6 cylinders is not allowed when the rpm is above 2600. Camshaft rpm is too high and the valve selector mechanism cannot deactivate the cylinders due to the short period of time between cylinder valve events above 2600 rpm.

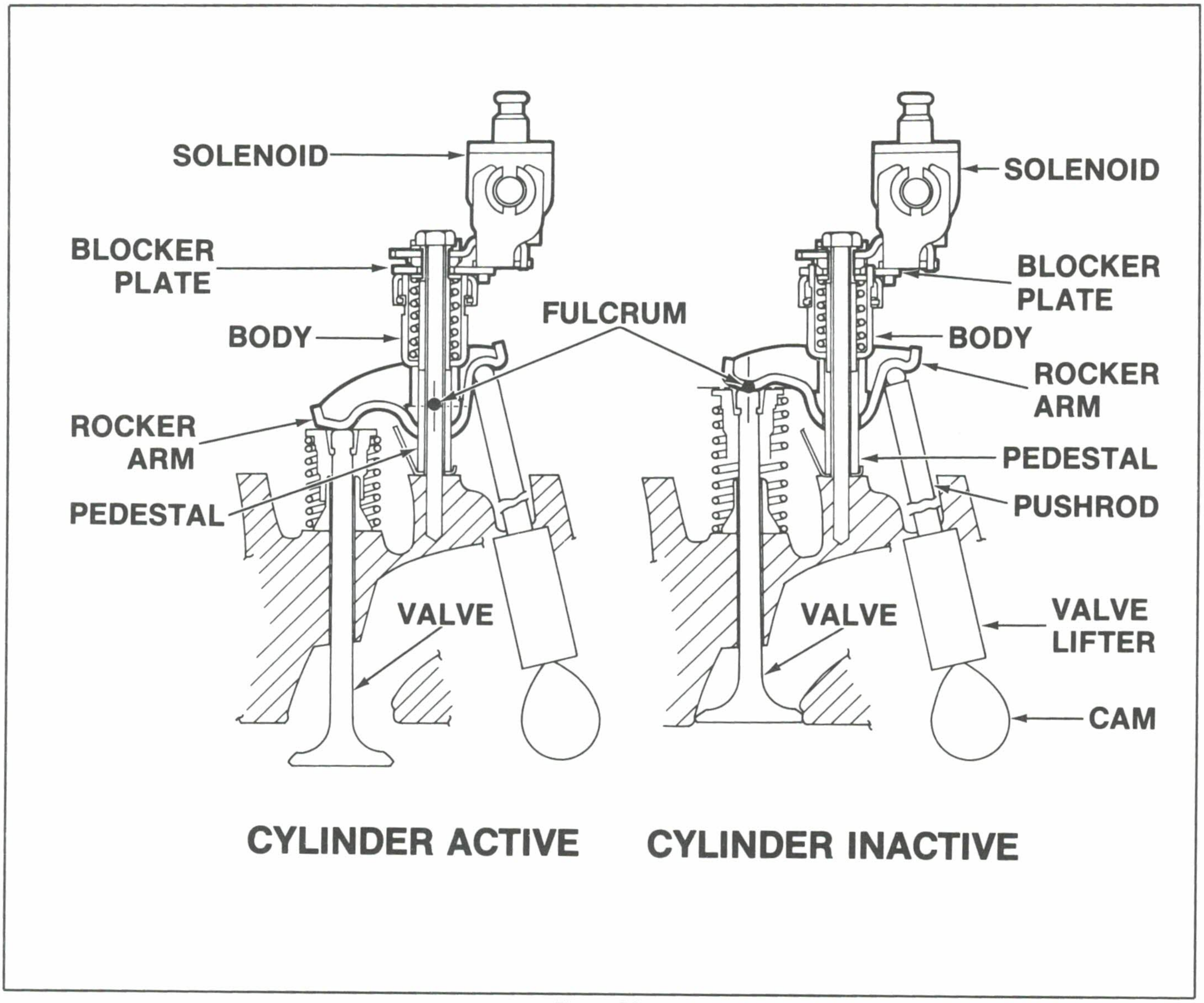

Figure 36

CRUISE CONTROL (1981)

Although the cruise control is not an integral part of the DFI system, in 1981 it is controlled by the ECM and diagnostic codes for cruise control can be set. Cruise control features are basically the same as for 1980, except, of course, for ECM control.

SECTION 2

DIAGNOSIS

TROUBLE CODES

The diagnostic charts in the service manual are selected on the basis of trouble codes which can be displayed during the diagnostic readout. Steps of a "tree", which require testing or explanation, are described.

When certain circuits need to be checked, a schematic diagram is included, and reference to a "circuit number" is sometimes made. The circuit number (410, 575, etc.) is shown inside the box which represents the connector body in the complete circuit diagram.

Diagnostic Charts CANNOT be used to diagnose intermittent failures. The testing required at various points of the chart depends upon the fault being present to locate the problem. If the fault is intermittent, (not present continually), an unnecessary ECM replacement will be indicated and the problem may remain.

Since many intermittent problems are caused at electrical connections, diagnosis of intermittent problems should start with a visual and physical inspection of the connectors involved in the circuit. These connectors, should be disconnected, examined, and reconnected before replacing any components of the system. Some causes of connector problems are:

Improperly formed terminals or connector bodies.

Damaged terminals or connector bodies.

Corrosion, body sealer, or other foreign matter on the terminal mating surfaces which could insulate the terminals.

CODE 23

EST BYPASS SIGNAL CIRCUIT

- O CHECK FOR AN OPEN OR GROUND ON THE "SET TIMING" JUMPER
- O DISCONNECT 4-WAY WEATHERPACK CONNECTOR AT THE DISTRIBUTOR
- O TURN IGNITION ON
- O MEASURE THE VOLTAGE BETWEEN HARNESS CONNECTOR PIN C (ECM SIDE) AND GROUND

VOLTAGE

CHECK CIRCUIT #462 AND #424 FOR A SHORT TO VOLTAGE

REPLACE ECM

BELOW 1V

- O RECONNECT THE 4-WAY WEATHER-PACK DISTRIBUTOR CONNECTOR
- O WITH THE ENGINE RUNNING, DIS-CONNECT THE 4-WAY WEATHERPACK DISTRIBUTOR CONNECTOR
- O MEASURE THE VOLTAGE BETWEEN HARNESS PIN C (ECM SIDE) AND GROUND

5V

CHECK CIRCUIT #424 FOR AN OPEN

SEE HEI DIAGNOSIS

BELOW 1V

- O IGNITION OFF
- O DISCONNECT B1/RED ECM CONNECTOR
- O CHECK CIRCUIT #462 FOR AN OPEN OR SHORT TO GROUND AND CIRCUIT #424 FOR A SHORT TO GROUND

