Module 27
Scan Tool

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Last Update: October 2000

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27 Scan Tool

27.1 General Overview

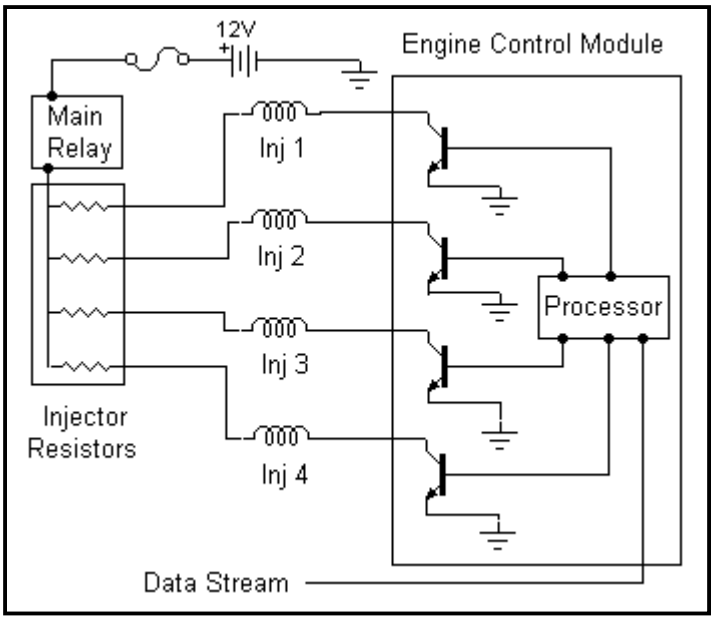
Data stream capabilities were added to some 1992 models, with full OBD-II data stream capabilities added to all the OBD-II equipped models in 1996 (95 V-6 Accords). While some manufacturers had processor data stream data available as early as the 1980's, Honda has relied on the self-diagnosing functions of its engine control modules (ECM) for reporting malfunctions. Honda reported malfunctions to techs via a flashing check engine light. Most input circuits, and some output circuits, were monitored. The addition of ECM data stream gave the technician a much more powerful diagnostic tool.

Scan tools fall into two main categories, OEM and generic OBD-II. This training module will focus on Honda's OEM scan tool, the Honda PGM Tester. We will compare the differences between the Honda PGM Tester, which is a special version of Vetronix's Mastertech, and a Mastertech using the now available aftermarket Honda / Acura software. Unless otherwise specified, when using the term "Honda OEM" scan tool in this training module, I am referring to both the Honda PGM Tester and the Mastertech with an aftermarket Honda / Acura Program Card.

The focus of this module is to cover standard OBD-II diagnostics using a scan tool. For more advanced uses of OBD-II scan tool read the training module, OBD-II Scan Tool Advanced.

27.2 Limitations Of Scan Data

Illustration 27-1 Data Stream



Before we get lost in the magic of data stream diagnostics, let's make sure we all understand exactly what it is. Scan tools, like every other tool in your toolbox, has advantages and disadvantages. It is important for you to understand it limitations and understand when it is time to grab a different diagnostic tool. Three limitations of any scan tool that you need to be aware of are, inability to guarantee an output device was acti-

vated, inability to report on all inputs, and slow data stream rate.

27.2.1 Inability To Guarantee An Output Device Was Activated

First, understand that scan tool data is data that is flowing straight out of the ECM's processor. This is an advantage when you are checking on an input device, since you are monitoring an input's value at the processor level. If there were problems anywhere in the input circuit, including internal of the ECM, it would show up in scan data.

The opposite is true when dealing with an output signal. Remember, the data you are receiving on a scan tool is the value that the processor commanded, not necessarily what occurred at the output device. Look at the fuel injector circuit in Illustration 27-1. If a scan tool is indicating a pulse width (PW) of 3ms, that means that the processor commanded the injector driver (transistor) to ground the injector for 3ms. Suppose the injector driver was malfunctioning and the injector was not being grounded, or the wire between the injector and the ECM was grounded and the injector was turned on all the time. These may be rare but the point is it can happen and many times no diagnostic trouble code (DTC) is set. Just keep this in mind when reading output signal data. If you have reason to question the scan data, you will need to check the values at the component with a digital storage oscilloscope (DSO).

