Module 6
Engine Control Module (ECM)

Author: Grant Swaim

E-mail: sureseal@nr.infi.net

URL: www.tech2tech.net

Phone: (336) 632-9882

Fax: (336) 632-9688

Postal Address: Tech-2-Tech Website
PO Box 18443
Greensboro, NC 27419

Physical Address: 220-4 Swing Rd
Greensboro, NC 27409

Last Update: April 2000

Tech-2-Tech offers the following training modules in printed manual, CD-ROM, and on-line formats.

PGMFI Training Modules

- The PGMFI System Overview—Part 1
- The PGMFI System Overview—Part 2
- PGMFI Flash Type DTCs
- Inputs / Outputs—Part 1
- Inputs / Outputs—Part 2
- Engine Control Module
- Air Flow / MAP Sensor—Base Inj Pulse Width
- Fuel Delivery System
- Closed Loop Strategies—Theory
- Closed Loop Strategies—Case Studies
- Thermistor Inputs
- Throttle Position Sensor
- EGR Valve Lift Sensor
- MAP / BARO Sensor
- Ignition Inputs
- Vehicle Speed Sensor
- Oxygen Sensor
- Lean Air Fuel Sensor
- Miscellaneous Input Signals
- Fuel Injectors—Multi-Port Injection
- Fuel Injectors—Dual Point Injection
- Ignition System—Outputs
- Idle Air Control Valve

OBD-II Training Modules

- On Board Diagnostics—General Overview
- Diagnostic Trouble Codes
- MIL / Freeze Frame
- Scan Tool
- Scan Tool—Advanced
- Monitor Tests—Overview
- Comprehensive Component Monitor
- Catalyst Monitor
- EGR Monitor
- Evaporative Monitor
- Fuel System Monitor
- Misfire Monitor
- Oxygen Sensor Monitor
- Oxygen Sensor Heater Monitor
- "P" Codes

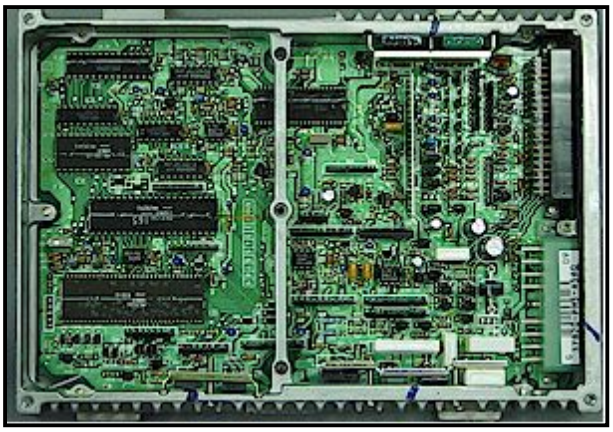
Miscellaneous Training Material

- Glossary of Terms

6 Engine Control Module

6.1 Control Modules - General Overview

Image 6-1 PCM Internal Components



At the heart of the PGMFI and OBD-II system is the engine control module (ECM) or powertrain control module (PCM). The difference between the two modules is in the systems they each control.

An ECM only controls engine functions such as fuel and ignition timing control. The ECM handles no significant transmission functions.

Some automatic transmission equipped models will have a separate control module for the transmission. This module is called a transmission control module (TCM). A TCM is shown in Image 6-2. A TCM is physically smaller than an ECM or PCM.

Image 6-2 TCM Components

Some models have one control module for both engine and transmission control. This module is called a PCM. A PCM with the top removed is shown in Image 6-1.

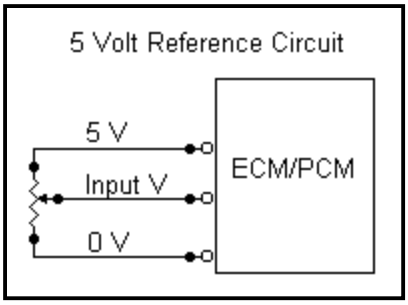
In the beginning these modules were only used to control fuel, ignition timing, and transmission functions. Later model Hondas use the ECM/PCM to also manage systems such as A/C compressor control and cooling fan activation.

6.2 Input Signals

Image 6-3 Input/Output Terminal Gauge

A control module receives analog input signals from the sensors and then controls several load devices such as fuel injectors, IAC valve, and solenoid valves. The incoming signals have very low current flow, however, the load de-

Illustration 6-1 5-volt Reference



vices can have a significant load requirement. The difference in current carrying capacity can be seen in the gauge of the connector terminals shown in Image 6-3.

The incoming signals have to be conditioned, strengthened and converted to a digital format before the processor can use the information. A large part of the electronic components shown in Image 6-1 are used to perform these tasks.