REPLACE ECM

Figure 37

1981 DFI DIAGNOSTICS — CADILLAC

CODE	TEST DESCRIPTION	CODE	TEST DESCRIPTION
12	No Distributor Pulses	37	Manifold Air Temp. (MAT) Sensor Fail High
—13	0_2 Sensor Not Ready	38	MAT Sensor Failed Low
14	Coolant Temp. Failed High (MD + EGR)	—44	** 0_2 Sensor Lean (Closed Loop)
15	Coolant Temp. Failed Low (MD + EGR)	—45	** 0_2 Sensor Rich (Closed Loop)
—16	Sys. Out of Voltage Range (All Solenoids)	—60	Transmission In Any Position Except Drive
—17	Crank Discrete Failed High	—61	Set and Resume Switches Depressed Simultaneously
—18	Crank Discrete Failed Low (EGR)	—62	Car Speed Exceeds a Max. Allowable Limit
—19	Fuel Pump Voltage Failed High	—63	Car Speed and Set Speed Tolerance Exceeded
—20	Fuel Pump Voltage Failed Low	—64	Car Acceleration Exceeds a Max. Allowable Limit
21	Throttle Position Sensor Failed High	—65	Coolant Temp. Exceeds a Max. Allowable Limit
22	Throttle Position Sensor Failed Low	—66	Engine RPM Exceeds a Maximum Allowable Limit
—23	EST Bypass Signal High/Low	—68	** Improper S/R/A During Cruise Unit (Cruise)
—24	Speed Sensor Fail (MD + Cruise)	70	System Ready for Other Checks
—25	** Modulated Displacement Fail (MD)	71	Brake Discrete Check
—26	Throttle Switch Short (ISC + MD)	72	Throttle Switch Discrete
—27	Throttle Switch Open (ISC + MD)	73	Drive Discrete
30	** ISC Motor Fail (ISC)	74	Reverse Discrete
31	MAP Sensor Failed High (MD)	—75	Cruise Enable Discrete
32	MAP Sensor Failed Low (MD)	—76	Set/Coast Discrete
33	** MAP-BARO Correlation (MD)	—77	Resume Accelerate Discrete
34	MAP Hose Off (MD)	78	Average MPG Discrete
35	BARO Sensor Failed High (MD)	79	Reset MPG Discrete
36	BARO Sensor Failed Low (MD)	—80	AC/Clutch-Press Rear Defogger

NOTE: — New for 1981
** Cycle Ign. Sw. to Clear
( ) Disabled Functions

Figure 38

Incomplete mating of the connector halves.

Terminals not fully seated in the connector body ("backed-out" terminals.)

Terminals not tightly crimped to the wire.

Trouble Code Diagnosis

The following abbreviations will be used in this section:

TPS - Throttle Position Sensor

ECM - Electronic Control Module

ISC - Idle Speed Control (includes Idle Speed Motor & Throttle Switch)

HEI - High Energy Ignition

MAP - Manifold Absolute Pressure (Sensor)

BARO - Barometric Pressure (Sensor)

ECC - Electronic Climate Control

MAT - Manifold Air Temperature (Sensor)

CTS - Coolant Temperature Sensor

MPG - Miles Per Gallon (Display Panel)

EGR - Exhaust Gas Recirculation

The dash-mounted "Check Engine" light is used to inform the technician of system problems or abnormal operation. These problems may be related to the sensors or to the ECM itself. The light goes out automatically if the fault clears (intermittent). However, the ECM stores the trouble code associated with the detected fault until the diagnostic system is "Cleared" or until 20 ignition switch (on-off) cycles have occurred without the fault reappearing.

The 1980/81 systems perform various self-diagnostic functions to:

1. Alert drivers when system failures occur, by a dash-mounted "check engine" light.

2. Provide system backup, wherever possible, when failures are detected.

3. Provide dealership technicans with useful information to be used in diagnosing system malfunctions.

4. Reduce excessive service costs by eliminating calculated guessing techniques.

The primary objective of the Diagnostic System is to detect system failures associated with the inputs and/or outputs of the ECM. Four types of tests are available to the service technician:

Parameter No.	Parameter	Typical Values	Units
1	Throttle Position	0-14	Degrees
2	MAP	14-31	kPa
3	BARO	14-99	kPa
4	Coolant Temp	0-99 (—40°C 150°C)	°C
5	MAT	0-99 (—40°C 150°C)	°C
6	Injector Pulse Width	0.0-9.9	MSEC
7	Oxygen Sensor Voltage	9-99	MV X 10
8	Spark Advance	10-51	Degrees
9	No. of Ignition Cycles	0-20	Cycles Since Last Fault
10	Operating Mode	1	Closed Loop
		0	Open Loop
11	Battery Voltage	42 (For 14.2)	Volts

Figure 39 Engine Data Values

1. Engine sensor malfunction checks
2. Input switch tests
3. Engine data checks (1981)
4. Actuator cycling tests (1981)

The type of test used depends on the particular failure or condition being tested.

Trouble Code Series

Since many inputs and outputs used in the DFI System change rapidly, the ECM continuously and automatically compares engine data to established limits for accuracy. Most variations from normal operation are looked at several times before the ECM decides that a true failure exists. When variations do occur, the errors are recorded in ECM memory and held for display when diagnostic read out is later called for by the repair technician.

If the ECM confirms a malfunction then corrective back up action is taken to temporarily compensate for the failure until the problem is corrected. The type of failsoft action depends on the particular failure. In most cases, a failed system input is replaced with a substitute value. In certain cases, vehicle functions are disabled while the failure is present and the operator will notice a slight decrease in engine performance.

In addition to detecting failures, storing them, and substituting back up values, a dash mounted "engine check" light is lighted. Should the malfunction be intermittent, the light will go out. However, in case of both hard and intermittent failures, the ECM will store the associated failure for 20 ignition cycles or until battery power is disconnected. The number of trouble codes has been increased from 14 in 1980 to a total of 36 in in 1981.

INPUT SWITCH TESTS

Various switch inputs that are not checked during normal vehicle operation, can be tested in the switch test mode of operation.

In this mode, switches are physically cycled one at a time. When each switch is cycled, the ECM looks for a signal change and indicates whether or not the change was recognized.

This test series has also been expanded from 7 in 1980 to a total of 10 for 1981.

ENGINE DATA CHECKS (1981)

This test series is completely new for 1981 and allows the technician to confirm diagnosis by reading various engine sensor range values. In simple terms, it refers to monitoring the operation of various sensors by reading a value representing their purpose. For example, after using the proper procedure, the ECM will display on the ECC panel the throttle angle in degrees, sensor pressures, temperature and voltage, as well as other self-explained engine parameters or limits.

