ECU (Electronic Control Unit)	
	The engine management system is controlled by a computer called the electronic control unit (ECU), which received information from a variety of input sensors and output elements and circuits to control the fuel system, ignition system, air control system and maintain optimal engine performance. The ECU adjusts the fuel-air mixture as close to the theoretical ratio as possible to minimize the production of harmful emissions during engine operation and vehicle movement.

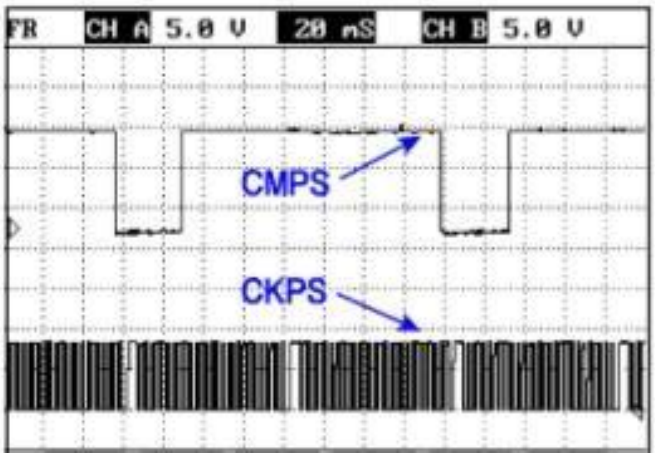
CMP (Camshaft Position Sensor) - TDC

The cam shaft rotates at half the speed of the crank shaft to control the engine intake and exhaust valve. A sensor detects the position of the cam shaft and determines whether a cylinder is in the compression stage or exhaust stage when the piston moved in the direction of the TDC. The cam shaft position sensor uses the Hall effect, with a sensor node made of metallic magnetic materials attached to the cam shaft and rotating together.

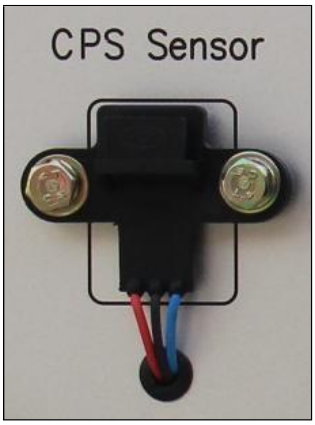
Specification

Type	Output	Air gap	LOW signal detection conditions	HIGH signal detectionconditions
Hall Effect	0~5V Digital	1.25mm	Below 2.0V	Above 3.8V

Output Waveform



CKP (Crankshaft Position Sensor) - CPS

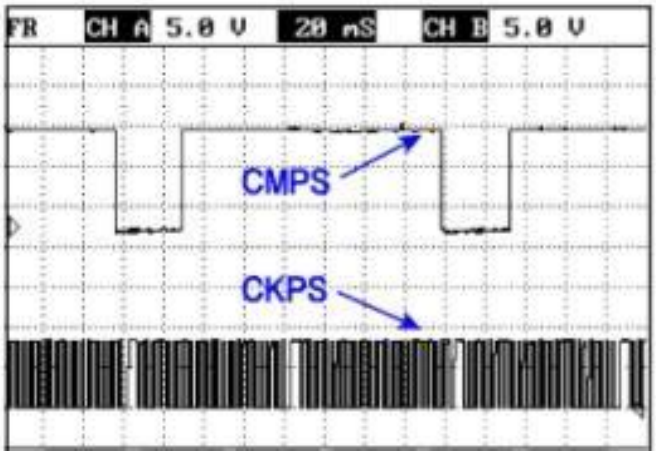


The crankshaft position sensor (CKPS) is a Hall-node type sensor that produces a digital signal using the blade and sensor installed on the engine's crankshaft. As the crankshaft blade passes through the sensor during engine revolution, the sensor shows nearly 0V. When the missing tooth passes through the sensor, the sensor returns a voltage of approximately 5V. Two square waves are produces during one rotation of the crankshaft, which can be used to determine which cylinder is at the apex point. The PCM uses the signal from the CKPS to calculate engine RPM, controlling ignition and fuel injection timing.

