1975-79 FUEL SYSTEMS
General Motors Electronic Fuel Injection

1975-79 Cadillac

DESCRIPTION

This Electronic Fuel Injection (EFI) system consists of 4 sub-systems: Fuel delivery, air induction, engine sensors, and the Electronic Control Unit (ECU). The fuel delivery system includes a chassis mounted electric fuel pump, an in-tank boost pump, frame mounted fuel filter, fuel rail, injectors, fuel pressure regulator and fuel supply and return lines.

The air induction system consists of throttle body, fast idle valve, idle air compensator and intake manifold. Engine sensors include, the Manifold Absolute Pressure (MAP) sensor, Throttle Position Switch (TPS), speed sensor, and the coolant and air temperature sensors.

This combination of sub-systems, working together, creates a 2-group timed port injection system. The 2 groups are based upon engine firing order. The first group consists of cylinders 1, 2, 7 and 8; the second group is made up of the center 4 cylinders 3, 4, 5 and 6. All 4 injectors in either group are actuated at the same time and the separate groups are actuated alternately.

Seville models include a solenoid operated idle air compensator to control idle speed when the A/C compressor is operating. Sevilles sold in California use a closed loop fuel injection system. This system uses an oxygen sensor, located in the right side exhaust manifold, to sense oxygen content in exhaust gases. Differently calibrated ECUs are used for each model and cannot be interchanged.

OPERATION

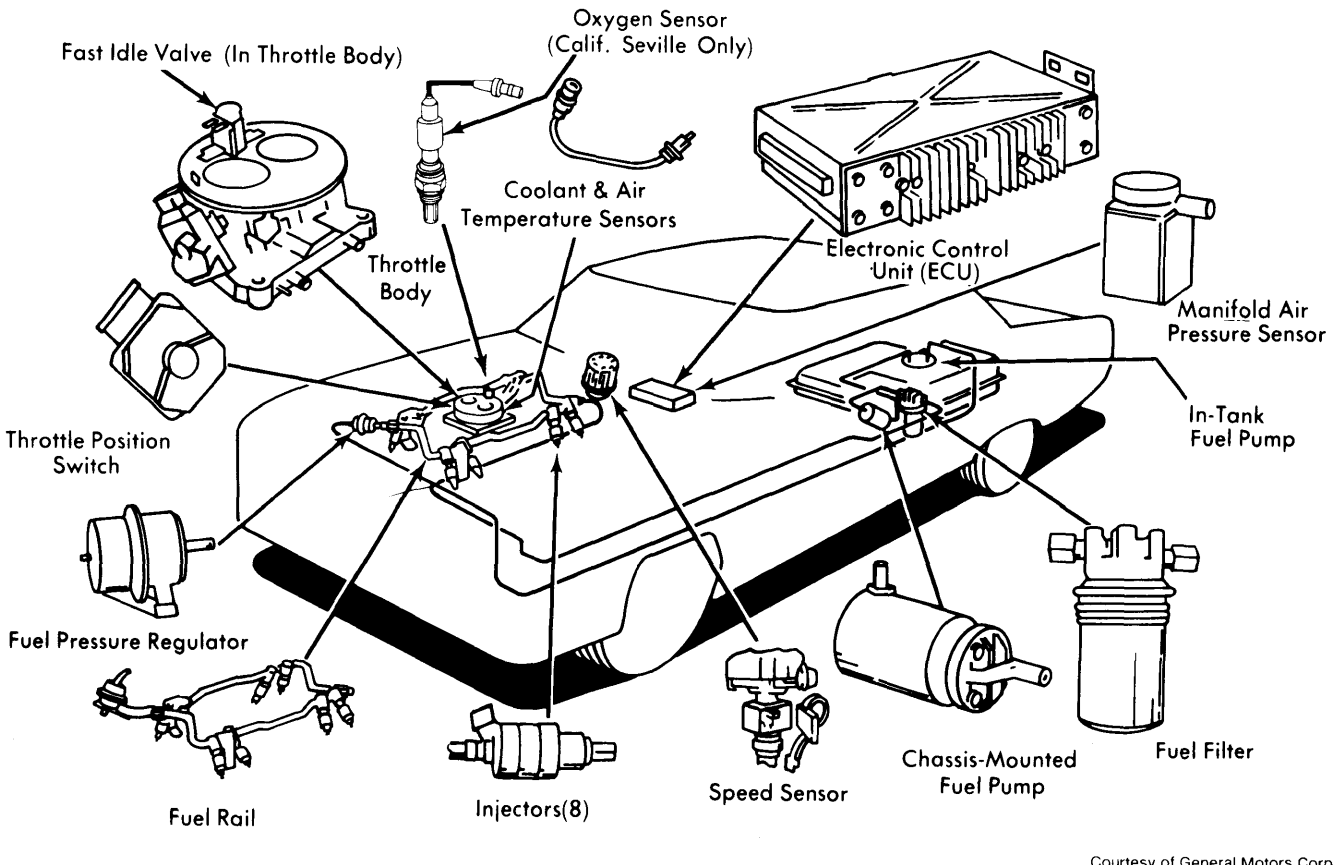
The amount of air entering the engine is measured by monitoring the intake manifold absolute pressure, the intake air temperature, and the engine speed. This information allows the electronic control unit to compute the flow rate of fuel required to achieve the desired air/fuel ratio for the particular engine operating condition. Each of the injector groups are activated once for every revolution of the camshaft or once for every two revolutions of crankshaft. The ECU converts the multi-variable information into an injector pulse width signal which opens the injectors for the proper duration and at proper time with respect to cylinder firing sequence.