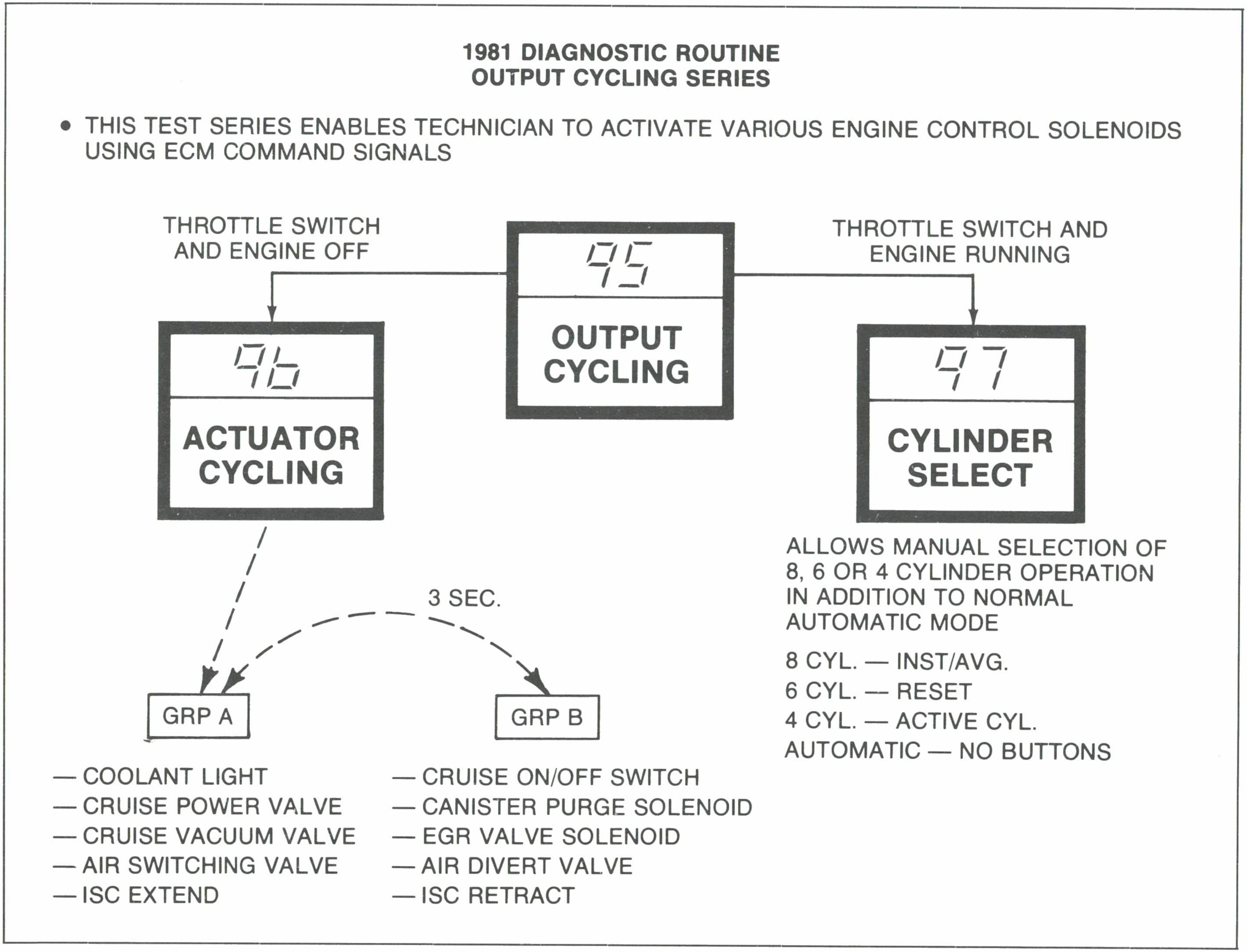
1981 DIAGNOSTIC ROUTINE
OUTPUT CYCLING SERIES
• THIS TEST SERIES ENABLES TECHNICIAN TO ACTIVATE VARIOUS ENGINE CONTROL SOLENOIDS USING ECM COMMAND SIGNALS
THROTTLE SWITCH AND ENGINE OFF
95
OUTPUT CYCLING
THROTTLE SWITCH AND ENGINE RUNNING
96
ACTUATOR CYCLING
97
CYLINDER SELECT
ALLOWS MANUAL SELECTION OF 8, 6 OR 4 CYLINDER OPERATION IN ADDITION TO NORMAL AUTOMATIC MODE
8 CYL. — INST/AVG.
6 CYL. — RESET
4 CYL. — ACTIVE CYL.
AUTOMATIC — NO BUTTONS
3 SEC.
GRP A
GRP B
— COOLANT LIGHT
— CRUISE POWER VALVE
— CRUISE VACUUM VALVE
— AIR SWITCHING VALVE
— ISC EXTEND
— CRUISE ON/OFF SWITCH
— CANISTER PURGE SOLENOID
— EGR VALVE SOLENOID
— AIR DIVERT VALVE
— ISC RETRACT

Figure 40

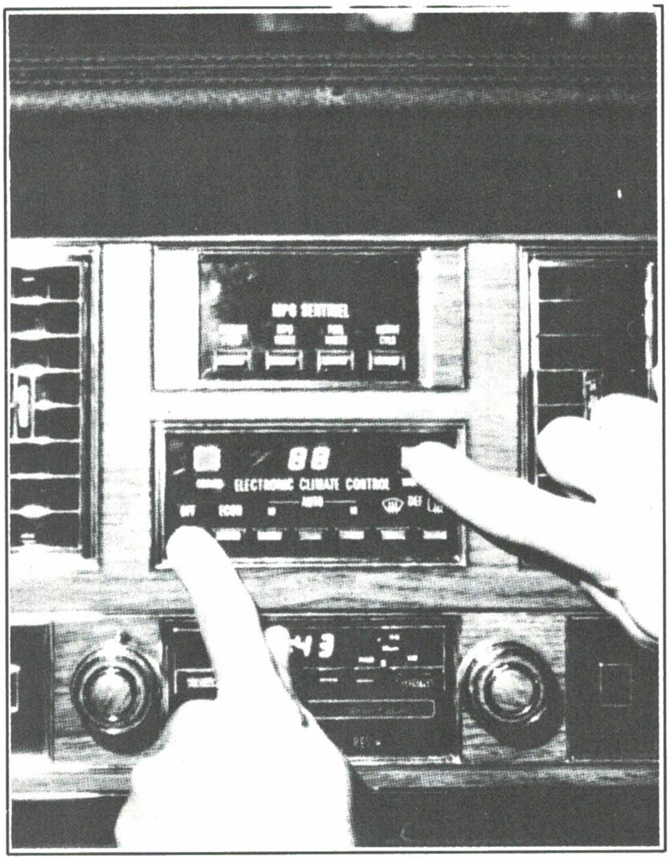

Figure 41

ACTUATOR CYCLING TESTS (1981)

This mode of operation allows service technicians to check various ECM outputs that have not been previously checked. The ECM on command electrically turns on various solenoids and circuits to be tested. During this time output circuit failures can be seen.