27.2.2 Inability To Report All Parameters

In addition to retrieving historical information such as: stored DTCs, freeze frame, and monitor readiness status information, a scan tool can be used to retrieve live engine parameters. The amount of live data that is available has practical limitations. In some cases, the information the processor uses has no significant meaning to a technician. For example there is no practical way for a scan tool to display a value for a TDC/CYL input signal. These inputs are waveforms and it would be difficult for the scan tool to equate it to a value. In the case of the TDC/CYL input signal, they have been assigned a DTC and a malfunction of these sensors should set a DTC. In some cases you may have components that will not set a DTC and are not reported to a scan tool.

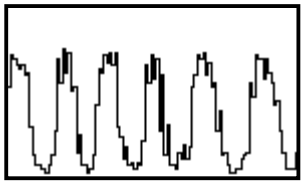
There are also some sub systems that are not going to be reflected in the scan tool data list. The processor does not monitor the ignition system “downstream” of the igniter trigger signal from the ECM. Once the ECM triggers the igniter to spark a cylinder, what happens after that is not under the control of the processor and will not be covered in scan tool data.

27.2.3 Slow Data Transfer Rate

The Bad News

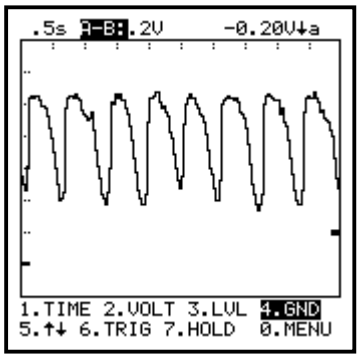
The information coming from the ECM into the scan tool is sent as a serial data stream. This means the information is sent over one wire. When your scan tool has requested a full data list, all the data that is available from the processor is sent over one wire, "nose to tail". The OBD-II data transfer rates are not particularly fast and a full data request cycle could take as long as 2-3 seconds. Most scan tools will allow you to reduce the number of parameters retrieved to get a quicker refresh cycle time. When only one parameter is requested the information can be updated as fast as 6 times a second.

Screen Capture 27-1



This slow sample rate is a big difference from what techs that have DSO experience are expecting to see. You can see the effect of this slow sample rate while graphing a parameter being retrieved via the OBD-II data link connector (DLC).

Screen Capture 27-2



Look at the jagged edges of the waveform in Screen Capture 27-1. This is the oxygen (O2) sensor voltage being graphed by a Mastertech while using the OBD-II DLC.

Now look at the difference in the waveform shown in Screen Capture 27-2. This waveform was also taken using a Mastertech. The difference is the OBD-II DLC was abandoned and the O2 voltage is being measured using the Mastertech in the DSO mode. The leads are attached directly to the O2 sensor. The software is drawing this waveform from many more samples and the waveform is smoother. The fact that it looks prettier is not the issue. The issue is that the O2 voltage is being reported to the screen at a much faster rate and the chances of catching a glitch are much better.

In many cases, the slow sample rate is not an issue. It is a trade-off to the convenience of using a scan tool Vs a DSO. The problem comes into play when you have a situation in which glitches in a circuit are causing a problem. Even if you are refreshing a parameter at 10 times per second, you may never catch a momentary glitch.

The decision of when it is time to switch from the OBD-II mode to the DSO mode is on a case to case basis, and it takes experience. If due to a set of symptoms, you strongly suspect a given component and the component looks OK when using the OBD-II DLC, you might want to re-check it in the DSO mode. For instance, if a car had a bad stumble as the throttle is moved through a certain position, you would strongly suspect the throttle position (TP) sensor. If you did not see any

drop outs in the TP sensor voltage as you checked it in graphing mode through the OBD-II DLC, you would be wise to also check it using the tester in the DSO mode.