Specification

Type	Output	Air gap	LOW signal detection conditions	HIGH signal detectionconditions
Hall Effect	0~5V Digital	1.25mm	Below 2.0V	Above 3.8V

Output Waveform



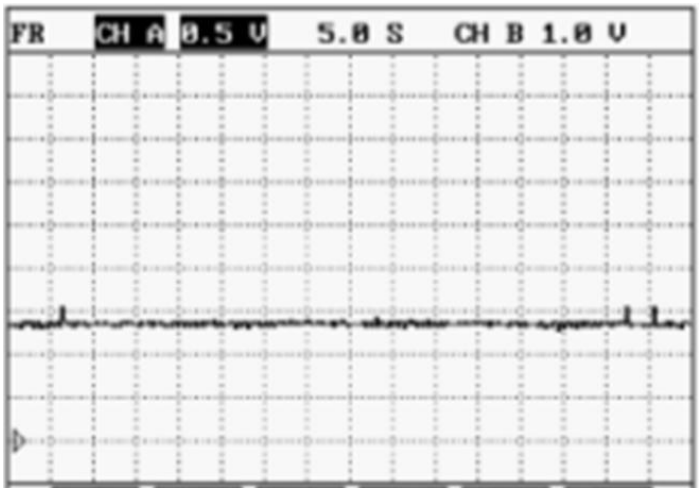
IATS (Intake Air Temperature Sensor)

The air temperature sensor uses a negative temperature coefficient (NTC) thermister that other sensors also employ to create augmenting signals for a variety of sensors (fuel, injection timing, fuel amount control during ignition, etc).

Specification

Temperature	Voltage
0°C	3.4~3.6V
20°C	2.5~2.7V
40°C	1.7~1.9V

Output Waveform



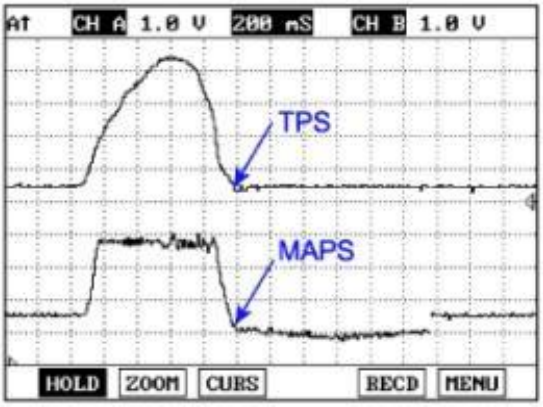
MAPS (Manifold Absolute Pressure Sensor)

The power train control unit (PCM) requires information and the exact amount of air pressure entering the engine in order to determine the basic fuel injection amount. The manifold absolute pressure sensor (MAPS) is used to measure the amount of air entering the engine by detecting the pressure inside the manifold to calculate the air intake amount indirectly, and is also classified as a speed-density type sensor. The MAPS sends an analogue output signal proportional to the absolute pressure to the PCM based on the pressure change in the intake manifold, which is used by the PCM as the basic data in determining engine RPM and air intake amount.

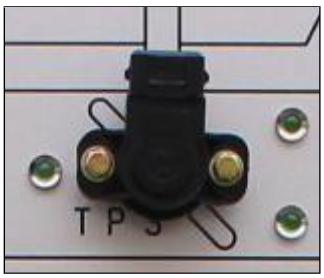
Specification

Pressure	Voltage
200 mmHg	1V
400 mmHg	2.1V
600 mmHg	3.2V
760 mmHg	4V

Output Waveform



TPS (Throttle Position Sensor)