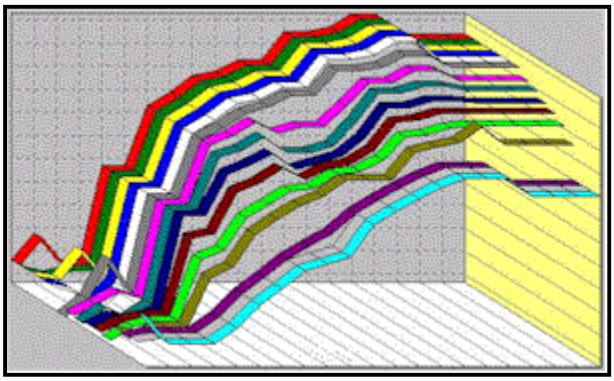
Many of the signals used by the control modules are based on a 5-volt reference signal as shown in Illustration 6-1. Most of the 5-volt reference inputs produce a voltage from about .5v to 4.5v, which represents its range of input.

In addition to 5-volt reference inputs the control module also receives signals from these types of sensors.

- Temperature sensing thermistors
- On/Off Switches
- Voltage producing (O2 Sensor)
- DC Square wave signals
- AC wave signals

6.3 Control Module Information Tables

Illustration 6-2 Honda Ignition Timing Map



The ECM/PCM takes all the input information and processes it to determine the proper outputs.

Not all inputs are used in every output decision. The authority each input has over a given output varies widely.

Most of the output decisions are based on programmed internal information. The information is often stored in the form of a matrix. These are sometimes referred to as look-up tables or data maps.

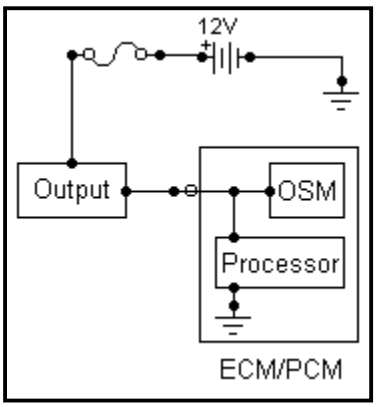
Illustration 6-2 is a graph drawn from an actual Honda ignition timing data table. This Honda had 14 ignition timing tables as shown by the 14 graphs. The ECM/PCM picked a timing table based on MAP voltage. Each table was a grid with RPM on one axis and ignition timing on the other axis.

In summary the ECM/PCM had 14 different ignition timing profiles. The profiles were chosen based on engine load. Note that the ignition timing advance is not infinitely changed; it is changed at specific RPMs and by a set amount.

The information stored in a Honda ECM/PCM cannot be changed. The Honda control modules cannot be reprogrammed with new information. If Honda needs to make a change in the fuel or ignition timing controls, the ECM/PCM has to be changed out.

6.4 Control Module Outputs

Illustration 6-3

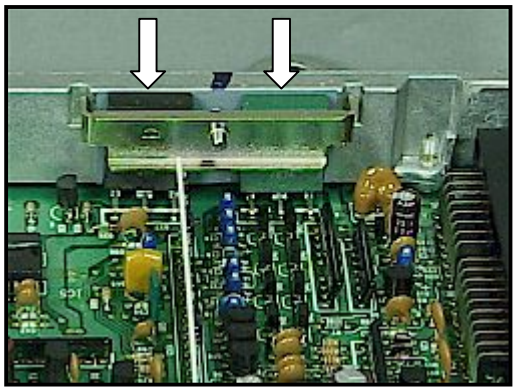


The ECM/PCM directly controls several outputs, such as ignition igniter trigger, fuel injectors, and idle air control (IAC) valve.

Illustration 6-3, on the left, shows the typical output circuitry. The PCM/ECM controls the load devices by providing a ground to its circuit. By controlling the ground side of the circuit, the ECM/PCM is not damaged by excessive current if a short to ground occurs in the circuit.

On OBD-II equipped models the outputs are also checked for functionality. When a device is activated by the ECM/PCM, an "output state monitor" checks the circuit. This special circuitry confirms that the correct current flowed when the load is activated.

Image 6-4 Injector Drivers



A transistor, often called a driver, grounds the load current when activated by the processor. A transistor can be thought of as an electronic relay. A small current from the processor activates the transistor to ground the load circuit, which can be significant.