The Good News

When you use a Mastertech unit in the "Generic OBD-II" mode, it has to use the mandated OBD-II protocol, which is extremely slow. When you use either the PGM Tester software or the Honda Aftermarket software, the tester is not operating as an OBD-II compliant scan tool. The Honda software uses a much faster protocol to stream data into the tester.

The Honda data transfer rate is so fast that a "full pull" with the Honda software is refreshed about as fast as a single parameter refresh from an OBD-II compliant scan tool.

PGM Tester Vs Mastertech

Image 27-1

The Honda PGM Tester was co-engineered between Honda and Vetronix Corp. The tester is based on Vetronix's Mastertech Multi-Function Tester. The Mastertech is shown on the left and a Honda PGM Tester is shown on the right, in Image 27-1. The two testers are functionally identical. What actually makes the Mastertech a Honda PGM Tester is the program card that is inserted into a PCMCIA slot on the top right side of the tester.

There are differences in the Honda PGM Tester Program Card (OEM) and the Honda / Acura Program Card (aftermarket). A photo of the PGM Tester Program Card, the Honda / Acura Program Card, and the Mastertech Multi-Function Tester Card is shown in Image 27-2.

Image 27-2

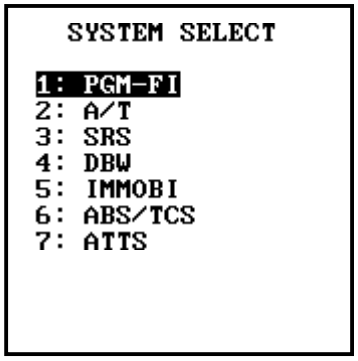
All these cards are physically interchangeable in any Mastertech tester. Vetronix, at the direction of Honda Corporation, has developed software protections that prevent PGM Tester cards from operating in anything but a PGM Tester. The Aftermarket Honda/Acura Program Card will not work in a PGM Tester unit either.

The PGM tester uses only one program card. All the Honda functions, generic OBD-II functions, and DSO operations are included on the one card. A user is given a menu choice to access these different areas.

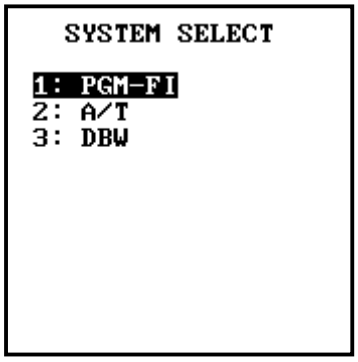
When using a Mastertech, with an older Honda /Acura Program Card (4 meg), the generic OBD-II functions and DSO functions are not included on that card. To access generic OBD-II operations and the DSO mode, you have to use the Multi-Function Tester Program Card. This card comes with a Mastertech when you purchased it.

The disadvantage of this is that the Honda / Acura Program Card does not have all the OBD-II tests on it. For instance, to check the monitor readiness status, you

Screen Capture 27-3



Screen Capture 27-4



have to shut the tester off and change cards. If you want to switch back and forth between scan tool mode and generic OBD-II or DSO mode, you have to keep changing cards.

The new 8 MEG Pro Card from Vetronix includes the OBD-II functions as well as OEM level software for six other Asian manufacturers.

The Honda / Acura Program Card also differs from the PGM Tester Program Card by only including powertrain information. You can see the differences in the systems covered in Screen Captures 27-3 and 27-4. Screen Capture 27-3 is the System Select menu from a PGM Tester. Screen Capture 27-4 is the System Select menu from a Mastertech using the Honda / Acura Program Card.

The Mastertech tester is also the OEM scan tool to Toyota, Suzuki, and some other manufacturers. Vetronix also offers the OEM program cards for these manufacturers. This makes the tester very attractive to a typical Asian repair shop since it is OEM to many Asian manufacturers.

27.3 Pre OBD-II Data Stream

Honda first made data stream available on 1992 Civics / Preludes and 1994 Accords. This system is a not an OBD-II system, but has many similarities. Obviously the Honda PGM Tester and a Mastertech equipped with a Honda / Acura Program Card can access this information. Other scan tools may be able to access this information, check your tester's manual.

