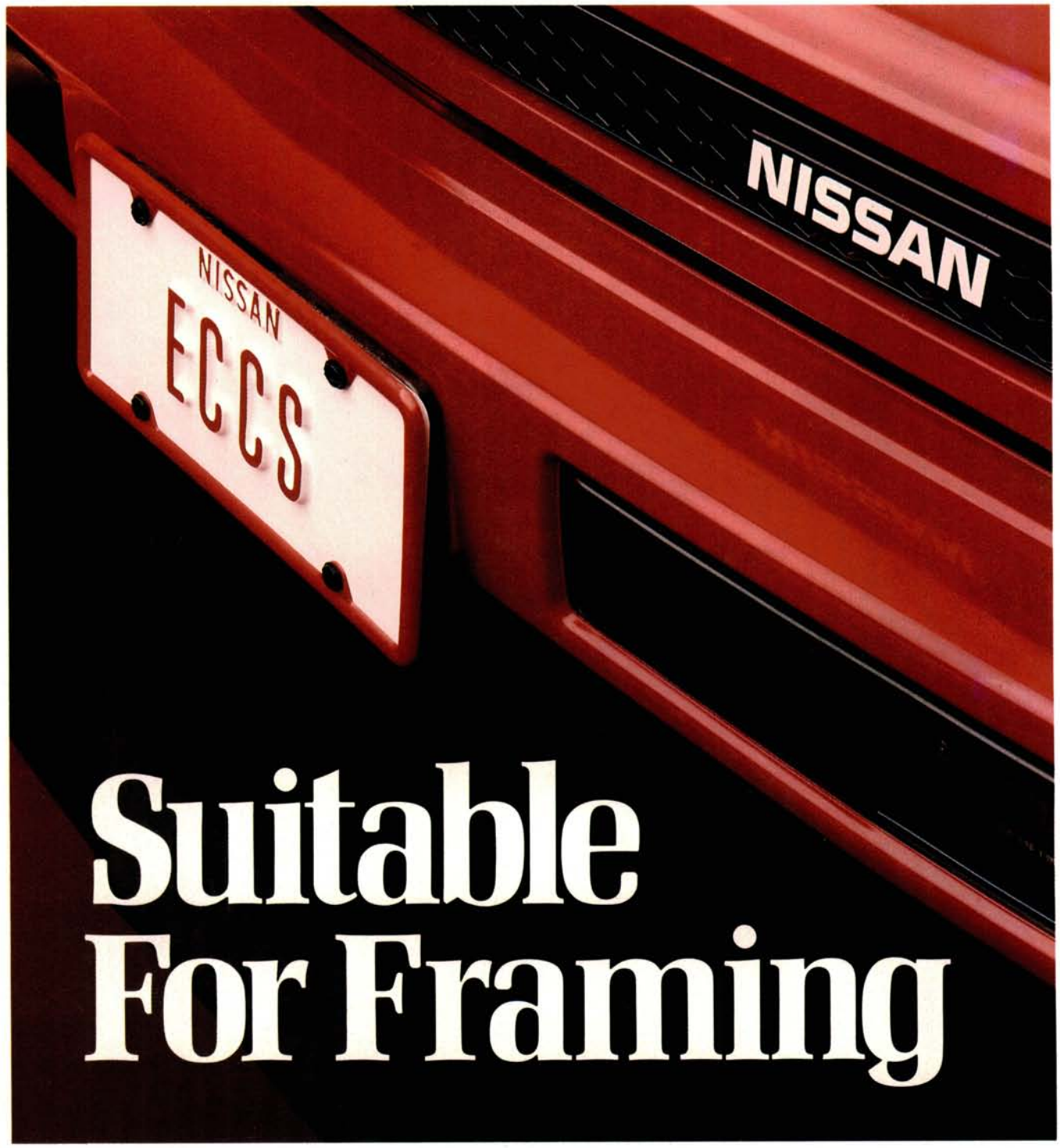


Suitable For Framing

Welcome to part one of a two part series that'll help you apply for your first class ECCS "license". A license we hope will be "suitable for framing".

Nissan got into the fuel injection picture in 1975 with an L-Jetronic system in the 1975 280Z. A few years later, the 1981 280 ZX Turbo became the first U.S. Nissan (they still called them Datsuns then) to feature an Electronic Concentrated Engine Control System (ECCS).

