Disclaimer of Warranties:

Although the test procedures and the test information in this manual were obtained by an ASE Certified Master Technician with known good test equipment on real Domestic and Import vehicles, individual tests may vary due to equipment and technicians. No warranty can be made to personal testing procedures for accuracy or completeness obtained from the ideas of this manual, nor does its author or anyone connected with him assume any responsibilities or liabilities. The use of this manual is conditional on the acceptance of this disclaimer. If the terms of this disclaimer are not acceptable, please return this manual immediately.

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What is the MODIS?

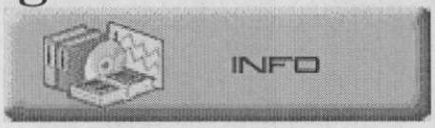
Modular Diagnostic Information System

- Full Blown Scan Tool
- Power Graphing Meter
- Portable Database
- 4 Channel Lab Scope
- Technical Service Bulletins
- Ignition Scope

The MODIS is the most versatile tool on the market today.

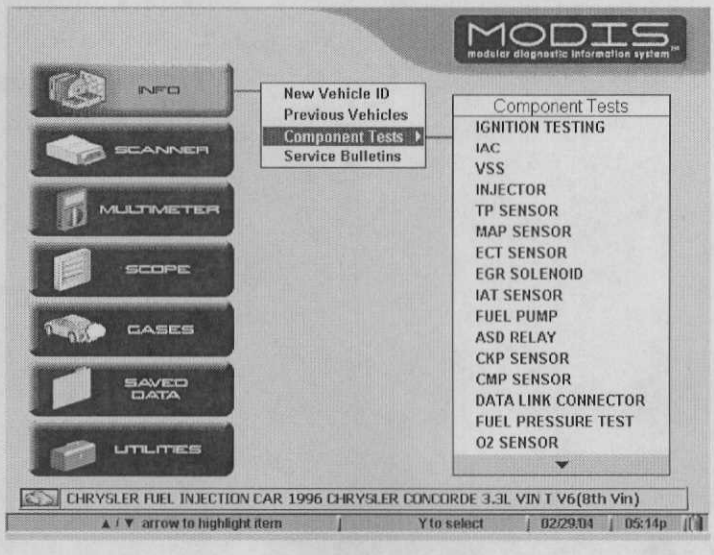
- All the familiar functions of the Snap-on scanner are built in.
- Graphing up to 8 PIDS of data at one time is possible.
- With the addition of version 3.2 or higher, you have all the functions of the Vantage Graphing Meter—including the database.
- You have the ability to view 4 separate waveforms at once with the powerful 4 channel lab scope.
- Technical Service Bulletins are now at the touch of your fingertips, with the addition of Technical Bulletin Software add-on package.
- With the latest addition (ver. 4.1), you now have the ability to perform Ignition Secondary tests.

Section 1
Vantage™ Module Section



In this section we will cover some of the basic functions of the Snap-on MODIS Vantage Module. We will guide you through the menu set-ups and explain their meanings.

Vantage Module

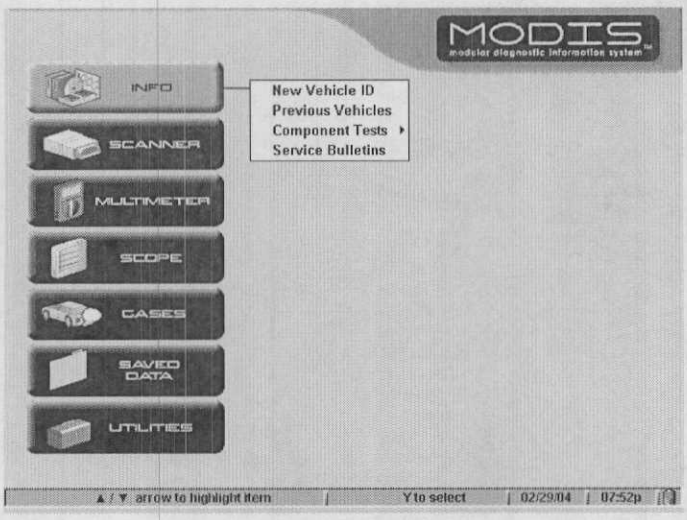


With Version 3.2 or higher you will add the Vantage database and functions to your MODIS. Do not confuse the Vantage section with the Multimeter section. Although you have a graphing meter in the Multimeter section, you ***do not*** have the database and the available tests that are in the Vantage section.

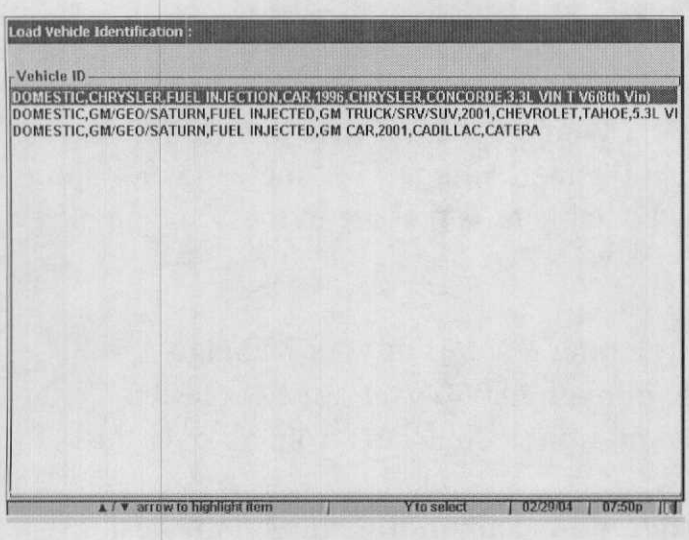
- This will give you all the graphing features of your Vantage.
- You will have the database of over 30,000 pages of field tested technical information gathered from technicians from all over the country.
- There are pin-outs, connector views and information on the best test point locations to gather the data for diagnosis.
- There is also a database of waveform examples.

At the bottom of the screen you will notice a vehicle listed. This is the last vehicle you selected. Also, you will notice the menu lists previous vehicles. The MODIS saves previous vehicles you selected for quick reference.

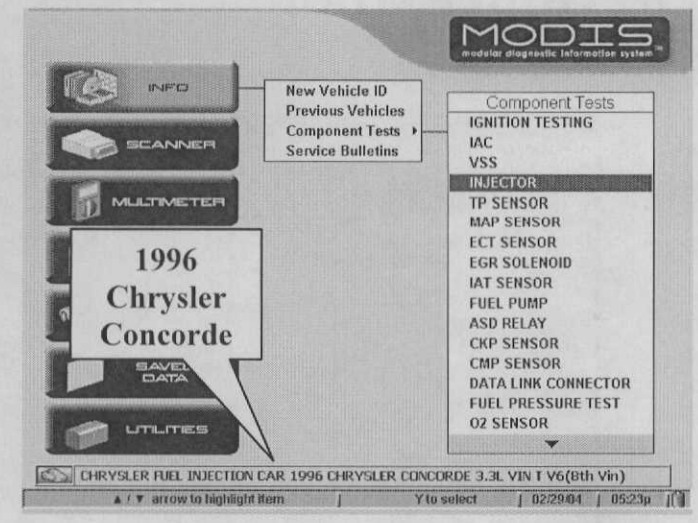
If you select the component test menu you will see a drop down menu similar to the one above. From this menu select the individual component that you want to test.



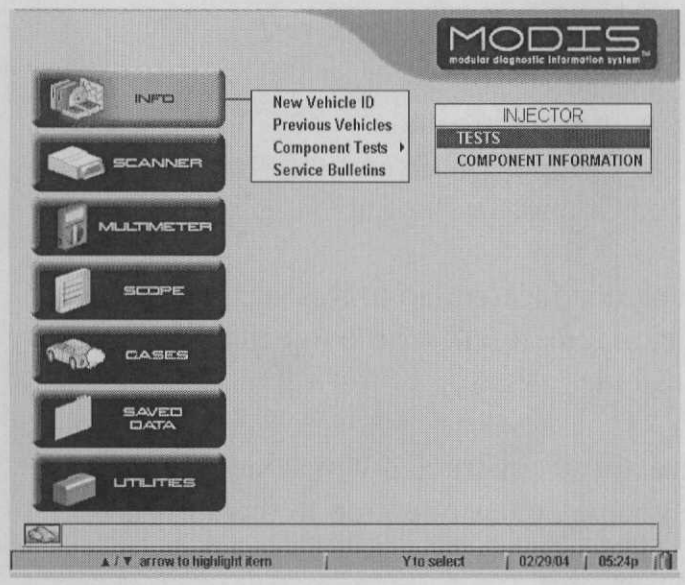
You will access the Vantage database under the "Info" section in the main screen. When you first access the info section you will need to select the vehicle you are working on. To do this, highlight "New Vehicle ID", press the "Y" button and follow the selections.