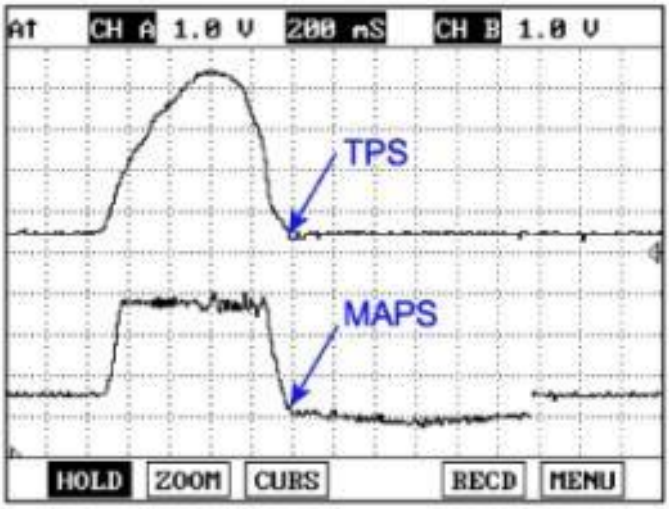
The throttle position sensor (TPS) is attached to the throttle body to measure the opening angle of the throttle valve. The TPS is a variable resistance sensor that outputs an electrical resistance change depending on the position of the throttle valve.

The output signal from the TPS is 0.3~0.9V when the throttle valve is closed, and 4.0~4.8V when the valve is completely open. The PCM uses the MAPS and TPS to measure the idle, partial load and acceleration and deceleration status to determine fuel injection amount and ignition timing.

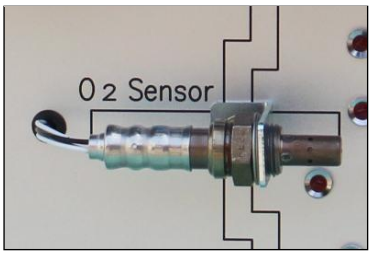
Specification

Throttle Valve	Output Voltage
Idle - 0%	0.2~0.463V
50%	2.9V
Full Acceleration - 90%	5V

Output Waveform (



O2 Sensor (Oxygen Sensor)



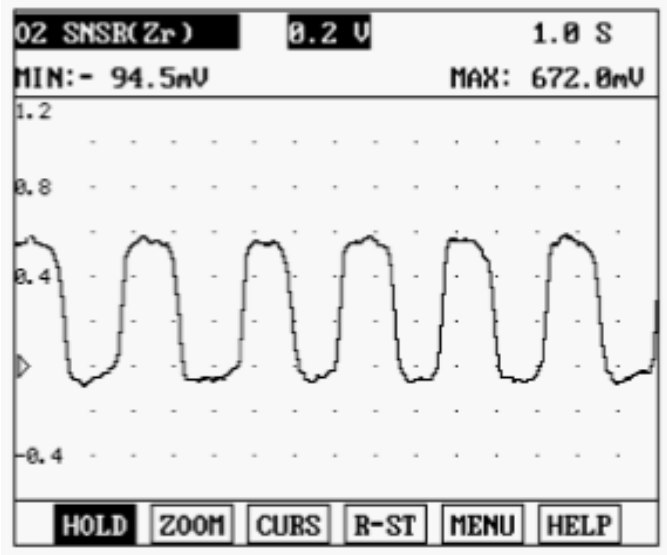
The heated oxygen sensor (HO2S) is located before the catalytic converter, and detects the concentration of oxygen in the exhaust gas to control the amount of carbon monoxide, hydrocarbons and nitrogen oxides. The O2 sensor outputs a value between 0V and 1V based on oxygen concentration, and the PCM uses this data to determine if the fuel is rich or lean.

The concentration of oxygen in the exhaust gas increases and the O2 sensor outputs a signal of 0~0.1V if the fuel is lean. The PCM determines the condition of the fuel using the O2 sensor's output, and adjusts the amount of fuel.

Specification

Output Voltage	Heater Resistance
0 ~ 1.0V	9.0 Ω (20°C)