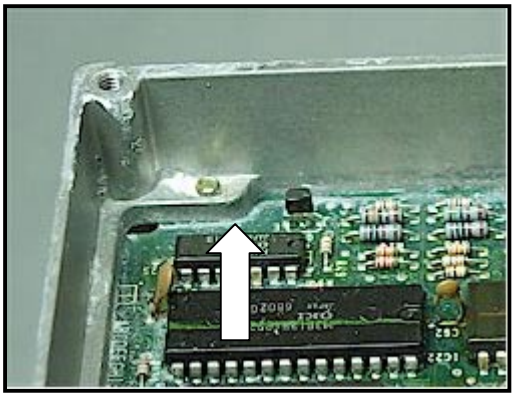
Image 6-4, on the left, shows the injector drivers of a dual point injection Honda. Drivers are typically bolted to the inside of the module case. Transistors tend to get hot when they are operating. They are bolted to the module's aluminum case to help in heat dissipation. The two transistors shown in Image 6-4 are sandwiched between the module case and an additional heat sink.

6.5 Control Module Service Issues

The control modules used by Honda are very reliable. It is very rare to have an ECM/PCM failure; however, there are a few service issues to be aware of.

6.5.1 Water Damaged Control Modules

Image 6-5 Water Damaged PCM



One of the biggest problems with Honda ECM/PCMs is that in most models they are located very low in the car. Some models have them actually mounted flat on the floorboard. This makes them susceptible to water damage.

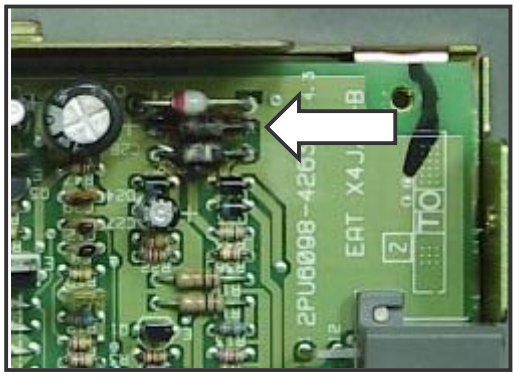
There are many ways, other than floodwaters, to get enough water inside the car to water damage the modules. Some of the more common sources of water are: leaking radio antenna, leaking moonroof drains and leaking windshields.

An ECM/PCM that has been water damaged should be replaced. Initially the effects of water damage may not be obvious. Typically the circuit board of a water damaged ECM/PCM will develop a chalky residue in time. This residue is a form of corrosion and will eventually damage solder joints. Image 6-5 shows this chalky residue.

If you suspect a module has been subjected to water, pull the top and bottom covers and look for signs of water damage. In addition to moisture still present and the chalky residue; look for rust on the inside of the covers.

The biggest problem with water damaged ECMs is that they can develop problems later. When this happens it is often difficult to diagnose. Most commercial module rebuilders will not repair an ECM/PCM that has been water damaged.

Image 6-6 Damaged ECM/PCM



6.5.2 Damaged ECM/PCM Circuit Boards

It is very rare for a Honda ECM/PCM to fail. A hard failure, such as a burnt circuit board competent, could be an indication of excessive current. Excessive

current flow could be caused by a failure in a load device or external circuitry. Image 6-6 shows two burnt electronic components on a Honda TCM.

Before replacing a ECM/PCM with a hard failure, the loads and external circuits should be checked for excessive current first. Failure to do this could result in damaging the replacement ECM/PCM with excessive current. Simply look at a schematic and identify all the loads the ECM/PCM controls. Identify the load grounds in the ECM/PCM connector. With the ECM/PCM disconnected and the key on engine off (KOEO) ground each load individually and check for excessive loads.

6.5.3 Poor ECM/PCM Grounds

Various load devices are directly controlled by the ECM/PCM. Some of the components that are controlled are the fuel injectors, the IAC valve, various solenoids, and the igniter trigger. These components are supplied with positive voltage and the ECM/PCM activates the devices by grounding them.

For example when the ECM/PCM's processor activates a fuel injector, it triggers a transistor, which in turn grounds the injector. The ground(s) that the ECM/PCM uses is actually external of the module. One or more of the ECM/PCM wire(s) is a ground wire(s). If there is excessive voltage drop across ECM/PCM grounds, the voltage applied to the load devices will be reduced by this amount. The reduced voltage applied to the loads can cause a malfunction or failure.

These ECM/PCM grounds typically attach to the powertrain. Some models used one of the thermostat bolts as the grounding point for the module grounds. These grounds would often drop too much voltage and cause problems.

6.5.4 The Effects of Installing an Incorrect ECM/PCM

Caution should be used when changing out ECM/PCM units, to make sure the correct unit is being used. While this is more of a problem when using a used module, a new module could be ordered incorrectly, too.

New features were added almost yearly and did not necessarily coincide with the body changes. For instance Honda added the vehicle speed sensor (VSS) input to the 88 Accord ECM. If the 1988 Accord ECM was installed into a 1987 Accord, which is the same generation and engine, it would set a VSS diagnostic trouble code (DTC) since no VSS signal would be present.

If a car starts setting new DTCs right after swapping out a ECM/PCM, suspect that the module is not compatible with the car.