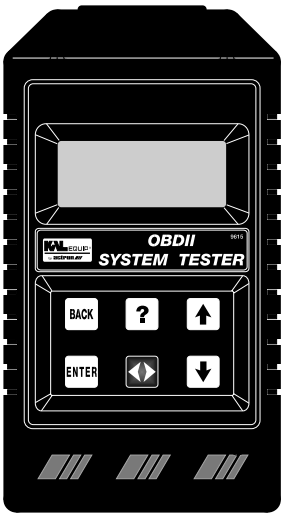


KAL EQUIP

OBD II System Tester 9615

Table of Contents

Vehicle Service Information

The following is a list of publishers who have manuals containing electronic engine control diagnostic information. Some manuals may be available at auto parts stores or your local public library. For others, you need to write for availability and pricing, specifying the make, model and year of your vehicle.

Vehicle Service Manuals

Chilton Book Company
Chilton Way
Radnor, PA 19089

Haynes Publications
861 Lawrence Drive
Newbury Park, CA 91320

Cordura Publications
Mitchell Manuals, Inc.
Post Office Box 26260
San Diego, CA 92126

Motor's Auto Repair Manual
Hearst Company
250 W. 55th Street
New York, NY 10019

Suitable manuals have titles such as:
"Electronic Engine Controls"
"Fuel Injection and Feedback Carburetors"
"Fuel Injection and Electronic Engine Controls"
"Emissions Control Manual"
. . . or similar titles

Vehicle Service Manuals from General Motors Corporation:
Buick, Cadillac, Chevrolet, GEO, GMC, Oldsmobile, & Pontiac
Helm Incorporated
Post Office Box 07130
Detroit, MI 48207

Saturn
Adistra Corporation
c/o Saturn Publications
101 Union St.
Post Office Box 1000
Plymouth, MI 48170

Vehicle Service Manuals from Ford Motor Company:
Ford, Lincoln, & Mercury
Ford Publication Department
Helm Incorporated
Post Office Box 07150
Detroit, MI 48207

Vehicle Service Manuals from Chrysler Corporation:
Chrysler, Plymouth, & Dodge
Chrysler Motors Service Training
26001 Lawrence Avenue
Center Line, MI 48015

Safety Precautions

General Safety Guidelines to Follow When Working on Vehicles

To prevent accidents that could result in serious injury and/or damage to your vehicle or test equipment, carefully follow these safety rules and test procedures at all times when working on vehicles:

- Always wear approved eye protection.
- Always operate the vehicle in a well-ventilated area. Do not inhale exhaust gases — they are very poisonous!
- Always keep yourself, tools and test equipment away from all moving or hot engine parts.
- Always make sure the vehicle is in **Park** (Automatic transmission) or **Neutral** (manual transmission) and that the **parking brake is firmly set.** Block the drive wheels.
- Never lay tools on vehicle battery. You may short the terminals together causing harm to yourself, the tools or the battery.
- Never use OBD II System Tester if its internal circuitry has been exposed to any liquids.
- Never smoke or have open flames near vehicle. Vapors from gasoline and charging battery are highly flammable and explosive.
- Never leave vehicle unattended while running tests.
- Always keep a fire extinguisher suitable for gasoline/electrical/chemical fires handy.
- Always use extreme caution when working around the ignition coil, distributor cap, ignition wires, and spark plugs. These components contain **High Voltage** when the engine is running.
- When performing a road test, **Never** operate the OBD II System Tester alone while driving the vehicle. **Always** have one person drive the vehicle while an assistant operates the tester.
- Always turn ignition key OFF when connecting or disconnecting electrical components, unless otherwise instructed.
- Always follow vehicle manufacturer's warnings, cautions and service procedures.

WARNING!

Some vehicles are equipped with safety air bags. You *must* follow vehicle service manual cautions when working around the air bag components or wiring. If the cautions are not followed, the air bag may open up unexpectedly, resulting in personal injury. Note that the air bag can still open up several minutes after the ignition key is off (or even if the vehicle battery is disconnected) because of a special energy reserve module.

Section 1: Welcome to the OBD II System Tester

1-1 Overview

OBD II (On-Board Diagnostic, second generation) systems are designed to meet or exceed a set of standards and regulations designed to improve air quality. The Environmental Protection Agency (EPA), in conjunction with California Air Research Board (CARB), issued these standards and regulations through the Clean Air Act of 1990. OBD II systems are required to monitor the performance of emission related systems and their components. The ability to detect hard and intermittent faults are further requirements of an OBD II compliant system. The Society of Automotive Engineers (SAE) defined several standards for OBD II systems. These standards include criteria for the diagnostic link connector, communication, Diagnostics trouble codes (DTCs), descriptor names, and other repair information.

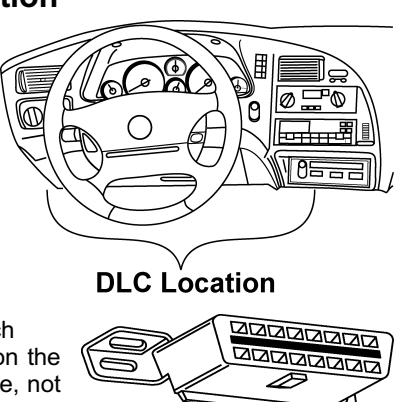
This OBD II System Tester will work on OBD II compliant cars and light trucks. If you use a vehicle service manual along with the tester, you will be able to diagnose and repair many automotive-related problems. Before proceeding, make sure you have read and fully understand the material in this **Manual**.

1-2 The OBD II System Tester

KAL Equip's OBD II System Tester was developed by experts in the automotive service industry to help diagnose today's vehicles and assist in troubleshooting procedures. When a problem occurs in the vehicle, its computer will store a record of the event and take corrective action to adjust the circuit at fault. The OBD II System Tester will allow you to monitor these vehicle events and read DTCs from the computer's memory to pinpoint problem areas. The OBD II System Tester will interpret the computer signals and provide you with a "real time" readout of vehicle data. In addition, the Code Lookup feature allows you to reference code descriptions without having to page through an instruction manual. A detailed description of the functions are provided in **Section 2: Diagnosing with the Tester**.

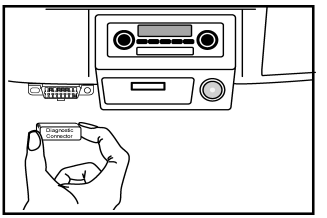
1-3 Diagnostic Connector and Location

The OBD II System Tester communicates with the vehicle via a diagnostic link connector (DLC). OBD II Specification J1962 defines the DLC's physical and electrical properties. The DLC is known as the J1962 connector. The Specification J1962 was introduced by the SAE (Society of Automotive Engineers) to make all compliant vehicles use the same DLC with the generic link information available on the same pins, no matter what make of vehicle. In addition to the connector specification, there is a guideline on where to locate the DLC or J1962 connector, which states it should be located under the dashboard on the driver's side of the vehicle. Even with this guideline, not all OBD II DLCs are located under the dash on the driver's side. If the DLC is not located in the specified area, then a note will be placed where the DLC should be informing the user of the location. If you cannot find the DLC, see the vehicle service documentation for its location.



DLC Location

1-4 Operating the OBD II System Tester



POWERING-UP

Connect the OBD II System Tester to the DLC. This connection will provide power for the OBD II System Tester. The DLC contains power even when the ignition is turned off. Connection to the battery is not necessary.

When the OBD II System Tester powers up, a series of screens are displayed. The screens start with a “Welcome” screen and end with a “Help for Instructions” screen.

Before the “Help for Instructions“ screen, the tool performs a self-test and then displays the software version “SW ID: xxxx.” Refer to this software version if you need to contact Actron’s technical support line with a problem.

The “Help for Instructions” screen allows the user to review the keypad definitions. Press the **?** key for instructions or the ENTER key to continue and display the MAIN MENU.

NOTE: Your OBD II System Tester requires a minimum of 8 volts to power up. If the power-up persists, review **Section 4-2: Tool Problems** to find the cause.

KEYPAD

The OBD II System Tester software was designed for ease in operation and navigation through the menus. Simply follow the instructions that match the keypad symbols and you will be using your OBD II System Tester like an expert in no time.

CAUTION! **DO NOT** use solvents like **ALCOHOL**! This could remove the keypad paint! Use a mild detergent or water to clean. Let dry thoroughly before operating tool.

Keyboard Functions

The OBD II System Tester uses 6 keys to navigate through the user-friendly software:

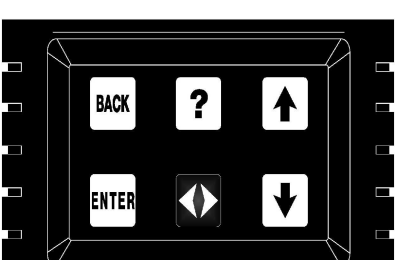
ENTER - Used to select functions and respond to requests.

? - Used to request help when the (?) symbol is displayed on the lower right hand corner of the display.

BACK - Used to move one screen back in OBD II System Tester flow.

ARROWS

UP & **DOWN** - are always used to move the solid cursor (▶) in the direction of the arrow or scroll the data list in the direction you want to move the list.



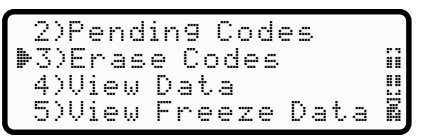
Tester Keypad

LEFT/RIGHT - The left/right arrow key is used to answer Yes or No questions.

DISPLAY

The OBD II System Tester has a 4 line x 20 character liquid crystal display (LCD) for easy viewing. This helps make the OBD II System Tester more “user friendly” by offering a large viewing area to display most Help and Instructional messages. This puts more information on the display to reduce reference to printed materials. The display will support a number of helpful symbols that will prompt you through test routines. These symbols are shown and defined below:

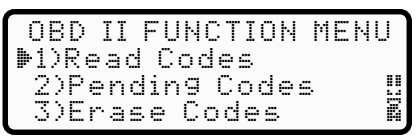
- Question Mark in lower right corner means there is **help** available for this screen or current selectable item.
- Pointer (cursor) is used to indicate current selectable choice.
- Down Arrow indicates there is additional information on the **next** screen.
- Up Arrow indicates there is additional information on **previous** screen.

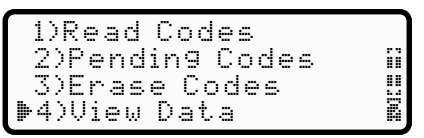


LISTS, MENUS AND QUESTIONS

The OBD II System Tester is designed to be as intuitive as possible. That is, its functions and controls should be easy to understand and use the first time you try it. All menu and screen lists operate the same way. By using the UP and DOWN arrow keys, you can move the cursor to a selection of your choice. The ENTER key selects that function or item. The screen example above illustrates a few selections available on the OBD II Function Menu.

Notice, in the screen below on the left, how the cursor (▶) is pointing at **1)Read Codes**. If you wish to read the vehicle’s DTCs, press the ENTER key to select that function. To make a different choice, such as View Data, use the DOWN arrow key to move the cursor down to **4) View Data** and press the ENTER key to select the View Data function.





Sometimes, a list will be longer than three or four items, and will not fit on a single screen. In these cases, the down arrow symbol (⁞) is visible in the last column of the display, indicating that there are more choices on the next screen, as shown below on the left. To go to the next choice, use the DOWN arrow key to move the cursor down the list. Keep going even after you have reached the bottom of the screen. The display will scroll to the list, shown above on the right:

You should see that there are now arrows in the last column pointing up and pointing down. This indicates that you can use the UP arrow key to move the cursor to the previous screen or the DOWN arrow key to move the cursor to the next screen.

Once the bottom of the list is reached, you will notice that there is now only an UP arrow (⁞) in the last column. This indicates that you have reached the end of this list, and that all other choices are on previous screens. You can return to those screens by pressing the UP arrow key. These up and down arrow characters on the screen are used throughout the OBD II System Tester. The UP and Down arrow keys work exactly the same way, even if you are just scrolling through text such as the On-Line Help screen.

Occasionally, you may be asked a question by the OBD II System Tester. These will always be YES or NO questions, and are answered in almost the same way you make choices in a Function Menu. In these screens, brackets < > will automatically appear next to the default response. If you wish to accept the default choice, simply press the ENTER key. If you wish to change the answer, use the LEFT/ RIGHT arrow key to move the brackets to the other response and press the ENTER key.

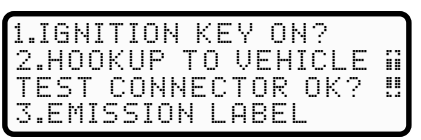
OTHER FUNCTIONS & KEYS

As you have reviewed moving through lists and functions in earlier sections, you probably noticed another symbol on the screen. In the lower right-hand corner of some screens, there is a ?. This question mark indicates that **On-Line Help** is available for that particular screen or item. To enter **On-Line Help**, press the ? key. The "Operating Error" help screen is shown at the right.