CLOSED LOOP EFI SYSTEM

California Seville - The closed loop system uses an oxygen sensor in exhaust manifold to sense oxygen content of exhaust gases. The oxygen sensor is an electrochemical device which produces a variable voltage depending upon oxygen content of exhaust gases. This variable voltage is sent to the ECU. The ECU uses this signal to regulate the amount of fuel to be injected. With this system, air/fuel ratio is maintained at the ideal ratio of 14.7:1.

AIR INDUCTION SYSTEM

Air for combustion enters engine through throttle body at a rate controlled by the throttle valves, which are connected to accelerator pedal linkage. An adjustable idle by-pass air passage is incorporated within the throttle body that allows a regulated amount of air to by-pass the throttle valves.



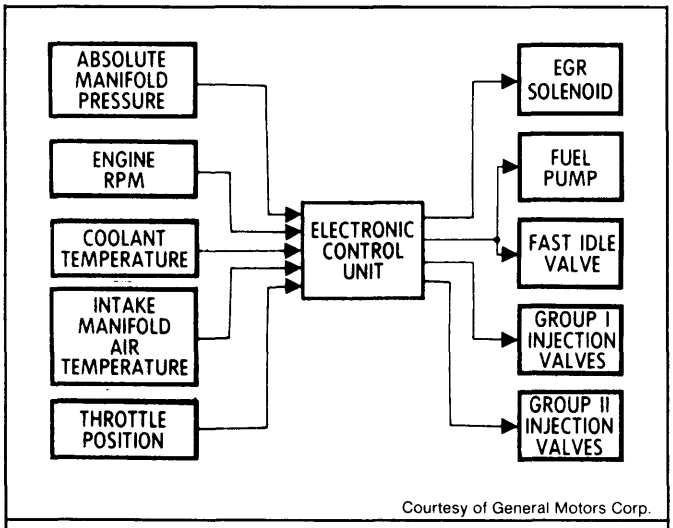
Courtesy of General Motors Corp.

Fig. 1: Typical Electronic Fuel Injection System Components & Location

1975-79 FUEL SYSTEMS
General Motors Electronic Fuel Injection (Cont.)

The throttle valves are pre-set to slightly open position, even when throttle lever is resting against the idle stop position. A solenoid operated idle air compensator is used on Sevilles and Eldorados to aid in smooth idle with the A/C compressor engaged.

NOTE: The throttle valve pre-set position is not adjustable. Additional air for cold starting is provided through an electrically operated (controlled) fast idle valve which is incorporated into top of throttle body.



Courtesy of General Motors Corp.

Fig. 2: Operating Conditions Sensed & Items Controlled

FUEL DELIVERY

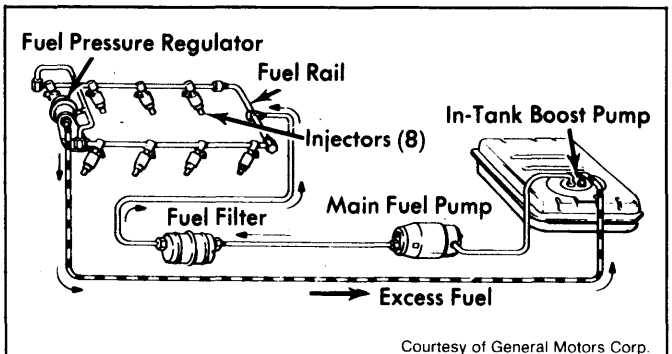
Fuel Pumps - Two electric fuel pumps are used on vehicles with EFI system. Located inside fuel tank, the in-tank pump is used to supply fuel to chassis-mounted (main) fuel pump. *See Fig. 3.*

The in-tank pump prevents vapor lock at suction side of main fuel pump. The main fuel pump is a constant displacement, rollervane type pump. Both fuel pumps are actuated by ECU when ignition switch is on and engine is either cranking or running.

NOTE: Both fuel pumps will deactivate in about one second if engine stalls or starter is not engaged.

Fuel Pressure Regulator - This unit maintains a constant 39 psi to the injectors. Excess fuel is returned to fuel tank via return lines. The regulator is located toward front of engine on fuel rail.

Injectors - Injectors are solenoid-operated pintle valves which meter fuel to each cylinder. To furnish adequate fuel under different engine operating conditions, the ECU controls length of time pintle is retracted and fuel is being injected.



Courtesy of General Motors Corp.