If you are going to diagnose a vehicle you previously worked on, access the "Previous Vehicles" menu to re-select. For quick reference, the MODIS saves the previous vehicles you have worked on in history.



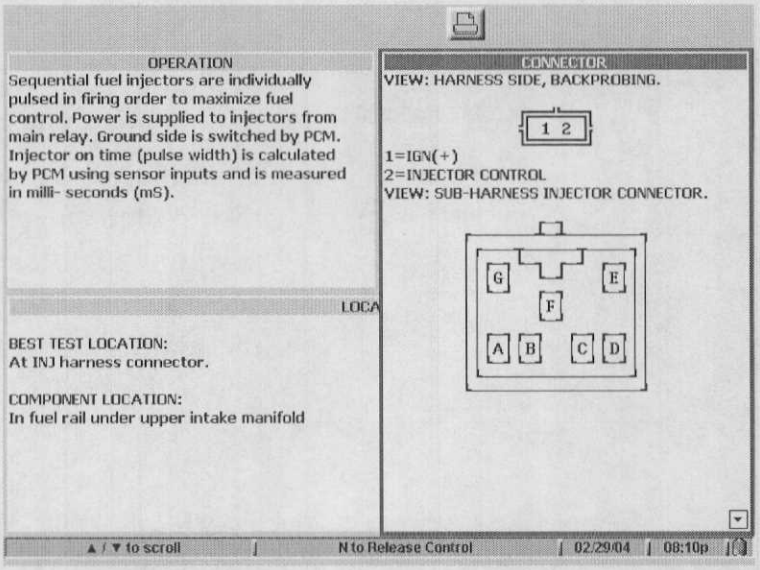
Once you have selected your vehicle you will need to access the "Component Tests" menu to begin specific diagnostic tests. On this example we chose "Injector" test. **Note:** Once you have selected a vehicle, you will see it listed at the bottom of the main screen when you are under the "Info" section.



As you can see, we now have the option of going into the "Tests" menu or selecting individual "Component Information". If you are unfamiliar with a component you are testing, go to "Component Information" first. You will find information on the component you are testing, pin-outs for the connector, best test locations and component location.

After you understand the item you are testing, select those tests from the menu. You can now choose the specific test you would like to perform.

Component Information

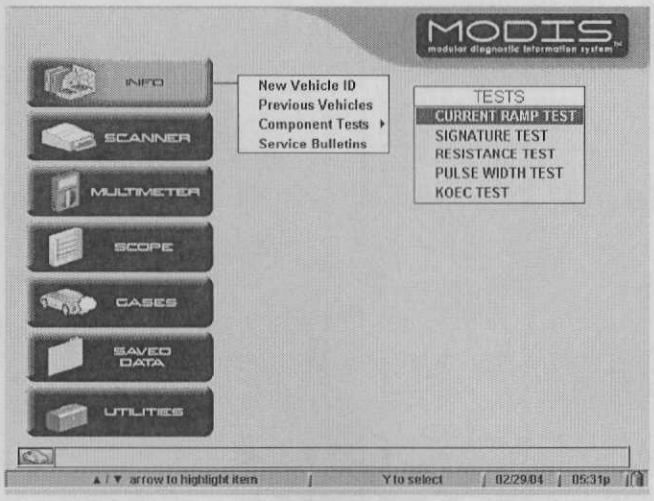


There is a large variety of valuable information under the "Component Information" section; items such as Component Operation, Best Test Location, Component Location and Connector Pin-outs.

If you are unsure where a component is located, go to this section for help. Although this is not the greatest example, it tells us the injector is located in the fuel rail under the intake manifold.

Under the pin-out section, you are always instructed which side the connector view is of. Make sure you pay close attention to this information to avoid any misdiagnosis of the vehicle.

Specific Tests

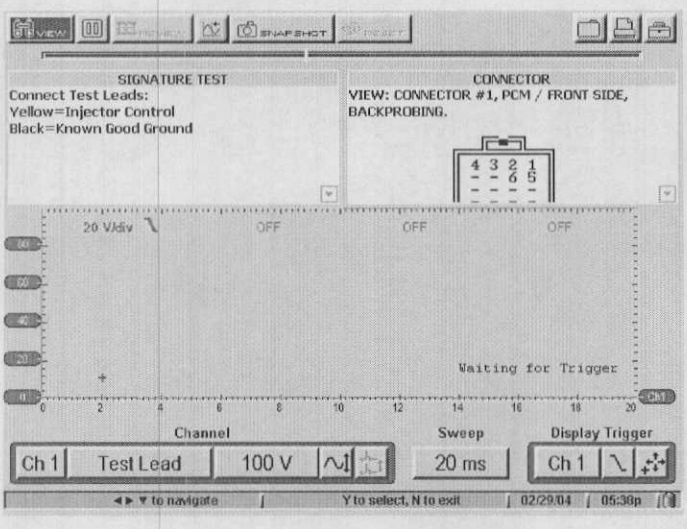


Some of the options you have under "Tests" are.

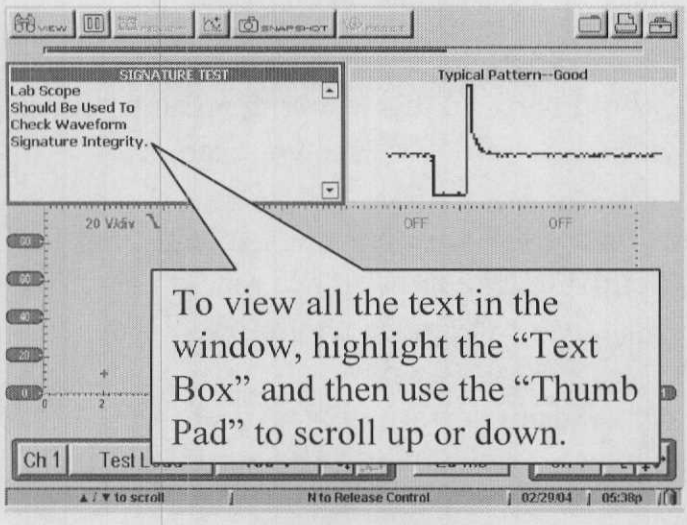
- **Current Ramp Test:** you would perform this test with an amp probe.
- **Signature Test:** This is a voltage pattern test. Use your scope test leads.
- **Resistance Test:** Again you would use your normal test leads, but place the leads in channel 3 and 4 to take a resistance reading.
- **Pulse Width Test:** This test analyzes the pulse width time for the injectors.
- **KOEC:** Use your normal test leads to perform this test. This test analyzes the integrity of the injector signal while cranking the vehicle.

Note: The tests you see listed under the menu selection will vary. Depending on the vehicle you are working on.

Performing Tests



This is an example of what you would see if you've selected "Signature Test". As you can see on the left of the screen, you are instructed where to hook-up your leads. To the right of the screen, you are shown the pin-outs for the connector.

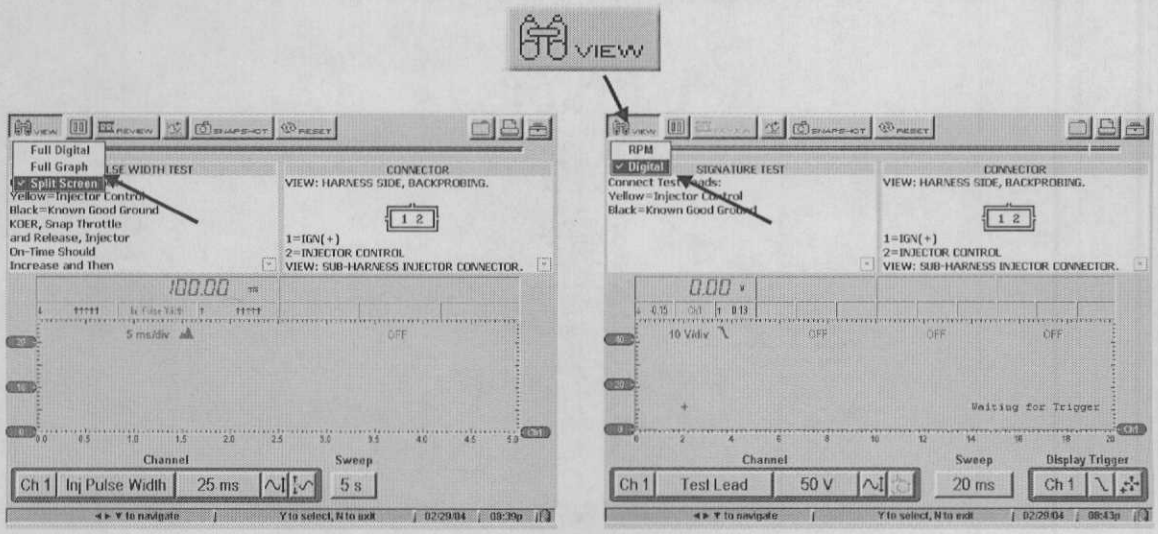


There are also examples of typical patterns built into the database. The image to the left shows us a typical saturation injector. Keep in mind that these patterns are not always 100% correct. This is why it is very important to look at known good patterns as often as possible.