The ECCS system used on the Turbo ZX was more than an electronic fuel injection system, it was a full-fledged engine management system. Fuel, ignition, idle speed, and emission control functions were all controlled by a single electronic control unit (ECU). The old L-Jetronic system had just seven ECU inputs and only one output, injector pulse duration control. ECCS's improvements made the new engine management system far more flexible.

Souped-Up L-Jetronic

Nissan has added ECCS to more models each year. For 1990, all Nissans use either multi-point or throttle body versions of the ECCS system. Carburetors have been replaced on even the least expensive models.

Each new ECCS system seems to include more sensor inputs, more actuator outputs, and improved self-diagnostic ability. ECCS owes a big debt to the original Bosch L-Jetronic system, however. You can still see traces of the old L-Jet lurking below the high tech surface. Any L-Jet experience that you already have will make understanding and repairing ECCS that much easier.

ECCS Overview

Because of the wide variety of models and systems in the Nissan line, this month's look at ECCS will be an overview. We'll familiarize you with system operation, and point out component functions and locations.

As we mentioned, ECCS controls the ignition, fuel injection, idle speed, and emission control from a central ECU. Since 1987, most ECCS systems also have a self-learning, random access memory (RAM) function built into the ECU. RAM works with the ECU's basic read only memory (ROM) programs, allowing the ECU to learn and remember new information.

Here's a quick example of how RAM helps the ECU do its job:

- The oxygen sensor detects a rich fuel mixture and sends its signals to the ECU.
- The ECU makes an adjustment to the injector pulse width, then stores the information in RAM.
- The next time the ECU receives the same set of signals from the oxygen sensor, the ECU goes back to RAM and looks for the correct injector pulse duration adjustment. It's something like learning to get somewhere without having to rely on a map for directions.
- As more information is stored in the ECU's RAM, the ECU gives faster and more accurate responses to information from its input sensors. The ECU learns to search its RAM for the quickest shortcut to its destination.

All that stored RAM information gets erased if the ECU loses its power supply. Disconnecting the battery cables will give the ECU a severe case of amnesia. Luckily, the RAM section of the ECU is a quick study, and starts collecting new information as soon as the power supply is reconnected and the vehicle is restarted. Relearning the lost RAM information takes about 20 minutes of driving the car under varied conditions.

Self-Diagnostics

Early ECCS systems were pretty crude in the self-diagnostics department. The 280 ZX Turbo's "One Mode", single LED diagnostic system was only able to monitor oxygen sensor operation. If you didn't have Nissan's dedicated tester, ECU pin testing was the only way to check for faults in the system's various inputs and outputs. The ECU couldn't store trouble codes.

Things got a little better on the 1983 Pulsar Turbo. Its two self-diagnostic LEDs could be used to retrieve stored trouble codes—a step in the right direction.

Following the Pulsar Turbo, most ECCS-equipped vehicles up to 1987 have a "Three Mode", two LED self-diagnostic system. 1987 and later systems use a "Five Mode" self-diagnostic system. Consult our chart for a brief explanation of both systems. We'll be spending more time using the five mode system at a later date when we cover ECCS troubleshooting and repair techniques.

Three and Five Mode Self-Diagnostic Systems

MODE	THREE MODE DIAGNOSTICS	FIVE MODE DIAGNOSTICS
MODE ONE	Oxygen sensor diagnosis	Oxygen sensor diagnosis
MODE TWO	Mixture ratio control checks	Mixture ratio control checks
MODE THREE	Input sensor and actuator circuit testing Trouble Code retrieval	Trouble code retrieval
MODE FOUR		Input sensor testing
MODE FIVE		"Real Time" input sensor testing

Maple-Walnut or Plain Vanilla

Nissan uses both multi-point and throttle body injection versions of the ECCS system. Except for the obvious differences in component design and locations, both versions work just about the same. System diagnosis and repair will be very similar whether you're working on a Pathfinder with an Electro-Injection throttle body system or a Stanza with a multi-point system.