The text in **On-Line Help** screens are in CAPITAL letters to remind you that you are viewing **On-Line Help** screens and not screens associated with a function. Some On-Line Help messages are longer than one screen. If this is the case, the arrow symbols (↑ ↓) will appear in the last column of the display. A ↓ means more information available on the next screen and a ↑ means more information available on the previous screen. Use the UP and DOWN arrow keys to page up or down through a series of On-Line Help screens.

The On-Line Help screen shown above has a ↓ in the last column. To view the next On-Line Help screen, press the DOWN arrow key.

Notice now that both arrow symbols (↑ ↓) are visible in the last column of the display. This indicates that you can either page up to a previous On-Line Help screen, or page down to the next On-Line Help screen by using the UP and DOWN arrow keys. The previous On-Line Help screen is always the one you just viewed, just as with Function Menu.



1-5 OBD II System Tester Setup

Tool Setup is used to change the OBD II System Tester's default measurement units. Select the Tool Setup option from the MAIN MENU and press the ENTER key.

The TOOL SETUP MENU appears. Use the UP and DOWN arrows to select English or Metric measurement units and then press the ENTER key. Press ENTER again to accept or the BACK key to change.

NOTE: If you change the Measurement Units to a setting other than the default, then it will revert back to the default settings the next time the OBD II System Tester is used.

Section 2: Diagnosing with the Tester

2-1 Preliminary Checks

Before using the OBD II System Tester on your vehicle, it is a good idea to perform a complete visual inspection. You can find the cause of many driveability problems by just looking, thereby saving yourself a lot of time. Check the following items before proceeding with OBD II System Tester testing:

- ☐ Has the vehicle been serviced recently? Sometimes things get reconnected in the wrong place, or not at all.
- ☐ Don't take shortcuts. Inspect hoses and wiring which may be difficult to see because of location beneath air cleaner housings, alternators and similar components.
- ☐ Inspect the air cleaner and ductwork for defects.
- ☐ Check sensors and actuators for damage.
- ☐ Inspect all vacuum hoses for:
  - Correct routing. Refer to vehicle service manual, or Vehicle Emission Control Information (VECI) decal located in the engine compartment.
  - Pinches and kinks.
  - Splits, cuts or breaks.
- ☐ Inspect wiring for:
  - Contact with sharp edges (this happens frequently).
  - Contact with hot surfaces, such as exhaust manifolds.
  - Pinched, burned or chafed insulation.
  - Proper routing and connections.
- ☐ Check electrical connectors for:
  - Corrosion on pins.
  - Bent or damaged pins.
  - Contacts not properly seated in housing.
  - Bad wire crimps to terminals.

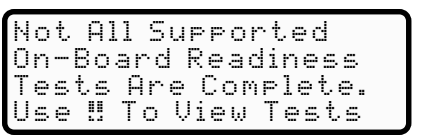
NOTE: Problems with connectors are common in the engine control system. Inspect them carefully for corrosion, bent pins, pushed out pins, or over expanded pins. Some connectors use a special grease on the contacts to prevent corrosion. Do not wipe off! Obtain extra grease, if needed, from your vehicle dealer. It is a special type for this purpose.

2-2 OBD II Functions

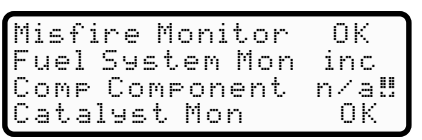
During the functions described below, a communication link is established, allowing the OBD II System Tester and the vehicle's PCM to exchange information. The way in which this information is exchanged is referred to as a data stream or data links. The OBD II Function Menu shows all OBD II Generic functions. Not every vehicle will have every function that is listed. If the function or part of function selected is not supported by the vehicle, a message screen informing you of this will be displayed.

After you select OBDII Functions from the MAIN MENU the OBD II System Tester will automatically link to the PCM and check the OBD II Readiness Monitors. OBD II Readiness Monitors are strategies designed to test the operation of emission related systems or components. The PCM may perform special tests on a system or component to complete its monitor. The vehicle may have to be operated under certain conditions to initiate a monitor. If the PCM loses power or the codes are erased the monitors will be cleared. The OBD II System Tester will display the condition of vehicle's OBD II Monitors.

Below is an example of the screen when the OBD II readiness monitors are completed. If any of the monitors are not completed, the following screen on the right will be displayed.



Press the down arrow key to view a list of the monitors. The monitor list consists of the OBD II monitor name followed by the monitor's condition. A monitor that is not supported by the test vehicle will be followed by "n/a", (not applicable). A monitor that has been completed will be followed by OK. If a monitor has not been completed, it will be follower by "inc" for incomplete.



Press the BACK key and the OBD II Function Menu will display. Use the UP and DOWN arrow keys to scroll through the choices.

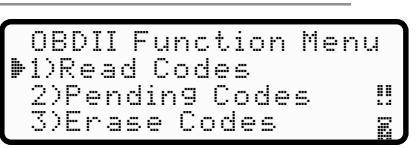
IMPORTANT: If you choose a test that your vehicle does not support, you will get a message telling you that the test is not applicable.

Read Codes

The **Read Codes** function is used to retrieve Diagnostic Trouble Codes (DTCs) from the vehicle's on-board computer. Diagnostic Trouble Codes are set when the PCM recognizes a condition outside preset ranges. A Malfunction Indicator Lamp (MIL) that is on indicates that a DTC has been recorded. Because DTCs indicate a circuit or system failure not component failures they are very useful in diagnosing vehicle concerns.

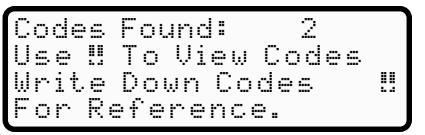
NOTE: Changing parts without diagnosing the circuit or system may result in good components being unnecessarily replaced.

Select **Read Codes** from the OBD II Function Menu and press the ENTER key. The PCM will check it's memory and report trouble conditions that were stored.



NOTE: If you get an Operating Error message, make sure the DLC adapter cable is properly attached to the vehicle connector. If the problem remains, refer to **Section 4: On-Line Help and Trouble-Shooting Tips**.

When the tester has finished reading the DTCs, one of two possible screens is displayed. If there are no DTCs stored in the vehicle's on-board computer, a "System Pass" screen is displayed. If there are DTCs stored in the vehicle's on-board computer, then the OBD II System Tester displays the number of codes found.



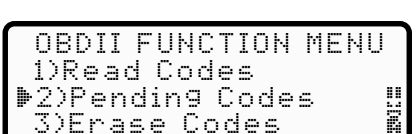
If codes are retrieved, press the DOWN arrow to view the DTC(s). Definitions for Generic DTCs (SAE J2012) will be displayed. Manufacturer specific DTCs will just display the code, no definition. Use an appropriate service manual to obtain code definitions. When more than one DTC is received, the DOWN arrow will be displayed on the right of the screen. The arrow indicates additional code information is available. Use the DOWN arrow key to view the codes stored in memory. The last code screen will just have a ⠿ symbol in the last column of the display. This indicates that this is the last screen and additional code information is found on previous screens.

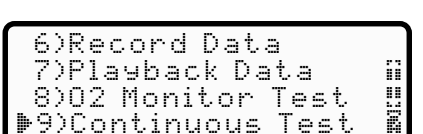
Use the BACK key to return to the OBD II Function Menu.

Pending Codes (or Continuous Test Codes)

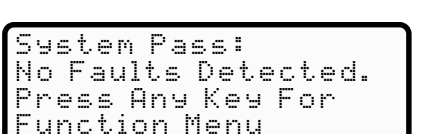
The purpose of this function is to obtain test results for continuously monitored emission-related powertrain components and systems. Certain tests are run continuously as the vehicle is driven within proper operating conditions. Unlike some trouble codes this function reports the test results after a single drive cycle. The **Pending Codes** function is identical to the Continuous Test function and is useful after a vehicle repair or after clearing the PCM's diagnostic information. Test results reported by this function do not necessarily indicate a faulty component or system.

To view the test results, select **Pending Codes** or **Continuous Test** from the OBDII Function Menu and press the ENTER key.



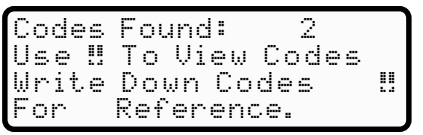


If no Pending Codes exist, the OBD II System Tester will display a single message screen indicating this condition.

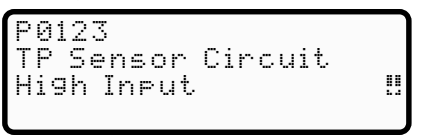


NOTE: If you get an Operating Error message, make sure the DLC adapter cable is securely attached, and the ignition key is ON, then try again. If the problem remains, refer to **Section 4: On-Line Help and Trouble-Shooting Tips**.

If any of these tests indicate a fault, the DTCs will be displayed in the same format as **Read Codes**. The tester will display codes similar to trouble codes. Press the DOWN arrow to view the pending code(s).



A DOWN arrow displayed on the right of the screen indicates additional codes can be found on the next screens. Use the DOWN arrow key to view the codes stored in memory. The last screen will just have a ⇑ symbol in the last column of the display. This indicates no more codes are available. Use the UP arrow key to view the previous codes.

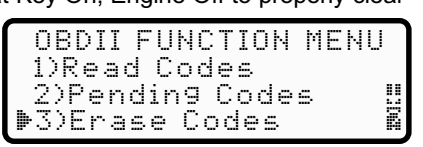


Use the BACK key to return to the OBD II Function Menu.

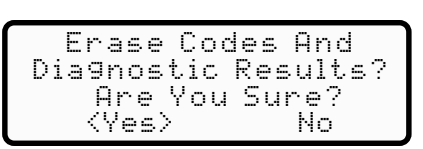
Erase Codes

The **Erase Codes** function is used to erase the trouble codes from the test vehicle's PCM. This function also erases freeze frame data, O2 sensor test data, and on-board monitoring test results, and resets the system monitors to the "Not Ready" status. Because of this you should erase codes only after you have checked the systems completely. **Erase Codes** should be performed at Key On, Engine Off to properly clear the PCM.

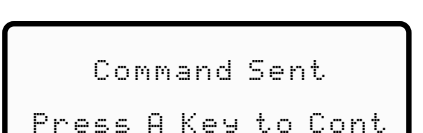
To Erase Codes from your vehicles on-board computer, select **Erase Codes** from the OBDII Function Menu.



A confirmation screen will be displayed to verify that you wish to erase codes. Select YES to erase the diagnostic results from the PCM or NO to cancel and retain the data.



If YES is selected, press the ENTER key and a message to "Turn ignition key ON, engine OFF" will display. Press the ENTER to continue. A "Command Sent" message is momentarily displayed before returning to the OBD II Function Menu.



NOTE: If you choose "No", a Command Cancelled message appears. "Hard" codes, are trouble codes that will remain in the vehicle's PCM memory until the condition is repaired.

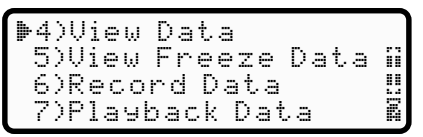
NOTE: If you get an Operating Error message, make sure the DLC adapter cable is securely attached, and the ignition key is ON, then try again. If the problem remains, refer to **Section 4: On-Line Help and Trouble-Shooting Tips**.

View Data

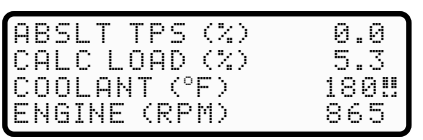
This function is used to view vehicle Parameter Identification Data (PID) in real time. Apart from **Read Codes**, **View Data** is the most helpful diagnostic function for determining the cause of a driveability problem. **View Data** is most often used for observing sensor data and the ON/OFF states of switches, solenoids and relays.

NOTE: **Multiple Responses to a PID Request -** Vehicles equipped with more than one on-board computer, for example a PCM and TCM (Transmission Control Module), can respond with multiple results to a certain parameter identification data (PID). In View Data, the OBD II Tester identifies the modules with their manufacturer assigned names such as $10 or $1F by blinking the module name near the end of the PID name. A PID that receives multiple responses, such as Engine (RPM), will display on two lines.

To view your vehicle's PIDs, select **View Data** from the OBD II Function Menu and press the ENTER key.



The OBD II System Tester will display the generic OBD II PIDs supported for the vehicle under test. Not all vehicles will have the same PIDs. Do not worry this is normal. The PIDs covered by the OBD II System Tester are defined in **Appendix B**.



Press the BACK key to display the OBD II Function Menu.

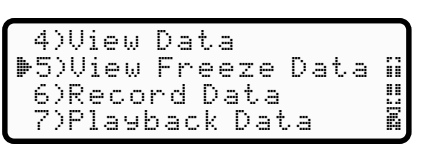
NOTE: If you get an Operating Error message, make sure the DLC adapter cable is securely attached and the ignition key is ON, then try again. If the problem remains, refer to **Section 4: On-Line Help and Trouble-Shooting Tips**.