Also note, even though the Vantage is a very powerful tool, it is not a Lab scope. You are automatically switched to the Lab Scope screen to check for waveform integrity. Yes, you can use the Vantage to view the injector pattern, but sometimes you will not see as great as detail in the pattern as you would with the Lab Scope.

Vantage Menu Functions

View Icon



Depending on the test you are performing, the options under this menu will vary. The left image is under the "Pulse Width Test" menu. Notice we have three choices: Full Digital, Full Graph or Split Screen.

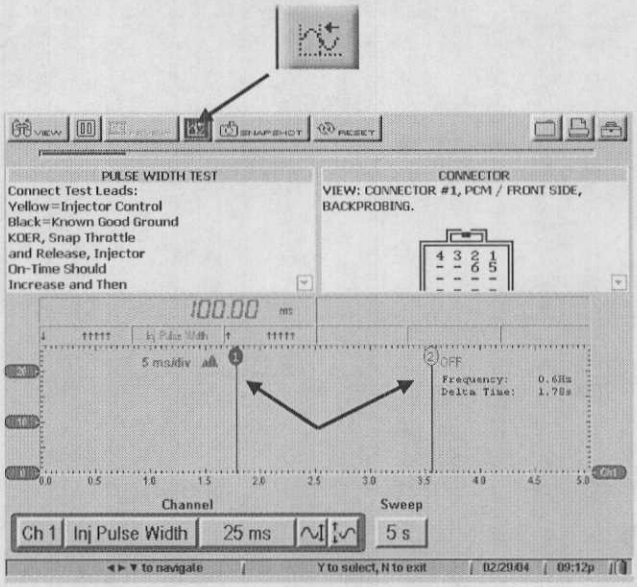
- **Full Digital:** This will change the lower screen to a digital readout.
- **Full Graph:** This will change the screen to a graphical display, similar to the images above.
- **Split Screen:** This will allow you to obtain a measurement in a digital and graphical form at the same time. The graph reading will be in the lower section (indicated by the lower arrow) and the digital reading will be in the upper section (indicated by the upper arrow).

The right image was captured from the "Signature Tests" menu. Notice we now have two different menu selections under the "View" icon—RPM and Digital. This will give you the option of viewing digital data above the graph or you are able to read RPM. **Note:** You must have the trigger lead connected to a spark plug wire to obtain an RPM reading.

Record, Snapshot & Zoom

These functions operate the same as they do in the Lab Scope. Refer to the Lab Scope section for detailed instructions on these subjects.

Cursors



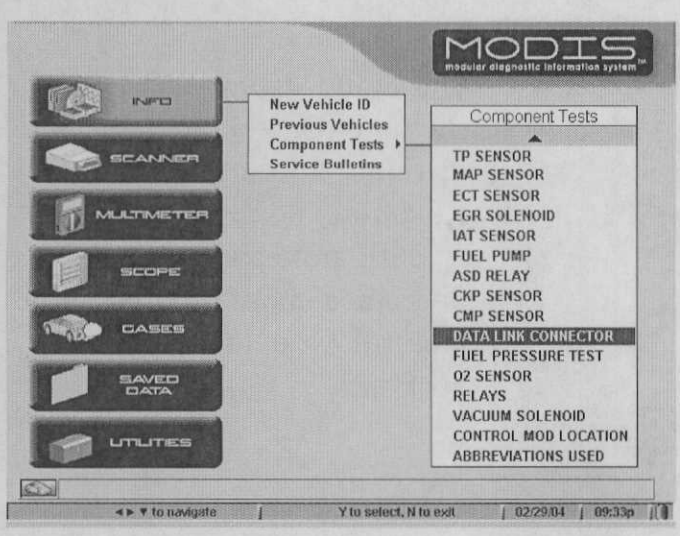
To active the cursors highlight the "Cursor" icon to the left of the "Snapshot" icon and press the "Y" button. To move the cursor bars, press the left and right arrows on the "Thumb Pad". To switch cursors press the "Y" button. As you move the cursors the reading under Frequency and Delta Time will change.

- **Frequency:** Cycles per/second. The frequency will be the cycles per/second between the two cursors.
- **Delta Time:** The amount of time between the two cursors.

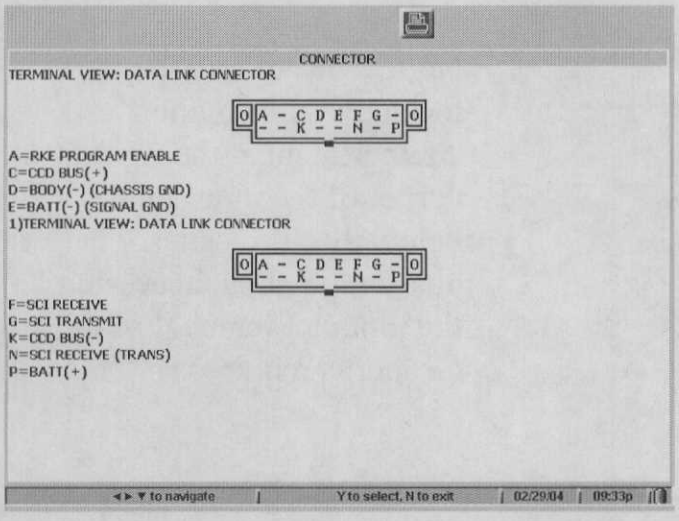
Reset Icon

By pressing this icon you will reset the minimum and maximum reading recorded. This only applies when you are viewing data in digital form. When there are no digital reading on the screen this icon will not be selectable.

Data Link Connector



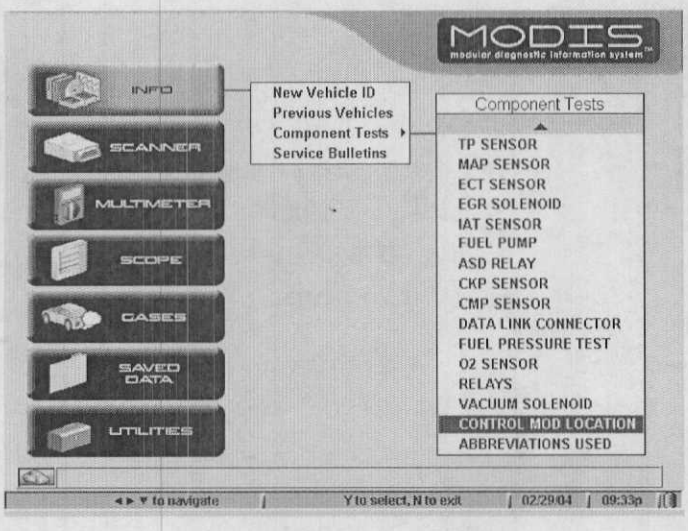
Under the Vantage section you have access to specific information about the Data Link Connector (DLC). Items such as: Location and Pin-out information.



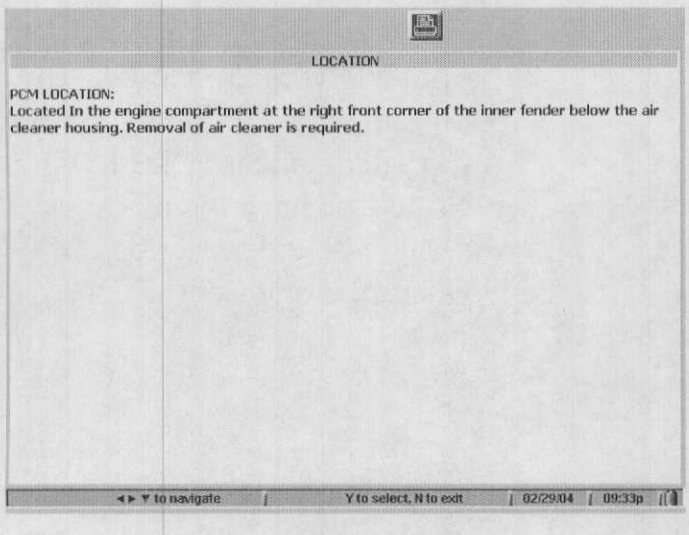
To the left we are viewing the Pin-outs of a DLC on a 1996 Chrysler Concorde 3.3 L. Notice we have the pin letter along with a description of what they represent.

Note: The DLC information may not be listed for all vehicles.