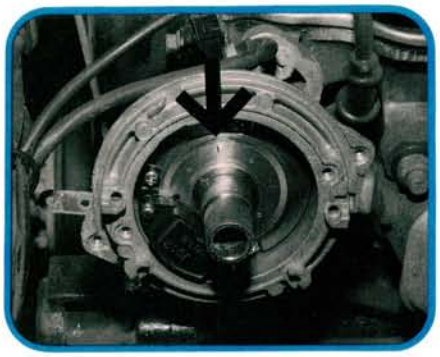
This article won't replace the hundreds of pages of information on individual models that you'll find in factory and aftermarket repair manuals. If you're deeply involved in an ECCS problem, you'll need the wiring diagrams, trouble code flow charts, and other information found there.

We'll get your feet wet this month with a look at the ECU's input sensors and output actuators.

—By Karl Seyfert

1

The Crank Angle Sensor uses a combination of photo diodes, LEDs, a shutter wheel, and a wave forming circuit inside the distributor to send crank angle and RPM signals to the ECU. The ECU uses the crank angle signal to control injector pulse duration, ignition timing, and other outputs.

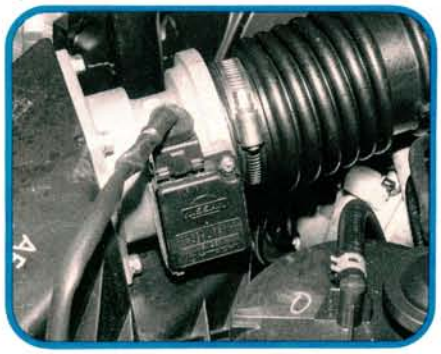


2

Three hundred and sixty slits in the shutter wheel tell the ECU how fast the engine is turning. Larger slots are used to signal crankshaft position. The largest slot indicates TDC for the number one cylinder. This is no place for dirt, oil, or stray light.

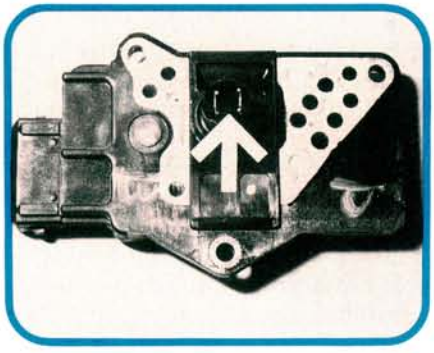
3

Early ECCS systems use vane type Air Flow Meters to measure intake air quantity and convert it into a voltage signal to the ECU. The ECU checks the Crank Angle Sensor and Air Flow Meter inputs, then adjusts the injector pulse duration to match changing engine loads.



4

Since 1984, some Nissan models have been equipped with "hot wire" Air Flow Meters. The air passes over a heated wire after entering the air flow meter. The air cools the wire and causes the circuit resistance to decrease. The ECU converts the changing resistance signal into a measurement of the inlet air flow.



5

Nissan's Electro-Injection (EI) throttle body injection systems use a small hot wire Air Flow Meter. A passage directs an air sample around the throttle plates and past the Air Flow Meter. The Air Flow Meter sends its resistance signal to the ECU, which determines the total air flow based on the small sample.

6

The Coolant Temperature Sensor contains a negative temperature coefficient (NTC) thermistor. Its resistance decreases as engine temperature increases. The ECU's 5-volt reference signal returns to the ECU at its lowest value when the engine is cold, and at its highest when the engine is warm.

7

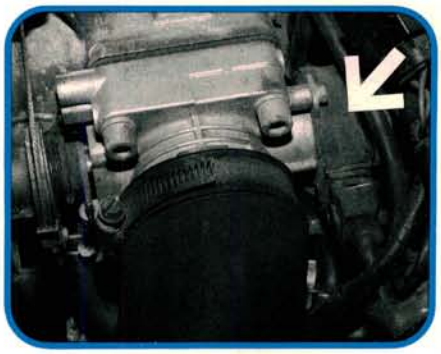
Air Temperature Sensors are less common on later models. Hot wire Air Flow Meters don't need an Air Temperature Sensor because they automatically compensate for changes in inlet air temperature and density. Look for the Air Temperature Sensor in front of the air flap on potentiometer-style Air Flow Meters.

8

The oxygen sensor gives the ECU an indirect measurement of the air/fuel ratio by measuring the amount of oxygen present in the exhaust gases. You'll find heated (three wire) and unheated (single wire) oxygen sensors on different models. Sensors are usually mounted in the exhaust manifold.