DIAGNOSTIC PROCEDURE

1. Entering Diagnostics

The diagnostic mode is turned on by pushing the "off" and "warmer" buttons on the ECC panel at the same time for two to five seconds. ".." will appear. The ECM will show "88" for two seconds and then display the stored trouble codes beginning with the lowest number and moving to the highest. Each code will be displayed for two seconds. When all stored codes have been displayed, "88" will again appear and then the stored codes will be repeated once. At the end of the second sequence, "88" and then "70" will be displayed. The "70" indicates that the trouble code display is complete and that other diagnostic features can now be used. While in the diagnostic mode the ECM will not recognize and store and new faults.

2. Clearing Trouble Codes

To clear the stored trouble codes, depress the "off" and "hi" buttons on the ECC panel at the same time for two seconds. When the codes are cleared, "00" will be displayed for three seconds, and then "70" will display to allow selection of the next diagnostic feature.

The clear function is also used to separate hard versus intermittent failures. In other words, if after a failure code appears and the clear code procedure is used followed by exit and re-entry, the code will appear again only if failure is hard. This procedure makes use of the ECM's ability to remember intermittent problems.

3. Exiting Diagnostic Mode

If any ECC button, (except rear defog) or combination of buttons (except "off" and "hi") are pushed while in the diagnostic mode, the program will be ended. The ECC will return to the automatic temperature control and the mph sentinel will resume the display of mph data.

4. Code "70"

Code "70" is a decision point. When code "70" is displayed, the technician should select the diagnostic feature that he wants to display. The following choices are available:

A. Switch tests

B. Engine data display (1981)

C. Output cycling tests (1981)

D. Exit diagnostics or clear codes and exit diagnostics

Switch Tests Procedure

Following switches/circuits can be tested: (* new for 1981)

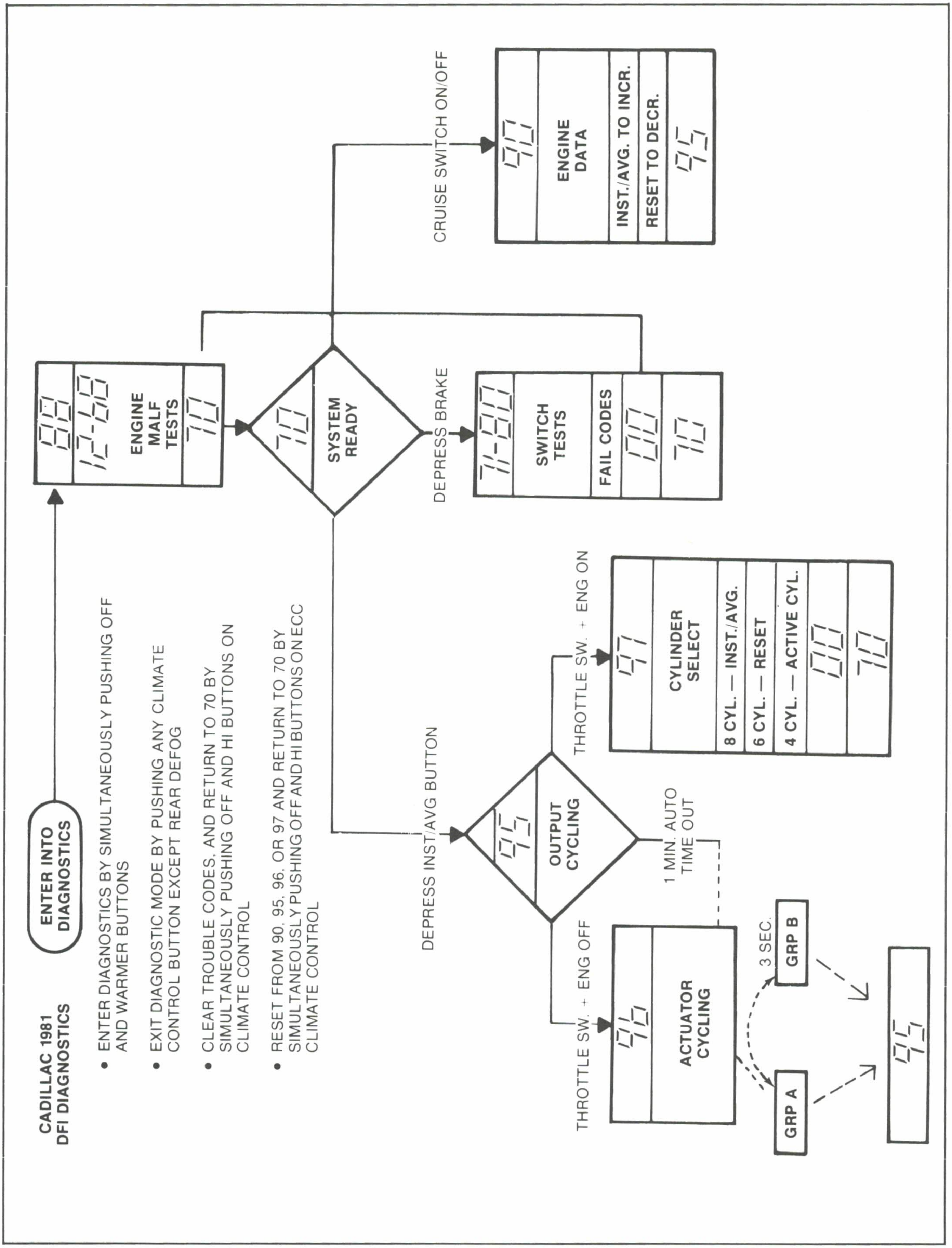
CADILLAC 1981
DFI DIAGNOSTICS
ENTER INTO DIAGNOSTICS
• ENTER DIAGNOSTICS BY SIMULTANEOUSLY PUSHING OFF AND WARMER BUTTONS
• EXIT DIAGNOSTIC MODE BY PUSHING ANY CLIMATE CONTROL BUTTON EXCEPT REAR DEFOG
• CLEAR TROUBLE CODES, AND RETURN TO 70 BY SIMULTANEOUSLY PUSHING OFF AND HI BUTTONS ON CLIMATE CONTROL
• RESET FROM 90, 95, 96, OR 97 AND RETURN TO 70 BY SIMULTANEOUSLY PUSHING OFF AND HI BUTTONS ON ECC CLIMATE CONTROL
88
12-88
ENGINE MALF TESTS
70
70
SYSTEM READY
DEPRESS BRAKE
71-80
SWITCH TESTS
FAIL CODES
00
70
CRUISE SWITCH ON/OFF
90
ENGINE DATA
INST./AVG. TO INCR.
RESET TO DECR.
95
DEPRESS INST/AVG BUTTON
95
OUTPUT CYCLING
THROTTLE SW. + ENG ON
97
CYLINDER SELECT
8 CYL. — INST./AVG.
6 CYL. — RESET
4 CYL. — ACTIVE CYL.
00
70
1 MIN. AUTO TIME OUT
THROTTLE SW. + ENG OFF
96
ACTUATOR CYCLING
3 SEC.
GRP A
GRP B
95