Control Module Location



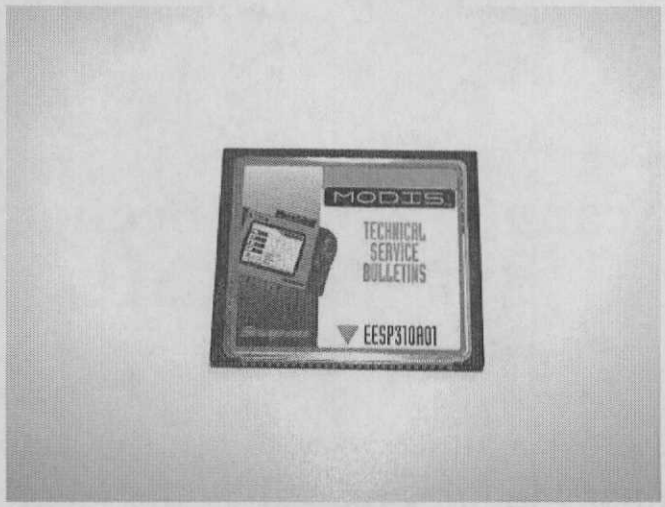
Under the "Component Tests" menu in the Vantage you can also find the Control Module Location. You will find specific note about location and notes about accessing the Control Module in this section.



Notice we are told the PCM is located in the engine compartment at the right front corner of the inner fender below the air cleaner. There is also a note about accessing the module; removal of the air cleaner is required.

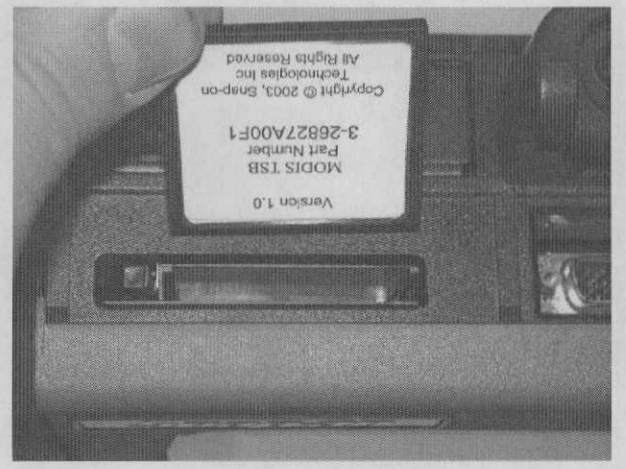
Depending on the vehicle, there may be more than one module listed. For example, a 2001 General Motors SUV list three different modules: The Powertrain Control Module, the Electronic Brake Traction Control Module and the Throttle Actuator Control Module. Although there are more modules on today's vehicles than this, these are the modules listed in the database. **Remember:** The Vantage database covers Powertrain and ABS information.

TSB Software



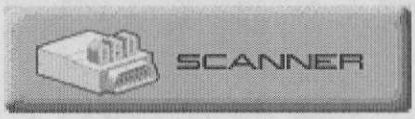
The latest accessory available for the MODIS is the Technical Service Bulletin compact flash card. With this card inserted into compact flash port in the top of the MODIS, you have access to more than 80,000 technical service bulletins. These are bulletins direct from the factory and cover engine and engine performance TSB's along with emission recalls.

The current software version covers model years 1990 – 2002.
Model coverage includes:
Domestic: Chrysler, Ford, GM, Geo, Saturn and Jeep
Import: Acura, Audi, BMW, Honda, Hyundai, Isuzu, Jaguar, Kia, Land Rover, Mazda, Mercedes-Benz, Mitsubishi, Nissan, Infiniti, Subaru, Toyota, Lexus, Volkswagen and Volvo.



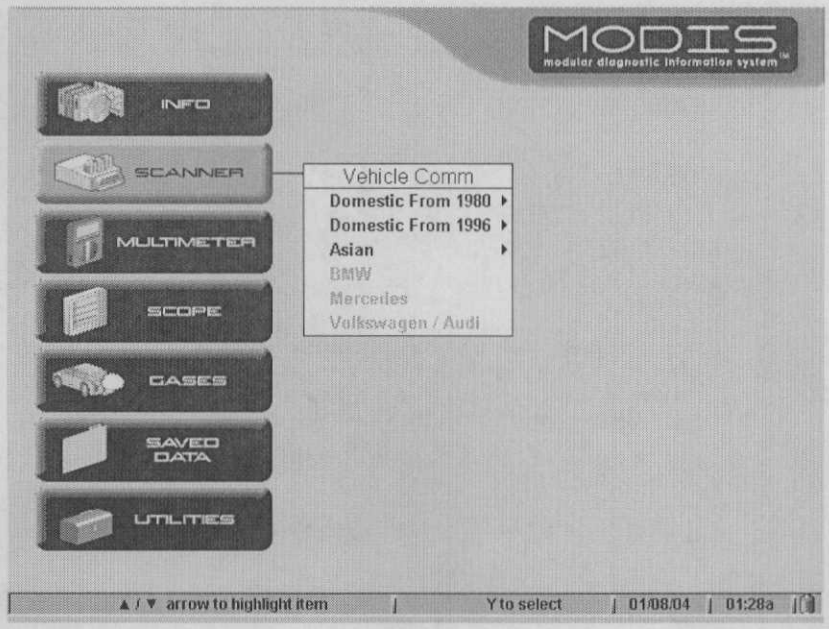
The compact flash card is inserted into the top slot on the MODIS. The TSB card ***must*** be in the MODIS when accessing the information. The TSB information is not permanently loaded in the into the memory board in the MODIS.

Section 2
Scanner Module Section



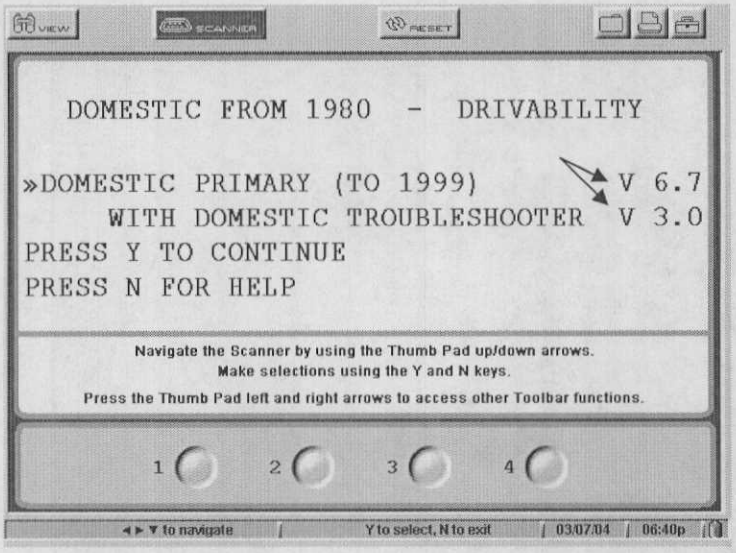
In this section we will cover some of the functions of the Snap-on Scanner Module. We will guide you through the set-ups and advanced functions of the scanner module.

Scanner Module

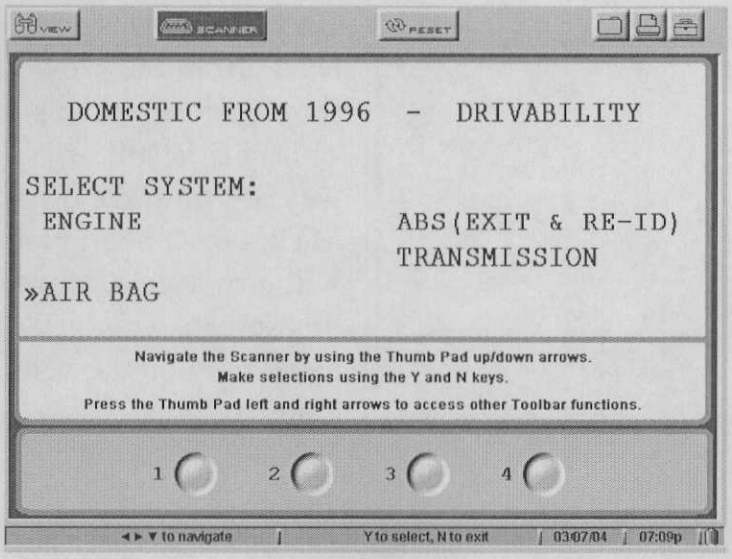


You have the ability to view not only Domestic and Asian data, but with the added modules you also have the ability to view Mercedes, BMW, Volkswagen, Audi and Heavy Duty Truck data. You also have the option to view driveability, transmission and ABS data along with the popular Snap-on Troubleshooter. As you can see in the image above, some of the text is displayed in light gray. This indicates that those particular modules for the MODIS have not been purchased and installed. After you purchase and load these modules, you would notice that the text is now dark and you now have the capability of selecting them.

