Module 12
Throttle Position (TP) Sensor

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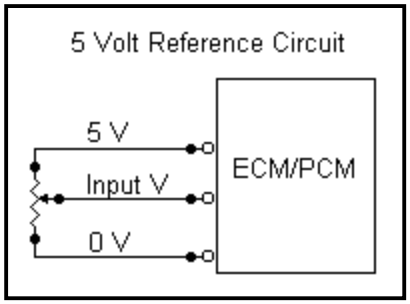
12 Throttle Position (TP) Sensor

12.1 General Overview

The throttle position (TP) sensor has gone virtually unchanged since the very first Honda PGMFI systems. The TP sensor input is used by the engine control module (ECM) to determine the throttle position and the rate of travel of the throttle. The TP sensor input is important for fuel control at idle and wide-open throttle (WOT). The rate at which the throttle opens is also an important parameter used by the ECM and used for fuel enrichment.

12.2 How Do They Work?

Illustration 12-1

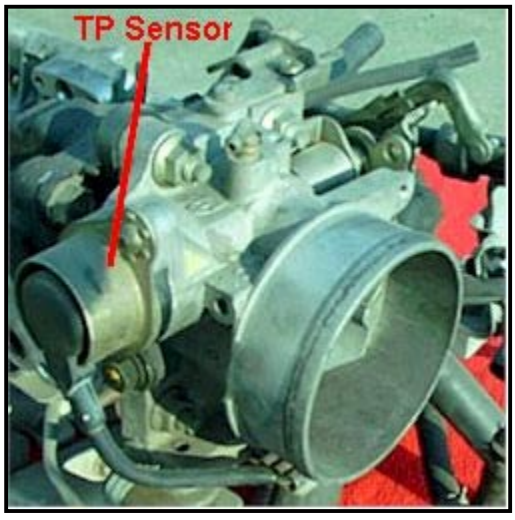


The TP sensor is a standard 5-Volt reference type sensor. As shown in the Illustration 12-1 on the left, the ECM supplies 5 volts to the sensor on one wire and a ground on another wire. The 5 volts is applied across a resistive strip that is shaped like an arc. The input signal wire is attached to a wiper that moves across the resistive strip as the throttle is being moved.

As the wiper is moved across the resistive strip the voltage will change proportionally to its position. When the wiper gets closer to the ground wire, the voltage will be low. When the wiper gets closer to the 5-volt wire the voltage will get higher. The wiper cannot go fully to each edge of the resistive material, so the typical voltage range of the TP sensor is .45V - 4.5V.

12.3 Component Location

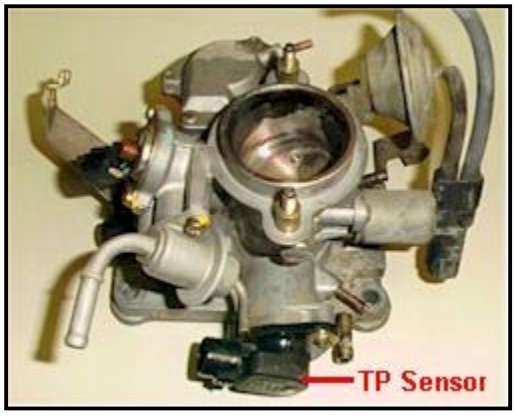
Image 12-1 TP Sensor / MPI System



The TP sensor is always mounted to the opposite side of the throttle body as the throttle cable is. The sensor is usually attached to the throttle body with shear bolts and is not available separately from any parts source.

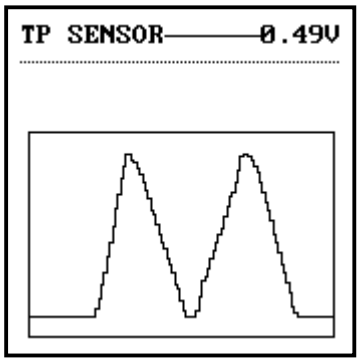
Image 12-1 is from a multi-port injection (MPI) PGMFI system. Image 12-2 is from a dual point injection (DPI) PGMFI system.