View Freeze Data

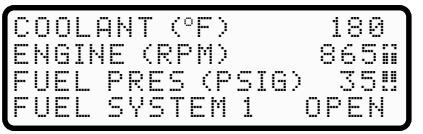
When an emission related fault is detected by the PCM the engine conditions are recorded and stored in memory. This recording is known as a freeze frame. The freeze frame is like a snapshot of the engine operating conditions at the time of a fault. Freeze frame data can only be overwritten by another fault with higher priority. The OBD II System Tester will allow you to look at the freeze frame data stored in the PCM's memory.

NOTE: If the Erase Codes function was performed, then no freeze frame data will be stored in the vehicle's memory.

To view the freeze frame data, select **View Freeze Data** from the OBD II Function Menu.



After selecting View Freeze Data, the OBD II System Tester establishes a communication link to the vehicle's PCM. All PIDs supported by the vehicle are displayed. Use the UP and DOWN arrow keys to scroll through all selected data parameters.



When done, press the BACK key to return to the OBD II Function Menu.

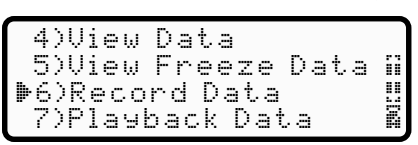
If no data exists, a message will display prompting the user to press any key to return to the OBD II Function Menu.

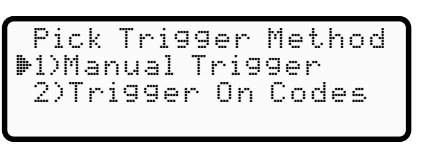
NOTE: If you get an Operating Error message, make sure the DLC adapter cable is securely attached and the ignition key is ON, then try again. If the problem remains, refer to **Section 4: On-Line Help and Trouble-Shooting Tips**.

Record Data

The **Record Data** function is used to record vehicle Parameter Identification Data (PIDs) while the vehicle is parked or being driven. This function is mainly used for diagnosing intermittent driveability problems that cannot be diagnosed by any other method. For example, if your vehicle sometimes loses power while going up steep hills, then you should start a recording as soon as your vehicle reaches the base of the hill. The OBD II System Tester records the supported PIDs in Frames at various time intervals. The first 5 Frames are recorded prior to the start time (0.0 seconds) Once started, Frames will be recorded for 8 to 35 seconds; the number of Frames depends on the vehicle's data rate and quantity of PIDs. The **Record Data** function allows you to diagnose an intermittent problem by analyzing data leading up to the problem, during the problem, and possibly after the problem, depending on problem duration. The PIDs covered by the OBD II System Tester are defined in **Appendix B.**

Select **Record Data** from the OBD II Function Menu and press the ENTER key. The Pick Trigger Method menu is displayed next. Select either **Manual Trigger** or **Trigger on Codes** then press the ENTER key.



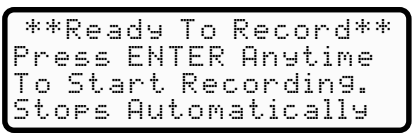


If the memory is full from a previous recording, it must be erased before recording more data. To erase memory and continue, select YES and press the ENTER key and then the Pick Trigger Method options will display. Otherwise, select NO and press the ENTER key to return to the OBD II Function Menu.

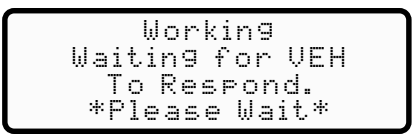
NOTE: If you get an Operating Error message, make sure the DLC cable is securely attached, and the ignition key is ON, then try again. If the problem persists, refer to **Section 4 of this Manual: On-Line Help and Trouble-Shooting Tips**.

The OBD II System Tester initializes by establishing the time intervals and then recording the first five Frames of data. When done, the system tester is ready to record data. To cancel this function, press the BACK key to return to the OBD II Function Menu.

If **Manual Trigger** was selected, then the OBD II System Tester will start recording when the ENTER key is pressed.



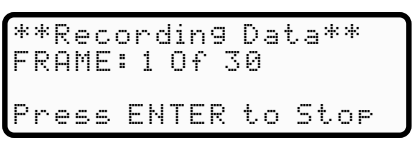
If **Trigger on Codes** was selected, then the tester will automatically start recording when a trouble code is set in the vehicle's on-board computer. Press the BACK key to cancel and return to the OBD II Function Menu.



WARNING! **Never operate the OBD II System Tester and drive your vehicle at the same time. Always have one person drive the vehicle while a helper operates the tester.**

The tester records for a time of varying duration. Remember, your recording will consist of 5 Frames of data prior to the start of the recording, and a number of Frames after with time intervals of 5 seconds or longer (depending on the number of PIDs). All applicable data parameters will be recorded for your vehicle.

When the recording is in progress, screens like the example below are displayed for the duration of the recording, displaying the Frame Number being recorded. You can record all the frames or press the ENTER key any time to stop recording.

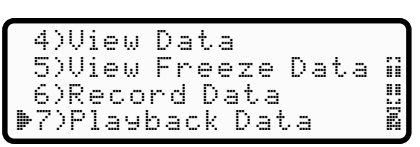


Next, You will be asked if you want to play back the recording now. If you answer "YES," then the Playback Data function will display, Answering "NO" returns you to the OBD II Function Menu.

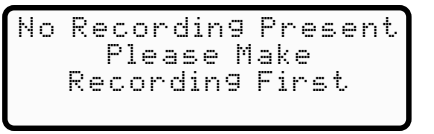
Playback Data

The **Playback Data** function is used to playback a recording. This function is very similar to **View Data**. The only difference is that **View Data** is a real time viewing of vehicle's PIDs, while **Playback Data** is a viewing of previously recorded ones.

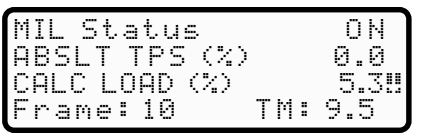
To view the PIDs recorded in the **Record Data** function, select **Playback Data** from the OBD II Function Menu.



If a recording does not exist in the OBD II System Tester's memory, then the message "No Recording Present, Please Make Recording First" will display. The **Record Data** function must be performed in order to play back the data. Press the BACK key to return to the OBD II OBD II Function Menu and select **Record Data** to make a recording.



If recorded data exists, the PIDs, Frame number and Time are displayed.



NOTE: Multiple-response PIDs (see **View Data)** are displayed with their module address in one frame and their measurement values in the next frame. Use the LEFT/RIGHT arrow key to alternate between the frames to identify the PIDs and their measurement values.

On the Playback Data screen, lines 1-3 are used to display the vehicle's PIDs. Use the UP/DOWN arrow keys to scroll through the PID list. The end of the list is reached when only the UP arrow is displayed at the right of line 3. The PID list scrolls line-by-line and will not wrap around to the beginning.

Use the LEFT/RIGHT arrow key to move through the Frame/Time index. Frame 0/ Time 0.0 is the trigger point; where the recording was started by either Manually Triggering or by Triggering On Codes. Frames -5 to -1 contain data prior to the trigger point.

NOTE: After reaching the last Frame/Time interval, the system tester will "wrap" to the first Frame/Time interval recorded. The **Frame/Time** display will change from a positive to the first negative number viewed. This is normal. The LEFT/ RIGHT arrow may be used to scroll through all time intervals.

A Frame is a "snapshot" of engine operating conditions at a certain time. The relationship between the Frame index and the Time index are based on the vehicle's on-board computer data rate and the number of PIDs being read. Remember, not all OBD II vehicles use the same data stream (communication protocol), data rates (baud) and the same number of PIDs. For this reason, not all vehicles will start and end with the same Frame number. The Frame number increases every time data is transmitted from the vehicle to the OBD II System Tester. The intervals when this occurs increases for slower data rates and larger PID lists. Frame 0 occurs at the trigger point, Time 0.0. Thus, negative and positive Frame numbers contain data before and after the trigger point, respectively.

NOTE: Some vehicles will wait 3 to 4 minutes after the driveability problem first occurs before storing a trouble code in the vehicle's on-board computer. If you selected "Trigger On Codes" when you made your recording, you might not see any drastic change in data parameters before and after the trigger point. In cases like this, it is better to manually trigger the start of the recording when the driveability symptom is first observed.

When you have finished playing back a recording, press the BACK key to return to the OBD II Function Menu.

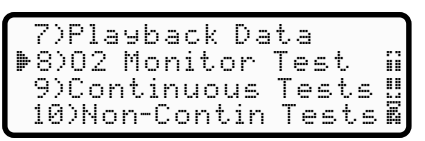
O2 Monitor Test

NOTE: This is NOT an on-demand test. The O2 sensors are not tested when this menu selection is made. The O2 sensors were tested at an earlier time when engine operating conditions were correct.

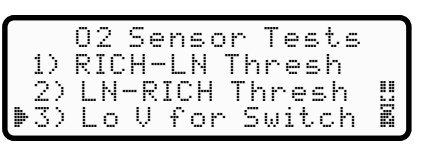
OBD II regulations require the vehicle to monitor and test the oxygen sensors. The **O2 Monitor Test** selection allows the technician to retrieve the completed test information on the oxygen sensors from the PCM. Information on the oxygen sensor monitors will be helpful in recognizing sensor or system problems related to fuel and emissions. The oxygen sensor test may include the following information:

- Rich to Lean sensor threshold voltage
- Lean to Rich sensor threshold voltage
- Low sensor voltage for switch time
- High sensor voltage for switch time
- Time between sensor transitions
- Rich to Lean sensor switch time
- Lean to Rich sensor switch time
- Minimum sensor voltage for test cycle
- Maximum sensor voltage for test cycle

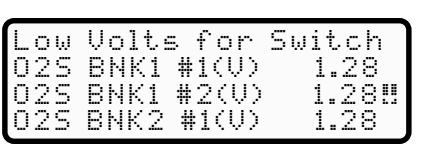
To view the oxygen sensor test results, select **O2 Monitor Test** from the OBD II Function Menu and press the ENTER key.



Once the **O2 Monitor Test** has been selected the recommended oxygen sensor tests list will be displayed. Select which test you want to review using the UP/DOWN arrow keys then press the ENTER key.



The OBD II System Tester will display selected information for all the vehicle's oxygen sensors. Listing the sensors together makes their data easier to compare. Tests not supported by the test vehicle will return three dashes after the sensor name.



NOTE: If you get an Operating Error message, make sure the DLC adapter cable is securely attached and the ignition key is ON, then try again. If the problem remains, refer to **Section 4: On-Line Help and Trouble-Shooting Tips**.

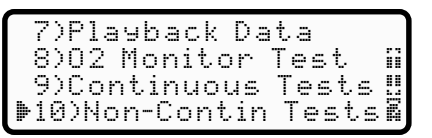
NOTE: Remember that some sensors are before the catalytic converter (precatalyst) and some are after (postcatalyst). The precatalyst and postcatalyst O2 sensors may act differently. Use the arrow keys to scroll through list if necessary.

Press the BACK key to return to the OBD II Function Menu.

Non-Continuous Tests

The purpose of this function is to obtain test results for emission-related powertrain components and systems that are not continuously tested. Certain tests are run only once per drive cycle when the vehicle is within proper operating conditions. This function reports the test results after a single drive cycle. The **Non-Continuous Test** function is useful after a vehicle repair or after clearing the PCM's diagnostic information. Test results reported by this function do not necessarily indicate a faulty component or system. Examples of systems not continuously monitored are catalyst and evaporative OBD II monitors.

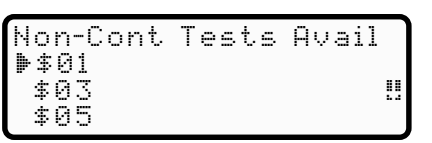
To view the Non-Continuous Monitors' test results, select **Non-Contin Test** from the OBD II Function Menu and press the ENTER key.



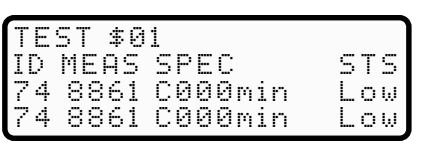
The OBD II System Tester will request the vehicle to transmit the test IDs for available non-continuous tests and display them in a list. The vehicle manufacturer is responsible to assign test IDs and component IDs to distinguish between the different systems and components. Refer to vehicle service manuals for test IDs and definitions.

NOTE: If you get an Operating Error message, make sure the DLC adapter cable is securely attached, and the ignition key is ON, then try again. If the problem remains, refer to **Section 4: On-Line Help and Trouble-Shooting Tips**.

Select a test ($xx) from the list then press the ENTER key. Selected test results are requested by the OBD II System Tester may also include test limits. Only one test limit is usually included in a responses message and displayed on the screen. The single limit could be either minimum or a maximum test limit. The OBD II System Tester will display the test ID, system or component ID the test measurement, specification and status.