27.3.1 3-Pin Data Link Connector

The DLC is a 3-pin connector and usually includes three wires, but some models only have two wires. The 3-pin connectors with all 3 wires, provide power to the tester, the two wire models do not. When using the Mastertech on a 3-pin connector with only two wires, the unit has to be plugged into a 12 volt power source. The 3-pin DLC is usually located close to the 2-pin SCS connector. Images 27-3 and 27-4 show the most popular locations for the 3-pin DLC.

Image 27-3 3-Pin DLC Location

Located at Right Lower Edge of Dash
94-95 Accord (L4)
92-95 Civic
93-95 del Sol

The 3-Pin DLC connector is on the right. The 2-Pin connector is on the left is the service check connector (SCS).

Image 27-4 3-Pin DLC Location

Behind Front of Console
92-95 Preludes

Notice that this is the two wire system and would require external power to the Mastertech

Behind Glove Box (not shown)
95 Odyssey

At Left Kick Panel (not shown)
94-95.5 Passport

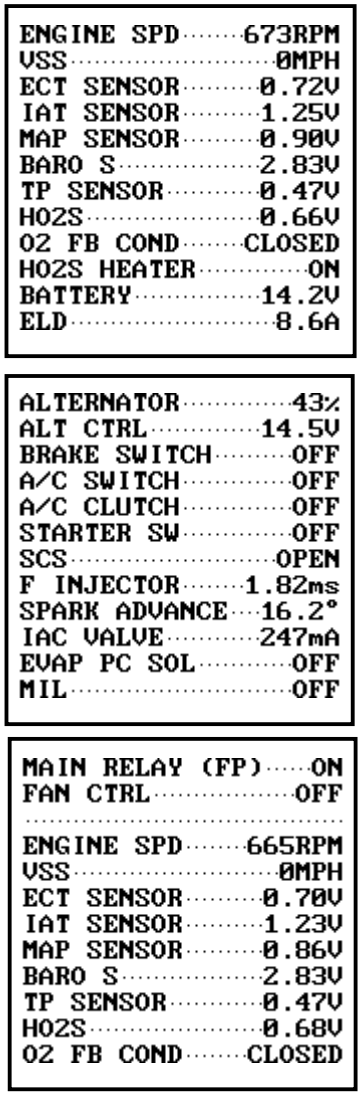
27.3.2 Data List

This early system reports live engine parameters, just like the OBD-II systems do. Screen Capture 27-5 shows a data list pulled from a 1994 Civic.

The parameter list is fairly extensive and far exceeds the OBD-II minimum requirement parameter list. The only parameters missing that are included in OBD-II are: short term fuel trim (ST FT), long term fuel trim (LT FT), and calculated load.

Many manufacturers offer expanded data parameters when using their OEM scan tool. This is a good example of that. Some of the parameters listed are handy, but not emissions related.

Screen Capture 27-5



These non-emission parameter come in handy:

Brake Switch
Good quick way to check for a defective brake switch

A/C Switch (ON/OFF) - A/C Clutch (ON / OFF)
This will help determine quickly if the ECM is getting an A/C signal from the switch side (includes A/C switch, evap thermostat, and low pressure switch). It will also be able to see if the ECM has energized the compressor clutch relay.

Main Relay - Fuel Pump (On / OFF)
Gives the tech a quick way to determine if the fuel pump relay has been energized.

Fan Control (ON / OFF)
Indicates if the radiator cooling fan has been commanded on or off by the ECM.

27.3.3 DTC Reporting / Freeze Frame

Screen Capture 27-6

This early system did have DTC reporting capabilities. The DTCs used were not the expanded "P" codes used on OBD-II models, but usually give some additional information over the malfunction indicator light (MIL) flash DTCs.