Image 12-2 TP Sensor / DPI System



12.4 How Do You Test Them?

Screen Capture 12-1



A TP sensor is tested just like any other 5-volt reference sensor, by measuring its input voltage. The input voltage should go from just under .5V at idle to close to 4.5V at WOT. As the throttle is moved from idle position to WOT the input voltage should make a smooth transition.

The TP sensor input voltage could be checked with a digital volt-ohm meter (DVOM), but it is best to graph the voltage. You can use a digital storage oscilloscope (DSO) or scan tool to graph the TP sensor voltage while the throttle is being moved.

Screen Capture 12-1 was taken from a Mastertech (with Honda software), using the line graph mode.

Due to the fact that Honda wiring harnesses give very little trouble, it may be easier to tap onto the TP sensor under the hood for testing. This is usually faster than installing the test harness. It is easy to find the input wire on a TP sensor. One of the wires will be 0V, one will be approx. 5V, and the input voltage wire will go from .45 at idle to 4.5 at WOT.

When checking the TP sensor waveform, look for nice smooth voltage transitions. The voltage should go from approximately .4V to 4.5V as the throttle is being moved from idle to WOT. The waveform should not have any dropouts (where the line drops below the normal pattern). To thoroughly test a TP sensor, open and close the throttle at different rates while monitoring the waveform. It is also a

good idea to test it hot and cold and to subject the sensor to some light shock (rapping on it with a screwdriver handle) while watching the waveform.

Image 12-3

When testing the TP sensor closed throttle voltage on the DPI models, you must add an extra step in the procedure. On the DPI throttle body, an extra vacuum diaphragm is added to open the throttle blade slightly when the engine is turned off. This will not give you an accurate idle TP Sensor voltage.

Before checking idle TP voltage on a DPI system, apply vacuum to the idle diaphragm (indicated in Image 12-3 by a circle). This will let the throttle shaft go fully closed and rest on the factory set throttle shaft stop.

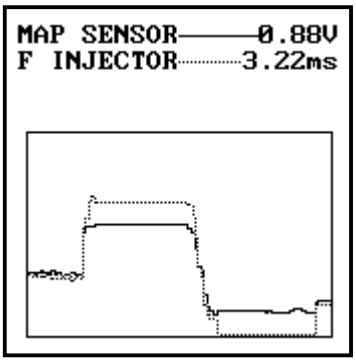
12.5 Input / Output Relationships

The TP sensor input is used to determine when the throttle is at idle and wide open throttle and when the throttle is opened rapidly. During these conditions the ECM makes changes to the fuel delivery; therefore, the output that is affected the most from throttle position is injector pulse width (PW). Lets take a look at the three different input/output relationships.

12.5.1 Idle Position Input

One of the primary uses of the TP sensor input is for the ECM to determine that the engine is at idle (throttle closed). It does this by looking for a voltage that is less than approx. .5V. When the ECM determines that the throttle is at idle, the ECM makes the following changes:

Screen Capture 12-2



Enrichens A/F Ratio
The PW is widened slightly when the throttle initially goes to idle. This helps to stabilize the engine as the engine goes towards idle speed. Within a few seconds the O2 sensor will correct for this momentary richer mixture.

Coasting fuel shutoff
If the ECM receives a closed throttle input (under.5V), the engine speed is above 1100 RPM, and the engine is warmed, the fuel injectors will be shut

off.

This is easy to see in the Screen Capture 12-2. In this screen capture a 1996 Honda Civic was driven at WOT for about 15 seconds and then the throttle was closed and the car coasted for an additional 15 seconds. This gives us a view of what the ECM does with fuel control during these two different conditions. The right side of the graph shows the fuel injectors (dotted line) going to a 0ms PW. During this deceleration time the injectors were turned completely off.

12.5.2 Wide Open Throttle Input

Another important condition that the ECM determines from the TP sensor input voltage is when the throttle is at WOT. During WOT operation the ECM makes adjustments to the fuel control.

When the ECM determines that the throttle is at WOT, the fuel mixture is enrichened above normal fuel delivery.

