ADVANCED ENGINE PERFORMANCE SPECIALIST TEST (L1)

COMPOSITE VEHICLE TYPE 2 REFERENCE BOOKLET

This booklet is intended only for reference when preparing for and taking the ASE Advanced Engine Performance Specialist Test. The composite vehicle type 2 engine control system is based on designs common to many vehicle manufacturers, but is not identical to any actual production vehicle.

ASE
ADVANCED ENGINE PERFORMANCE SPECIALIST TEST
— COMPOSITE VEHICLE TYPE 2 INFORMATION —

GENERAL DESCRIPTION

This generic four cycle, V6 engine has four overhead chain-driven camshafts, 24 valves, distributorless ignition, and a mass airflow-type closed-loop sequential multiport fuel injection system. The Powertrain Control Module (PCM) receives input from sensors, calculates ignition and fuel requirements, and controls engine and transmission actuators to provide the desired driveability, fuel economy, and emissions control. The powertrain control system has OBD II sensors and diagnostic capabilities. The PCM receives power from the battery and ignition switch and provides a regulated 5 volt supply for the engine and transmission sensors. The engine is equipped with a single exhaust system and a three-way catalytic converter, without any secondary air injection. The vehicle has a four-speed automatic overdrive transaxle, with shifting controlled by the PCM. The vehicle's charging system is controlled by the PCM.

FUEL SYSTEM

- Sequential Multiport Fuel Injection (SFI)
- Returnless Fuel Supply with electric fuel pump mounted inside the fuel tank
- Fuel pressure is regulated to a constant 50 psi (345 kPa) by a mechanical regulator in the fuel tank. Minimum acceptable fuel pressure is 45 psi (310 kPa). The fuel system should maintain a minimum of 45 psi (310 kPa) for two minutes after the engine is turned off.

IGNITION SYSTEM

- Distributorless Ignition (EI) with six ignition coils (coil-over-plug)
- Firing Order: 1-2-3-4-5-6
- Cylinders 1, 3, and 5 are on Bank 1, Cylinders 2, 4, and 6 are on Bank 2
- Ignition timing is not adjustable
- Timing is determined by the PCM using the Crankshaft Position (CKP) Sensor signal
- The ignition control module is integrated into the PCM

IDLE SPEED

- Non-adjustable closed throttle stop (minimum air rate)
- Normal no-load idle range is 850 to 900 rpm with an Idle Air Control (IAC) value of 15% to 25%

SENSORS

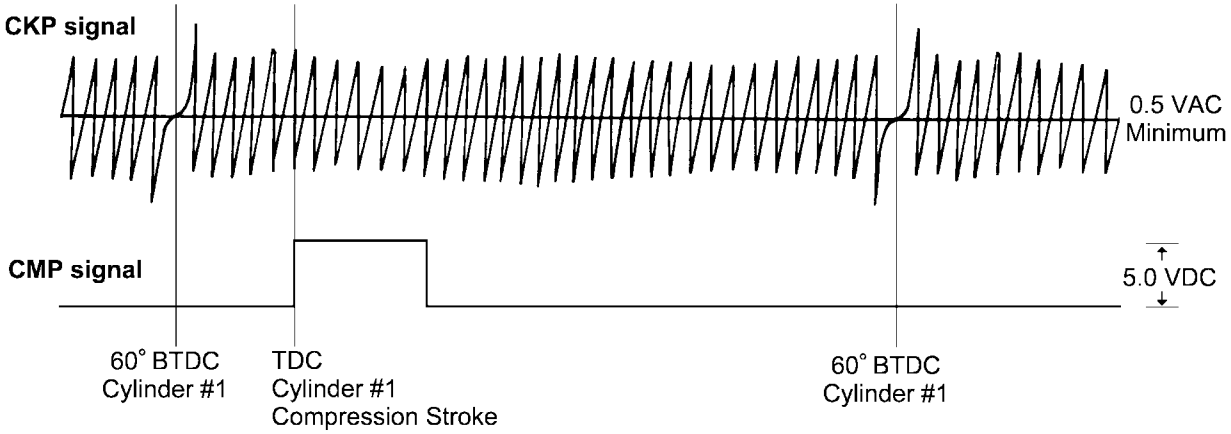
- **CRANKSHAFT POSITION (CKP) SENSOR**

  A magnetic-type sensor that generates 35 pulses for each crankshaft revolution. It is located on the front engine cover, with a 35-tooth iron wheel mounted on the crankshaft just behind the balancer pulley. Each tooth is ten crankshaft degrees apart, with one space for a "missing tooth" located at 60 degrees before top dead center of cylinder number 1.

SENSORS (CONTINUED)

• CAMSHAFT POSITION (CMP) SENSOR

A three-wire solid state (Hall-effect or optical-type) sensor that generates a signal at top dead center of cylinder number 1's compression stroke. This signal allows the PCM to determine fuel injector and ignition coil sequence. If no CMP signal is detected during cranking, the PCM will repeatedly fire the injectors and coils until the engine starts. Located on the front of the Bank 1 valve cover, with an interrupter mounted on the Bank 1 exhaust camshaft timing gear to generate the signal. The following diagram shows the CKP and CMP sensor signal waveforms.



• MASS AIRFLOW (MAF) SENSOR

Senses airflow into the intake manifold. The sensor reading varies from 0.2 volts (0 gm/sec) at key-on, engine-off, to 4.8 volts (175 gm/sec) at maximum airflow. At sea level, no-load idle (850 rpm), the sensor reading is 0.7 volts (2.0 gm/sec). Located on the air cleaner housing.

• MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

Senses intake manifold absolute pressure. The MAP sensor signal is used by the PCM for OBD II diagnostics only. The sensor reading varies from 4.5 volts at 0 in. Hg vacuum/101 kPa pressure (key on, engine off, at sea level), to 0.5 volts at 24 in. Hg vacuum/20.1 kPa pressure. At sea level, no-load idle with 18 in. Hg vacuum (40.4 kPa absolute pressure), the sensor reading is 1.5 volts. Located on the intake manifold.

• THROTTLE POSITION (TP) SENSOR

A three-wire, non-adjustable potentiometer that senses throttle position. The sensor reading varies from 0.5 volts at closed throttle to 4.5 volts at maximum throttle opening. The PCM interprets a throttle opening of 80% or greater as wide open throttle. At 80% throttle opening, the sensor reading is 3.7 volts. Located on the throttle body.

• ENGINE COOLANT TEMPERATURE (ECT) SENSOR

A negative temperature coefficient (NTC) thermistor that senses engine coolant temperature. The sensor values range from -40°F to 248°F (-40°C to 120°C). At 212°F (100°C), the sensor reading is 0.46 volts. Located in the engine block water jacket.

SENSORS (CONTINUED)

• INTAKE AIR TEMPERATURE (IAT) SENSOR

A negative temperature coefficient (NTC) thermistor that senses air temperature. The sensor values range from -40°F to 248°F (-40°C to 120°C). At 86°F (30°C), the sensor reading is 2.6 volts. Located in the air cleaner housing.

• VEHICLE SPEED SENSOR (VSS)

A magnetic-type sensor that senses rotation of the final drive and generates a signal that increases in frequency as vehicle speed increases. The PCM uses the VSS signal to control upshifts, downshifts, the torque converter clutch and high-speed fuel cutoff. The signal is read in miles-per-hour (mph). Located on the transaxle housing.