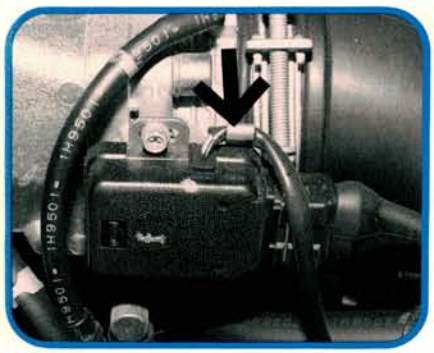
9

The ignition switch sends engine "start" and "on" signals to the ECU. The ECU uses these signals to control the Fuel Pressure Regulator, the Auxiliary Air Regulator, EGR operation, idle speed, ignition timing, fuel enrichment, and fuel pump operation.



10

The Throttle Position Switch monitors throttle opening from its perch on the side of the throttle housing. Many throttle switches contain a set of closed and wide-open throttle contacts. The Throttle Position Switch sends an open circuit signal to the ECU when the throttle opening is between these points.

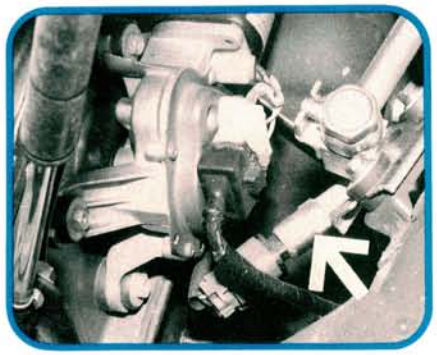


11

The Throttle Position Switch may also contain a potentiometer called a Throttle Sensor. The Throttle Sensor helps the ECU determine the actual throttle opening and how quickly the throttle position changes. In some ECCS systems, this sensor input helps the ECU control fuel shut-off during closed throttle deceleration.

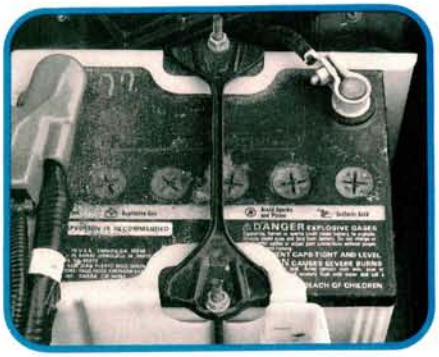
12

The Fuel Temperature Sensor measures fuel rail temperature from its position in the Pressure Regulator. The ECU monitors the sensor's signal, and increases the injector pulse duration when fuel temperature rises. This sensor is especially helpful in preventing hot restart problems.



13

The headlight, radiator fan, power steering oil pressure, rear defogger, and heater switches are all Load Sensors. They signal the ECU about increased engine loads caused by the alternator or power steering pump. The ECU activates the Idle-up Solenoid Valve to maintain the correct idle speed.

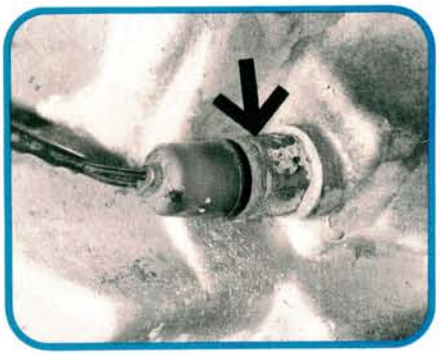


14

Battery voltage is an important ECU input too. The ECU monitors battery voltage, and changes output signals to some actuators if battery voltage is low. The ECU needs a steady supply of battery voltage to run built-in programs, power the ROM and RAM circuits, and control the injectors.

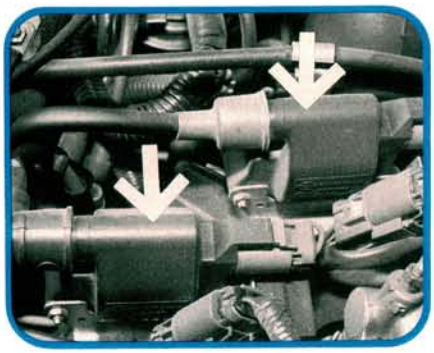
15

The input signals from the Vehicle Speed Sensor are used by the ECU to control injector pulse width, ignition timing, idle speed, and the fuel cut system. Speed Sensor signals may also be used by the cruise control and voice warning systems.