Figure 42

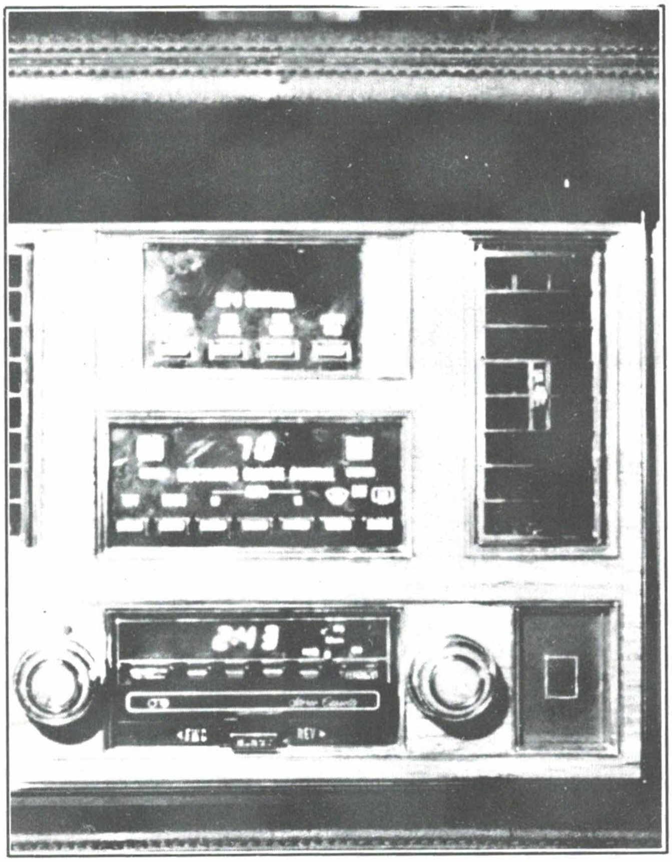

Figure 43

Code "70" must be displayed on the Electronic Climate Control panel before the switch tests can begin. To perform the switch tests, proceed as follows:

a. Push and release the brake pedal. The switch tests begin as the display switches from code "70" to code "71", (If the display doesn't advance to code "71", refer to the diagnosis chart, code 71, because the ECM is not processing the brake signal.)

b. With code "71" displayed, push and release the brake pedal again to test the Cruise Control brake circuit. When this check is complete, the display will automatically display to code "72". If this check is not performed within 10 seconds, the display will automatically advance to code "72" but code "71" will be stored in the ECM memory as a failure.

c. With code "72" displayed, push the throttle from the idle position to the wide open throttle and then releae the throttle. While this action is being taken, the ECM checks the throttle switch for proper operation.

When this check is complete, the display will automatically sequence to code "73". If this check is not performed within 10 seconds, the display will automatically advance to code "73" but code "72" will be stored in ECM memory as a failure.

d. With code "73" displayed, shift the transmission lever into drive and then neutral. This action checks the operation of the drive (adl) switch. When this check has been completed, the display will automatically advance to code "74". If this check is not performed within 10 seconds, code "73" will be stored in ECM memory as a failure.

e. With code "74" displayed, shift the transmission lever to reverse and then to park. This action checks the operation of the reverse switch. If the transmission is not shifted within 10 seconds, a code "74" will be stored as a failure. When the check is completed, the panel will automatically advance to code "75".

f.* With code "75" displayed, switch the Cruise Control instrument panel switch from off to on and back to off. When this check is complete, the display will automatically sequence to code "76." If this check is not performed within 10 seconds, the display will automatically advance to code "76" but code "75" will be stored in ECM memory as a failure.

g.* With code "76" displayed and with the cruise instrument panel switch in the on position, depress and release the set/coast button to verify the operation of this switch. When this check is complete, the display will automatically sequence to code "77". If this check is not completed within 10 seconds, the ECM will store code "76" as a failure.

h.* With code "77" displayed and with the cruise instrument panel switch in the on position, depress and release the resume/acceleration switch to check the operation of this switch. If this check is not completed within 10 seconds, the ECM will store code "77" as a failure. The display will advance to code "78".

i. With code "78" displayed, push and release the "average" button on the mpg panel. When this check is complete, the display will automatically advance to code "79". This must be completed within 10 seconds or a code "78" will be set as a failure.

j. With code "79" displayed, push and releae the "reset" button on the mpg panel within 10 seconds to test the operation of this switch. The panel with automatically advance to code "80".

k.* With code "80" displayed, push and release the rear defogger button on the ECC panel. This action checks ECM ability to recognize and process the air conditioning clutch signal. However, the compressor cycling switch leading to the compressor drive circuit of the ECC power module must be closed in order to engage the A/C compressor clutch. Sometimes it may be necessary for the engine to be running with the ECC operation in auto and 60° to close the contacts of the compressor cycling switch. This procedure must be completed within 10 seconds to avoid setting code "80" as a failure. This is the end of the switch tests.

l. When the switch tests are completed, the ECM will display the switch codes which did not test properly. Each code which did not pass will be displayed beginning with the lowest number. The codes will not disappear until the affected switch circuit has either been repaired or retested. Refer to the appropriate service manual diagnosis chart for each trouble code.

m. After the switch tests are completed and all circuits pass, the ECC panel displays "00" and then returns to code "70". "00" indicates that the switch circuits are operating properly.

Engine Data Display Procedure

Code "70" must be displayed on the Electronic Climate Control panel before the engine data display can begin to

Figure 44

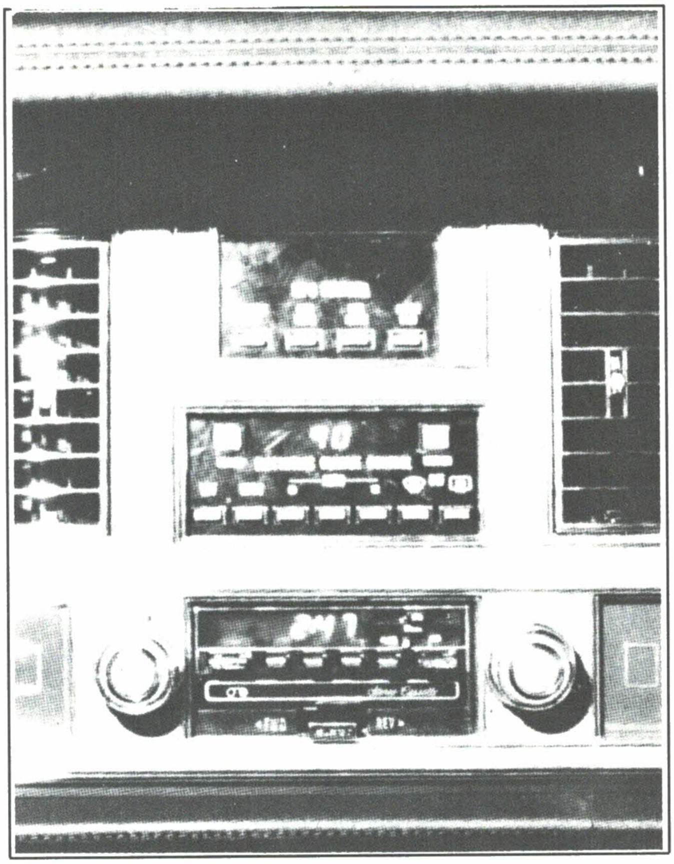

Figure 45

display the engine data series. To display the engine data information, proceed as follows:

1. Slide the cruise instrument panel switch from the on position to the off position. The engine code series begins as the display switches from code "70" to code "90". (If the display doesn't advance to code "90", refer to code "75" of the switch tests.)

2. To advance the display, depress the instant/average button located on the mpg panel. To return to a previously displayed parameter, push the reset button on the mpg panel. It is possible to leave the engine data series at anytime and return to code "70" by simultaneously depressing the "off" and "hi" buttons on the climate control. After the last parameter is displayed, the system will advance to code 95 and wait for the next command.

3. When troubleshooting a malfunction, the engine data display can be used to compare the problem vehicle to a vehicle which is functioning properly. A brief summary of each parameter is provided below:

01 The throttle angle is displayed in degrees.

02 The MAP value is displayed in kPa as a number between 1 and 99. kPa readings of 100 and 101 are displayed as 99 because it is not possible to display more than 2 digits on the ECC panel.

03 The BARO value is displayed in the same manner as the MAP value.

04 The coolant temperatures is a scaled number which reads between 0 and 99. The value of 0 corresponds to -40°C, and the value of 99 corresponds to 150°C.

05 The manifold air temperature value is displayed in the same manner as the coolant temperature.

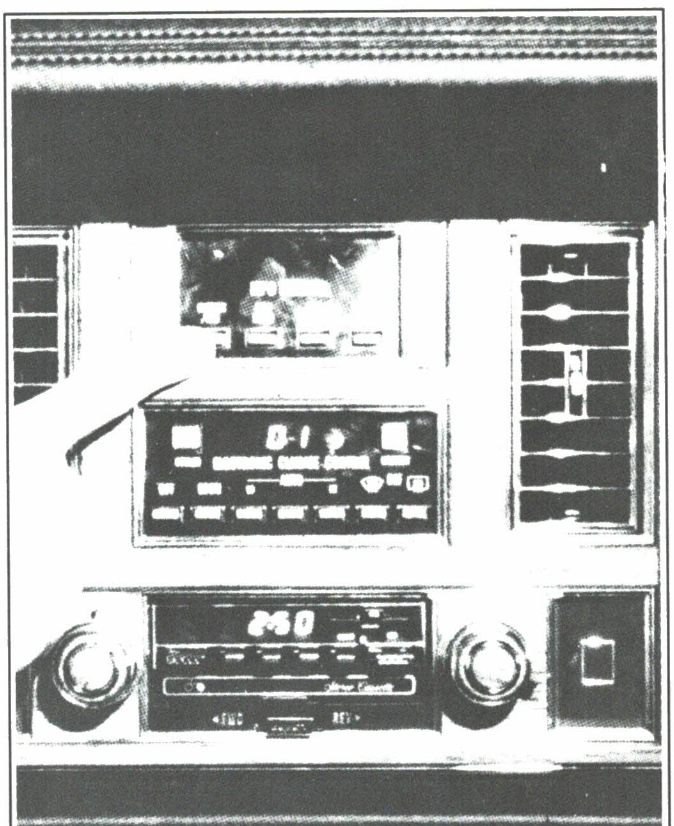

Figure 46

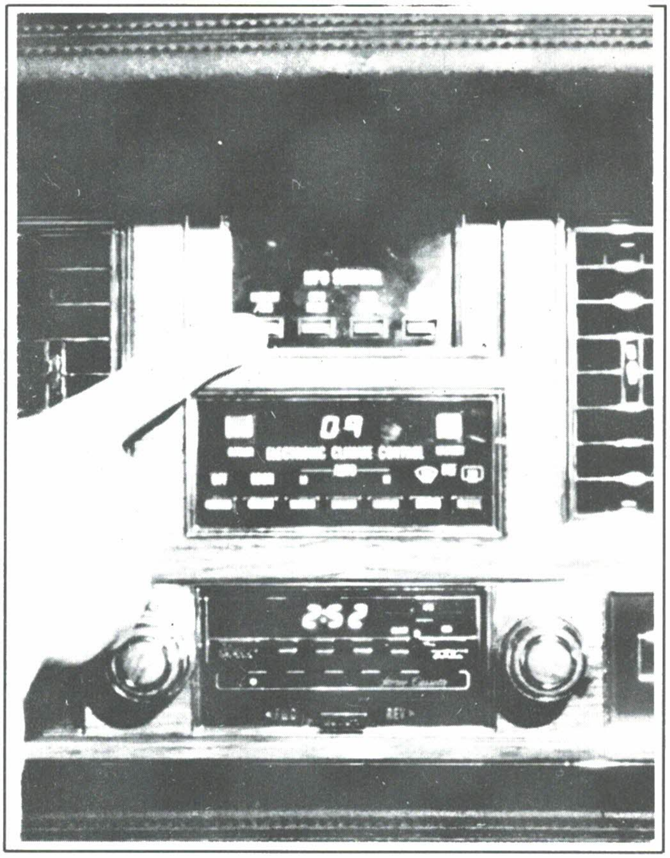

Figure 47

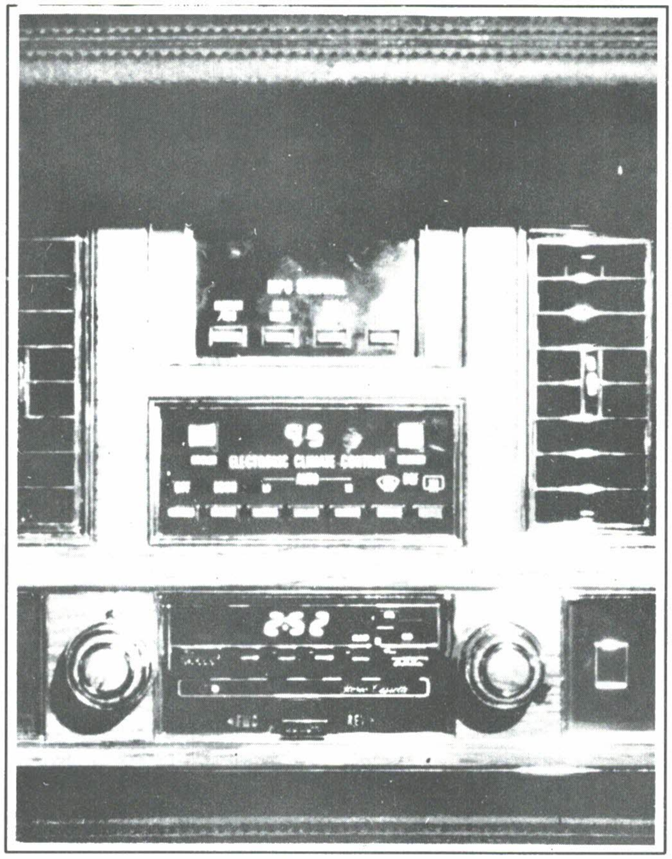

Figure 48

06 The injector pulse width is displayed in milliseconds. A decimal point will not appear but it has to be assumed between the two digits.