• HEATED OXYGEN SENSORS (HO2S 1/1, HO2S 2/1, AND HO2S 1/2)

Electrically heated zirconia sensors that measure oxygen content in the exhaust stream. Sensor 1/1 is located on the Bank 1 exhaust manifold (cylinders 1, 3 and 5). Sensor 2/1 is located on the Bank 2 exhaust manifold (cylinders 2, 4, and 6). Both upstream sensor signals are used for closed loop fuel control and OBD II monitoring. Sensor 1/2 is mounted in the exhaust pipe after the catalytic converter (downstream). Its signal is used for OBD II monitoring of catalytic converter operation. The sensor outputs vary from 0.0 to 1.0 volt. When a sensor reading is less than 0.45 volts, oxygen content around the sensor is high; when a sensor reading is more than 0.45 volts, oxygen content around the sensor is low. No bias voltage is applied to the sensor signal circuit by the PCM. With the key on and engine off, the sensor readings are zero volts. Battery voltage is continuously supplied to the oxygen sensor heaters whenever the ignition switch is on.

• POWER STEERING PRESSURE (PSP) SWITCH

A switch that closes when high pressure is detected in the power steering system. The signal is used by the PCM to adjust idle air flow to compensate for the added engine load from the power steering pump. Located on the P/S high pressure hose.

• BRAKE PEDAL POSITION (BPP) SWITCH

A switch that closes when the brake pedal is depressed (brakes applied). The signal is used by the PCM to release the torque converter clutch. Located on the brake pedal.

• A/C ON/OFF REQUEST SWITCH

A switch that is closed by the vehicle operator to request a/c compressor operation. Located in the climate control unit on the instrument panel.

• A/C PRESSURE SENSOR

A three-wire solid-state sensor for A/C system high-side pressure. The sensor reading varies from 0.25 volts at 25 psi to 4.50 volts at 450 psi. The signal is used by the PCM to control the a/c compressor clutch, radiator fan, and to adjust idle air flow to compensate for the added engine load from the a/c compressor. The PCM will also disable compressor operation if the pressure is below 40 psi or above 420 psi. Located on the a/c high side vapor line.

SENSORS (CONTINUED)

• FUEL LEVEL SENSOR

A potentiometer that is used to determine the fuel level. The reading varies from 0.5 volts / 0% with an empty tank to 4.5 volts / 100% with a full tank. When the fuel tank is ¼ full, the sensor reading is 1.5 volts. When the fuel tank is ¾ full, the sensor reading is 3.5 volts. Used by the PCM when testing the evaporative emission (EVAP) system. Located in the fuel tank.

• FUEL TANK (EVAP) PRESSURE SENSOR

Senses vapor pressure or vacuum in the evaporative emission (EVAP) system compared to atmospheric pressure. The sensor reading varies from 0.5 volts at 1/2 psi (14 in. H_2O) vacuum to 4.5 volts at 1/2 psi (14 in. H_2O) pressure. With no pressure or vacuum in the fuel tank (gas cap removed), the sensor output is 2.5 volts. Used by the PCM for OBD II evaporative emission system diagnostics only. Located on top of the fuel tank.

• TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR

A negative temperature coefficient (NTC) thermistor that senses transmission fluid temperature. The sensor values range from -40°F to 248°F (-40°C to 120°C). At 212°F (100°C), the sensor reading is 0.46 volts. This signal is used by the PCM to delay transmission shifting when the fluid is cold and control torque converter clutch operation when the fluid is hot. Located in the transaxle oil pan.

• TRANSMISSION TURBINE SHAFT SPEED (TSS) SENSOR

A magnetic-type sensor that senses rotation of the torque converter turbine shaft (input / mainshaft) and generates a signal that increases in frequency as transmission input speed increases. Used by the PCM to control torque converter clutch operation and sense transmission slippage. Located on the transaxle housing.

• TRANSMISSION RANGE (TR) SWITCH

A six-position switch that indicates the position of the transaxle manual select lever: Park/Neutral, Reverse, Manual Low (1), Second (2), Drive (3), or Overdrive (OD). Used by the PCM to control transmission line pressure, upshifting, and downshifting. Located on the transaxle housing.

ACTUATORS

Note: All coils, injectors, solenoids and relays receive a constant battery positive voltage feed from the ignition switch, and are controlled by the PCM providing a ground connection.

• FUEL PUMP (FP) RELAY

When energized, supplies battery voltage (B+) to the fuel pump. The relay coil resistance spec is 48 ± 6 ohms.

• FAN CONTROL (FC) RELAY

When energized, provides battery voltage (B+) to the radiator/condenser cooling fan motor°. The PCM will turn the fan on when engine coolant temperature reaches 210°F (99°C) and off when coolant temperature drops to 195°F (90°C). The fan also runs whenever the A/C compressor clutch is engaged. The relay coil resistance spec is 48 ± 6 ohms.

ACTUATORS (CONTINUED)

• A/C CLUTCH RELAY

When energized, provides battery voltage (B+) to the A/C compressor clutch coil. The relay coil resistance spec is 48 ± 6 ohms.

• IDLE AIR CONTROL (IAC) VALVE

A stepper motor that regulates the amount of air allowed to bypass the throttle plate. Used to control engine idle speed during closed throttle operation. A value of 0% indicates a PCM command to fully close the idle air passage, and a value of 100% indicates a PCM command to fully open the idle air passage (maximum idle speed compensation).

• MALFUNCTION INDICATOR LAMP (MIL)

When the ignition switch is turned on, the lamp lights for a bulb check. Afterward, the MIL will light only for emissions related concerns. There are two cases in which the MIL will light and remain on: A failure on the first trip of a "one trip" monitor, or a failure on the second consecutive trip of a 'two trip" monitor. Once lit, the MIL will remain on until the vehicle has completed three consecutive good trips (three trips in which the affected diagnostic monitor runs and passes.) The MIL is also turned off when stored DTCs are cleared. Whenever an engine misfire severe enough to damage the catalytic converter is detected, the MIL will blink on and off.

• EXHAUST GAS RECIRCULATION (EGR) VALVE CONTROL SOLENOID

A duty cycle controlled solenoid that, when energized, supplies manifold vacuum to open a diaphragm-type EGR valve. When the solenoid is not energized, the vacuum supply is blocked, and the EGR valve's diaphragm chamber is vented to close the valve. The EGR valve opening will vary with the pulse width modulated signal from the PCM. A value of 0% indicates a PCM command to fully close the EGR valve, and a value of 100% indicates a PCM command to fully open the EGR valve. The solenoid is enabled when the engine coolant temperature reaches 150°F (66°C) and the throttle is not closed or wide open. The solenoid winding resistance spec is 48 ± 6 ohms.

• FUEL INJECTORS

Electro-mechanical devices used to deliver fuel to the intake manifold at each cylinder. Each injector is individually energized once per camshaft revolution timed to its cylinder's intake stroke. The injector winding resistance spec is 12 ± 4 ohms.

• IGNITION COILS

These six coils, mounted above the spark plugs, generate a high voltage to create a spark at each cylinder individually. Timing and dwell are controlled by the PCM directly, without the use of a separate ignition module. The coil primary resistance spec is 1 ± .5 ohms. The coil secondary resistance spec is 10K ± 2K ohms.

• GENERATOR FIELD

The PCM supplies this variable-duty cycle signal to ground the field winding of the generator (alternator), without the use of a separate voltage regulator. Increasing the duty cycle results in a higher field current and greater generator (alternator) output.