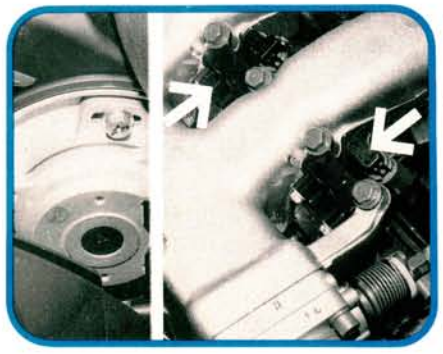
16

The ECU uses the input signal from either the Neutral Switch (manual transmission) or the Inhibitor Switch (automatic transmission) to help determine the correct idle speed. The ECU adjusts the idle speed to handle the extra engine load when the automatic transmission is shifted into drive or reverse.



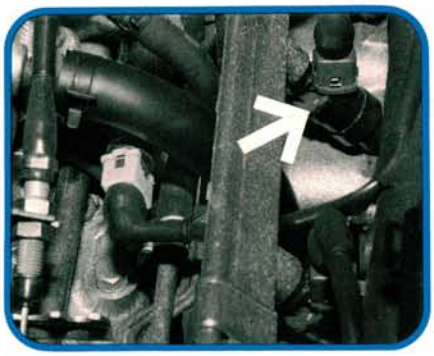
17

The ECU constantly adjusts the ignition timing by sending a pulsed signal to the Power Transistor. The Power Transistor controls the ignition coil ground circuit. Twin spark plug engines use a pair of ignition coils and Power Transistors (arrows), which are separately controlled by the ECU.



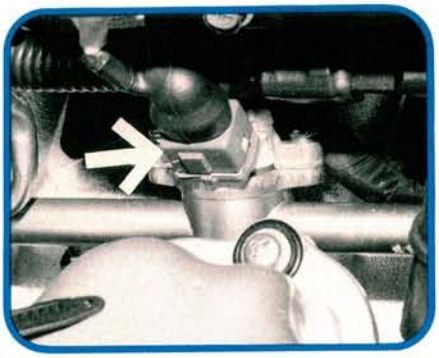
18

Late model 300 ZX and twin-cam Pulsars use distributorless ignition systems. The Crank Angle Sensor is driven off the end of the camshaft (left photo). Individually controlled ignition coil/power sit on top of each spark plug (right photo).



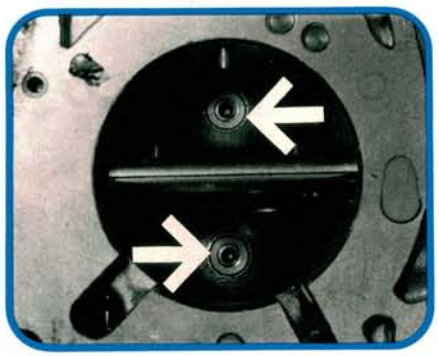
19

Top Feed Injectors are used on older ECCS systems. The ECU's millisecond signal energizes a magnetic coil inside the injector, opening the pintle. Top Feed Injectors have no built-in fuel return. The Fuel Pressure Regulator maintains fuel pressure at the injectors, and fuel is used as needed.



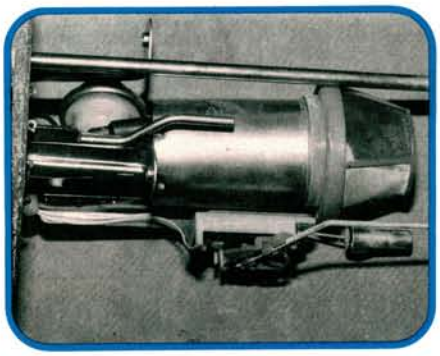
20

Two types of Bottom Feed Injectors are used on later ECCS systems. Multi-point systems feed fuel into the nozzle end of the injectors. Unused fuel is forced upwards to the fuel return line. The fuel circulates constantly, so fuel temperature is kept lower and trapped vapors are flushed out.



21

The Bottom Feed Injectors used on EI throttle body systems operate like Bottom Feed Multi-point Injectors. One advantage of throttle body injectors' larger fuel discharge ports and spray pattern is that it makes them less prone to clogging and blockage from debris.