Output Waveform



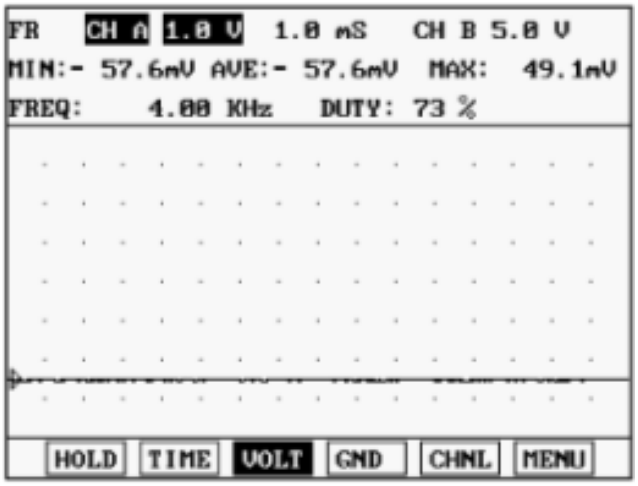
KNS (Knock Sensor)

The knock sensor (KS) is located in the center of the cylinder block to detect engine vibrations (knock in each cylinder). Vibration from the cylinder block resulting from the increase or decrease in engine RPM is transmitted to the pressure elements, and the KS uses this vibration to output a voltage signal. The PCM uses the KS signal as well as altitude data to control ignition timing. For example, if knocking occurs In the engine, the PCM retards ignition timing to create maximum engine torque.

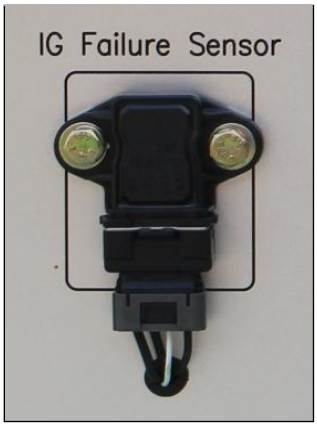
Specification

Resistance	1Ω ~10MΩ

Output Waveform

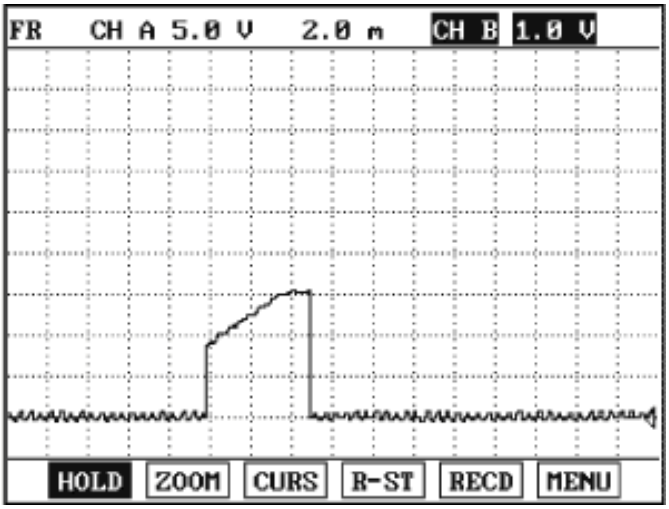


IG Failure Sensor



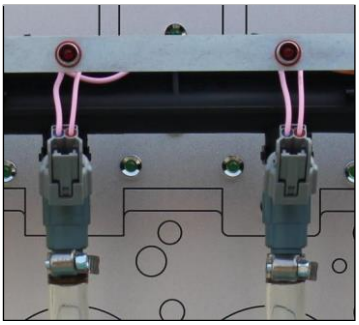
A power transistor regulating current flow in the vehicle is located inside the ignition coil. An ignition failure sensor is used to detect malfunctions in the ignition coil, power transistor and wiring as well as operating the tachometer.