ACTUATORS (CONTINUED)

• EVAPORATIVE EMISSION (EVAP) CANISTER PURGE SOLENOID

A duty cycle controlled solenoid that regulates the flow of vapors stored in the canister to the intake manifold. The solenoid is enabled when the engine coolant temperature reaches 150°F (66°C) and the throttle is not closed. A duty cycle of 0% blocks vapor flow, and a duty cycle of 100% allows maximum vapor flow. The duty cycle is determined by the PCM, based on engine speed and load. The solenoid is also used for OBD II testing of the evaporative emission (EVAP) system. The solenoid winding resistance spec is 48 ± 6 ohms. There is also a service port with a schrader valve and cap installed on the hose between the purge solenoid and the canister.

• EVAPORATIVE EMISSION (EVAP) CANISTER VENT SOLENOID

When energized, the fresh air supply hose to the canister is blocked. The solenoid is only energized for OBD II testing of the evaporative emission (EVAP) system. The solenoid winding resistance spec is 48 ± 6 ohms.

• TORQUE CONVERTER CLUTCH (TCC) SOLENOID VALVE

A duty cycle controlled solenoid valve that applies the torque converter clutch by redirecting hydraulic pressure in the transaxle. With a duty cycle of 0%, the TCC is released. When torque converter clutch application is desired, the pulse width is increased until the clutch is fully applied. The solenoid will then maintain a 100% duty cycle until clutch disengagement is commanded. Then the pulse width is decreased back to 0%. If the brake pedal position switch closes, the duty cycle is cut to 0% immediately. The solenoid is enabled when the engine coolant temperature reaches 150°F (66°C), the brake switch is open, the transmission is in 3rd or 4th gear, and the vehicle is at cruise (steady throttle) above 40 mph. In addition, whenever the transmission fluid temperature is 248°F (120°C) or more, the PCM will command TCC lockup. The solenoid winding resistance spec is 48 ± 6 ohms.

• TRANSMISSION PRESSURE CONTROL (PC) SOLENOID

This pulse width modulated solenoid controls fluid in the transmission valve body that is routed to the pressure regulator valve. By varying the duty cycle of the solenoid, the PCM can vary the line pressure of the transmission to control shift feel and slippage. When the duty cycle is minimum (10%), the line pressure will be maximized. When the duty cycle is maximum (90%), the line pressure will be minimized. The solenoid winding resistance spec is 12 ± 4 ohms.

• TRANSMISSION SHIFT SOLENOIDS (SS 1 AND SS 2)

These solenoids control fluid in the transmission valve body that is routed to the 1-2, 2-3, and 3-4 shift valves. By energizing or de-energizing the solenoids, the PCM can enable a gear change. The solenoid winding resistance spec is 12 ± 4 ohms.

Gear	SS 1	SS 2
P, N, R, or 1	On	Off
2	Off	Off
3	Off	On
4	On	On

SFI System Operation and Component Functions

• Starting Mode

When the ignition switch is turned on, the PCM energizes the fuel pump relay for 2 seconds, allowing the fuel pump to build up pressure in the fuel system. Unless the engine is cranked within this two-second period, the fuel pump relay is de-energized to turn off the pump. The fuel pump relay will remain energized as long as the engine speed (CKP) signal to the PCM is 100 rpm or more.

• Clear Flood Mode

When the throttle is wide open (throttle opening of 80% or greater) and the engine speed is below 400 rpm, the PCM turns off the fuel injectors.

• Run Mode: Open and Closed Loop

• Open Loop

When the engine is first started and running above 400 rpm, the system operates in open loop. In open loop, the PCM does not use the oxygen sensor signal. Instead, it calculates the fuel injector pulse width from the throttle position sensor, the coolant and intake air temperature sensors, the MAF sensor, and the CKP sensor.

The system will stay in open loop until all of these conditions are met:

- Both upstream heated oxygen sensors (HO2S 1/1 and HO2S 2/1) are sending varying signals to the PCM.
- The engine coolant temperature is above 150°F (66°C).
- One minute has elapsed since start-up.
- Throttle position is less than 80%.

• Closed Loop

When the oxygen sensor, engine coolant temperature sensor, and time conditions are met, and the throttle opening is less than 80%, the system goes into closed loop. Closed loop means that the PCM adjusts the fuel injector pulse widths for Bank 1 and Bank 2 based on the varying voltage signals from the upstream oxygen sensors. An oxygen sensor signal below 0.45 volts causes the PCM to increase injector pulse width. When the oxygen sensor signal rises above 0.45 volts in response to the richer mixture, the PCM reduces injector pulse width. This feedback trims the fuel control program that is based on the other sensor signals.

• Acceleration Enrichment Mode

During acceleration, the PCM uses the increase in mass airflow and the rate of change in throttle position to calculate increased fuel injector pulse width. During wide open throttle operation, the control system goes into open loop mode.

• Deceleration Enleanment Mode

During deceleration, the PCM uses the decrease in mass airflow, the vehicle speed value, and the rate of change in throttle position to calculate decreased fuel injector pulse width.

• Fuel Cut-Off Mode

The PCM will turn off the fuel injectors, for safety reasons, when the vehicle speed reaches 110 mph, or if the engine speed exceeds 6000 rpm.

OBD II SYSTEM OPERATION

• COMPREHENSIVE COMPONENT MONITOR

The OBD II diagnostic system continuously monitors all engine and transmission sensors and actuators for shorts, opens, and out-of-range values, as well as values that do not logically fit with other powertrain data (rationality). On the first trip during which the Comprehensive Component Monitor detects a failure that will result in emissions exceeding a predetermined level, the PCM will store a diagnostic trouble code (DTC), illuminate the malfunction indicator lamp (MIL), and store a freeze frame.

• SYSTEM MONITORS

The OBD II diagnostic system also actively tests some systems for proper operation while the vehicle is being driven. Fuel control and engine misfire are checked continuously, and catalyst efficiency, EGR operation, EVAP integrity, oxygen sensor response, and the oxygen sensor heaters are tested once per trip. When any of the System Monitors detects a failure that will result in emissions exceeding a predetermined level on two consecutive trips, the PCM will store a diagnostic trouble code (DTC) and illuminate the malfunction indicator lamp (MIL). Freeze frame data captured during the first of the two consecutive failures is also stored.

- **Fuel Control** - This monitor will set a DTC if the Long Term Fuel Trim is excessively high or low anytime after the engine is warmed up, indicating the loss of fuel control. This is always the case when the Long Term Fuel Trim reaches its limit (+30% or -30%).
- **Engine Misfire** - This monitor uses the CKP sensor signal to continuously detect engine misfires, both severe and non-severe. If the misfire is severe enough to cause catalytic converter damage, the MIL will blink as long as the severe misfire is detected.
- **Catalytic Converter** - This monitor compares the signals of the two upstream heated oxygen sensors to the signal from the downstream heated oxygen sensor to determine the ability of catalyst to store free oxygen. If the converter's oxygen storage capacity is sufficiently degraded, a DTC is set.
- **EGR System** - This monitor uses the MAP sensor signal to detect changes in intake manifold pressure as the EGR valve is commanded open and closed. If the pressure changes too little or too much, a DTC is set.
- **EVAP System** - This monitor first turns on the EVAP vent solenoid to block the fresh air supply to the EVAP canister. Next, the EVAP purge solenoid is turned on to draw a slight vacuum on the entire EVAP system, including the fuel tank. Then the EVAP purge solenoid is turned off to seal the system. The monitor uses the Fuel Tank (EVAP) Pressure Sensor signal to determine if the EVAP system has any leaks. If the vacuum decays too rapidly, a DTC is set. In order to run this monitor, the engine must be cold (below 86°F / 30°C) and the fuel level must be between ¼ and ¾ full.
- **Oxygen Sensors** - This monitor checks the maximum and minimum output voltage, as well as switching and response times for all oxygen sensors. If an oxygen sensor signal remains too low or too high, switches too slowly, or not at all, a DTC is set.
- **Oxygen Sensor Heaters** - This monitor checks the time from cold start until the oxygen sensors begin to operate. If the time is too long, a DTC is set. Battery voltage is continuously supplied to the oxygen sensor heaters whenever the ignition switch is on.