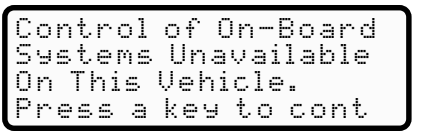
The first line of the display will show the Non-Continuous test that was selected using its ID number. The ID column displays the system or component ID number, refer to vehicle service manual for ID definitions and explanations. A column labeled MEAS will contain the measured data of the test. The test measurement data is displayed in hexadecimal number format (a system based on 16 digits where letters "A" through "F" represent the digits greater than 9. The specification values for the system tested are found in SPEC column and displayed in hexadecimal number format. The final column, STS (Status) information is calculated by the OBD II System Tester using the measurement and specification data. The status can be Low, High or OK, depending upon the measurements relationship to the specification.



Press the BACK key to return to the OBD II Function Menu.

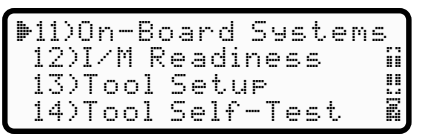
On-Board Systems

The purpose of this function is to allow the OBD II System Tester to control the operation of vehicle component, test or system. Certain manufacturers do not allow OBD II System Testers to control vehicle systems. A screen informing you that the vehicle does not support on boards systems will be displayed in these cases.



An example of a possible On-Board System application is a test mode that enables the conditions required to conduct an evaporative system leak test, but does not actually run the test.

To perform the **On-Board Systems** function, select **On-Board Systems** from the OBD II Function Menu then press the ENTER key.



A list of On-Board systems and components available for testing will be displayed if supported by the test vehicle. Select a test and press the ENTER key to activate the test. The OBD II System Tester informs you that the command was sent. The manufacturer is responsible to determine the criteria to automatically stop the test. Use the vehicle service manuals for more detailed information on test procedures.

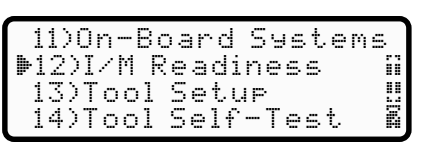
Press the BACK key to return to the OBD II Function Menu.

NOTE: If you get an Operating Error message, make sure the DLC adapter cable is securely attached, and the ignition key is ON, then try again. If the problem remains, refer to **Section 4: On-Line Help and Trouble-Shooting Tips**.

I/M Readiness

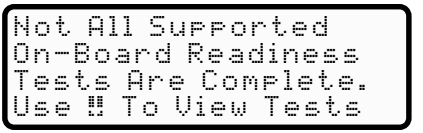
The purpose of the **I/M** (Inspection and Maintenance) **Readiness** function is to display the current status of emissions-related systems required by OBD II regulations. The operation of emission-related systems and components are verified using monitors. . The scan tool will display the condition of vehicle's OBD II Monitors. Monitors are used by the vehicle's PCM to check the proper operation of systems and components as well as identifying out-of-range values. The PCM may perform a special test on a system or component to complete its monitor. A vehicle may have to be operated under certain conditions for the monitor test to be performed. If the vehicle's PCM loses power or the **Erase Codes** function has been performed, then the status of the monitors will be reset.

To view the status of supported monitors, select **I/M Readiness** from the OBD II Function Menu and press the ENTER key.



NOTE: If you get an Operating Error message, make sure the DLC adapter cable is securely attached and the ignition key is ON, then try again. If the problem remains, refer to **Section 4: On-line Help and Trouble-Shooting Tips**.

A message will state whether the “On-Board Readiness Tests are Complete” or “Not All Supported On-Board Tests are Complete. Press the down arrow key to view the monitor list with their status. Use the vehicle service manuals for detailed information on required emissions-related monitors and their status.



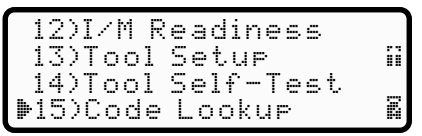
The monitor list consists of the OBD II monitor name followed by the monitor’s condition. A monitor that is not supported by the test vehicle will have “n/a” after it. A monitor that has been completed will be followed by “OK”. If a monitor has not been completed “inc” will be displayed after the name. Use the UP/DOWN arrow keys to scroll through the list.

Press the BACK key to return to the OBD II Function Menu.

Section 3: Diagnostic Trouble Code Lookup

Code Lookup is a built-in OBD II Generic Diagnostic Trouble Code (DTC) database. The database does not include manufacturer specific DTC definitions, only generic.

To look up code definitions, select **Code Lookup** from either the MAIN MENU or the OBD II Function Menu, then press the ENTER key.



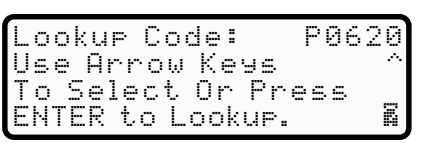
The OBD II System Tester will display the Code Lookup screen. When entering codes it is only necessary to enter the last three numbers. The first two characters (P0) of the DTC are set for OBD II Powertrain.

When the Code Lookup screen is first displayed, a P0000 is displayed in the columns that mark the code digit locations. Underneath the third digit there is a "^" symbol. The "^" symbol is used as a cursor to identify the digit that will change when the UP/DOWN arrow keys are pressed to increase/decrease the digit. The cursor starts at the third digit because the fourth and fifth are fixed (P0xxx).

- **Entering Third Digit (P0x00)**

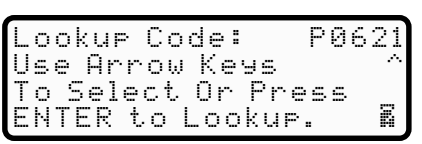
Set the third digit by using the UP and DOWN arrow keys to scroll the third digit characters until the desired character is displayed.

- **Entering Second Digit (P00x0)**



To enter the second code digit, press the LEFT/RIGHT arrow key to move the cursor "^" one column to the right. Use the UP/DOWN arrow keys to increase/decrease the digit.

- **Entering First Digit (P000x)**



To enter the first or final digit, press the LEFT/RIGHT arrow key to move the cursor "^" to the last column on the right. Use the UP/DOWN arrow keys to increase/decrease the digit.

- **Editing A Code Number**

If you make a mistake on any of the digits, simply use the LEFT/ RIGHT arrow key to move the cursor "^" underneath the digit you wish to change. Then use the UP and DOWN arrow keys to change the digit's value.

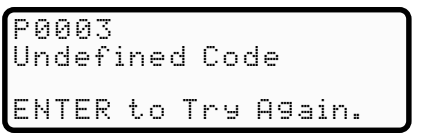
- **Lookup the Code's Definition**

Press the ENTER key to display the code's definition. When done, press the BACK key to return to the Code Lookup Menu.

- **Scrolling the Code Definitions**

Once a code definition screen is displayed, you may use the UP/DOWN arrow keys to scroll through the library of code definitions.

If the trouble code number does not exist a No Code Definition Found message will be displayed. Press the ENTER key to return to the Code Lookup screen to enter another trouble code number.



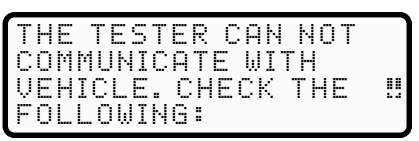
Press the BACK key to return to the Code Lookup screen so a different trouble code number can be looked up. Press the BACK key again to return to the OBD II Function Menu.

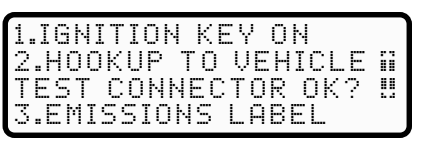
Section 4: On-Line Help and Troubleshooting Tips

4-1 How to Use On-Line Help

The tester contains On-Line Help for specific screens, functions, and error messages. When the On-Line Help symbol (▒) appears in the lower right-hand corner of the display, On-Line Help is available.

To enter On-Line Help, press the HELP key. All Help screens are CAPITAL LETTERS. This is reminder that you are viewing On-Line Help and not screens associated with a function. Some On-Line Help messages are longer than one screen. Use the UP and DOWN arrow keys to scroll through a series of On-Line Help screens. For the screen example above, the help message would look like screens below:





To exit Help and return to the screen you where, press the BACK key.

4-2 Tool Problems

There may be times when your tester does not seem to be communicating with the vehicle. Since the tester has built-in diagnostics, it is easy to isolate a problem with the tester. There will be two basic types of problems that you will deal with: vehicle problems and tool problems. Both might affect your test. Remember, the OBD II System Tester always goes through a SELF CHECK each time you power the unit up. Use the troubleshooting tips below to help diagnose OBD II System Tester problems before calling Actron's Technical Support line:

1. The OBD II System Tester will not power up:

- Check the OBD II connector for power. If not, check the fuse if applicable.
- Verify vehicle's battery is 8 volts or higher.
- Unplug and plug back in the Data Link Connector (DLC) to verify the connector is properly seated to the vehicle connector.

2. Tool will not "Link" to the vehicle computer:

- Ignition key is ON.
- Unplug the DLC adapter from the vehicle and plug it back to verify connection.

3. Your Keyboard does not function properly:

- Perform the Keyboard Test by entering the Self-Test and select the Keyboard Test function.
- If the keyboard test shows nothing and you still experience the problem, then call Actron's technical support personnel at 1-800-253-9880.

4. One or more modules drops the communication link:

When the OBD II System Tester initially links to the vehicle, it builds a list of all OBD II compliant computer modules. If in the course scanning the vehicle, a module drops the link, a message will display.

Answering YES will continue operation without the lost module. Answering NO try to restore the communication links to get all modules back to an active status.

4-3 Vehicle Problems

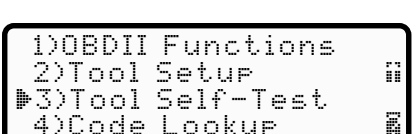
If your tester is having difficulty "linking" with the vehicle computer, be sure that you have double checked the DLC connection. The problem may be with the vehicle's electrical system or with the vehicle computer itself. Check the following:

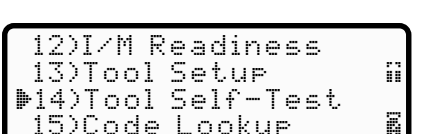
- Verify that the vehicle's fuse is OK.
- Make sure the vehicle's battery exhibits at least 8.0 volts (V), the minimum voltage to power the OBD II System Tester.
- Verify the ignition key is ON and not in the accessories (ACC.) position.
- Check the vehicle's on-board computer for a blown PCM fuse. The PCM fuse is located on the fuse block in the passenger compartment. If the PCM fuse is blown, the vehicle's on-board computer cannot transmit data.
- Check to be sure your vehicle's calibration is OBD II compatible.
- Make sure the vehicle's on-board computer has a good ground. If your vehicle's on-board computer has a ground going directly to the computer's case, then clean up this connection and apply a conductive grease to the mating surfaces.
- As a last resort, the vehicle's on-board computer or calibration PROM may be defective. Check vehicle service manual to determine correct computer tests for your particular vehicle.

4-4 OBD II System Tester Self-Tests

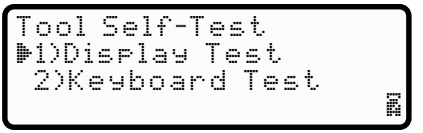
OBD II System Tester Self-Tests are used to test the operation of the OBD II System Tester's display, keyboard, and internal memory. The tool's Self-Tests menu can be accessed from the MAIN MENU, when the tester is initially powered up, or from the OBD II Function Menu.

From either menu, use the UP/DOWN arrow keys to select the **Tool Self-Tests** option, then press the ENTER key.



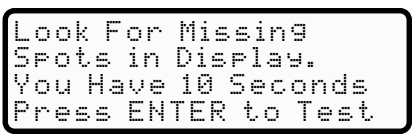


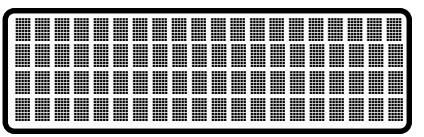
The Tool Self-Test menu will display. Two tests can be selected, the **Display Test** and the **Keyboard Test**. Use the UP/DOWN arrow keys to move the cursor to option of your choice, then press the ENTER key.



Display Test

After you have selected **Display Test** as your choice, a screen detailing the test is displayed. The Display Test will fill every pixel of the tester's LCD display with a solid black character. Look for pixels that are not black. Press the BACK key to exit to the Tool Self-Test menu. Press the BACK key again to display the OBD II Function Menu.