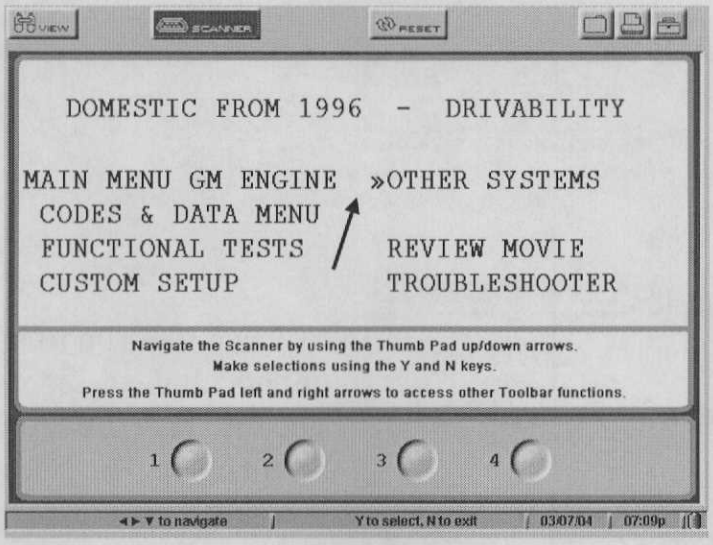
Start-up Screen



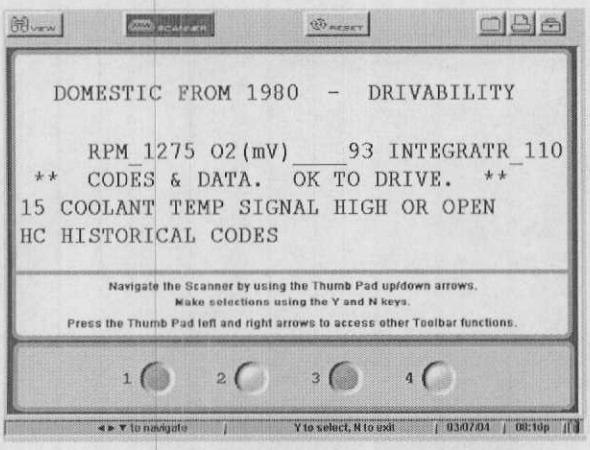
When you enter the Scanner Module, the first thing you will notice is the layout is the same as the already familiar MT2500 Snap-on scanner. The big plus is that you now have a larger screen to view the data. **Note:** V 6.7 and V 3.0 indicate the current software versions for Domestic Primary and Domestic Troubleshooter.



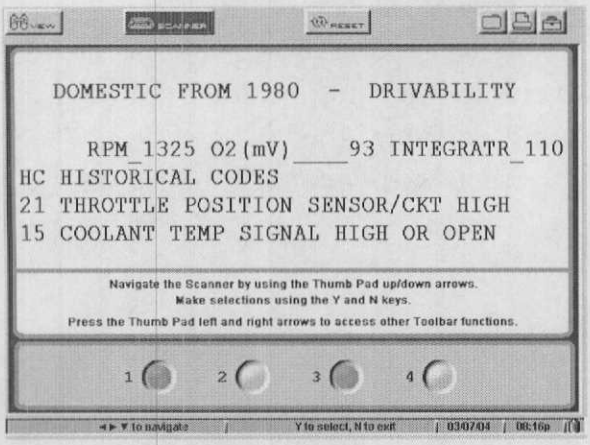
Once you have entered all the pertinent vehicle information, this will be the next screen you see. Again, use the "Thumb Pad" and the "Y" button to make your selection. The choices on this screen will vary, depending on the vehicle.



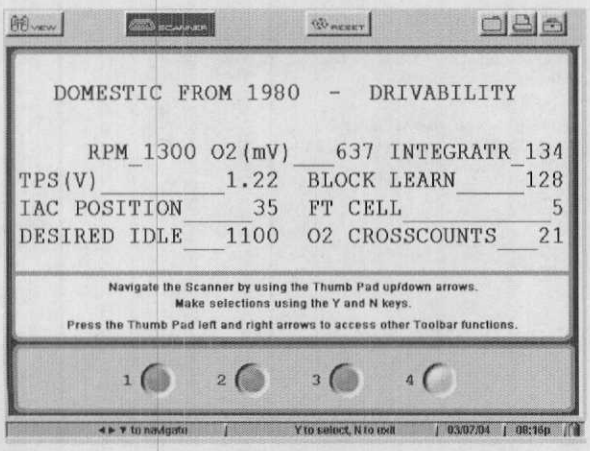
Once you have entered the vehicle info, you will be at the "Main Menu". Use the "Thumb Pad" to scroll and make your selection. Notice as you press the "Thumb Pad" up and down, the double arrows, shown by "Other Systems" selection, will move. **Note:** You ***can not*** move the arrow side-to-side—only up and down. The arrow will move side-to-side as needed as you move up and down.



Once you have selected "Codes and Data" from the previous screen, you should see a screen similar to this. This data is still organized the same way it was in the original Snap-on MT2500 scanner. Notice that you will also access computer codes on this screen. This will vary, depending on the vehicle manufacturer.

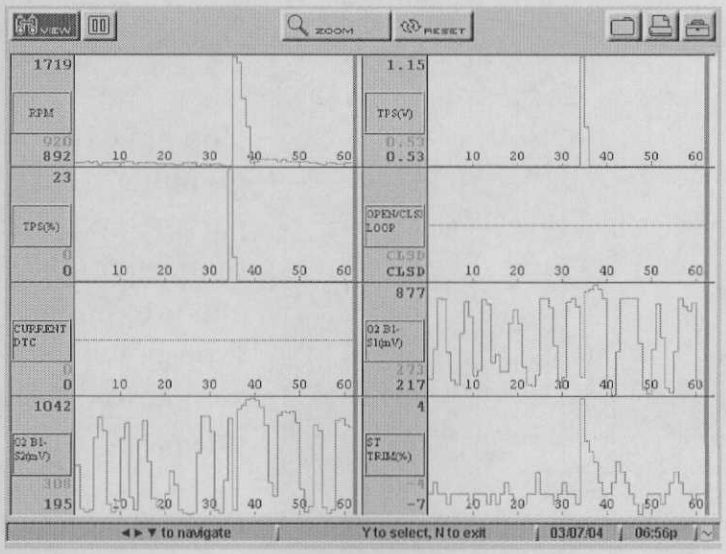


As you scroll down the list, you see "History Codes". These are codes that were stored at an earlier time when a failure was occurring, but is not failing at the present time.



You can view up to nine parameters of data on the screen at one time. The top three are fixed and can not be changed. The lower six change as you scroll up and down the list. You can lock lines one and two—we will discuss this later.

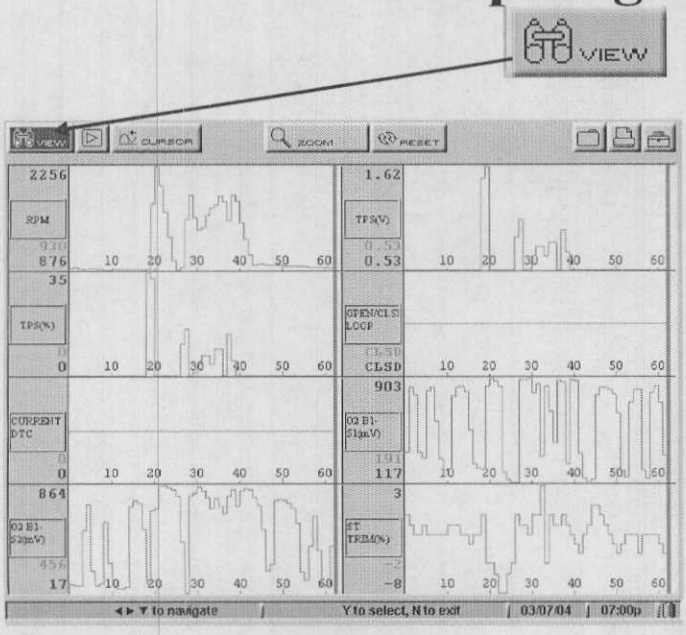
Graphing Data



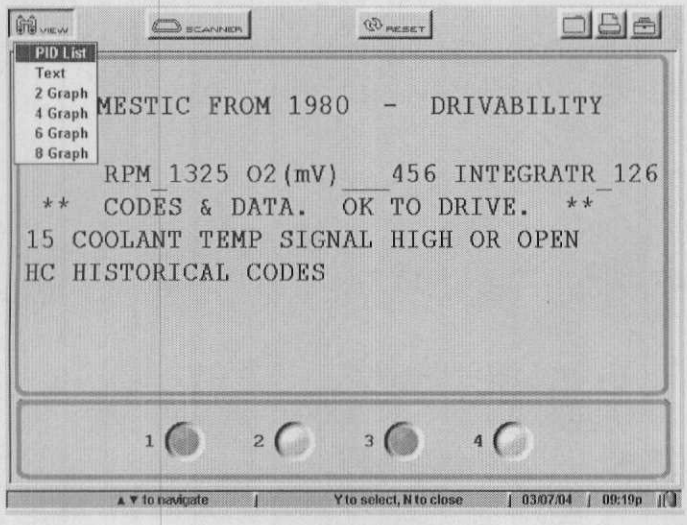
Let's discuss some of the features that the MODIS has over a conventional scanner:

- The ability to graph from 2 PIDS up to 8 PIDS of data at one time.
- When you are viewing scan data in the graph mode, you have the ability to zoom in on that data.
- You can also view up to 16 PIDS of data at once.
- When viewing scan data, you can switch to the lab scope and the scanner will continue to record in the background.