OBD II SYSTEM OPERATION (CONTINUED)

• MONITOR READINESS STATUS

The monitor readiness status indicates whether or not a particular OBD II diagnostic monitor has been run since the last time that DTCs were cleared from PCM memory. If the monitor has not yet run, the status will display on the Scan Tool as "NO". If the monitor has been run, the status will display on the scan tool as "YES". This does not mean that no faults were found, only that the diagnostic monitor has been run. Whenever DTCs are cleared from memory or the battery is disconnected, all monitor readiness status indicators are reset to "NO". Monitor readiness status indicators are not needed for the Comprehensive Component, Fuel Control, and Engine Misfire monitors because they run continuously. The readiness status of the following system monitors can be read on the scan tool:

Catalytic Converter	YES/NO	Oxygen Sensors	YES/NO
EGR System	YES/NO	Oxygen Sensor Heaters	YES/NO
EVAP System	YES/NO		

• WARM UP CYCLE

Warm Up Cycles are used by the PCM for automatic clearing of DTCs and Freeze Frame data as described below. To complete one warm up cycle, the engine coolant temperature must rise at least 40°F (22°C) and reach a minimum of 160°F (71°C).

• TRIP

A trip is a key-on cycle in which all enable criteria for a particular diagnostic monitor are met and the diagnostic monitor is run. The trip is completed when the ignition switch is turned off.

• DRIVE CYCLE

Most OBD II diagnostic monitors will run at some time during normal operation of the vehicle. However, to satisfy all of the different Trip enable criteria and run all of the OBD II diagnostic monitors, the vehicle must be driven under a variety of conditions. The following drive cycle will allow <u>all</u> monitors to run on this vehicle.

1. Ensure that the fuel tank is between ¼ and ¾ full.
2. Start cold (below 86°F / 30°C) and warm up until engine coolant temperature is at least 160°F (71°C) - one minute minimum.
3. Accelerate to 40-55 mph at 25% throttle and maintain speed for five minutes.
4. Decelerate without using the brake (coast down) to 20 mph or less, then stop the vehicle. Allow the engine to idle for 10 seconds, turn the key off, and wait one minute.
5. Restart and accelerate to 40-55 mph at 25% throttle and maintain speed for two minutes.
6. Decelerate without using the brake (coast down) to 20 mph or less, then stop the vehicle. Allow the engine to idle for 10 seconds, turn the key off, and wait one minute.

• FREEZE FRAME DATA

A Freeze Frame is a miniature "snapshot" (one frame of data) that is automatically stored in the PCM memory when an emissions-related DTC is first stored. If a DTC for fuel control or engine misfire is stored at a later time, the newest data are stored and the earlier information is lost. The following data is captured in the Freeze Frame: Calculated Load Value, Engine RPM, Short Term Fuel Trim, Long Term Fuel Trim, Vehicle Speed, Engine Coolant Temperature, Mass Airflow, Closed/Open Loop Status, DTC stored with the freeze frame, and Cylinder ID if misfire detected.

OBD II SYSTEM OPERATION (CONTINUED)

• STORING AND CLEARING DTC'S & FREEZE FRAME DATA, TURNING THE MIL ON & OFF

• **One Trip Monitors**: A failure on the first trip of a "one trip" emissions diagnostic monitor causes the PCM to immediately store a DTC and Freeze Frame data, and turn on the MIL. All Comprehensive Component Monitor faults require only one trip.

• **Two Trip Monitors**: A failure on the first trip of a "two trip" emissions diagnostic monitor causes the PCM to store a temporary DTC and Freeze Frame data. If the failure does not recur on the next trip, the temporary DTC and Freeze Frame data are cleared from memory. If the failure does recur on the next trip, the PCM will store a DTC and turn on the MIL. All of the System Monitors are two trip monitors. Engine misfire which is severe enough to damage the catalytic converter is a two trip monitor. However, the MIL will always blink when the severe misfire is occurring.

• **Automatic Clearing**: If the vehicle then completes three consecutive "good trips' (three consecutive trips in which the monitor that set the DTC is run and passes), the MIL will be turned off, but the DTC and Freeze Frame will remain stored in PCM memory. If the vehicle completes 40 Warm Up cycles without the same fault recurring, the DTC and Freeze Frame are automatically cleared from the PCM memory.

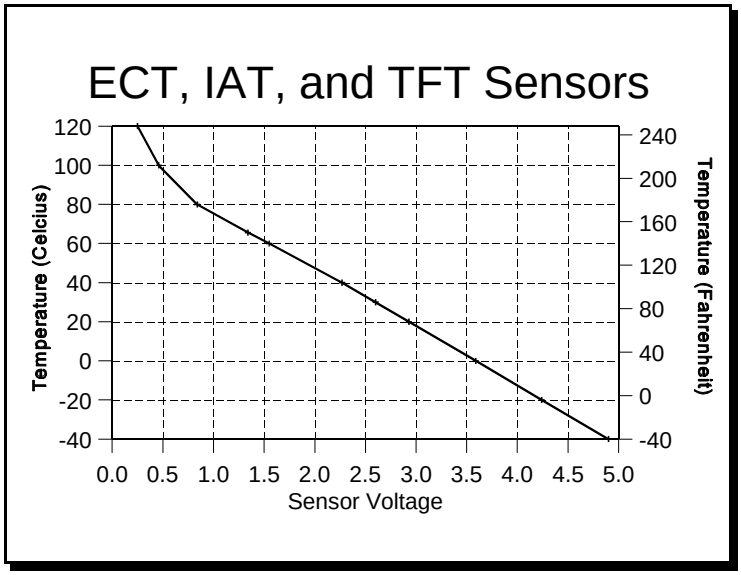
• **Manual Clearing**: Any stored DTCs and Freeze Frame data can be erased using the scan tool, and the MIL (if lit) will be turned off. Although it is not the recommended method, DTCs and Freeze Frame data will also be cleared if the PCM power supply or the battery is disconnected.

• SCAN TOOL DATA

These are the different types of information that can be displayed on the OBD II scan tool.