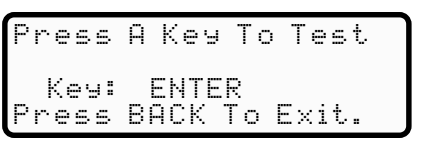




Keyboard Test

The **Keyboard Test** is used to check the functionality of the OBD II System Tester's keypad. Select **Keyboard Test** from the Tool Self-Test menu then press the ENTER key. The Keyboard Test screen with instructions is displayed:

Each time you press a key, check OBD II System Tester display. The key name should appear. For example, if you press the UP arrow, the screen will display "Key: UP ARROW." If the button name is not displayed, the key is not working.



The only exception is the BACK key. When the BACK key is pressed, the OBD II System Tester returns to the Tool Self-Test Menu. If you are not returned to the Tool Self-Test Menu, then the BACK key is not working

Appendix A: Vehicle Computer Basics

Basics of Computer-Controlled Vehicles

This section explains the engine computer control system, the types of sensors and how the computer controls engine fuel delivery, idle speed and timing. Additional information may be found in technical support books at your local library or auto parts store. The more you know about the computer system, the better you can diagnose vehicle computer problems.

Computer controls were originally installed on vehicles to meet federal government regulations for lower emissions levels and improved fuel economy. This began in the early 1980's when basic mechanical systems were no longer able to accurately control key engine parameters. A computer could be programmed to control the engine under various operating conditions, making the engine more reliable. While these early systems were very limited in the scope of their control, providing only 10-14 trouble codes, they did help guide the vehicle repair process.

Today, computer controls have made cars and trucks faster, cleaner, and more efficient than ever before.

What the computer controls:

The main control areas of the vehicle computer are fuel delivery, idle speed, spark advance, and emissions controls. Some on-board computers may also control the transmission, brakes, and suspension systems as well.

What has not changed?

A computer-controlled engine is very similar to the older, non-computerized engine. It is still an internal combustion engine with pistons, spark plugs, valves, and camshaft(s). The ignition, charging, starting, and exhaust systems are very similar as well. You test and repair these systems just as before. The technical manuals for these components show you how to perform the tests. Additionally, compression gauges, vacuum pumps, engine analyzers, and timing lights will continue to be used.

The Engine Computer Control system

The vehicle's on-board computer, or Powertrain Control Module (PCM), is the "heart" of the system. It is sealed in a metal box and connected to the rest of the engine by a wiring harness. The PCM is located, in most cases, in the passenger compartment, behind the dashboard or in the "kick panel" position, although some manufacturers locate the computer control module in the engine compartment area. Most PCMs can withstand a lot of vibration and are built to live in a rugged environment.

The PCM is programmed by the factory. The program is a complex list of lookup tables and instructions telling the computer how to control the engine based on various driving conditions. To do its job, the computer uses sensors to know what is happening and then provide instructions back to a network of switches and actuators throughout the vehicle.

Sensors give the computer information

Sensors are devices which measure operating conditions and translate them into signals the computer can understand. Some examples of sensors: thermistors (for temperature readings), potentiometers (like a throttle position sensor), and signal generators (such as an 02 sensor).

The network of sensors has the job of converting information the computer needs into electrical signals the computer can understand. Signals running from sensors to the PCM are referred to as "inputs." Sensors monitor the key parameters shown in the table.

Engine Temperature
Throttle position
Incoming Air Temperature
Air Fuel Ratio, in percentage (%)
Intake Manifold Vacuum
Engine RPM
Volume of Incoming air

NOTE: Not all engines use every sensor listed.

Relays and Actuators

Relays and Actuators are electric devices energized by the computer to allow commands to perform a specific function. Relays can be called switches (such as the coolant fan switch). Actuators might include solenoids (such as fuel injector valves) and small motors (such as the Idle Speed Control). Not all of the computer's outgoing signals are routed to relays and actuators. Sometimes information is sent to other system computers like transmission, brakes, ignition modules, and trip computers. These signals are also called "outputs."

How the computer controls fuel delivery

Engine operation and emissions performance depend upon precise fuel delivery and ignition control. Early computer systems controlled fuel by electronically adjusting the carburetor metering and jet systems. Soon, however, this was replaced by the more precise fuel delivery of fuel injection.

In an electronically carbureted system, the computer simply controls fuel flow based on how far the throttle is opened by the driver. The computer "knows" how much air can flow through the carburetor at various throttle openings, and adds the appropriate amount of fuel to the mixture at the carburetor.

Fuel injection is some what more sophisticated in the way it delivers fuel. The computer still adds an appropriate amount of fuel to the entering air, but now it uses fuel injectors (either in a throttle body or at each intake port). Fuel injectors are far more precise than carburetor jets, and create a much finer fuel "mist" for better combustion and increased efficiency. In addition, most fuel injection systems have ways of measuring exactly how much air is entering the engine, and can calculate the proper air/fuel ratio using lookup tables. Computers no longer have to "estimate" how much air the engine is using.

In many modern systems, the computer also uses information provided by sensors to give it an idea of how well it is doing its job, and how to do it better. Sensors can tell the computer how warm the engine is, how rich or lean the fuel mixture is, and whether accessories (like the air conditioner) are running. This feedback information allows the computer to "fine tune" the air/fuel mixture, keeping the engine operating at its peak.

What the Computer needs to know:

- **Engine operating condition.** Sensors used are: coolant temperature, throttle position, manifold pressure (vacuum), air flow and RPM.
- **Air intake.** Sensors used are: mass air flow, manifold absolute pressure, manifold air temperature and RPM.
- **Air/fuel mixture status.** Sensors used are: oxygen sensor(s).

Open and Closed Loop Modes:

Open or closed loop operation refers to the way the computer is deciding how much fuel to add to the air entering the engine. During cold start and other low temperature situations, the computer operates in **open loop** mode. This means that it is relying on a set of internal calculations and data tables to decide how much fuel to add to the incoming air. It uses sensors such as the coolant temperature sensor (CTS), the throttle position sensor (TPS), and the manifold absolute pressure sensor (MAP) to determine optimum mixtures. The important difference here is that it *does not* check to see if the mixtures are correct, leaving the computer adjustment loop **open**.

In **closed loop** mode, the computer still decides how much fuel to add by using the sensors listed above, and by looking up the appropriate numbers on a data table. However, it now checks itself to determine whether the fuel mixture is correct. It is able to check itself by using the information provided by the oxygen sensor(s) (O2S) in the exhaust manifold. The oxygen sensors will tell the computer if the engine is running rich or lean, and the computer can take steps to correct the situation. In this way, the computer **closes** the adjustment loop by checking itself and making necessary corrections. It should be noted that the O2 sensors must be at a very high operating temperature (approximately 650° F) before they will begin to feed information back to the computer. This is why open loop mode is necessary—to give the O2 sensors time to warm up to operating temperature.

As long as the engine and O2 and Coolant Temperature Sensors are at operating temperature, the computer can operate in the closed loop mode. Closed loop mode constantly corrects to obtain an air/fuel mixture at the ideal 14.7:1. But in stop and go cycles, the O2 sensor may in fact cool down enough that the computer will need to rely on a set of internal parameters and go into open loop mode again. In some cases, this may also happen during extended periods of idling. Many newer vehicles now use heated O2 (HO2S) sensors to prevent this condition.

In many vehicles, the computer controls other systems related to open and closed loop modes, including idle speed, electronic spark control, exhaust gas recirculation, and transmission torque converter clutches. In open loop mode, some of these systems will be adjusted to speed the warming of the engine and get the computer into closed loop mode as quickly as possible.

OBD II

In 1994, manufacturers began equipping vehicles with a new class of computer technology which puts more processing power under your dash than ever before. It is called On-Board Diagnostics, Second Generation, or OBD II. It is required on all vehicles sold in the US beginning January 1, 1996 (though most domestic manufacturers introduced it earlier than required), and offers increased system monitoring and diagnostic information. This new system stores a library of more than 650 general trouble codes and another approximately 400 manufacturer-specific codes, all of which you can access with the OBD II System Tester. These codes cover Body Systems (B-Codes), Chassis Systems (C-Codes), Communications Codes (U-Codes), and Power Train Systems (P-Codes). Now, basic terms are standardized and all generic codes will share a common format and terminology that the manufacturers and the Society of Automotive Engineers (SAE) designed. You will be glad to know that as your vehicle gets smarter, it will be easier for you to keep track of what is going on under the hood.

About Diagnostic Trouble Codes (DTCs)

Where do they come from and what are they for?

Engine computers can *find* problems

The computer systems in today's vehicles do more than control engine operations—they can help you find problems, too! Special testing abilities are permanently programmed into the computer by engineers. These tests check the components connected to the computer which are used for (typically): fuel delivery, idle speed control, spark timing, emission systems, and transmission shifting. Mechanics have used these tests for years. Now you can do the same thing by using your Actron OBD II System Tester!

Engine computers perform special tests

The engine computer runs the special tests, depending on the manufacturer, engine, model year, etc. There is no "universal" test that is the same for all vehicles. The tests examine INPUTS (electrical signals going INTO the computer) and OUTPUTS (electrical signals coming OUT of the computer), as well as internal calculations made by the computer. Input signals which have "incorrect" values, or output circuits which do not operate properly are noted by the test program and the results are stored in the computer's memory. These tests are important. The computer cannot control the engine properly if it has incorrect input information or faulty output circuits.

Code numbers reveal test results

The test results are stored by using code numbers, usually called "diagnostic trouble codes" or "DTCs." For example, a code P0122 might mean "throttle position sensor signal voltage is too low." Generic code meanings are a part of your OBD II System Tester's software—all you have to do is look them up! Manufacturer specific DTCs will require the use of a vehicle service manual. See page **2** for more information on ordering service manuals.

Read Trouble Codes with the OBD II System Tester

You can obtain DTCs from the engine computer by using the OBD II System Tester. You can also monitor the operation of systems throughout the vehicle, helping to pinpoint the system where there may be a problem. Once you have read the DTCs, you can either:

- Have your vehicle professionally serviced.

  or

- Repair the vehicle yourself using the diagnostic trouble codes to help locate the source of the problem.

Diagnostic Trouble Codes and Diagnostics help you fix the problem

To find the cause of the problem yourself, you need to perform special test procedures called "diagnostics." These procedures are in the vehicle's service manual. There are many possible causes for any problem. For example, suppose you turned on a wall switch in your home and the ceiling light did not turn on. Is it a bad bulb or light socket? Are there problems with the wiring or wall switch? Maybe there is no power coming into the house! As you can see, there are many possible causes. The diagnostics are written for servicing a particular trouble code take into account all the possibilities. If you follow these procedures, you should be able to find the problem causing the code and fix it yourself.

KAL makes it easy to fix computer-controlled vehicles

Using the KAL OBD II System Tester to obtain trouble codes is fast and easy. Trouble codes give you valuable knowledge - whether you go for professional service or do it yourself. Now that you know what trouble codes are and where they come from, you are well on your way to fixing today's computer-controlled vehicles!

When to Read Codes

Many vehicles have a "Malfunction Indicator Lamp" or MIL, which has been referred to as a "Check Engine" light in the past. With the advent of OBD II, all engine trouble lights are now called "Malfunction Indicator Lamps" or MIL.

Use the Malfunction Indicator Lamp to tell you when trouble codes have been stored in memory

About the Malfunction Indicator Lamp

- **Malfunction Indicator Lamp: normal operation**

  The engine computer turns the Malfunction Indicator Lamp on and off as needed. This dashboard message is either amber or red and labeled:

  "Check Engine", "Service Engine Soon", "Service Engine Now", or marked with a small engine picture or diagram

  The Malfunction Indicator Lamp is normally OFF when the engine is RUNNING.

NOTE: The Malfunction Indicator Lamp will turn on when the ignition key is in ON position, but the engine is OFF prior to starting the vehicle. This is a normal test of all the dashboard message lights.

- **Malfunction Indicator Lamp: problem spotted**

  If the Malfunction Indicator Lamp does not come on, you may have an electrical problem which needs repair. Refer to the "Diagnostic Circuit Check" steps in the "Basic Diagnostic Procedures" section of your vehicle service manual.

- **Malfunction Indicator Lamp: intermittent problem**

  When the light remains ON after the engine is RUNNING, the computer sees a problem that does not go away (known as a "current" failure). The light will stay on as long as the problem is present. A trouble code is stored in computer memory (a "history" or "memory" code). Use the OBD II System Tester at the earliest convenient time to obtain codes.

  When the light comes ON, then goes OFF while the engine is RUNNING, the computer saw a problem, but the problem went away (known as an "intermittent" failure). A trouble code is stored in computer memory (a "history" or "memory" code). The light went out because the problem went away, but the code stays in memory. Use the OBD II System Tester at the earliest convenient time to obtain codes.

NOTE: The computer will automatically erase these codes after repeated restarts if the problem does not return.

- **Poorly running engine, No Malfunction Indicator Lamp**

  Most likely, this condition is not due to computer system failures, but reading codes can still be useful as part of a basic troubleshooting procedure. Check wiring and bulb for “Check Engine” light failures. Refer to vehicle service manual for additional diagnostic information.