Fig. 3: Fuel Delivery System Components

ENGINE SENSORS

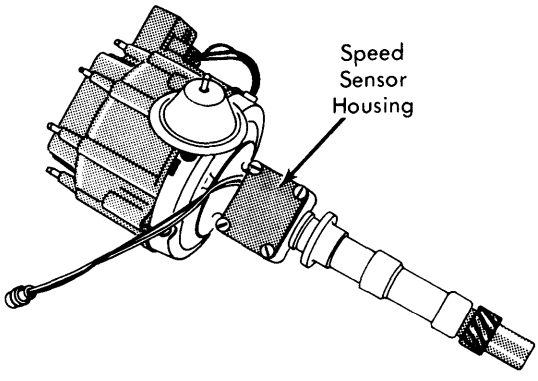
Each sensor furnishes an electronic signal to ECU, modifying the injection time commands which changes the fuel injection rate to conform with operating conditions of engine.

Manifold Absolute Pressure (MAP) - This sensor monitors changes in intake manifold pressure which results from engine load, speed and barometeric pressure variations. As intake manifold pressure increases, additional fuel is required. MAP sends this information to ECU so that the pulse width is increased (time injector is open). Conversely, as manifold pressure decreases, pulse width is shortened.

Throttle Position Switch (TPS) - This slide switch is mounted on side of throttle body and connected directly to throttle shaft. This switch senses shaft movement and positions and transmits appropriate electrical signals to ECU. When throttle is closed (idle position) signal sent to ECU helps to determine basic pulse width. A signal is sent to ECU when accelerating and ECU provides additional pulses to enrichen fuel mixture. A signal is used for wide open throttle operating conditions. A signal is also used during wide open throttle, but with engine not running. This wide open throttle signal provides for clearing a flooded engine.

Temperature Sensors - Both coolant temperature sensor and air temperature sensor are exactly the same and therefore interchangeable. These sensors consist of a coil of high temperature nickel wire which changes internal resistance according to temperature. A low temperature produces a low resistence.

Speed Sensor - Located just below base plate of distributor, the speed sensor consists of 2 components. First component is a set of reed switches mounted within a plastic housing. *See Fig. 4.* The second component is a plastic rotor with 2 magnets (called flags), attached to and rotating with distributor shaft. Each flag furnishes signal for each injection group. As flags rotate past reed switches, the switches open and close and this information is sent to ECU. This type of signal is basically a tachometer signal for each group of injectors.



Courtesy of General Motors Corp.

Fig. 4: EFI Speed Sensor Location

ELECTRONIC CONTROL UNIT

The Electronic Control Unit (ECU) is a pre-programmed analog computer which is installed in front of heater housing and below radio or above glove box. *See Figs. 5, 6 and 7.* It is electrically connected to vehicle power supply and to the components of the electronic fuel injection system. As signals are received from the sensors, ECU processes the signals and commands injectors to open for a specific time duration. The duration of injection (pulse width) varies as the engine operating conditions change. The desired air/fuel ratios for any possible combination of driving or atmospheric conditions are programmed into the ECU.

General Motors Electronic Fuel Injection (Cont.)

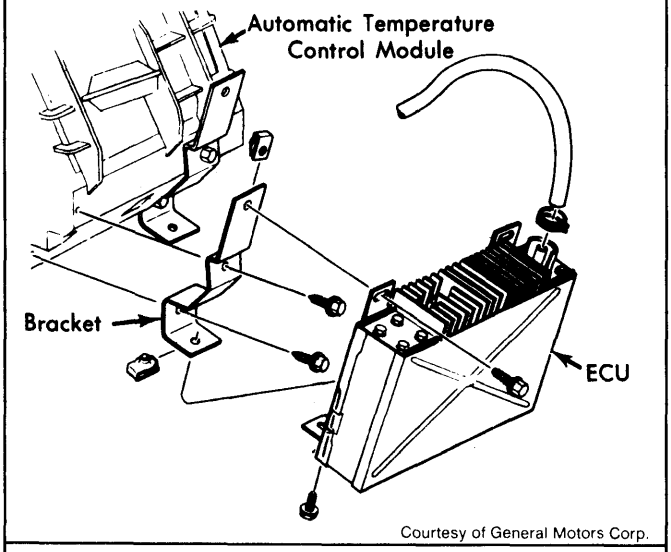


Fig. 5: Brougham & DeVille ECU Removal & Installation

ADJUSTMENTS

IDLE SPEED ADJUSTMENT

1) Disconnect and plug distributor vacuum advance hose at distributor. Disconnect and plug parking brake hose at vacuum release cylinder. Engage parking brake and block wheels. Connect tachometer to engine.
2) Start engine and warm-up to operating temperature. Place transmission in Drive and turn A/C off. Adjust slotted idle by-pass screw to obtain 600 RPM on Eldorado and Seville, or 650 RPM on Brougham and Deville. Turn off engine. Disconnect tachometer. Reconnect all disconnected hoses.