As you can see from Screen Capture 27-6, the DTC set used was the same as the one reported by the flashing MIL. In many cases a sub code was added, such as the 1 that was added in this case. The sub

Screen Capture 27-7

ENGINE SPD	2170RPM
VSS	41MPH
ECT SENSOR	176°F
IAT SENSOR	64°F
MAP SENSOR	27.8inHg
BARO S	28.8inHg
TP SENSOR	59.3%
HO2S	0.04V
BATTERY	14.1V
F INJECTOR	13.68ms
EGR V L S	1.31V
IAC VALVE	688mA

code of 1 gave us additional information about the O2 sensor voltage, it was low.

The pre-OBD-II system also had freeze frame writing capabilities. The freeze frame written by the storing of this DTC is shown in Screen Capture 27-7. It is similar to a freeze frame written in the OBD-II systems.

Screen captures shown in Figures 12 and 13 were taken from a 1992 Prelude, using a Mastertech equipped with the Honda / Acura Program Card.

27.4 OBD-II Data Stream

In 1995 Honda added OBD-II to the V-6 Accord. All 1996 and later models are equipped with OBD-II. The OBD-II DLC is a 16-Pin connector whose size, shape and location has been standardized across all manufacturers by standards developed by the Society of Automotive Engineers (SAE).

OBD-II only uses a maximum of 7 of the 16 pins in the DLC. The manufacturer is free to use the other pins in any way they want. The ECM can use any of three protocols (SAE J1850 VPW, SAE J1850 PWM and ISO 9141) to communicate with a scan tool. Chrysler, all Europeans, and most Asian - including Honda use the ISO 9141 protocol. Don't worry about this, since an OBD-II scan tool must be able to distinguish which protocol is being used by the processor and switch to that protocol automatically.

27.4.1 16-Pin Data Link Connector

Image 27-5

Bottom Left Edge of Dash (pointing straight down)

Typical Location For:

- 98-00 Accord (All)
- 96-00 Civic
- 96-97 Passport

Image 27-6

Behind Ashtray

Typical Location For:

- 95-97 Accord (V6)
- 96-97 Accord (L4)

Image 27-7

Behind Front Of Center Console (behind access plug)

Typical Location For:

- 96-97 Odyssey

Image 27-8

Behind Front Of Center Console (no trim panel to remove)

Typical Location For:

- 96-97 del Sol
- 97-00 CR-V

Image 27-9

Behind Front Of Center Console (remove trim panel)

Typical Location For:

- 97-98 Prelude

Image 27-10

Behind Beverage Holder

Typical Location For:

- 96 Prelude

27.4.2 Data List

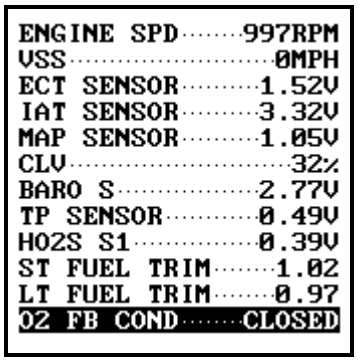
As to be expected, the live parameters available using the Honda OEM scan tool is expanded over the list you would get using a standard OBD-II scan tool. OBD-II regulations specify certain parameters that must be made available at the DLC when using a generic scan tool. A comparison of the two data lists is shown in the table below. The data list available when using the OEM scan tool is shown in the left column (Screen Capture 27-8). The data list available when using a generic OBD-II scan tool is shown in the right column (Screen Capture 27-9).

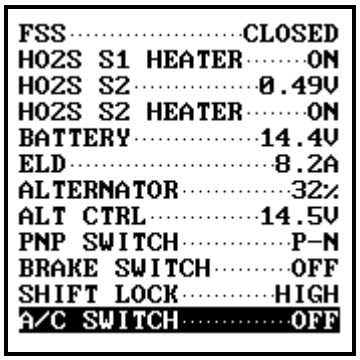
The OEM scan tool pulled 39 parameters from this 1996 Civic, while the generic scan tool only pulled 19 parameters. The trend in the automotive industry is for more and more parameters to be made available from the OBD-II DLC. The 1999 Fords are approaching several hundred available parameters!