Graphing Data

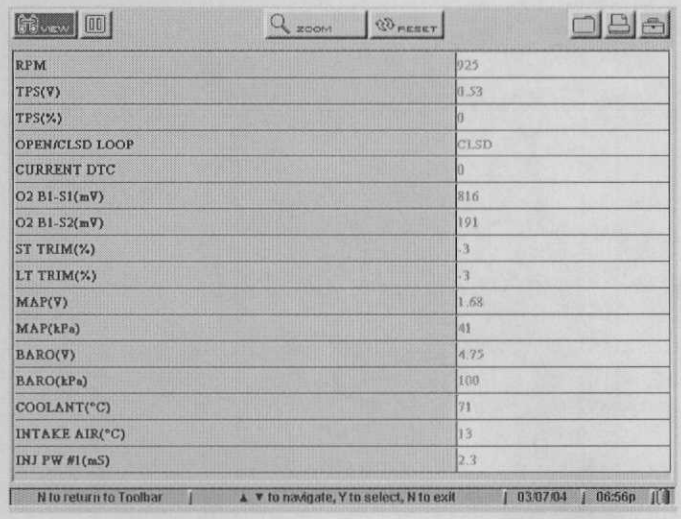


You have the option of graphing from 2 to 8 parameters of data at one time. By highlighting "View" and pressing the "Y" button a drop-down menu will appear similar to the one in the next image.

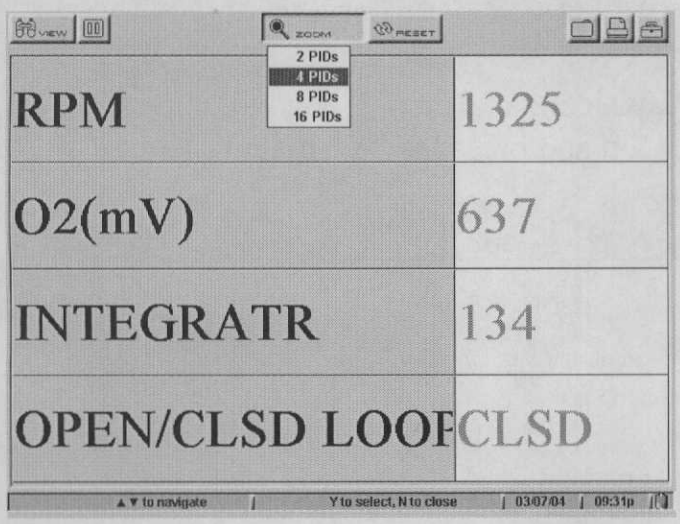


From the drop-down menu you have the option of viewing 2 to 8 parameters of data in a graph form. To make a selection, scroll up and down with the "Thumb Pad" and press the "Y" button. You also have the option of selecting "PID List" from this menu.

PID List

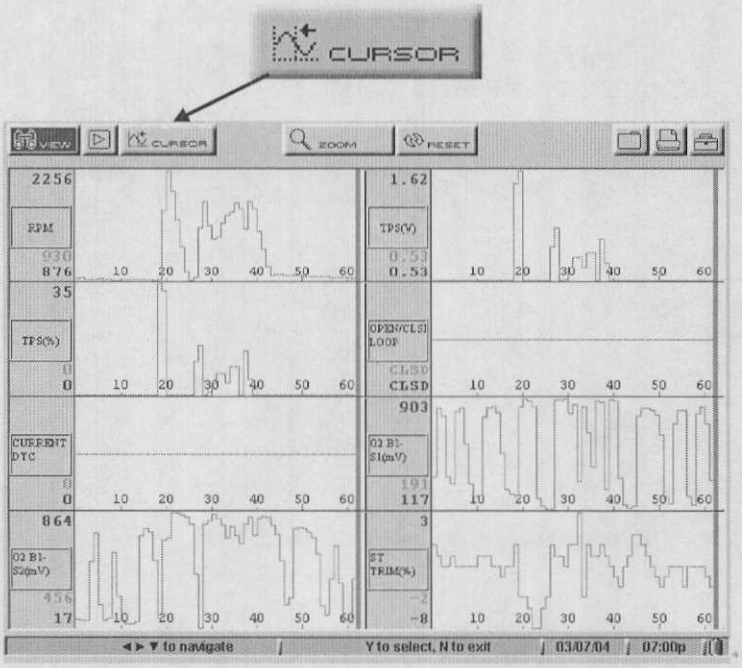


Another feature in the MODIS is the option of viewing data in a PID List form. You have the choice of viewing the list four different ways: 2, 4, 8, or 16 PIDS at once.

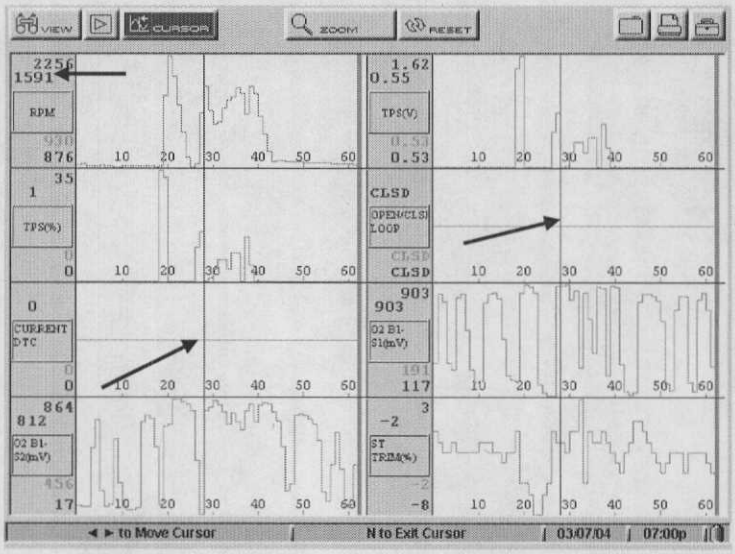


To change the list, highlight the "Zoom" icon and press the "Y" button. Use the "Thumb Pad" to scroll up and down and press the "Y" button to make your selection.

Cursor

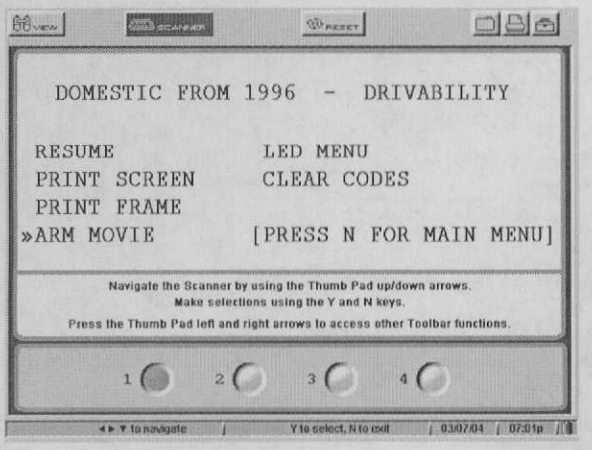


Anytime you press the "Pause/Play" icon, a "Cursor" icon will appear. To activate the cursor, highlight the icon and press the "Y" button.

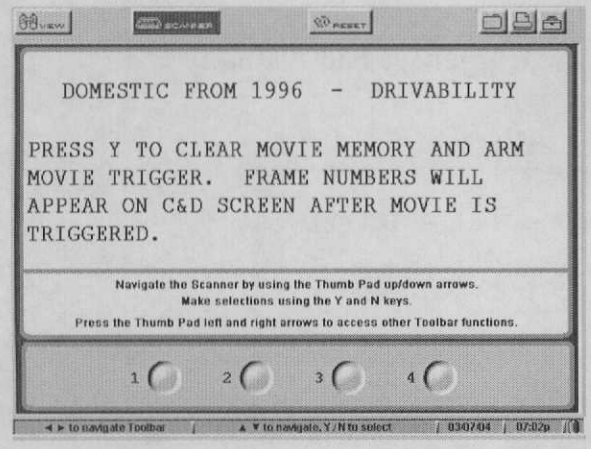


The blue line on the screen indicates the cursor. To move the cursors press the "Thumb Pad" to the left or right. When the cursor is activated you will notice a new set of numbers on the screen, indicated by the upper left arrow. These numbers represent the value that intersects with the cursor.