THROTTLE POSITION SWITCH

Loosen 2 throttle position switch mounting screws just enough to permit rotation of switch. Hold throttle valve in idle position and turn throttle position switch counterclockwise until end-stop is reached. Tighten mounting screws. Release throttle valves and make sure that throttle valves close to throttle stop. If not, repeat procedure.

TROUBLE SHOOTING

NOTE: The Fuel Injection Analyzer (J-25400) will functionally test each component of the system as well as the ECU. However, there are many problems which can be solved without this analyzer by following the diagnostic procedure.

ENGINE CRANKS BUT WILL NOT START

1) Check for blown 10 amp in-line fuel pump fuse, which is located below instrument panel near ECU connectors. Turn ignition switch to "ON" position and listen for one second pump whine.
2) Check for open circuit in Black wire (Purple wire on some models) between starter solenoid and ECU. Also check for open circuit in Dark Green wire (fusible link) between alternator "BAT" connection and ECU. Listen for a one second fuel pump whine when ignition switch is turned to "ON" position.
3) Check for poor connection at ECU harness, fuel pump harness, engine temperature sensors, or at distributor trigger (speed sensor). To check engine temperature sensors, connect an ohmmeter across each sensor connector. If ohmmeter reading is not between 600 and 1600 ohms, replace sensor.
4) Check for a malfunctioning main fuel pump, check voltage of wire at pump connection. Check for a malfunctioning throttle position switch, disconnect switch and engine should start.
5) Check for fuel flow restriction by disconnecting pump outlet line and turning ignition switch to "ON" position. If fuel flow is abnormal, locate and repair fault.

HARD STARTING

1) Check for open coolant temperature sensor circuit. Indication of this condition is an engine that it will start normally when engine is hot, but is hard to start when engine is cold or only partially warm.
2) To check sensor, connect an ohmmeter across sensor connector. If ohmmeter reading is more than 1600 ohms, replace sensor.
3) Check for a malfunctioning throttle position switch, disconnect switch and engine should start normally. Check for a malfunction in fuel pump(s) or pressure regulator, check pressure of fuel supply system.

POOR FUEL ECONOMY

1) Check for a disconnected or leaking MAP sensor. Replace or repair as necessary. Check for a disconnected vacuum hose at fuel pressure regulator. Check all vacuum connections.
2) Check for a malfunctioning air temperature sensor. Check for closed (shorted) circuit in temperature sensor by connecting an ohmmeter across connector terminals. If sensor resistance is less than 600 ohms, replace sensor.

ENGINE STALLS AFTER STARTING

1) Check for open circuit in Yellow or Yellow/Black wire (Gray wire at ECU) from fuse block to ECU. *See Fig. 10.* Also check for poor connection at ECU harness, which is located below instrument panel, near ECU.
2) Check for poor connection at coolant temperature sensor. Check for open circuit in sensor wire or in sensor wiring connector. To check for open circuit in sensor, connect ohmmeter across sensor terminals. If resistance is greater than 1600 ohms, replace sensor.
3) Check idle air compensator for stalling after start or at idle. When compensator is working properly, an increase in air noise will be heard when A/C compressor cuts in. Idle RPM with A/C on and transmission in Drive should be within 30 RPM of normal (A/C off) idle speed. Under extremely warm conditions, this difference in RPM may be greater. If electrical connections to compensator and compressor are okay, compensator valve may be sticking and should be replaced.

ROUGH IDLE

1) Check for disconnected or leaking MAP sensor hose. On cold engine only, check for poor connection at temperature sensors or for possible open circuit at sensors. To check for open circuit, connect ohmmeter across sensor terminals. If resistance is greater than 1600 ohms, replace sensor.
2) Check for poor connection at injector wiring. Check engine coolant sensor for shorted (closed) circuit. To check, connect ohmmeter across sensor terminals. If resistance is less than 600 ohms, replace sensor. Check for a speed sensor harness that is located too close to secondary ignition wires (false injector signal).

PROLONGED FAST IDLE

Check for possible poor connection at fast idle valve or for an open circuit in fast idle valve heating element. Check adjustment of throttle position switch. Check for possible vacuum leaks.

NO FAST IDLE

Check for bent fast idle valve micro-switch causing heater to malfunction and drive valve section down to locked closed position.

ENGINE HESITATES OR STUMBLES ON ACCELERATION

1) Check for disconnected, leaking, or pinched MAP sensor hose. Check for electrical malfunction or improper mechanical alignment of throttle position switch.

1975-79 FUEL SYSTEMS
General Motors Electronic Fuel Injection (Cont.)

2) Check for intermittent malfunction of distributor trigger (speed sensor). Check ECU harness connector for loose connections. On cold engines, check EGR solenoid for loose connection or for open circuit.

LACK OF HIGH SPEED PERFORMANCE

1) Check throttle position switch for proper alignment at wide open throttle. Also check for any other malfunctions in throttle positioning switch. Check for a malfunctioning main fuel pump.
2) Check for intermittent malfunction of distributor trigger (speed sensor). Check fuel system for restrictions. Check for open circuit in Purple wire between ECU and starter solenoid.