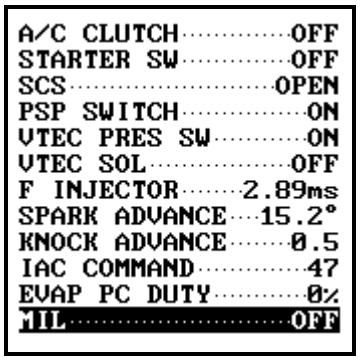
27.4.3 Scan Tool Parameter List Comparison Table

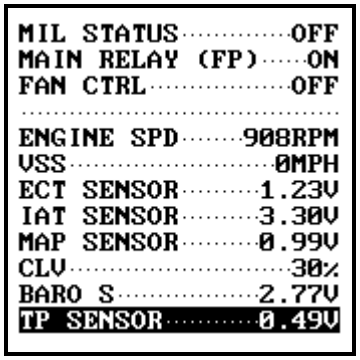
Honda - Aftermarket Card

Screen Capture 27-8



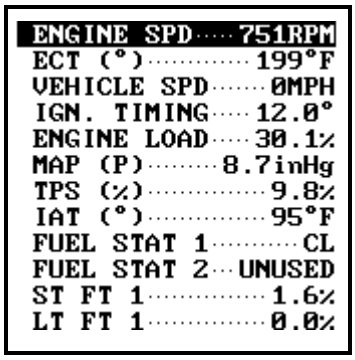


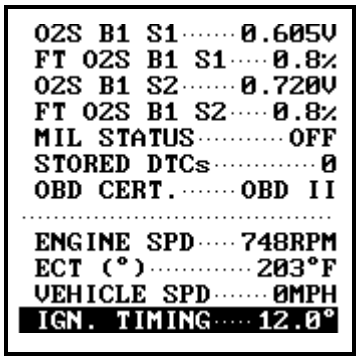




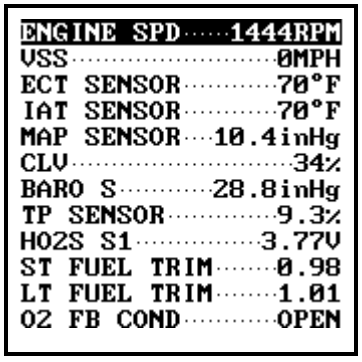
Honda - OBD Generic

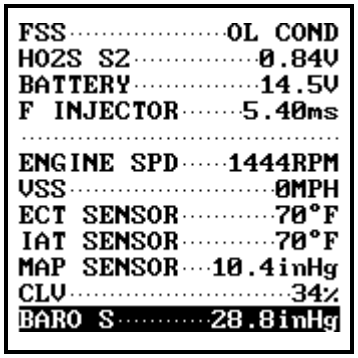
Screen Capture 27-9





Screen Capture 27-10





27.4.4 DTC / Freeze Frame

The OBD-II systems went to a more robust DTC set. The DTCs reported by the Honda OBD-II system follow the industry standards established by SAE.

As you can see in the first screen capture in Screen Capture 27-10, if a DTC is stored in the ECM's memory, a"*** DTC***" warning will flash at the bottom of every screen.

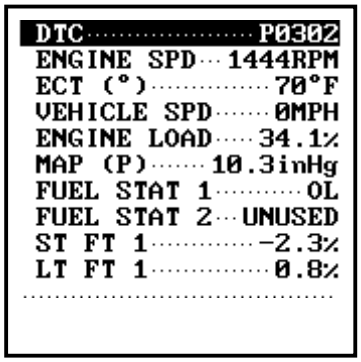
The next screen capture shown, lists all the DTCs stored in the ECM. In this case there are two stored DTCs a P0301, and a P0302. There is only one freeze frame written and it was written when P0302 was stored (it is highlighted). Since both of these DTCs are misfire codes, and are the same priority, we know that P0302 occurred first.

After pressing [ENTER] from the second screen, the freeze frame screen (third and fourth screen captures) would be displayed. This freeze frame was taken using the Honda OEM tester and gives more detail than is required by OBD-II regulations.

The freeze frames shown in this series include 16 parameters. Freeze frame data is one of the best diagnostic tools available to a technician. It takes a snapshot of important engine parameters at the instant a DTC is stored. A tech can use this information to help duplicate driving conditions when testing the car. When trying to duplicate a malfunction, it is best to drive a car within 10% of the freeze frame parameters.