  On OBD II vehicles, the Malfunction Indicator Lamp also signals an emissions-control related failure. The vehicle may not run any differently, but the OBD II system is designed to note very small changes in the engine’s operation which could lead to emissions damage or failure.

Appendix B: Data Parameter List & Definitions

All data parameters or parameter identification data (PID) listed in Appendix B were verified on actual vehicles to guarantee their accuracy. Definitions used to describe all PIDs were obtained from reliable sources and are accurate at the time of printing. It is possible that some newer vehicles may contain data different from that listed in Appendix B. Always refer to a vehicle service manual for vehicle-specific PIDs.

Data Parameter List Format

The data parameter list is organized in alphabetical order — the same way as on the OBD II System Tester. For all data parameters, Appendix B will define the data parameter, tell what type of reading it is (i.e. input, output, or calculated) and give some helpful tips on what to do if the reading is unsatisfactory. Remember to always refer to a vehicle service manual for detailed diagnostic procedures for troubleshooting incorrect data parameter readings.

Types of Data Parameters

INPUT: These data parameters are obtained from sensor circuit outputs. Sensor circuit outputs are inputs to the vehicle's PCM. For example, if the Oxygen Sensor circuit was generating a 400mV signal, then the OBD II System Tester would display O2S (v) 0.40.

OUTPUT: These data parameters are outputs or commands that come directly from the PCM. For example; the ignition spark advance is controlled by PCM, on most vehicles, monitoring this PID shows the spark output from the PCM. The OBD II System Tester would display IGN ADV(°) 10.

CALCULATED VALUE: These data parameters are calculated after analyzing various inputs inputs to the vehicle's PCM. For example, the engine load. The PCM calculates this from sensor inputs and displays it in a percentage.

PCM VALUE: Is information that is stored in the PCM's memory and determined to be useful to the service technician. An example of this is the TROUBLE CODE value, the DTC that caused a freeze frame capture.

NOTE: Several different causes can have the same parameter indication. For information on diagnostics consult the vehicle service manuals .

DATA PARAMETER LIST

ABSLT TPS (%) (Absolute Throttle Position Sensor - PCM input)

Display: **0 - 100%**

This PID represents how far the throttle plate has been opened by the driver. The TPS produces a voltage signal proportional to the throttle position. This voltage is converted to a percentage by the PCM. A low voltage reading calculates to 0%, closed throttle while a high voltage which equates to 100% reading indicates fully opened throttle.

CALC LOAD (%) (Calculated Engine Load - PCM calculated value)

Display: **0 - 100%**

The percentage reading of this PID indicates the amount of load on the engine. The higher the reading the greater the load on the engine.

The PCM uses engine load to help determine correct air/fuel ratios, spark advance, idle speed, and emission device operation. Higher engine load conditions will cause the PCM to increase the injector pulse widths.

COOLANT (°F) (Engine Coolant Temperature - PCM input)
COOLANT (°C)

Display: Numeric temperature value: ***-40*** *to* ***419*** (°F) or **-40** to **215** (°C).

This is a measure of the engine's coolant temperature. A voltage signal is sent to the PCM from a sensor that is in contact with the coolant. The voltage signal increases as temperature increases. The PCM converts this voltage reading to a degree measurement.

The PCM uses coolant temperature to help determine correct air/fuel ratios, spark advance, idle speed, and emission device operation depending on the engine's temperature. Coolant temperature is also used to decide whether to run the engine in open or closed loop mode.

The coolant parameter may be displayed in English or Metric, depending upon the tool setup.

ENGINE (RPM) (Engine Speed in Revolutions Per Minute - PCM input)

Display: **0** to (**maximum RPM**)

This signal is sent from a triggering device (usually on the crankshaft or in the distributor) to the PCM indicating engine speed.

Engine speed measurements can be used in the calculation on fuel injector pulse widths and other powertrain operating strategies.

FUEL PRES (PSIG) (Fuel Pressure - PCM input)
FUEL PRES (KPA)

Display: **0 - 110** (psig) or **0 - 765** (kPa)

Fuel pressure is a measurement of the fuel rail (regulated) pressure. A sensor sends the PCM an electrical signal which is converted to psig or kPa depending upon English or Metric tool setup.

FUEL SYSTEM 1 (Fuel System Bank 1/2 - PCM calculated value)
FUEL SYSTEM 2

Display: **OPEN, CLSD, OPEN1, OPEN2, CLSD1**

The fuel system PIDs show the loop status of the fuel system banks. If the vehicle calibration only uses one loop status for the fuel system the FUEL SYSTEM 1 PID will be used.

There are four states the fuel system can be running in:

1. **OPEN** PCM is operating in the Open Loop control strategy. The vehicle has not yet satisfied conditions for the PCM to go closed loop.
2. **CLSD** PCM currently functioning in Closed loop control strategy, using O2 sensor(s) as feedback for fuel control
3. **OPEN1** Open Loop control strategy is being used by the PCM due to driving conditions. Driving conditions that may cause this to happen are power enrichment and deceleration enrichment.
4. **OPEN2** The PCM is operating in Open Loop control strategy due to detected system fault. Certain actuator or sensor faults will cause the PCM to use an open loop strategy.
5. **CLSD1** Closed Loop control is current storage being used by the PCM, but a fault with at least one O2 sensor has been detected. The control system may be using single O2 for fuel control calculations.

IAT TEMP (°C) (Intake Air Temperature - PCM input)

IAT TEMP (°F)

Display: Numeric temperature value: **-40** to ***419*** (°F) or **-40** to **215** (°C)

This is a measure of intake air temperature to determine correct air/fuel ratios and spark timing operations. The voltage from a thermistor in the intake manifold is sent to the PCM. The PCM converts this voltage signal to a numerical temperature value.

IGN ADV (DEG) (Ignition Advance - PCM output)

Display:**-64** to **+63.5**

This is a signal from the PCM to the Ignition Control Module (ICM) telling it how much spark advance to add to base engine timing (expressed in crankshaft degrees).

The ICM sends a base timing signal taken from a sensor (either in the distributor or on the crankshaft) and sends it to the PCM. The PCM decides how much advance to add to the signal based on operating conditions, then sends the signal back to the ignition to fire the spark plugs. Depending on the vehicle, this signal may mean one of two things. In some systems, the display shows exact timing (base timing plus PCM-directed advance). In other systems, the display will show only the amount of advance the PCM is adding to the base timing supplied by the ICM.

LT FL TRM 1(%) (Long-Term Fuel Trim Bank 1/2 - PCM calculated value)

LT FL TRM 2(%)

Display: **Positive** (rich fuel trim) or **Negative** (lean fuel trim) Percentage

This value represents the long-term correction to the fuel control calculations. The Long Term Fuel Trim is an indication of the PCM's commanded fuel mixture adjustments. The number can range from -100% to +100%, with the midpoint being 0. A positive reading indicates that the PCM has commanded a long-term rich mixture correction in response to a lean operating condition. A negative reading indicates that the PCM has commanded a long-term lean mixture in response to a rich operating condition. Fuel Trim is used to adjust the fuel injector pulse width calculations.

Long-Term Fuel Trim corrections usually operate in closed loop mode only. In open loop mode, the number typically defaults to a fixed value of 0. Depending on the vehicle, the Long Term Fuel Trim values may be reset to the default of 0 every time the engine is shut off, or corrected values may be retained in computer memory. Retained values are reapplied when the vehicle is restarted.

Some PCMs are able to control the left and right cylinder bank Fuel Trim individually, shown by the LT FL TRM 1 & 2 parameters. LT FL TRM 1 is use in injection Bank 1 fuel correction and LT FL TRM 2 for Bank 2.

MAF (LB/M) (Mass-Air Flow rate - PCM calculated value)

MAF (GM/S)

Display: **0 - 86.5** lb/min or **0** - **655.35** gm/s

A signal sent from the Mass Air Flow Sensor to the PCM indicating the mass of the air entering the engine, as a voltage reading. This voltage reading may be used with other engine information obtained to calculate the Mass Air Flow Rate. This information is used to determine the correct injector pulsewidths to maintain proper air/fuel ratio. MAF readings should be low at idle and increase as the throttle opens.
NOTE: Some engines may display an MAF reading even with the engine off.

Most MAF Sensor operates on a hot film or wire in the air intake between the air filter and the throttle body. The wire is heated to a preset temperature. As incoming air cools the wire or film, the PCM measures the voltage required to maintain the preset temperature. The PCM translates this voltage reading into airflow measurements based on internal lookup tables.

MAP ("HG) (Manifold Absolute Pressure - PCM input)

MAP (KPA)

Display: numeric **inches of Mercury ("HG)** or **kiloPascals (KPA)**

The Manifold Absolute Pressure sensor converts intake manifold vacuum or pressure to an electric signal and sends it to the PCM. The PCM converts this signal into a numerical pressure value expressed in kiloPascals (kPa) or inches of Mercury ("Hg). The MAP reading will vary with engine speed and load. Vehicles should show a MAP Sensor reading even if the engine is not running (indicating atmospheric pressure in the manifold).

MIL STATUS (Malfunction Indicator Lamp Status - PCM output)

Display: **ON** or **OFF**

This PID shows the state that the PCM is commanding of Malfunction Indicator Lamp. ON indicates that the PCM is requesting that the MIL to be ON (illuminated). If the MIL Status is ON and the Malfunction Indicator Lamp is not on there is a problem in MIL circuit. A MIL status of OFF show the request for the MIL to be off.

The PCM commands the MIL on when it wants to show the operator there is a problem.

OBD2 STATUS (OBD II Status - PCM value)

Display: **CAL, FED, CA/FED, or OBD 1**

This data parameter shows you the OBD requirement to which the vehicle was designed.

CAL - Indicates that the test vehicle meets California OBD II requirements

FED - Informs you the test vehicle meets Federal OBD II requirements

CA/FED - California and Federal OBD II requirements are meet when this status is displayed.

OBD 1 - A display of OBD 1 informs you that the test vehicle does not meet OBD II requirements

O2 BNK1 #1 (V) (Oxygen Sensor Bank 1 Sensor 1 - PCM input)

O2 BNK1 #1 (%)

Display: **0.00 - 1.00 volts** or **-100 - +100 %**

The Oxygen Sensor sends a signal to the PCM indicating whether the engine is running rich or lean. The Oxygen Sensor generates a voltage signal ranging from 0 to approximately 1000 mV (1 volt). A lean signal is .450V or less. A rich signal is .450V or higher.

In normal operation, the Oxygen Sensor signal should be constantly switching between rich and lean values. **NOTE:** The Oxygen Sensor must be above 500° and the PCM must be in closed loop mode before the PCM will respond to the sensor signals. Because of this most oxygen sensors are now heated to speed closed loop operation and improve cold-start emissions and efficiency

The Bank (BNK) in the PID name refers to the exhaust manifold bank if more than one is used on a vehicle. The Number (#) indicates the oxygen sensor location in the exhaust system, 1 usually meaning before the catalytic convert and 2 after. Refer to the vehicle's service manual for correct identification.

PTO STATUS (Power Take-Off - PCM input)

Display: **Active - InAct**

This input allows the PCM keep track of the Power Take-Off status. Either the PTO is engaged/active or disengaged/ inactive.

SECONDARY AIR (Secondary Air System Status - PCM output)

Display: **UPSTR, DNSTR, ATMSP**

The secondary air injection system on newer vehicles is controlled by the PCM. The PCM use actuators to control this pollution control system. Secondary air can be added the exhaust system near the exhaust manifold (before any catalytic converts), at the catalytic convert(s) or not at all.

UPSTR - UP STREAM the PCM is demanding that secondary air be added at the exhaust manifolds

DNSTR - DOWN STREAM the PCM is demanding secondary air to added at the catalytic converter

ATMSP - ATMOSPHERE the PCM is demanding no secondary air to be added, because the air pump can not be turned off the air will simply be dumped to the outside air (Atmosphere).

ST FL TRM 1 (%) (Short-term Fuel Trim Bank 1/2 - PCM calculated value)

ST FL TRM 2 (%)

Display: **Positive** (rich fuel trim) or **Negative** (lean fuel trim) Percentage

This value represents the short-term correction of the fuel metering on a fuel-injected engine. The ST Trim indicates whether the PCM is commanding a rich or lean fuel mixture for the engine. The SF Trim number can range from -100% to +100%, with the midpoint being 0. A positive ST Trim reading indicates that the PCM has commanded a short-term rich mixture correction in response to a lean operating condition. A negative ST Trim reading indicates that the PCM has commanded a short-term lean mixture in response to a rich operating condition. Fuel Trim is adjusted by varying the fuel injector pulse widths.

Short-term Fuel Trim corrections operate only in closed loop mode. In open loop mode, the number usually defaults to a 0 (fixed value). Depending on the vehicle, the ST Trim values may be reset to the default of 0 every time the engine is shut off, or corrected values may be retained in computer memory. Retained values are reapplied when the vehicle is restarted. All values are erased when the battery is disconnected.