07 The oxygen sensor voltage is displayed in volts and the decimal point has to be assumed before the two digits.

08 The spark advance value is displayed in degrees.

09 The ignition cycle value is the number of times that the ignition has been cycled since the trouble code was set.

10 The open/closed loop indicator tells whether the ECM is operating the system in closed loop or open loop. A value of 1 indicates closed loop operation; a value of 0 indicates open loop operation.

11 The battery voltage is read in volts; however, the 10's digit will not display and a decimal point has to be assumed between the two numbers (23 should be read as 12.3 volts).

When the engine data display is started, the ECC will display 01 for one second to indicate the first parameter check and then a two digit number will be displayed for five seconds to indicate the first parameter value. A single digit parameter value will be displayed as a "--X". The ECC will continue to repeat this sequence of events until the technician decides to move to the next parameter.

Output Cycling Tests Procedure

This series of tests can be initiated after 95 is displayed on the ECC panel. The display of 95 can be reached by the following methods:

1. Depress the instant/average button while code 70 is displayed on the ECC panel. If the display doesn't advance to code 95, refer to code 78 of the switch tests.

2. Depress the instant/average button while parameter #11 of the engine data display series is being displayed.

The output cycling tests consist of two separate operation:

A. With the engine running, the cylinder select test, code "97", operates the modulated displacement solenoids.

B. With the engine off, the actuator cycling test, code "96", turns the ECM output on and off.

To enter the actuator cycling tests, proceed as follows:

A. The engine must be running.

B. Turn the engine off and within 5 seconds, turn the ignition on.

C. Enter diagnostics and display code "95".

D. Depress the accelerator pedal to the wide open throttle position (throttle switch open) and release it (throttle switch closed). Code "96" will appear on the display.

E. Turn the cruise instrument panel switch to the on position so that the Cruise Control outputs will cycle.

F. The actuator cycling test will end automatically after 2 minutes of cycling and the display will switch from code "96" to code "95".

The group A outputs will cycle on and off for 3 seconds and then the group B outputs will cycle on and off for 3 seconds. Group A will continue to alternate with Group B until the 2 minute automatic shutoff occurs.

To enter the cylinder select tests, proceed as follows:

A. The engine must be running.

B. Enter diagnostics and display code "95".

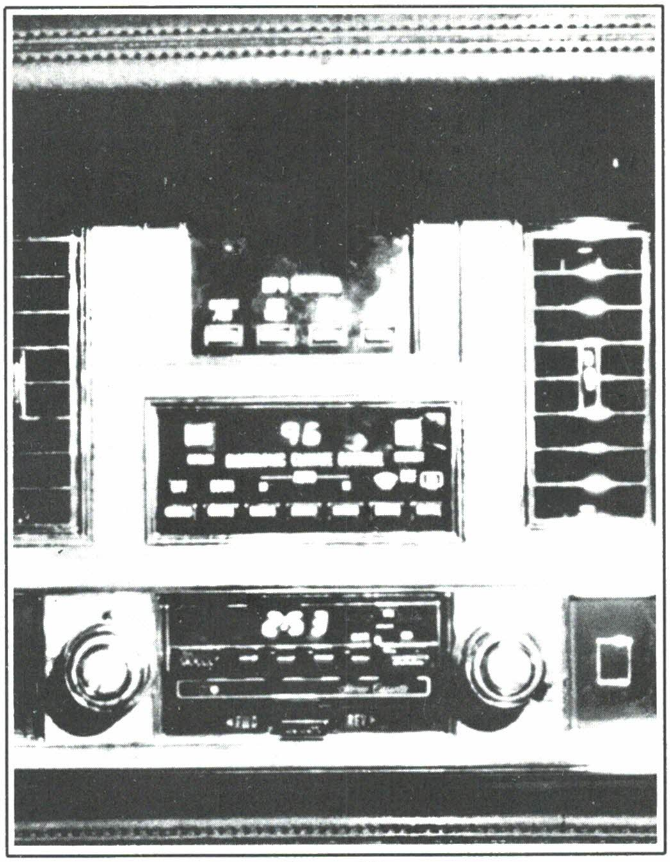

Figure 49

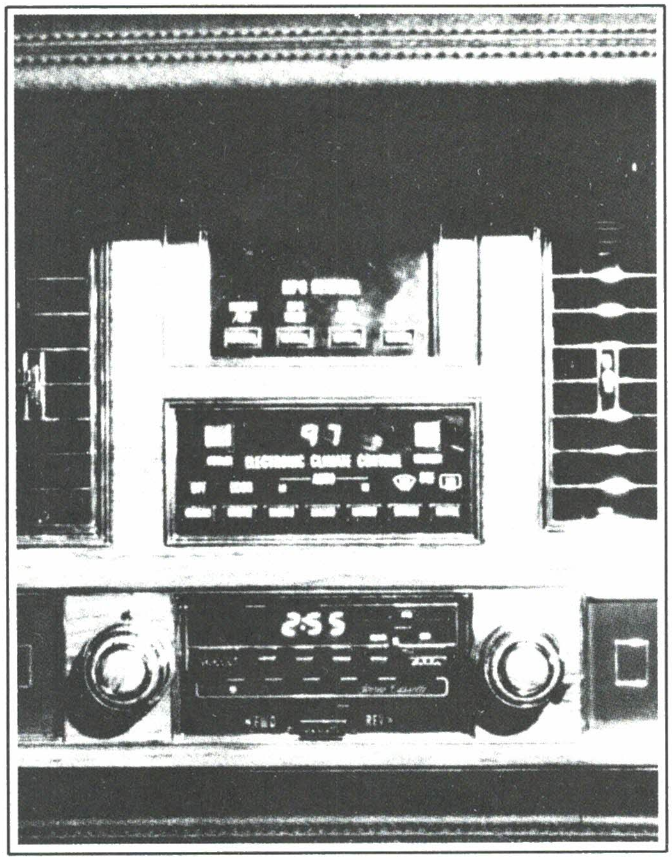

Figure 50

C. Depress the accelerator pedal to the wide open throttle position (throttle switch open) and release it (throttle switch closed). Code "97" will appear on the display.