REMOVAL & INSTALLATION

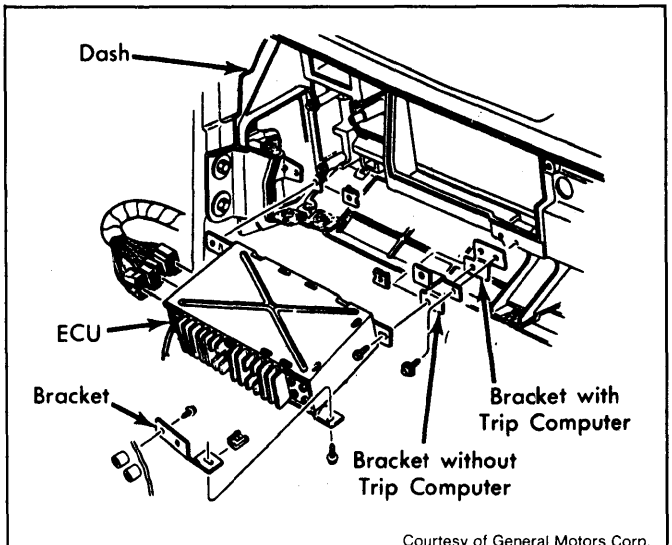
RELIEVING FUEL PRESSURE

CAUTION: Fuel system is under approximately 39 psi. Use caution when relieving pressure on fuel system. Anytime fuel fittings are separated, a new conically shaped metal gasket (Part No. 1608786) should be installed. Do not reuse gaskets.

On models without Schrader valves on rear of fuel rail, place shop towel over fitting to be removed and loosen fitting slowly to relieve fuel pressure. On models with Schrader valves, remove protective cap from pressure fitting and loosely install Adapter (J-5420) on fitting. Arrange shop towel or container so that discharged fuel will be contained. Slowly tighten adapter, until pressure is relieved.

ELECTRONIC CONTROL UNIT

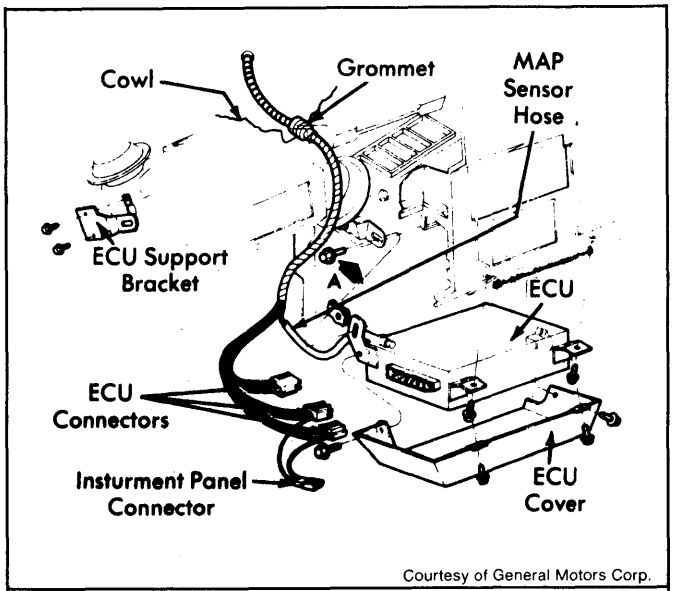
Removal & Installion (Brougham & DeVille) - 1) Disconnect negative battery cable. *See Fig. 5.* Remove glove box liner. Remove 4 mounting screws and ECU. Unplug electrical connectors and MAP sensor hose. To install, reverse removal procedure.



Courtesy of General Motors Corp.

Fig. 6: Eldorado ECU Removal & Installation

Removal & Installion (Eldorado) - Disconnect negative battery cable. Remove instrument panel lower cover. Remove mounting screw at front of ECU. Remove 2 screws attaching ECU to instrument panel. Unplug harness connectors and MAP sensor hose. *See Fig. 6.* To install, reverse removal procedure.
Removal & Installion (Seville) - Disconnect negative battery cable. Remove ECU cover. While supporting ECU, remove mounting screws. Lower ECU enough to disconnect wiring harness connectors and MAP sensor hose. Lower and remove ECU. *See Fig. 7.* To install, reverse removal procedure.

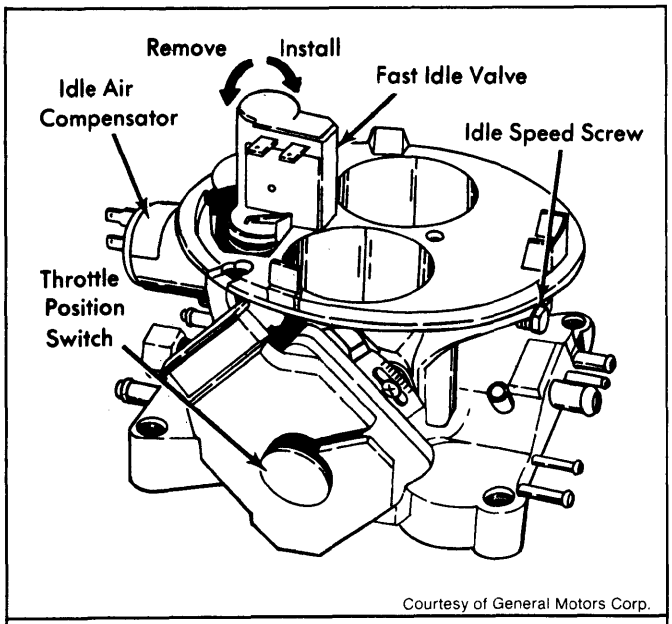


Courtesy of General Motors Corp.