Some PCMs are able to control the left and right cylinder bank Fuel Trim individually, shown by the ST TRIM1 & 2 parameters.

TROUBLE CODE (Trouble Code - PCM value)

Display: any code possible of causing a freeze frame capture

The Trouble Code parameter will give you the diagnostic trouble code that caused a freeze frame capture. This information is helpful in diagnosing the cause of a driveability. If no freeze frame data has been captured this PID will be zero.

VEH SPEED (KPH) (Vehicle Speed Sensor - PCM input)

VEH SPEED (MPH)

Display: **numeric speed indication** (kph or mph)

This is a value calculated by the PCM using electric pulses from the Vehicle Speed Sensor to determine actual vehicle speed, expressed in either miles per hour (mph) or kilometers per hour (kph). The PCM uses the vehicle speed measurements primarily for torque converter clutch engagement and electronic cruise control systems. Vehicles not equipped with automatic transmissions or cruise control may not have a Vehicle Speed Sensor. The OBD II System Tester may display a Vehicle Speed value, but it should always be 0.

Appendix C: Glossary of Terms

A/C:
Air Conditioning.

A/F:
Air/Fuel ratio. This refers to the proportion of air and fuel delivered to the cylinder for combustion. For example, if you have 14 times more air than fuel (by weight) then the A/F ratio is 14:1 (read as "fourteen to one"). The ideal operating A/F ratio in an automotive application is 14.7:1.

AC Clutch Relay:
The PCM uses this relay to energize the A/C clutch, turning the A/C system on or off.

AC Pressure Sensor:
This sensor is connected to the A/C refrigerant line. It measures refrigerant pressure and sends a voltage signal to the PCM. The PCM will turn off the A/C system (by de-energizing the A/C Clutch Relay) to prevent compressor damage if the pressure is too high or low.

AC Pressure Switch:
This is a mechanical switch connected to the A/C refrigerant line. The switch is activated (sending a signal to the PCM) when the A/C refrigerant pressure becomes too low. The PCM will turn off the A/C system (by de-energizing the A/C Clutch Relay) to prevent compressor damage. Some vehicles have a second switch activated when the refrigerant pressure is too high.

Actuator:
Devices that are powered by the PCM to control things. Actuator types include relays, solenoids, and motors. Actuators allow the PCM to control system operation.

Air Injection Reaction (AIR) System:
This is an emission control system operated by the PCM. During cold starts, an air pump injects outside air into the exhaust manifold to help burn hot exhaust gases. This reduces pollution and speeds warm-up of oxygen sensors and catalytic converters. After the engine is warm, the air will either be "dumped" back to the atmosphere (or into the air cleaner assembly) or sent to the catalytic converter. There are several versions of the AIR system, depending on the vehicle.

Analog Signal:
A voltage signal which can have any voltage reading. For example, thermistors send analog signals indicating small changes in temperature. In contrast are digital signals, which are either "high" or "low" with no variations in between. Also see "Digital Signal" definition.

BARO:
Barometric Pressure Sensor. See "MAP Sensor" definition for full explanation.

Boost Control Solenoid:
Used on certain supercharger-equipped engines. This solenoid is normally energized by the PCM, allowing the supercharger system to operate normally. Under high engine speed and load conditions, the PCM de-energizes the solenoid to reduce boost pressure.

Brake Switch Signal:
An input signal to the PCM indicating that the brake pedal is being pressed. Vehicles with Cruise Control Systems monitor the brake switch to determine when to engage or disengage the cruise control function. The brake switch may also have a circuit supplying power to the Torque Converter Clutch (TCC) solenoid. This connection insures the TCC solenoid will disengage when the brake pedal is depressed. Also see "TCC" definition.

CAM:
Camshaft Position Sensor. This sensor sends a frequency signal to the PCM. Vehicles with sequential fuel injection (SFI) use this signal to synchronize the injector firing order. Some DIS type ignition systems use this signal to synchronize spark plug firing.

CARB:
California Air Research Board

CKP REF:
Crankshaft Reference.

CKP:
Crankshaft Position Sensor.

Closed Loop (C/L):
This is when a control system performs an action (expecting a certain result), then checks the results and corrects its actions (if necessary) until the desired results are achieved. Example: Fuel delivery. The PCM operates a fuel injector in a way that should deliver an optimum air/fuel mixture, as long as everything in the fuel system is operating as expected. In closed loop operation, the PCM uses the oxygen sensor to check the results (fuel delivery may be different than expected because of variations in fuel pressure or injector operation). If the oxygen sensor indicates a "rich" condition, the PCM will compensate by reducing fuel delivery until the oxygen sensor signals an optimum air/fuel mixture. Likewise, the PCM will compensate for a "lean" condition by adding fuel until the oxygen sensor once again signals an optimum air/fuel mixture. Thus, closed loop operation means the PCM can "fine tune" control of a system to achieve an exact result providing the PCM has a means to check results (like an oxygen sensor).

CO:
Carbon Monoxide

Continuous Memory Codes:
See Pending Codes.

CPS:
Crankshaft Position Sensor. This sensor sends a frequency signal to the PCM. It is used to reference fuel injector operation and synchronize spark plug firing on distributorless ignition systems (DIS).

CTS:
Coolant Temperature Sensor. IA thermistor — a sensor whose resistance decreases with increases in temperature — is threaded into the engine block, contacting the engine coolant. It sends a voltage signal to the PCM indicating the temperature of the coolant. The PCM uses this signal for control of fuel delivery, spark advance, and EGR flow.

Data Link Connector (DLC):
The Data Link Connector (DLC) is a universal term for the interface port between the vehicle's on-board computer and a diagnostic tool. Vehicles with OBD II use a 16-pin connector located in the passenger compartment.

Data Stream:
This is the actual data communications broadcast from the vehicle's PCM to the data connector. The individual manufacturers determine the number of "data bytes" a specific engine will broadcast. The size of the data stream is usually dependent on the complexity of the engine, transmission, ABS, and other systems supported by the PCM. All manufacturers supply program documents for each year, engine, and option combination that a particular PCM supports in all the manufacturer's vehicles. This information is used to design and build aftermarket diagnostic equipment.

DEPS:
Digital Engine Position Sensor.

Detonation:
Uncontrolled ignition of the air/fuel mixture in the cylinder. Also referred to as "knock," detonation indicates extreme cylinder pressures or "hotspots" which are causing the air/fuel mixture to detonate early. High cylinder pressures may be caused by excessive load (trailer towing, A/C operation, etc.) or by excessive spark advance. High octane fuel has a higher resistance to uncontrolled ignition, and may be used to control detonation when the PCM is unable to retard timing sufficiently to prevent it from occurring. NOTE: High octane fuel is not a cure for the problem, only the symptom. If your vehicle experiences long-term detonation, check for other causes.

DiagnosticTrouble Codes:

Diagnostic Trouble Codes (DTC) indicate a malfunction flagged by a vehicle computer. The computer will display a corresponding code based on a lookup table in the program of the on-board computer. Most systems have the ability to store codes in memory, which are commonly referred to as "history codes" or "soft codes." Malfunctioning circuits will generate continuous Check Engine lamp illumination, called "current codes" or "hard codes." OBD II Systems will transmit many more DTCs than the past systems, and therefore will allow a technician the ability to better pinpoint failures and past events. The only way to clear codes on OBD II systems will be with a scan tool that has the proper programming to perform the function.

Digital Signal:

An electronic signal which has only two (2) voltage values: a "low" value (close to zero) and a "high" value (usually 5 volts or more). Sometimes the low voltage condition is called OFF and the high voltage condition is called ON. Signals which can have any voltage value are called "analog" signals.

DIS:

Distributorless Ignition System or Direct Ignition System. A system that produces the ignition spark without the use of a distributor.

Driver:

A transistor "switch" inside the PCM used to apply power to an external device. This allows the PCM to control relays, solenoids, and small motors.

Duty Cycle:

A term applied to frequency signals — those which are constantly switching between a small voltage value (close to zero) and a larger value (usually 5 volts or more). Duty cycle is the percentage of time the signal has a large voltage value. For example, if the signal is "high" (large voltage) half of the time, the duty cycle is 50%. If the signal is "high" only one fourth of the time, then the duty cycle is 25%. A duty cycle of 0% means the signal is always at a "low" value and not changing. A duty cycle of 100% means the signal is always at a "high" value and not changing. The PCM uses duty cycle type signals when it wants more than just "on-off" control of an actuator. This is how it works: 50% duty cycle signal going to a vacuum switching solenoid means the solenoid will be "on" (passing full vacuum) half the time, and "off" (passing no vacuum) half the time. The average amount of vacuum passing through the solenoid will be one half the full value because the solenoid is only "on" for half the time. This signal changes at a rapid rate, as often as ten times per second. Thus the PCM can get a vacuum controlled actuator to move halfway between "no vacuum" and "full vacuum." Other positions can be achieved by changing the duty cycle of the control signal which in turn changes the average amount of control vacuum.

DVM:

Digital Volt Meter. An instrument using a numeric readout to display measured voltage values as opposed to a moving needle on a gauge face. Usually the instrument has other measuring capabilities, such as resistance and current, and may be called a Digital Multi-Meter (DMM). Most DVMs have 10 Megohm input impedance. This means the circuit under test will not be electronically disturbed when the DVM is connected for a measurement.

ECT:

Engine Coolant Sensor. A thermistor — a sensor whose resistance decreases with increases in temperature — is threaded into the engine block, contacting the engine coolant. It sends a voltage signal to the PCM indicating the temperature of the coolant. The PCM uses this signal for control of fuel delivery, spark advance, and EGR flow.

EFI:

Electronic Fuel Injection. A term applied to any system where a computer controls fuel delivery to the engine by using fuel injectors.

EGR:

Exhaust Gas Recirculation. The EGR system recirculates exhaust gases back into the intake manifold to reduce NOx emissions. The EGR valve controls the flow of exhaust gases back into the intake manifold. Some EGR valves are operated with a vacuum signal while others are electrically controlled. The amount of EGR valve opening determines the flow through the valve. EGR Recirculation is only used during warm engine cruise conditions. EGR flow at other times can cause stalling or no starts. There are many different types of EGR systems controlled by the PCM.

Engine Parameters:

This is the translated information that is displayed on the system tester screen. Parameters will include the information inputs and the output information from the PCM. Engine Parameters are often referred to as PIDs (Parameter Identification Data).

EPA:

Environmental Protection Agency.

ESC:

Electronic Spark Control. This is an ignition system function that works on vehicles having a knock sensor mounted on the engine block. The knock sensor is wired to circuitry in a separate module (early version) or inside the PCM (later versions). If the sensor detects engine knock, the ESC function alerts the PCM that will immediately retard the spark to eliminate the knocking condition.

EST:

Electronic Spark Timing. An ignition system where the PCM controls the spark advance timing. A signal called EST goes from the PCM to the ignition module that fires the spark coil. The PCM determines optimum spark timing from sensor information — engine speed, throttle position, coolant temperature, engine load, vehicle speed, Park/Neutral switch position, and knock sensor condition.

EVAP:

Evaporative Emissions System.

EVRV:

Electronic Vacuum Regulator Valve. This actuator is controlled by the PCM and is used to control the amount of vacuum applied to a vacuum-operated device.

Fuel Injector:

An electronically controlled flow valve. Fuel injectors are connected to a pressurized fuel supply (fuel pressure is created by a fuel pump). No flow occurs when the injector is off (not energized). When the injector is energized, it opens fully, allowing fuel to flow. The PCM controls fuel delivery by varying the amount of time the injector solenoids are turned on.

Fuel Pump Relay:

The PCM energizes this relay to apply power to the vehicle fuel pump. For safety reasons, the PCM removes power from the fuel pump when ignition signals are not present.

Fuel Pump Signal:

This is a wire between the PCM and the fuel pump motor power terminal. The PCM uses this signal to verify when voltage is at the fuel pump (for diagnosing fuel pump problems).

Gear Switches:

These are switches (usually two) located inside certain automatic transmissions. The PCM monitors the switches to determine what transmission gear is engaged. The switches are activated by hydraulic pressure and may be normally open or closed, depending on the vehicle. The PCM uses gear information for control of the torque converter clutch, some emission systems, and for transmission diagnostic purposes.

Ground:

Ground is the return path for current to flow back to its source (Usually the negative battery terminal). It is also the reference point from which voltage measurements are made (the connection place for the negative (-) test lead from a voltmeter).

Hall Effect Sensor:

This sensor is a three wire-type of sensor containing electronic circuitry. Two wires supply power and ground, while a third wire carries the sensor signal back to the PCM. The sensor consists of a permanent magnet and a small module containing a transistorized Hall Effect switch. A small air gap separates the sensor and the magnet. The magnetic field causes the Hall switch to turn on and send out a low voltage signal. If a metal strip (iron or steel) is placed in the gap, it will block the magnetic field from reaching the Hall device. This causes the Hall switch to turn off and send a high voltage signal out on the signal wire.