D. With no button of the MPG panel depressed, the ECM will continue to control the cylinders automatically.

E. Depressing the instant/average button of the MPG panel will force the engine to operate in 8 cylinder mode as long as the button is depressed.

F. Depressing the reset button of the MPG panel will force the engine to operate in 6 cylinder mode until the button is released.

G. Depressing the active cylinder button of the MPG panel will force the engine to operate in 4 cylinder mode until the button is released.

The switch tests, the engine data displays, and the output cycling tests can be used to isolate intermittent failures.

"Intermittent" Codes Versus "Hard Failure" codes

Trouble codes stored in the ECM's memory at any time can be either:

a. A code for malfunctions which are occuring now (a "hard failure"). This malfunction will cause illimination of the "check engine" light.

B. A code for any intermittent malfunctions which have occurred within the last 20 ignition switch cycles. These codes will not cause the "check engine" light to be on now.

DIAGNOSTIC CHARTS CANNOT BE USED TO DIAGNOSE INTERMITTENT FAILURES. Intermittent codes should be diagnosed by inspecting the connectors involved with the affected circuits. However, if an affected circuit is one that may be checked by the switch tests, output cycling tests, or engine data displays, make the check on the appropriate circuit.

During any diagnostic check, it is necessary to determine if the trouble code or codes are hard failures or intermittent failures. To determine which are hard failures and which are intermittent, proceed as follows:

1. Enter diagnostics and note stored trouble codes.
2. If more than one code exists, clear trouble codes.
3. Exit diagnostics by turning the ignition switch off for 10 seconds.
4. Turn the ignition on, wait 5 seconds, and then start the engine.
5. Accelerate the engine to approximately 2000 rpm for a few seconds.
6. Return the engine to idle speed.
7. Shift the transmission into drive.
8. Shift the transmission back into park.
9. If the "check engine" light comes on, enter diagnostics, read, and record the trouble codes. This will reveal only "hard failures" codes. The Cruise Control codes 60 through 68 never set a check engine light: therefore, treat them as hard failures. Codes 24 and 25 may require a road test to reset a "hard failure" after the trouble codes have been cleared.

If the light does not come on, then all stored codes are intermittent failures except for codes 13, 33, 44, and 45. If the intermittent code is a code 33, a special procedure must be followed. Refer to diagnostic chart 33A, "intermittent MAP/BARO Correlation Test". If the intermittent code is code 13, 44, or 45, use the diagnostic chart for code 13, 44, or 45 because these particular charts have been designed to account for intermittents.

If the vehicle still exhibits performance problems, refer to the performance diagnosis charts in the service manual.

10. Begin in the diagnosis with the lowest code number which is displayed. If codes 51 or 16 are present, begin the diagnosis with code 51 and then proceed to code 16.

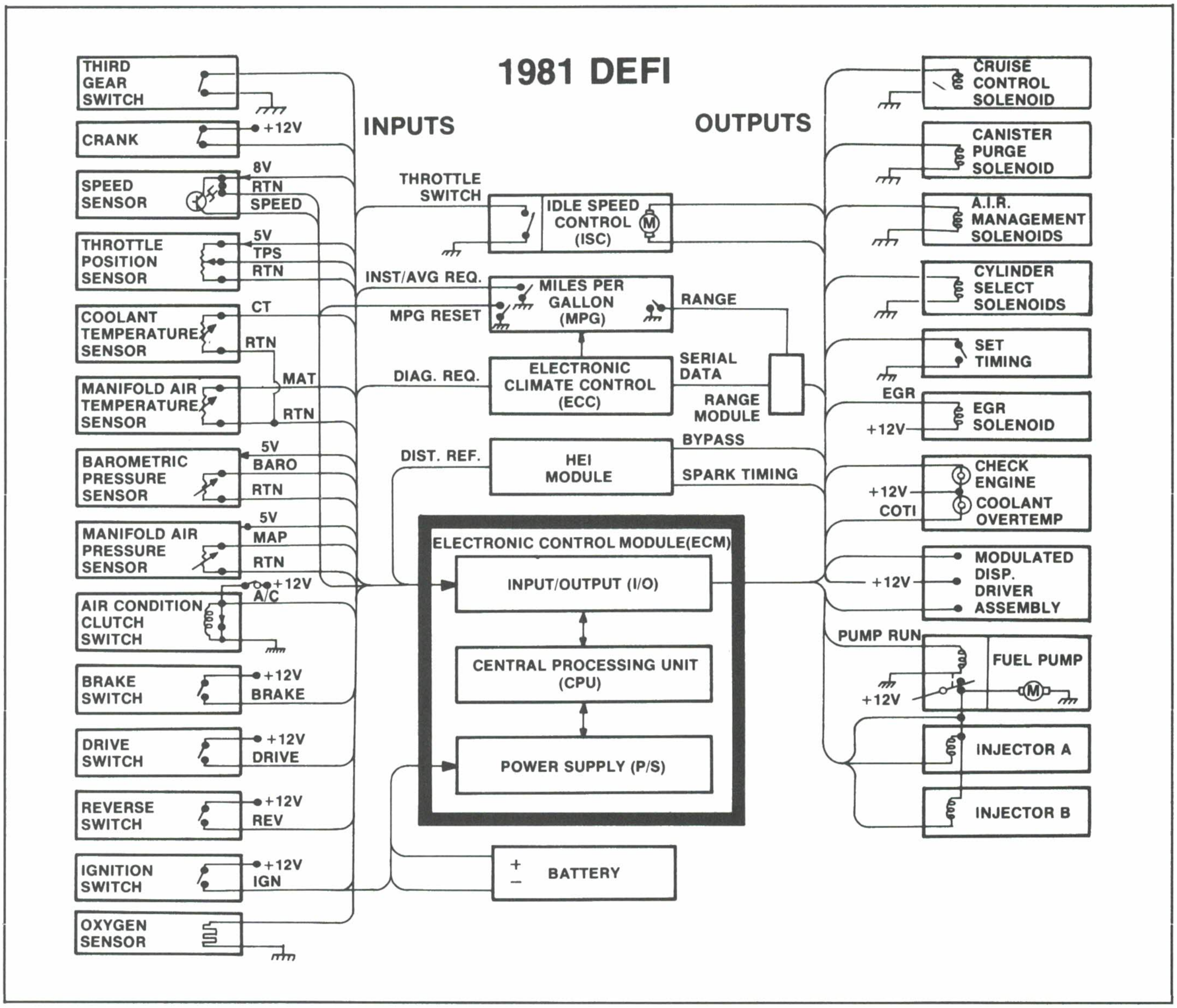

Figure 51