Fig. 7: Seville ECU Removal & Installation

THROTTLE BODY ASSEMBLY

Removal - 1) Remove air cleaner. Disconnect throttle return springs. Remove cruise control retainer (if equipped). Remove clip to disconnect throttle cable from throttle lever.
2) Remove left rear throttle body mounting screws which hold throttle bracket to intake manifold. Disengage downshift switch from throttle lever and move switch out of way.
3) Unplug TPS connector, idle air compensator solenoid valve wire, and fast idle valve connector. *See Fig. 8.* Slide fast idle valve wiring out of notch in throttle body.
4) Using back-up wrench, remove power brake vacuum line. Remove all vacuum hoses from throttle body. Remove remaining throttle body mounting screws and remove throttle body. Remove gasket from intake manifold.
Installation To install, reverse removal procedure. Check operation of transmission downshift switch and for proper operation of wide open throttle switch.



Courtesy of General Motors Corp.

Fig. 8: EFI Throttle Body Assembly

1975-79 FUEL SYSTEMS
General Motors Electronic Fuel Injection (Cont.)

THROTTLE POSITION SWITCH

Removal - Unplug connector from throttle position switch. Remove 2 screws securing throttle switch to throttle body. Remove throttle position switch. *See Fig. 8.*

Installation - Install throttle position switch on right side of throttle body. Ensure that tab engages with flat spot on throttle shaft. Install 2 mounting screws and adjust switch. See ADJUSTMENTS in this article.

FAST IDLE VALVE

Removal - Remove air cleaner. Unplug electrical connector from fast idle valve. *See Fig. 8.* Remove air cleaner stud. Push down and turn fast idle valve counterclockwise. Remove fast idle valve, spring, and seat from throttle body.

Installation - Position seat, spring, and fast idle valve in throttle body. Position heater on top of fast idle valve and push down to compress spring. Align tabs of fast idle valve heater with cut-out in throttle body and further compress spring. Rotate heater 90 degrees clockwise and plug electrical connector. Install air cleaner.

FUEL RAILS

NOTE: Fuel rail removal and installation procedures for Eldorado and Seville is the same as fuel injector removal and installation procedures. See INJECTORS in this article.

Removal & Installation (Front) - 1) Relieve fuel pressure. See RELIEVING FUEL PRESSURE in this article. Remove and discard hose clamp securing pressure regulator hose to front fuel rail. *See Fig. 3.*

2) Use back-up wrench at side of rail fitting and remove flare nut from each end of front fuel rail. Disengage front rail from pressure regulator hose and remove rail from vehicle. To install, reverse removal procedure. Turn ignition on and off several times to pressurize fuel system. Check fuel rail for leaks.

Removal & Installation (Rear) - 1) Relieve fuel pressure. See RELIEVING FUEL PRESSURE in this article. Use back-up wrench on fuel rail fitting and remove fitting from rear fuel rail. *See Fig. 3.*

2) Use back-up wrench on fuel rail and remove flare nut from each side of rear fuel rail. Remove rear fuel rail. To install, reverse removal procedure. Turn ignition on and off several times to pressurize fuel system. Check fuel rail for leaks.

INJECTORS

Removal - 1) Remove front and rear fuel rails. Remove electrical conduit from injector brackets. Remove 2 screws holding each injector bracket to intake manifold. Remove brackets and rubber grommets. Unplug electrical leads from injectors.

2) Remove fuel rails and injectors as an assembly. Some injectors will stay with fuel rail, while others will remain with manifold. Remove injectors from fuel rail and/or from intake manifold. Remove and discard "O" rings.

Installation - 1) Lubricate and install new "O" rings on fuel rail side of injectors. Install injectors into fuel rail with connector facing inboard. Lubricate and install new "O" rings into each injector port of intake manifold.

2) Install fuel rail assembly into intake manifold, making sure that each injector is properly seated. Install rubber grommets (flange side down) on fuel rail and install injector brackets in position. Secure each bracket with 2 screws and tighten screws to specifications.

3) Route electical harness along bracket and secure to bracket. Injectors may need to be rotated to provide proper harness routing. Install front and rear fuel rails. Turn ignition on and off several times to pressurize fuel system. Check fuel rails for leaks.