The metal strips (blades) are part of a cup or disk attached to a rotating component such as the crankshaft or camshaft. As the blades pass through the sensor gap, the signal voltage will switch high and low, creating a series of pulses. The PCM determines the speed of rotation by measuring how fast pulses appear. Hall Effect type sensors may be used to measure speed and position of the crankshaft or camshaft — for spark timing and fuel injector control.

HO2S

Heated Oxygen Sensor.

IAC:

Idle Air Control. This is a device mounted on the throttle body which adjusts the amount of air bypassing a closed throttle so that the PCM can control idle speed. The IAC moves a pintle within the air bypass passage. When the PCM wants to change idle speed, it will move the pintle backwards for more air and a fast idle, or forward for less air and a slower idle.

ICM:

Ignition Control Module.

I/M:

Inspection and Maintenance.

Inputs:

Electrical signals running into the PCM. These signals come from sensors, switches or other electronic modules. They give the PCM information about vehicle operation.

ISC:

Idle Speed Control. This refers to a small electric motor mounted on the throttle body and controlled by the PCM. The ISC motor moves a spindle back and forth. When the throttle is released during idle, it rests on this spindle. The PCM can control idle speed by adjusting this spindle position. The PCM determines the desired idle speed by looking at battery voltage, coolant temperature, engine load, and RPM.

Knock Sensor (KS):

This sensor is used to detect engine detonation or “knock.” When spark knock occurs, the sensor emits a pulsing signal. Depending on the vehicle, this signal either goes to the PCM or a separate ESC (Electronic Spark Control) module. Then the spark advance is retarded until detonation stops. The sensor contains a piezoelectric element and is threaded into the engine block. Vibrating the element generates the signal pulse. Special construction makes the element sensitive only to engine vibrations associated with detonation “knocking.”

Knock:

See “Detonation.”

KOEO:

Key On, Engine Off.

KOER:

Key On, Engine Running.

LCD:

Liquid Crystal Display.

LT:

Long Term fuel trim.

M/T:

Manual transmission or manual transaxle.

MAF:

Mass Air Flow Sensor. This sensor measures the amount of air entering the engine using a wire or film heated to a specific temperature. Incoming air cools the wire. The MAF sensor sends a frequency or voltage signal (depending on sensor type) to the PCM based on the voltage required to maintain that temperature. The signal frequency or voltage increases when the mass of the incoming air goes up. This gives the PCM information required for control of fuel delivery and spark advance.

MAP:

Manifold Absolute Pressure Sensor. This sensor measures manifold vacuum or pressure and sends a frequency or voltage signal (depending on sensor type) to the PCM. This gives the PCM information on engine load for control of fuel delivery, spark advance, and EGR flow.

MAT:

Manifold Air Temperature sensor. A thermistor — a sensor whose resistance decreases with increases in temperature — is threaded into the intake manifold. It sends a voltage signal to the PCM indicating the temperature of the incoming air. The PCM uses this signal for fuel delivery calculations.

MFI:

Multi-Port Fuel Injection. See “MPFI.”

MIL:

Malfunction Indicator Lamp. The MIL is also known as a Check Engine Light or CEL.

Mode:

Refers to a type of operating condition, such as “idle mode” or “cruise mode.”

MPFI:

Multi-Port Fuel Injection. MPFI is a fuel injection system using one (or more) injector(s) for each cylinder. The injectors are mounted in the intake manifold, and fired in groups rather than individually.

NOx:

Oxides of Nitrogen. A pollutant. The EGR system injects exhaust gases into the intake manifold to reduce these gases at the tailpipe.

O2S:

This is an oxygen sensor that is threaded into the exhaust system, directly in the stream of exhaust gases. The PCM uses the sensor to “fine tune” fuel delivery. The sensor generates a voltage of 0.6 to 1.1 volts when the exhaust gas is rich (low oxygen content). The voltage changes to 0.4 volts or less when the exhaust gas is lean (high oxygen content). The sensor only operates after it reaches a temperature of approximately 349°C (660°F).

ODM:

Output Device Monitor.

On-Board Diagnostics, Second Generation (OBD II):

With the passing of the 1990 Clean Air Act Amendment, the EPA imposed more stringent requirements. These requirements include the addition of multiple oxygen sensors, one before the catalytic converter and one after to provide the PCM with information on catalyst efficiency and condition. There are also computer-controlled EGR, fuel pressure regulators, and smart ignition systems.

OBD II requires a common data connector and connector location. Further requirements include an industry-standard data message, defined by both an industry committee of engineers from most major manufacturers and the SAE. Vehicle manufacturers are required by law to provide at least a minimum amount of data for emissions programs to access the critical emissions data available through OBD II. OBD II began to appear in vehicles in late 1994, and is supposed to be equipment on all cars sold in the US after January 1, 1996.

Open (Circuit):

A break in the continuity of a circuit such that no current may flow through it.

Open Loop (O/L):

This is when the control system performs an action (expecting a certain result), but does not verify if the desired results were achieved; i.e. the PCM operates a fuel injector expecting a certain amount of fuel to be

delivered (The PCM assumes everything in the fuel system is performing properly). In open loop operation, the PCM does not check the actual amount of fuel delivered. Thus, a faulty fuel injector or incorrect fuel pressure can change the amount of fuel delivered and the PCM would not know it. In general, a control system operates in open loop mode only when there is no practical way to monitor the results of an action; i.e. Fuel delivery during cold engine warm-up. The computer runs in open loop mode because the oxygen sensors are ready to send a signal. Without the sensor signal, the computer cannot check the actual amount of fuel delivered.

Outputs:
Electrical signals sent from the PCM. These signals may activate relays or other actuators for control purposes throughout the vehicle. The signals can also send information from the PCM to other electronic modules, such as the ignition or trip computer.

P/N:
Park/Neutral Switch. This switch tells the PCM when the gear shift lever is in the Park or Neutral position. Then the PCM will operate the engine in an “idle” mode.

PCM:
Powertrain Control Module. The “brains” of the engine control system. It is a computer housed in a metal box with a number of sensors and actuators connected with a wiring harness. Its job is to control fuel delivery, idle speed, spark advance timing, and emission systems. The PCM receives information from sensors, then energizes various actuators to control the engine. The PCM is frequently called the ECM (Engine Control Module).

PROM:
Programmable Read-Only Memory. The PROM contains programming information the PCM needs to operate a specific vehicle model.

Pending Codes:
Also referred to as Continuous Memory codes and Maturing Diagnostic Trouble codes. These codes are set when intermittent faults occur while driving. If the fault does not occur after a certain number of drive cycles, the code is erased from memory.

Purge Solenoid:
This device controls the flow of fuel vapors from the carbon canister to the intake manifold. The canister collects vapors evaporating from the fuel tank, preventing them from escaping to the atmosphere and causing pollution. During warm engine cruise conditions, the PCM energizes the Purge Solenoid so the trapped vapors are drawn into the engine and burned.

Relay:
An electric/mechanical device for switching high current circuits on and off. It is electronically controlled by a low current circuit. Relays allow a low power PCM signal to control a high power device such as an electric cooling fan.

Reluctance Sensor:
Crankshaft or *Camshaft* - Speed, position (for spark timing or fuel injector control). *Driveshaft* - Vehicle speed (transmission or torque converter control, cooling fan use, variable assist power steering, and cruise control). *Wheel Speed* - Anti-lock brakes or traction control systems

ROM:
Read-Only Memory. Permanent programming information stored inside the PCM, containing the information to operate a specific vehicle model.

SAE:
Society of Automotive Engineers.

Sensor:
Devices which give the PCM information. The PCM can only work with electrical signals. The job of the sensor is to take something the PCM needs to know, such as engine temperature, and convert it to an electrical signal that the PCM can understand. The

PCM uses sensors to measure such things as throttle position, coolant temperature, engine speed, incoming air mass and temperature, etc.

SFI or SEFI:

Sequential Fuel Injection or Sequential Electronic Fuel Injection. A fuel injection system that uses one or more injectors for each cylinder. The injectors are mounted in the intake manifold, and are fired individually.

Shift Solenoid:

Used in computer controlled transmissions, the solenoids are located in the transmission housing and are controlled by the PCM. The PCM energizes the solenoids individually or in combination to select a specific gear. The solenoids control the flow of hydraulic fluid to the transmission shifting valves. The PCM selects the appropriate gear ratio and shift point based on engine operating conditions.

Solenoid:

A solenoid is a device to convert an electrical signal to mechanical movement. It consists of a coil with a wire and a moveable metal rod in the center. When the power is applied to the coil, the resulting electromagnetism moves the rod and performs some mechanical action. The PCM often uses solenoids to switch vacuum lines on and off. This allows the PCM to control vacuum operated devices such as the EGR valve. Fuel injectors are operated by another type of solenoid.

ST:

Short Term fuel trim.

Stepper Motor:

A special type of electric motor with a shaft that rotates in small “steps” instead of continuous motion. A certain sequence of frequency-type signals is required to step the motor shaft. A different signal sequence will step the motor in the opposite direction. No signal maintains current shaft position A constant signal drive will continuously rotate the shaft. The shaft is usually connected to a threaded assembly which moves back and forth to control things such as idle speed bypass air flow (see “IAC” definition).

TBI:

Throttle Body Injection. A fuel injection system having one or more injectors mounted in a centrally located throttle body, as opposed to positioning the injectors close to an intake valve port. TBI is also called Central Fuel Injection (CFI) in some vehicles.

TDC:

Top Dead Center. When a piston is at its uppermost position in the cylinder.

Thermistor:

A resistor whose resistance changes with temperature. Thermistors are used as sensors for vehicle coolant and manifold air temperature. The resistance decreases as temperature goes up, sending a voltage signal to the PCM where it is converted to a temperature measurement.

Throttle Body:

A device which performs the same function as a carburetor in a fuel injection system. On a throttle body injection (TBI) system, the throttle body is both the air door and the location of the fuel injectors. On port fuel injection systems (PFI, MPFI, SFI, etc.) the throttle body is simply an air door. Fuel is not added until the injectors at each intake port are activated. In each case, the throttle body is attached to the accelerator pedal.

TPS:

Throttle Position Sensor. This is a rotary-type potentiometer connected to the throttle shaft. It has a voltage signal output which increases as the throttle is opened. This sensor is used by the PCM for idle speed, spark advance, fuel delivery, emission systems, and electronic automatic transmission control.

TTS:

Transmission Temperature Sensor. A thermistor, a sensor whose resistance decreases with increases in temperature, is mounted in the transmission housing in contact with the transmission fluid. It sends the transmission temperature as a voltage signal to the PCM.

VECI:

Vehicle Emission Control Information.

VIN:

Vehicle Identification Number. This is the factory-assigned vehicle serial number. This number is stamped on a number of locations throughout the vehicle, but the most prominent location is on top of the dashboard on the driver's side, visible from outside the vehicle. The VIN includes information about the vehicle, including where it was built, body and engine codes, and a sequential build number.

VSS:

Vehicle Speed Sensor. This sensor sends a frequency signal to the PCM. The frequency increases as the vehicle moves faster to give the PCM vehicle speed information used to determine shift points, engine load, and cruise control functions.

WOT:

Wide-Open Throttle. The vehicle operating condition brought about when the throttle is completely (or nearly) open. The PCM will typically deliver extra fuel to the engine and de-energize the A/C compressor at this time for acceleration purposes. The PCM uses a switch or the Throttle Position Sensor to identify the WOT condition.

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THREE (3) YEAR LIMITED WARRANTY

Actron Manufacturing Company ("Actron") warrants to the original purchaser that this product will be free from defects in materials and workmanship for a period of three (3) years from the date of original purchase. Any unit that fails within this period will be replaced or repaired at Actron's discretion without charge. If you need to return product, please follow the instructions below. This warranty does not apply to damages (intentional or accidental), alterations or improper or unreasonable use.

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LIMITATION OF REMEDIES

IN NO CASE SHALL ACTRON BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES BASED UPON ANY LEGAL THEORY INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOST PROFITS AND/OR INJURY TO PROPERTY. SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THIS LIMITATION OR EXCLUSION MAY NOT APPLY TO A SPECIFIC BUYER. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

TO USE YOUR WARRANTY

If you need to return the unit, please follow this procedure:

1. Call Actron Tech Support at (800) 253-9880. Our Technical Service representatives are trained to assist you.
2. Proof of purchase is required for all warranty claims. For this reason we ask that you retain your sales receipt.
3. In the event that product needs to be returned, you will be given a Return Material Authorization number.
4. If possible, return the product in its original package with cables and accessories.
5. Print the RMA number and your return address on the outside of the package and send to the address provided by your Customer Service representative.
6. You will be responsible for shipping charges in the event that your repair is not covered by warranty.

OUT OF WARRANTY REPAIR

If you need product repaired after your warranty has expired, please call Tech Support at (800) 253-9880. You will be advised of the cost of repair and any freight charges.

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