22

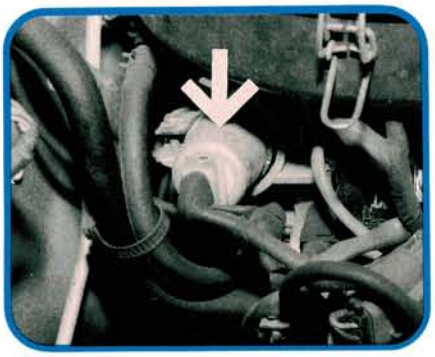
Many ECCS systems also have a Fuel Pump Voltage Control System. The system varies the pump voltage between 9.4 and 13.4 volts, depending on engine operating conditions. The ECU runs the pump at a lower voltage much of the time, so there's less pump wear and quieter operation.

23

Idle Speed Controls adjust to changing engine loads by bypassing a controlled amount of air around the throttle plate. Models using a Fast Idle Control Device or Idle-up Solenoid Valve receive steady on or off signals from the ECU, and raise engine idle speed by a set amount.

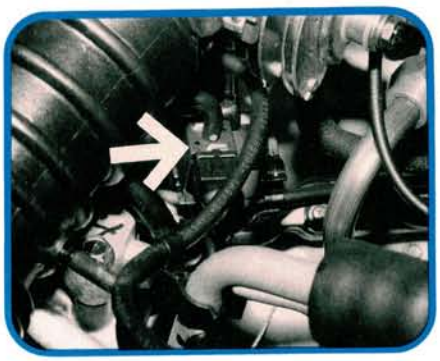
24

Many models still have an Auxiliary Air Regulator (a carry-over from L-Jet systems) for fast idle control during engine warm-up. The regulator allows metered air to bypass the throttle plate. The ECU provides a ground to the air regulator heater during cranking and while the engine is running.



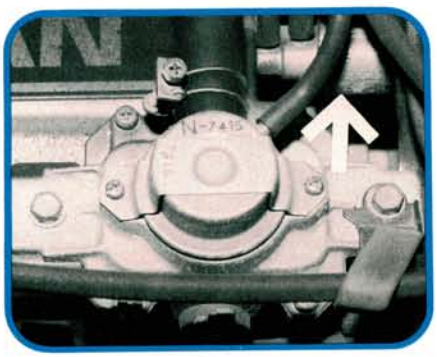
25

EI models use an Idle Speed Control Valve (ISC) to maintain a steady idle speed, provide a fast idle, and control manifold pressure during closed throttle deceleration. The ECU monitors its input sensors, then sends a pulsed ground signal to either open or close the ISC valve.



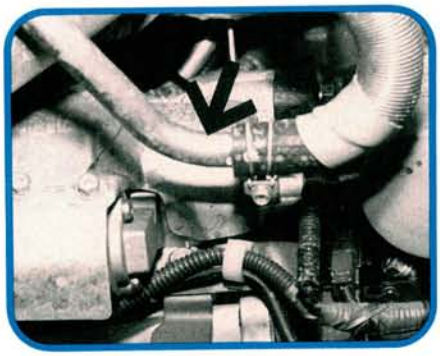
26

The EGR Control Solenoid Valve works with the Venturi Vacuum Transducer to tailor the amount of EGR supplied to the engine under all conditions. The ECU monitors signals from its input sensors, then either opens or closes the EGR Control Solenoid Valve to control the flow of vacuum to the EGR valve.



27

The ECU controls the "cold" Air Induction Valve (AIV) system through the AIV Vacuum Control Solenoid. During open loop operation and closed throttle deceleration, the ECU directs secondary air to the exhaust manifold by activating the AIV solenoid.



28

The "hot" AIV system sends secondary air to the catalytic converter whenever the engine is running. The air enters the exhaust below the oxygen sensor so that it doesn't affect the sensor's readings. Both cold and hot AIV systems draw their fresh air using the engine's negative pressure pulses.

29

The Mixture Heater is an extra driveability output used on EI systems. The heater is located between the throttle valve and the intake manifold to help atomize fuel during cold engine starts. The ECU controls the "on" signal to the Positive Temperature Coefficient (PTC) Mixture Heater.

30

The last two ECU outputs that we'll mention are the self-diagnostic LED Inspection Lamps. The Inspection Lamps provide a window into the ECCS system and simplify repair diagnosis. Newer ECCS systems have either three or five mode self-diagnostic systems. We'll cover ECCS self diagnosis next time.