FUEL PRESSURE REGULATOR

Removal & Installation - 1) Relieve fuel pressure. See RELIEVING FUEL PRESSURE in this article. Remove vacuum hose from nipple on top of fuel pressure regulator. Remove and discard hose clamp securing flexible pressure regulator hose to front fuel rail.

2) Remove fuel return line. Remove Metric nut securing pressure regulator to fuel rail. Work regulator off flexible fuel hose and out of bracket. To install, reverse removal procedure. Turn ignition on and off several times to pressurize fuel system. Check fuel rails for leaks.

FUEL FILTER ASSEMBLY

Removal & Installation - 1) Relieve fuel pressure. See RELIEVING FUEL PRESSURE in this article. Remove fuel inlet hose and discard clamp. Remove fuel outlet line from fuel filter fitting.

2) Remove 2 screws securing fuel filter assembly to bracket and remove filter assembly. To install, reverse removal procedure. Turn ignition on and off several times to pressurize fuel system. Check fuel filter assembly for leaks.

AIR TEMPERATURE SENSOR

Removal & Installation - Locate air tempeature sensor at right rear of intake manifold. Unplug sensor from wiring harness. Remove sensor from intake manifold. To install, reverse removal procedure.

COOLANT TEMPERATURE SENSOR

Removal & Installation - 1) Drain coolant from radiator until coolant level is below cylinder heads. Locate coolant temperature sensor at left front of intake manifold (Eldorado and Seville) or below thermostat housing (all other models).

2 Disconnect sensor from wiring harness and remove. To install, apply non-hardening sealer to threads on sensor and install sensor. Fill radiator to proper level.

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs.
Fuel Rail Flare Nuts	25
Fuel Pump Bracket-to-Frame	20
Injector Hold-Down Bracket	30
Sensors	15
Throttle Body Mounting Screws	15
Throttle Linkage Bracket-to-Manifold	30
Fuel Pump Mounting Screws	INCH Lbs. [1] 25

[1] - Tighten to 55 INCH Lbs. on Eldorado and Seville.

1975-79 FUEL SYSTEMS
General Motors Electronic Fuel Injection (Cont.)