Screen Capture 27-11 (on the next page) was taken from this same car, but using the Mastertech in the OBD-II generic mode. This freeze frame includes only 9 parameters. These are the parameters that are required by OBD-II regulations to be available to any generic OBD-II scan tool. These screen captures were taken from a 1996 Honda Civic.

Screen Capture 27-11



27.4.5 Monitor Readiness Status

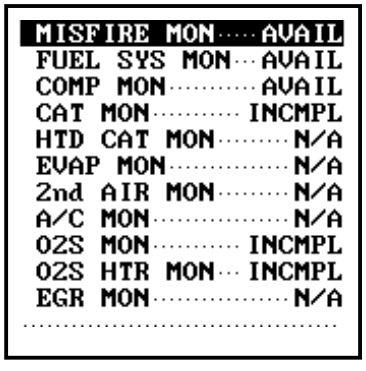
The last major use of an OBD-II scan tool is for checking the readiness status of the monitors. This can be an important test if you are trying to road check repairs done to a DTC that were generated as a result of the running of a once-per-trip monitor. For a more detailed explanation of this concept, read the *Monitors Overview* training module.

This test is not part of the actual Honda software. You have to use the Mastertech, or Honda PGM Tester in the OBD-II generic mode to find this test.

If you are using the Honda PGM Tester you will have to switch to OBD-II generic mode. This software is part of the PGM Tester Program Card and is a menu choice at the very beginning of the menus. Not all Canadian PGM Testers are OBD-II compliant; however, all the USA PGM Testers are.

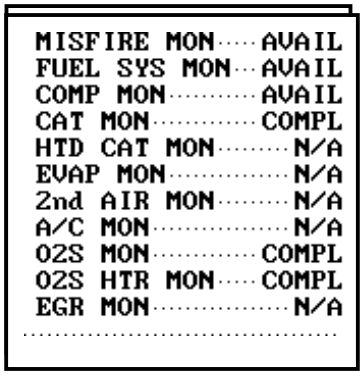
If you are using a Mastertech with an older Honda / Acura Program Card, it is not on the card. You will have to use the Multi-Function Tester Card (shipped with all new Mastertechs) to go into generic OBD-II to find the monitor status information. This is not too convenient it you want to switch back and forth between the OEM data list and the monitor readiness status. These two programs are now offered on one 8 Megabyte card.

Screen Capture 27-12



Screen Capture 27-12 shows the monitor status right after a DTC reset was performed. Using a scan tool is the best way to clear DTCs since pulling power to the ECM will erase any adaptive learning. This sets all the monitors' status to "incomplete".

Screen Capture 27-13



The screen capture in Screen Capture 27-13 is after all the monitors have run to completion since they all indicate, "complete".

27.5 DTC / ECM Resets

In addition to being able to retrieve historical and live ECM information, an OBD-II scan tool is used to reset (clear) stored DTCs. All DTCs must be cleared before attempting to run diagnostics on a Honda.

When a DTC is stored, the ECM can substitute normal strategies with "back up" strategies. One stored DTC could cause modifications to many strategies. A tech that is not aware of this may be diagnosing a Honda with information that is not accurate.

It is also important to clear stored DTCs so a new freeze frame can be written. You should clear stored DTCs immediately after recording the DTCs (plus any freeze frame information) and prior to running any diagnostics on a car.

The Mastertech unit has two options; you can clear just the DTCs or reset the ECM. A DTC clear will also clear the freeze frame data and reset all the monitor's status to incomplete. A DTC clear will not erase any adaptive learning from the ECM. The ECM reset will clear DTCs and adaptive learning. The ECM reset is the equivalent to removing power to the ECM.

27.6 Advanced OBD-II Scan Tool Functions

This module just covered the basics. Any tech that is going to be working with OBD-II should be very familiar with all the information covered in this module. For more advanced uses of OBD-II scan tool you should read the Advanced Scan Tool Chapter.