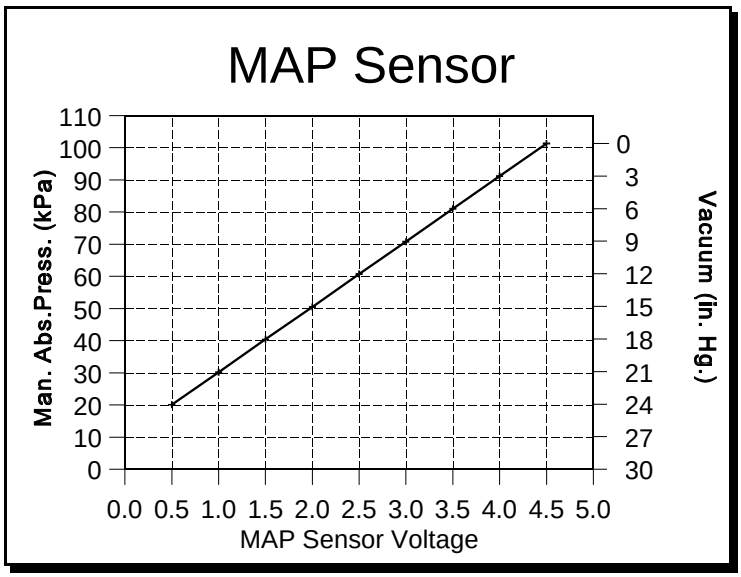
ECT: 248 to -40°F / 120 to -40°C / 0.0 to 5.0 v.
IAT: 248 to -40°F / 120 to -40°C / 0.0 to 5.0 v.
MAP: 20 to 101 kPa pressure / 24 to 0 in.Hg. vacuum / 0.0 to 5.0 v.
MAF: 0 to 175 gm/sec / 0.0 to 5.0 volts
TP: 0 to 100%
Tach: 0 to 6000 rpm
VSS: 0 to 110 mph
Calculated Load Value: 0 to 100%
HO2S 1/1: 0.00 to 1.00 v.
HO2S 2/1: 0.00 to 1.00 v.
HO2S 1/2: 0.00 to 1.00 v.
Loop: Open / Closed
Bank 1 Injector Pulse Width: 0 to 15 ms
Bank 2 Injector Pulse Width: 0 to 15 ms
Bank 1 Long Term Fuel Trim: -30% to +30%
Bank 1 Short Term Fuel Trim: -30% to +30%
Bank 2 Long Term Fuel Trim: -30% to +30%
Bank 2 Short Term Fuel Trim: -30% to +30%
Timing Advance: 0 to 60° BTDC
IAC: 0 to 100%
Battery: 0 to 18 v.
Generator Field: 0 to 100%
EGR: 0 to 100%
Evap Purge: 0 to 100%
Evap Vent: On/Off
Fuel Tank (EVAP) Pressure: -14.0 to +14.0 in.H_2O / -0.5 psi to 0.5 psi / 0.0 to 5.0 v.
Fuel Tank Level: 0 to 100% / 0.0 to 5.0 v.
P/S Switch: On / Off
Brake Switch: On / Off
A/C Request: On / Off
A/C Pressure: 25 to 450 psi / 0.0 to 5.0 v.
A/C Clutch: On / Off
Fan Control: On / Off
Fuel Pump: On / Off
TR: P/N, R, 1, 2, 3, OD
TFT: 248 to -40°F / 120 to -40°C / 0.0 to 5.0 v.
TSS: 0 to 6000 rpm
SS 1: On / Off
SS 2: On / Off
TCC: 0 to 100%
PC: 0 to 100%
MIL: On / Off / Flashing
DTCs: P0###
Misfire Cylinder #: 1, 2, 3, 4, 5, 6

Temperature ° F	Temperature °C	Sensor Voltage
248	120	0.25
212	100	0.46
176	80	0.84
150	66	1.34
140	60	1.55
104	40	2.27
86	30	2.60
68	20	2.93
32	0	3.59
-4	-20	4.24
-40	-40	4.90

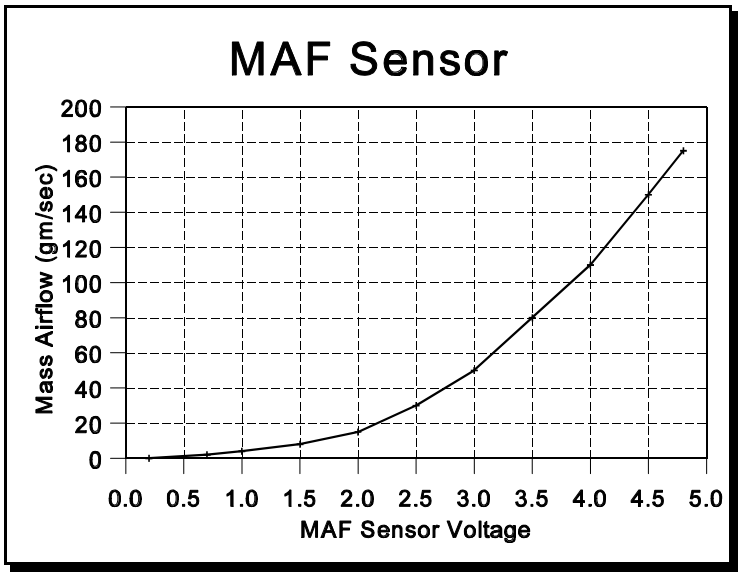


Note: All three sensors have the same temperature/voltage relationship

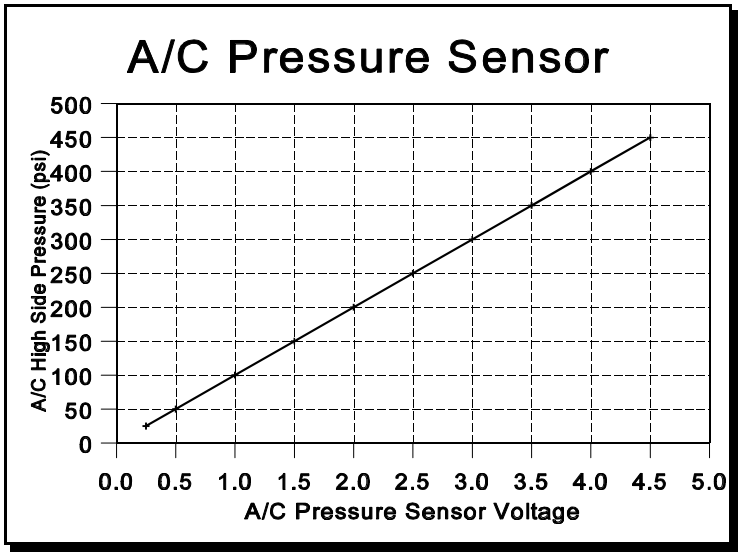
Vacuum at sea level (in. Hg.)	Manifold Absolute Pressure (kPa)	Sensor Voltage
0	101.3	4.5
3	91.2	4.0
6	81.0	3.5
9	70.8	3.0
12	60.7	2.5
15	50.5	2.0
18	40.4	1.5
21	30.2	1.0
24	20.1	0.5



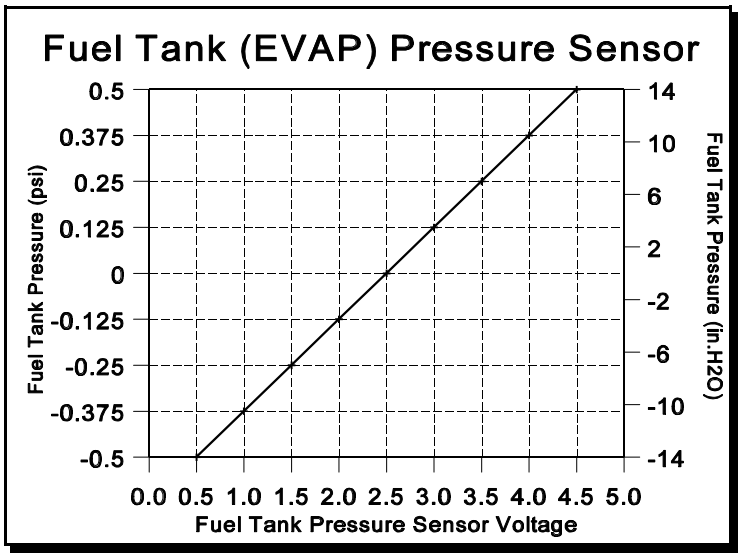
Mass Airflow (gm/sec)	Sensor Voltage
0	0.2
2	0.7
4	1.0
8	1.5
15	2.0
30	2.5
50	3.0
80	3.5
110	4.0
150	4.5
175	4.8