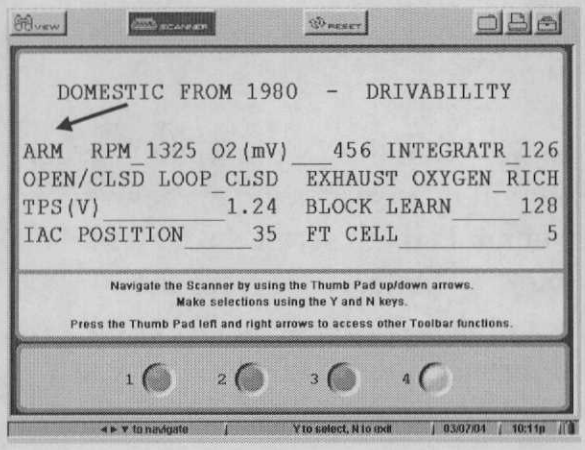
Recording a Movie



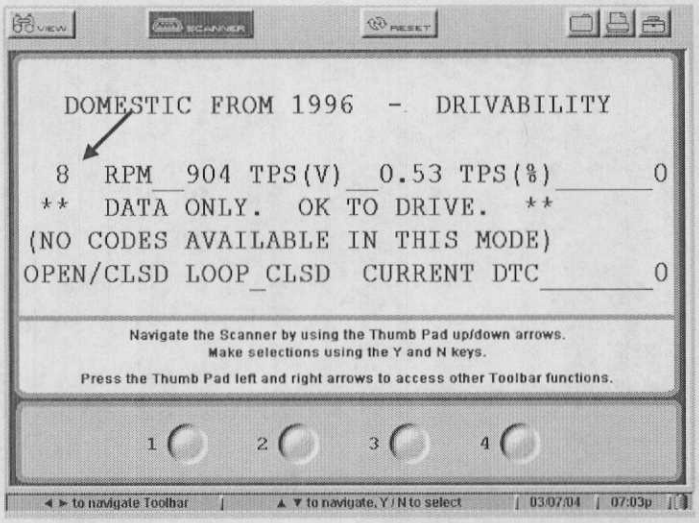
While you are in the normal data list you have the option to record a movie. To arm the movie press the "N" button while viewing data. This will bring you to this screen. Use the "Thumb Pad" to scroll down to "Arm Movie" and press the "Y" button.



Once you press the "Y" button, you will see this screen. You are instructed to press the "Y" button to clear the movie and arm the trigger.



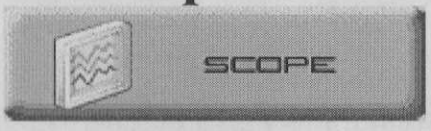
Once you press the "Y" button you will return to the data screen and you will see the word "ARM" on the left of the screen. You can now monitor the data and operate the scanner as normal. When you wish to begin a recording, press the "Y" button.



When you press the "Y" button the scanner will begin to save a recording. The size of the recording will vary, depending on the system. On average the scanner will record between 49 to 99 frames of data before the trigger and almost always, 25 frames of data after the trigger was activated.

To review the movie, select "Review Movie" from the "Main Manu" screen. Once you press the "Y" button the movie will open and begin at the trigger point, which will be frame 0. Use the "Thumb Pad" to scroll through the data. To switch to the next frame press the "Y" button then press the "Thumb Pad" to move through the frames of data. Press the "Y" button again and use the "Thumb Pad" to scroll through the PID list on the next frame.

Section 3
Lab Scope Module



In this section we will cover some of the functions of the Snap-on MODIS Lab Scope Module. We will guide you through the menu set-ups and explain there meanings along with guiding you through some of the advanced features of the Lab Scope Module.

Why do I need a lab scope?

Is the data I see on my scanner valid information? Do I know that the engine temperature is correct? Is the MAP sensor reading correct? Etc. The scanner may say that the EVAP purge solenoid is activated. We would use a lab scope to verify that these readings are correct. Then, we would look for glitches in the circuit, check for proper supply voltage and proper ground circuit integrity.

This is the reason the MODIS was designed with the lab scope, graphing meter and scanner all in one unit. You can perform all the tests with one piece of equipment. By hooking up your scanner, you can keep recording data in the background while you are testing a component with the lab scope.

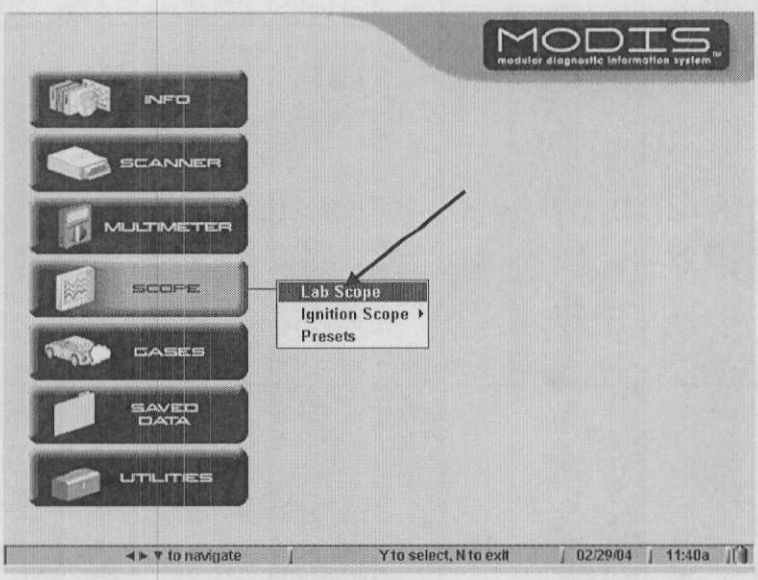
In automotive applications, what are we testing? We are testing voltage, amperage, ohms (resistance) and computer data. To properly test a component, you need to test it dynamically. This means to test it under its normal operating conditions. You need to observe the voltage patterns and amperage patterns if possible. Without a lab scope you can not thoroughly test the system.

MODIS Lab Scope

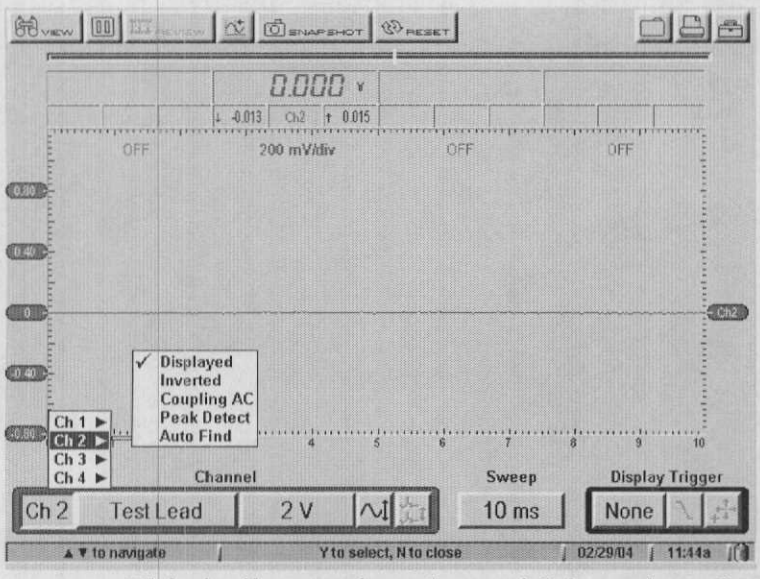
- Up to 4 channels can be displayed at one time
- Channels can be inverted
- You have the option of dc or ac coupling
- You can use auto find when you are not sure of the set-up

When navigating through the menu, you will notice MODIS controls are set up the same way as the already familiar MT2500 scanner and the Vantage. The only difference is, using a "Thumb Pad" rather than the "Scroll Wheel". The "Y" and "N" buttons are the same.

Menu Selections

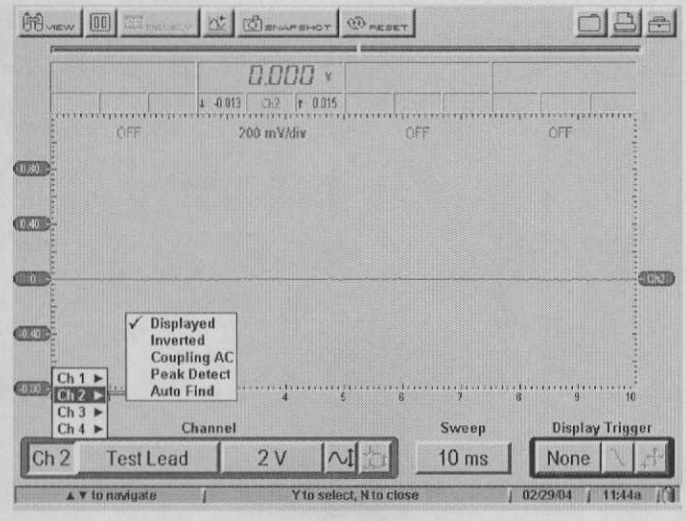


To access the lab scope, use the thumb pad to highlight the "Scope" menu. Then highlight "Lab Scope" and press the "Y" button, or push the thumb pad to the right, if you have the "Easy Scroll" option activated.