Output Waveform



<Power TR Base>

10. INJ (Injector)

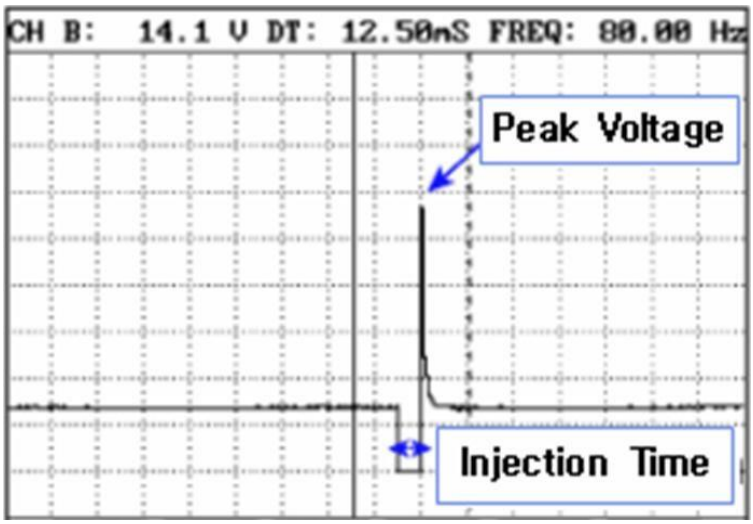


The injector is composed of injection nozzles with solenoid valves that are used by the engine control module to regulate the amount of fuel injection by controlling the opening and closing of the valves. When the engine control module acticate4s the injector, the solenoid becomes magnetized to open the valve and inject the fuel. When the PCM releases the ground, the injector valve closes and an instant peak voltage occurs.

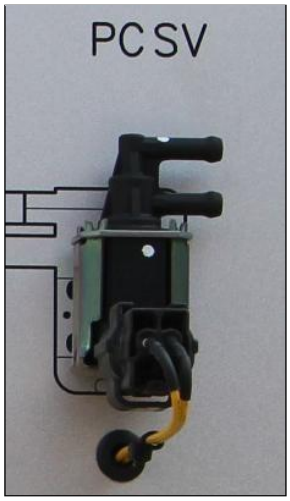
Specification

Temperature	Coil Resistance
20 °C	13 ~ 16 Ω (20°C)

Output Waveform



PCSV (Purge Control Solenoid Valve)

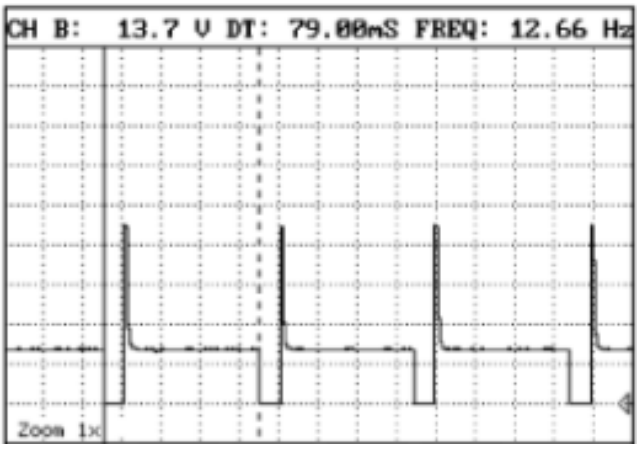


The exhaust gas control system prevents the formation of photochemical smog from the HC steam from the fuel tank. The fuel vapors are collected in a canister, and the PCM controls the purge control solenoid valve (PCSV) to redirect the fuel vapors collected in the canister back into the engine to be used as fuel. This valve is controlled by a PCM control signal to regulate fuel vapor gas between the canister and the intake manifold.

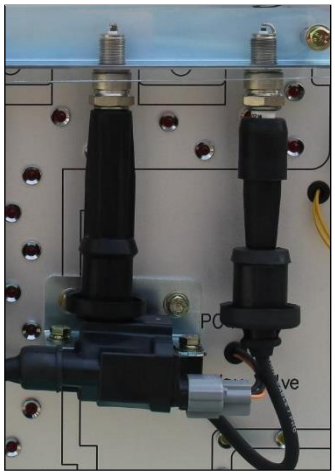
Specification

Temperature	Coil Resistance
20 °C	32 Ω

Output Waveform



IG Coil



Each ignition coil is composed of two coils. High voltage is directed into each cylinder, and the ignition coil ignites two spark plugs for each stroke. During cylinder compression and combustion, the PCM is grounded in order to transfer voltage into the primary ignition coil, using the crankshaft sensor or camshaft sensor signal to regulate the timing. If the voltage does or does not pass into the primary ignition coil, the secondary ignition coil creates a high voltage in its spark plug.

Specification

Type	Two Mold Coil Type
First Coil Resistance	0.78Ω
Second Coil Resistance	20kΩ

Output Waveform