This condition can also be observed in the Screen Capture 12-2. Notice in the left portion of the graph how the injector PW (dotted line) is following its major input, the manifold absolute pressure (MAP) sensor input voltage (solid line). When the MAP sensor reached its highest value the PW continued to widen. This additional enrichment is due to the WOT position of the throttle blade.

12.5.3 Rapid Throttle Opening Input

The ECM also looks at the TP sensor input voltage for a rapid change in voltage. A sudden rise in the voltage would indicate that the throttle was opened quickly. When the ECM determines that the throttle was rapidly opened it momentarily enrichens the fuel. This works much like an accelerator pump on a carb.

The fuel enrichment from a rapid throttle movement is momentarily. As soon as the MAP sensor senses the drop in vacuum, the mixture will be richened by this input.

12.6 TP Sensor and OBD-II

With the addition of OBD-II, the TP sensor input now is also used in some of the rationality testing. Prior to OBD-II, inputs were only checked against a high/low value. With OBD-II some input parameters are checked against each other for rationality.

The most common of the rationality checks is to compare the TP sensor input to MAP input. If these two values are not rational, a DTC could be set.

Take this case for an example:

- The MAP sensor voltage is reading high (indicating the engine is under a load)
- The TP sensor voltage is reading under .5 volts (indicating closed throttle)

This situation cannot be a rational condition. The engine should not be under a load if the throttle is closed. The vacuum should not be low, causing the high MAP sensor reading. This condition would probably set a diagnostic trouble code (DTC). A DTC based on two (or more) irrational inputs will have this type of description:

"PO1121 TP Sensor Lower Than Expected"

12.7 Service Tips / Issues

12.7.1 Pattern Failures

The TP sensor has been a durable sensor. There are very few TP sensor failures. The only significant failures were on 1988 DPI Civics and a few early 1989 DPI Civics. It seems that these early TP sensors did not have a drain hole in its cover. My theory is that fuel vapors would condense inside the TP sensor and damage the resistive strip.

12.7.2 Parts Availability

Luckily the TP sensor has been a durable sensor, since it is not available as a separate component. The TP sensor is sold with the throttle body assembly. To my knowledge, there is also not an aftermarket source for these sensors.

12.7.3 Throttle Being Held Open

It is important for the throttle to go to the fully closed position at idle so that the TP sensor voltage will be below .5. The TP sensor can be operating correctly, but if something holds the throttle slightly open the ECM will not determine that the car is at idle.

Some of the more common reasons a throttle will not come back to idle position are:

Condition	Repair Procedure
Tight throttle cable	Adjust throttle cable so that there is play in the cable.
Carboned up throttle blade	Clean the throttle body assembly

Improperly adjusted throttle stop	There is a screw on the throttle body that positions the throttle. This screw is set at the factory and should not be changed. The purpose of the idle stop is to keep the throttle blade from hitting the inside of the throttle bore and wearing a grove in it. If somebody has moved this, reset it so that the stop barely holds the throttle blades off the bore.

12.7.4 Closed Throttle Voltage Too High

One of the main things the TP sensor is used for is to indicate to the PCM when the throttle is closed. Many PCM strategies are based on closed throttle. If the TP sensor fails to indicate less than .5 when the throttle is closed, some strategies will fail to run and some may run when they should not. Here is a list of symptoms related to a TP sensor failing to correctly report a closed throttle:

- **Poor Idle** – The PCM makes adjustments to the timing and fuel delivery to help stabilize the idle. If the TP sensor voltage is too high, the PCM will not enter into this idle mode.

- **Loss of Fuel Cut** – When the TP sensor voltage is under .5-volts, the engine is fully warmed, and the engine RPMs are above 1100, the fuel injectors are shut off. If the TP sensor voltage is too high, the PCM will not enter into this fuel cut strategy.

- **Idle Air Control (IAC) Valve Activation** – When the TP sensor indicates off idle and the vehicle speed sensor (VSS) indicates any speed, the IAC valve is activated. This will cause the idle speed to stay high if coasting and the throttle is closed. It will also cause the idle to jump up if coasting in a parking lot, even with the throttle closed.