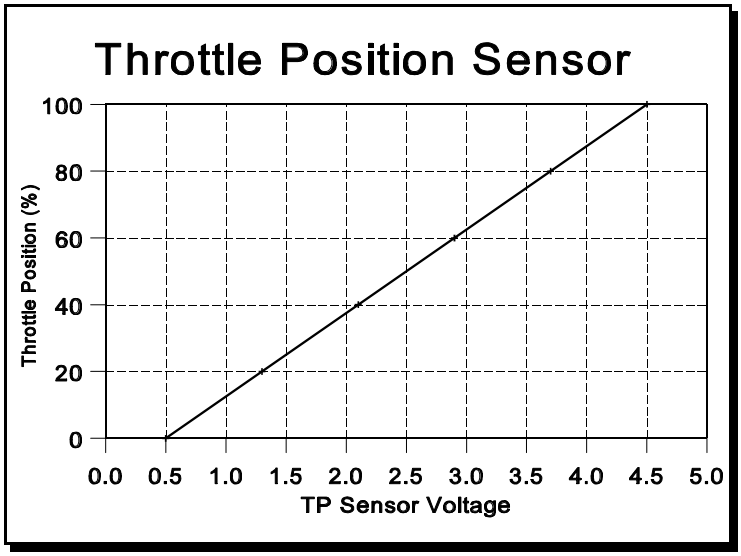
A/C High Side Pressure (psi)	Sensor Voltage
25	0.25
50	0.50
100	1.0
150	1.5
200	2.0
250	2.5
300	3.0
350	3.5
400	4.0
450	4.5