WIRING DIAGRAMS

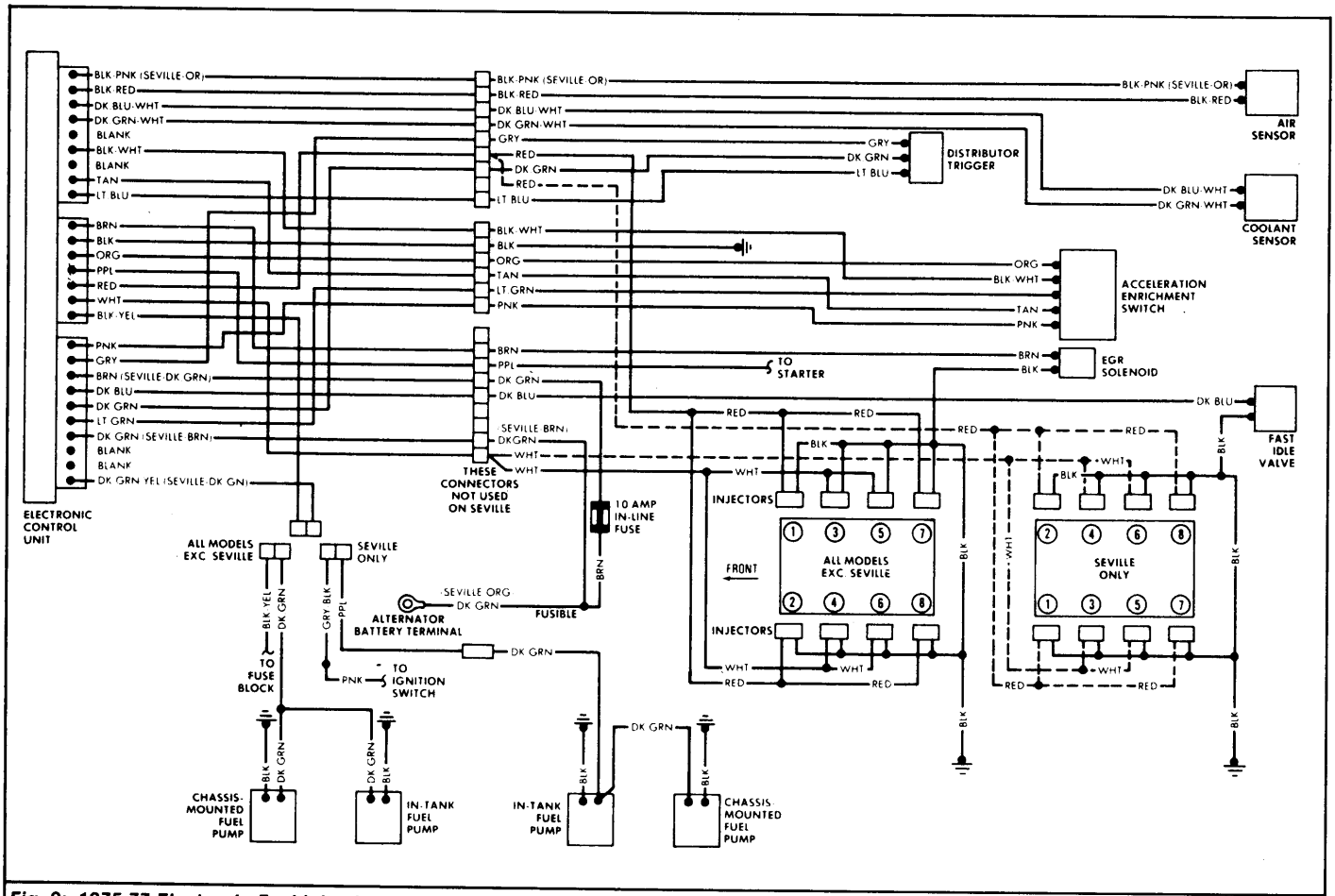


Fig. 9: 1975-77 Electronic Fuel Injection Wiring Diagram

1975-79 FUEL SYSTEMS
General Motors Electronic Fuel Injection (Cont.)

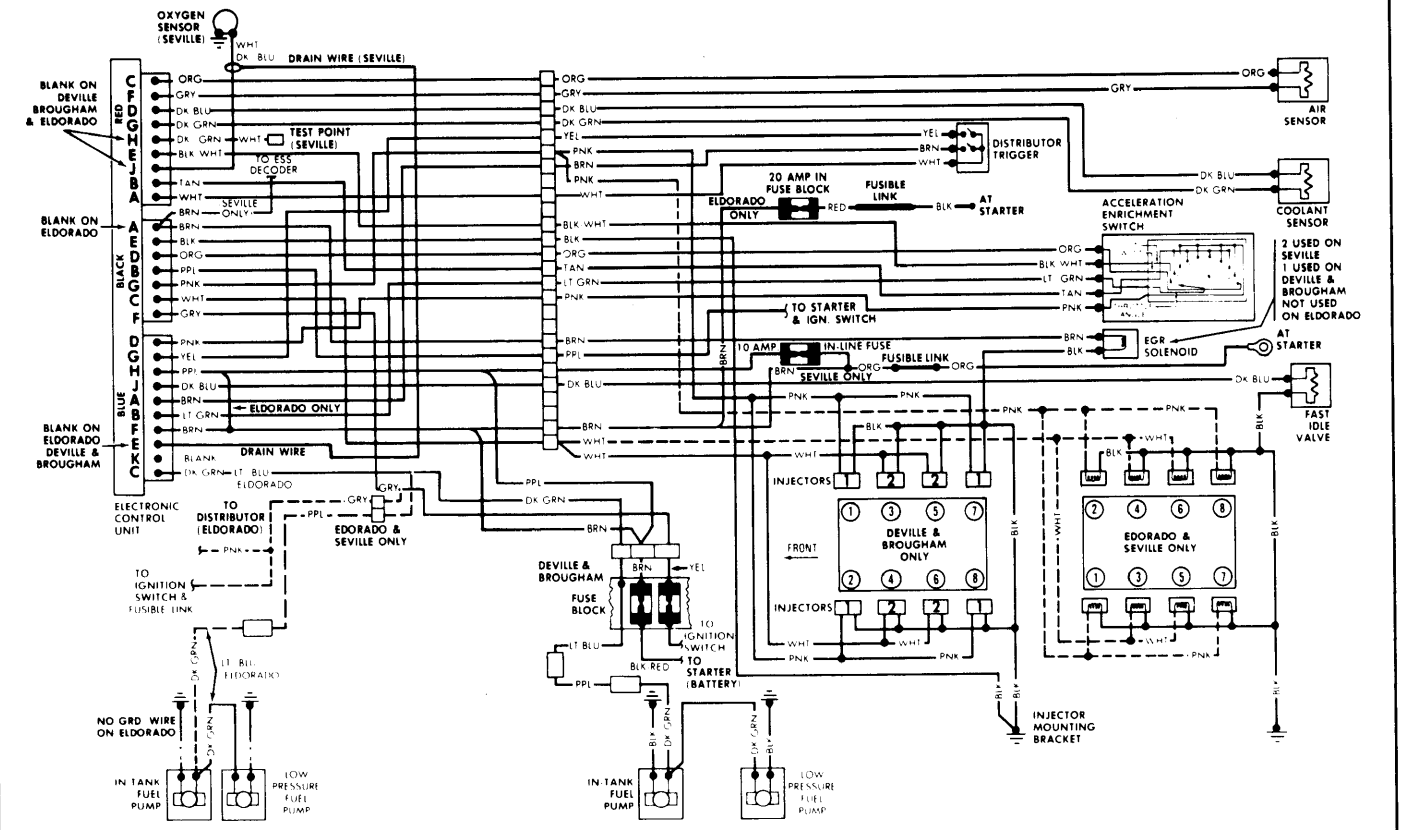


Fig. 10: 1978-79 Electronic Fuel Injection Wiring Diagram