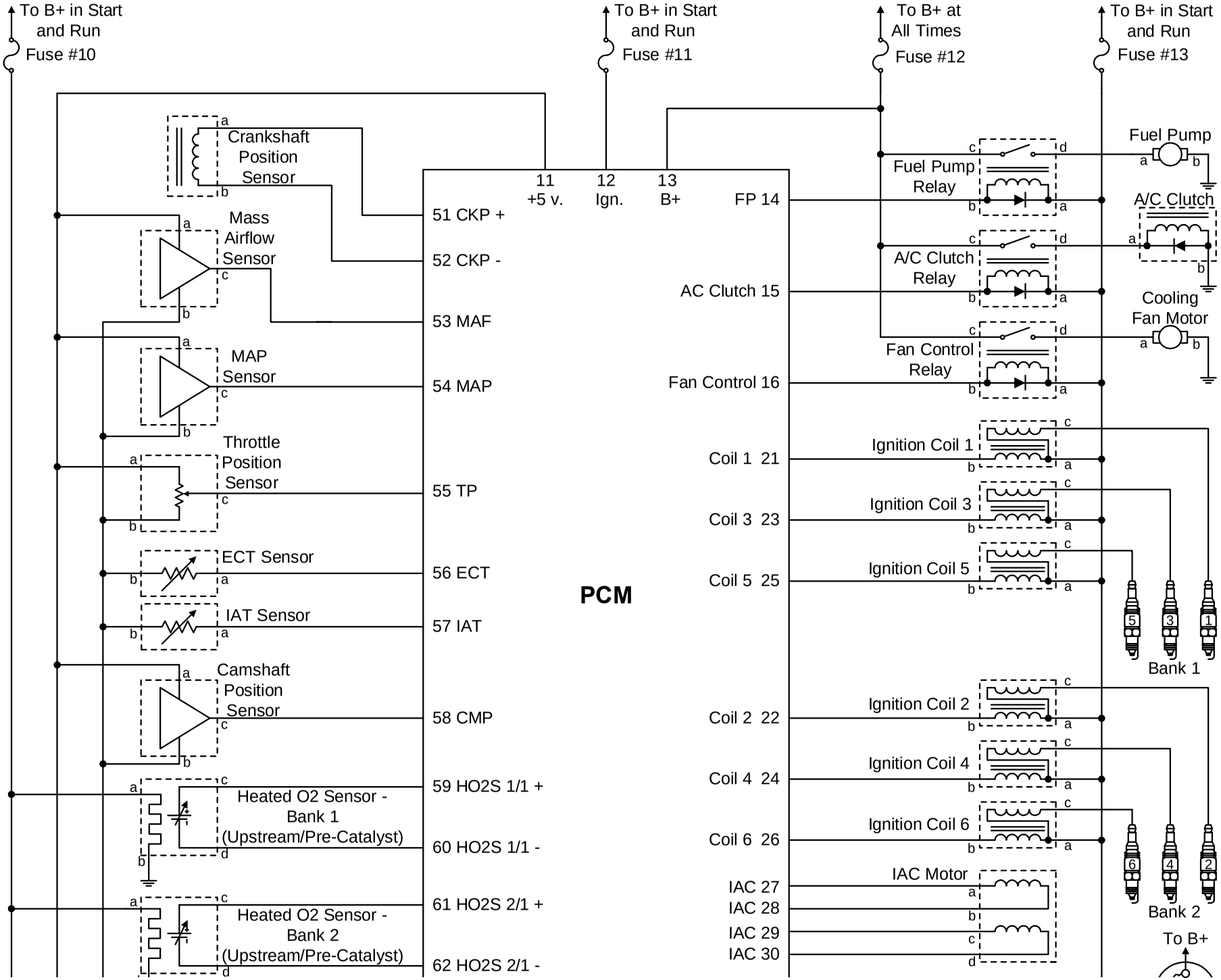


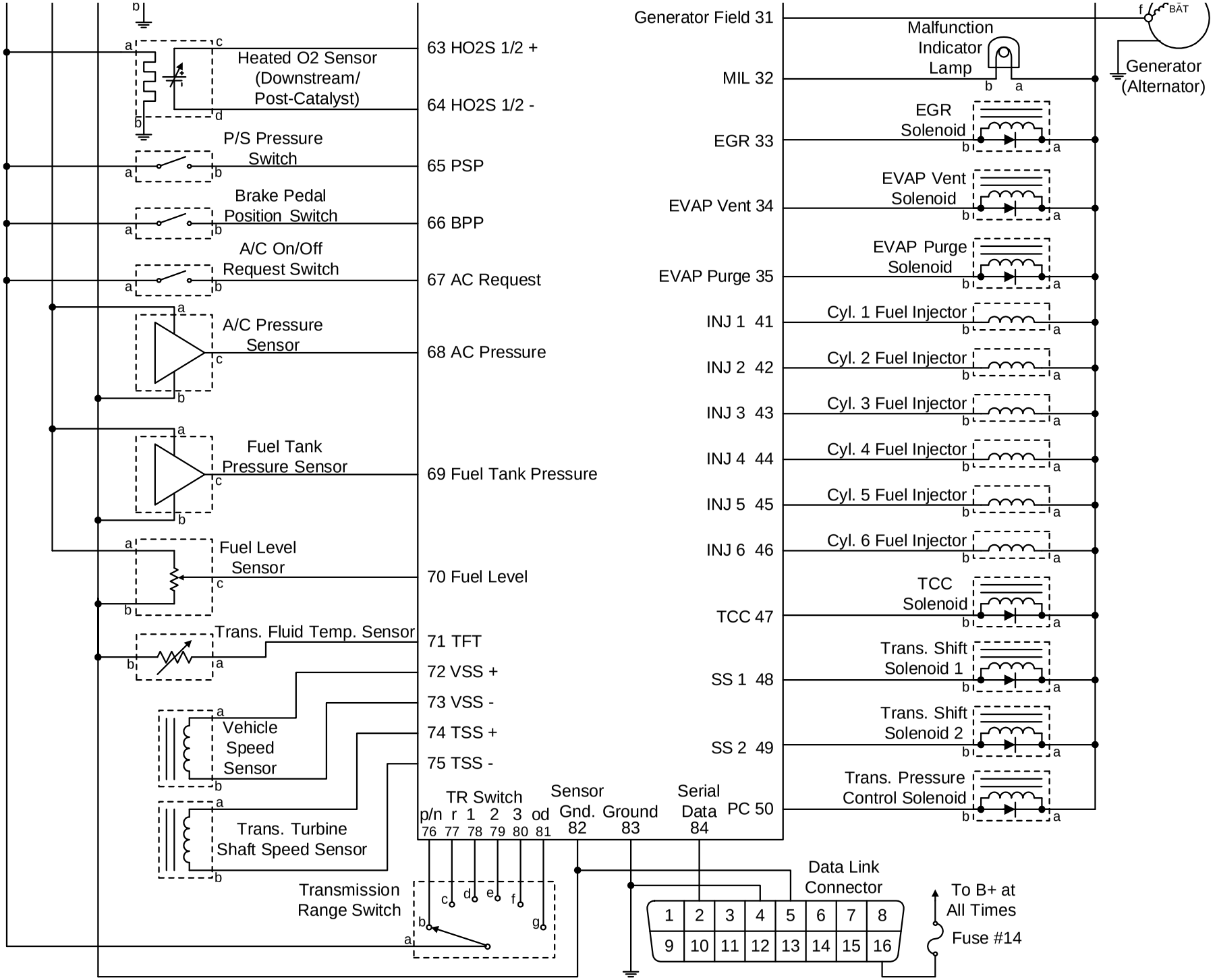
Fuel Tank (EVAP) Pressure ($in.H_2O$)	(psi)	Sensor Voltage
-14.0	-0.5	0.5
-10.5	-0.375	1.0
-7.0	-0.25	1.5
-3.5	-0.125	2.0
0.0	0.0	2.5
3.5	0.125	3.0
7.0	0.25	3.5
10.5	0.375	4.0
14.0	0.50	4.5

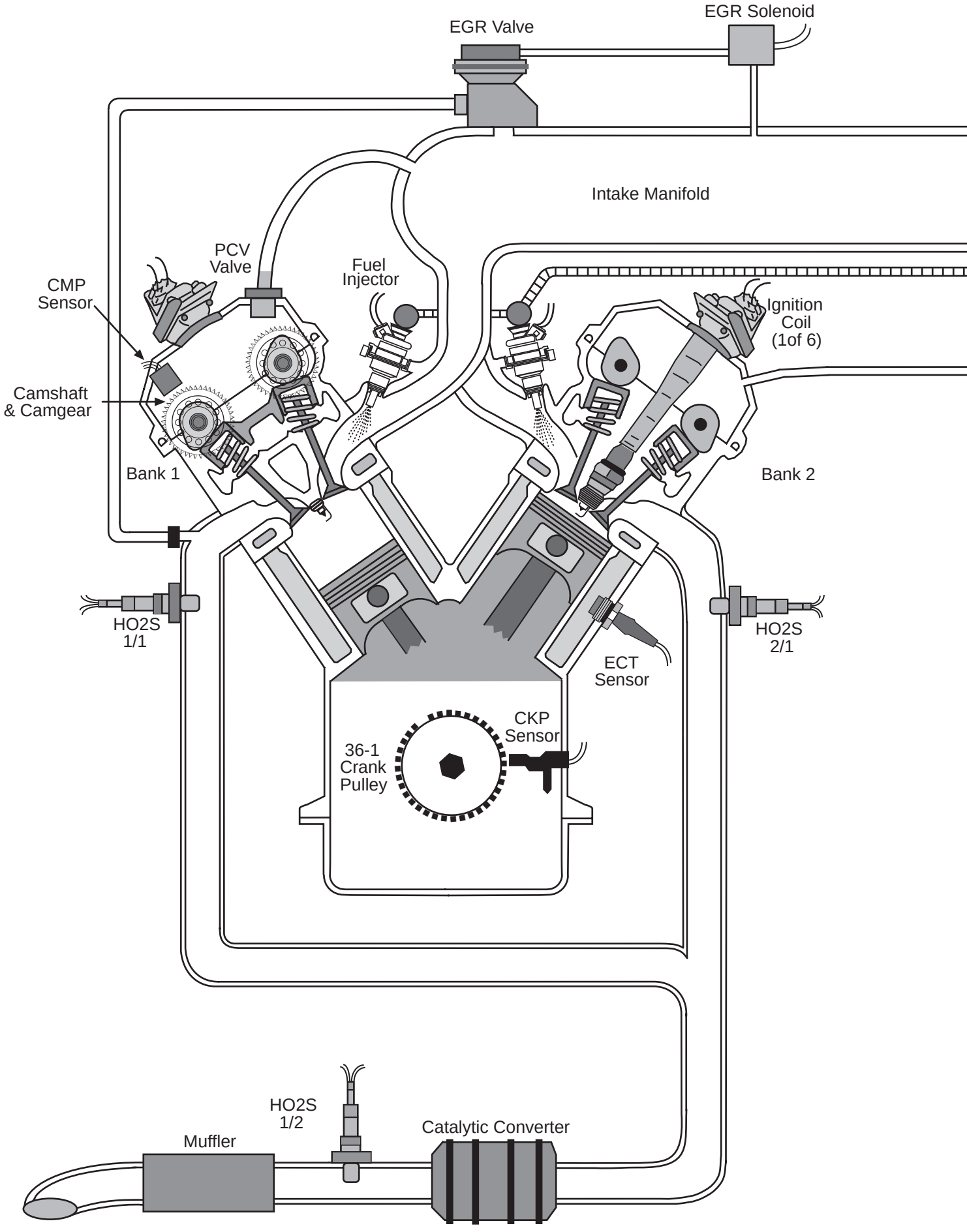


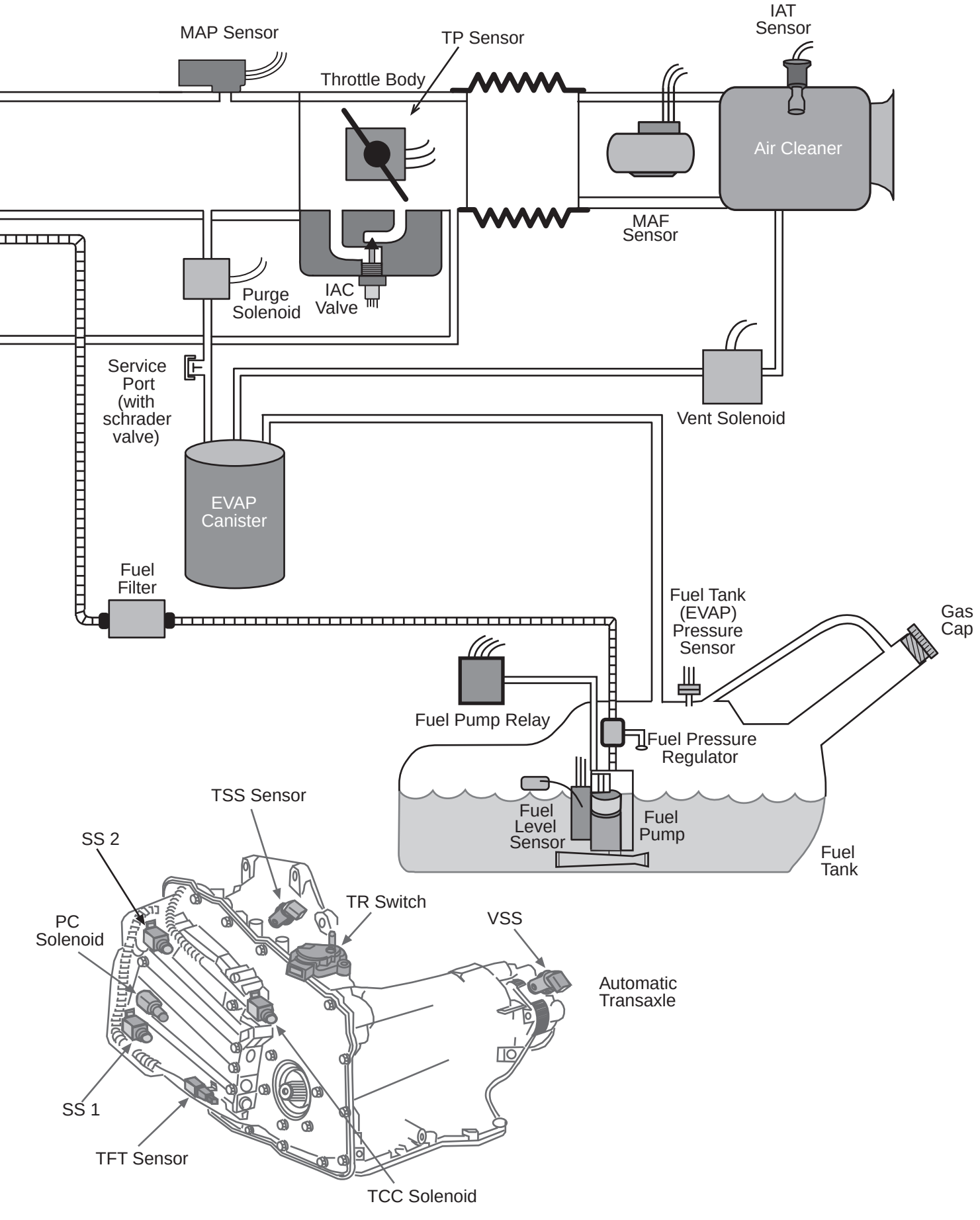
Throttle Position (percent open)	Sensor Voltage
0 (closed)	0.5
20	1.3
40	2.1
60	2.9
80	3.7
100	4.5




To B+ in Start and Run Fuse #10
To B+ in Start and Run Fuse #11
To B+ at All Times Fuse #12
To B+ in Start and Run Fuse #13
Crankshaft Position Sensor
Mass Airflow Sensor
MAP Sensor
Throttle Position Sensor
ECT Sensor
IAT Sensor
Camshaft Position Sensor
Heated O2 Sensor - Bank 1 (Upstream/Pre-Catalyst)
Heated O2 Sensor - Bank 2 (Upstream/Pre-Catalyst)
11 +5 v.
12 Ign.
13 B+
51 CKP +
52 CKP -
53 MAF
54 MAP
55 TP
56 ECT
57 IAT
58 CMP
59 HO2S 1/1 +
60 HO2S 1/1 -
61 HO2S 2/1 +
62 HO2S 2/1 -
PCM
FP 14
AC Clutch 15
Fan Control 16
Coil 1 21
Coil 3 23
Coil 5 25
Coil 2 22
Coil 4 24
Coil 6 26
IAC 27
IAC 28
IAC 29
IAC 30
Fuel Pump Relay
A/C Clutch Relay
Fan Control Relay
Fuel Pump
A/C Clutch
Cooling Fan Motor
Ignition Coil 1
Ignition Coil 3
Ignition Coil 5
Ignition Coil 2
Ignition Coil 4
Ignition Coil 6
IAC Motor
Bank 1
Bank 2
To B+


Heated O2 Sensor (Downstream/ Post-Catalyst)
P/S Pressure Switch
Brake Pedal Position Switch
A/C On/Off Request Switch
A/C Pressure Sensor
Fuel Tank Pressure Sensor
Fuel Level Sensor
Trans. Fluid Temp. Sensor
Vehicle Speed Sensor
Trans. Turbine Shaft Speed Sensor
Transmission Range Switch
63 HO2S 1/2 +
64 HO2S 1/2 -
65 PSP
66 BPP
67 AC Request
68 AC Pressure
69 Fuel Tank Pressure
70 Fuel Level
71 TFT
72 VSS +
73 VSS -
74 TSS +
75 TSS -
TR Switch p/n 76 r 77 1 78 2 79 3 80 od 81
Sensor Gnd. 82
Ground 83
Serial Data 84
PC 50
Generator Field 31
MIL 32
EGR 33
EVAP Vent 34
EVAP Purge 35
INJ 1 41
INJ 2 42
INJ 3 43
INJ 4 44
INJ 5 45
INJ 6 46
TCC 47
SS 1 48
SS 2 49
Malfunction Indicator Lamp
EGR Solenoid
EVAP Vent Solenoid
EVAP Purge Solenoid
Cyl. 1 Fuel Injector
Cyl. 2 Fuel Injector
Cyl. 3 Fuel Injector
Cyl. 4 Fuel Injector
Cyl. 5 Fuel Injector
Cyl. 6 Fuel Injector
TCC Solenoid
Trans. Shift Solenoid 1
Trans. Shift Solenoid 2
Trans. Pressure Control Solenoid
BAT
Generator (Alternator)
Data Link Connector
1 2 3 4 5 6 7 8
9 10 11 12 13 14 15 16
To B+ at All Times
Fuse #14


EGR Solenoid
EGR Valve
Intake Manifold
PCV
Valve
Fuel
Injector
CMP
Sensor
Ignition
Coil
(1of 6)
Camshaft
& Camgear
Bank 1
Bank 2
HO2S
1/1
HO2S
2/1
ECT
Sensor
CKP
Sensor
36-1
Crank
Pulley
HO2S
1/2
Catalytic Converter
Muffler


MAP Sensor
TP Sensor
IAT Sensor
Throttle Body
Air Cleaner
MAF Sensor
Purge Solenoid
IAC Valve
Service Port (with schrader valve)
Vent Solenoid
EVAP Canister
Fuel Filter
Fuel Tank (EVAP) Pressure Sensor
Gas Cap
Fuel Pump Relay
Fuel Pressure Regulator
Fuel Level Sensor
Fuel Pump
Fuel Tank
TSS Sensor
SS 2
TR Switch
VSS
PC Solenoid
Automatic Transaxle
SS 1
TFT Sensor
TCC Solenoid