The first menu option we will discuss is the channel menu. First highlight the channel menu and press "Y" or press up on the "Thumb Pad". You will now see all 4 channels listed. Highlight channel 2 and you will then see that a new menu appears. Highlight "Displayed" and a check mark will appear. This indicates that channel 2 is active. On the next page we will discuss the other options available in this menu.

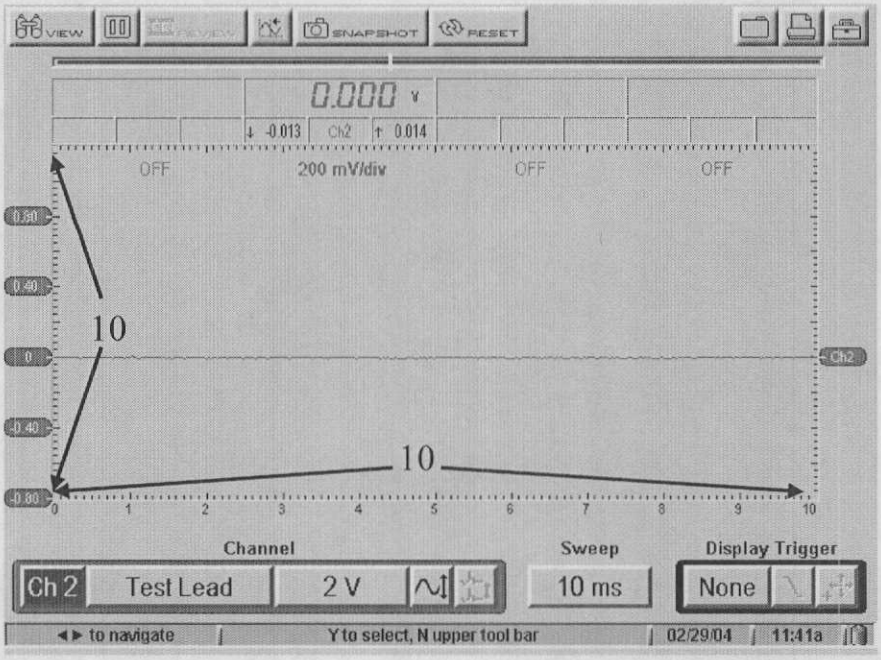
Menu Selections



Now let's cover the remaining menu options available under the channel selection menu:

- **Inverted:** This function does exactly what it says. It inverts or flips the pattern over. This would be useful if you were viewing an ignition pattern on an EI (distributorless) ignition system where one of the patterns might be upside down or if you were using your amp probe and the pattern needed flipped or inverted.
- **Coupling AC:** This function is used to view an ac signal, such as a pick-up coil or an ABS speed sensor.
- **Peak-Detect:** This function tells the scope to sample at its maximum sampling speed. This is useful when you're trying to find a glitch in a TP sensor or if you were looking at an ignition pattern and having trouble seeing the voltage spike. Normally, you would not use this option. If you have Peak-Detect turned on when viewing most signals you will pick up excessive noise in the pattern. This may lead you to believe that there is a problem—when actually there is not.
- **Auto Find:** This function will help you find a signal when you're not sure of how to set up the scope for the signal you want to view. Keep in mind that this may not give you the best set-up for the pattern, but it will get you close enough to see the pattern. You can then make further adjustments as needed.

Scope Divisions

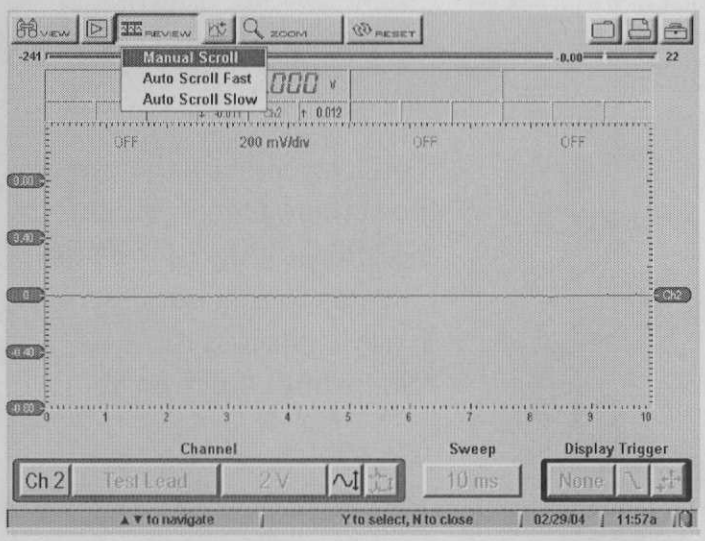


The MODIS, **unlike most scopes on the market,** has 10 divisions from the bottom of the screen, to the top of the screen. Most other lab scopes have 8 divisions. There are also 10 divisions from the left of the screen to the right of the screen.

There are a couple of other things to note while you're looking at the image. The numbers on the left, going from the bottom to the top, indicate the volts per division. The numbers on the bottom, going from left to right, indicate the time per division.

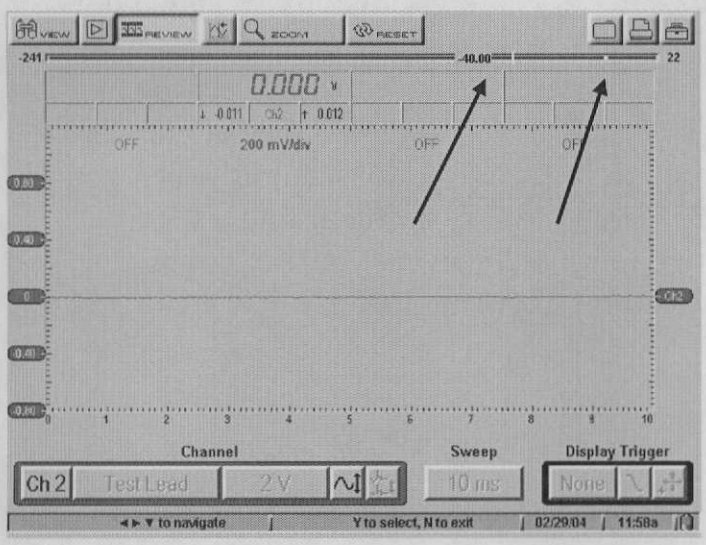
Tip: When setting up your scope, focus first on the voltage settings. Then focus on your time sweep, then on the trigger settings. This will allow you to quickly get a pattern to display on the screen.

Record, Zoom & Snapshot Functions



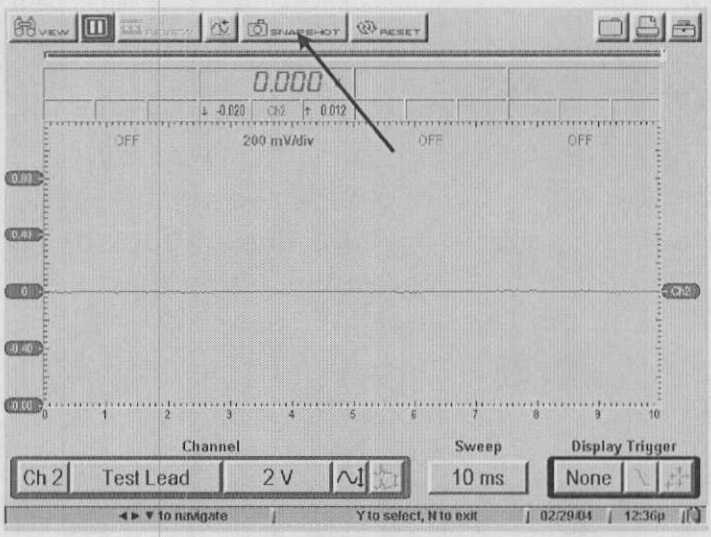
As you're using the MODIS lab scope, the "Record" function automatically starts to record. The buffer will store up to 300 frames in its memory. By pressing the "Play/Pause" icon in the menu bar, you can freeze your recorded data and play it back.

To play back a movie in the buffer, highlight and press the "Pause/Play" icon. This will freeze the screen and allow you to select the "Preview" icon. Highlight the "Preview" icon and press the "Y" button twice to open the drop-down menu. You now have the option of playing the movie manually or by auto scrolling fast or slow.

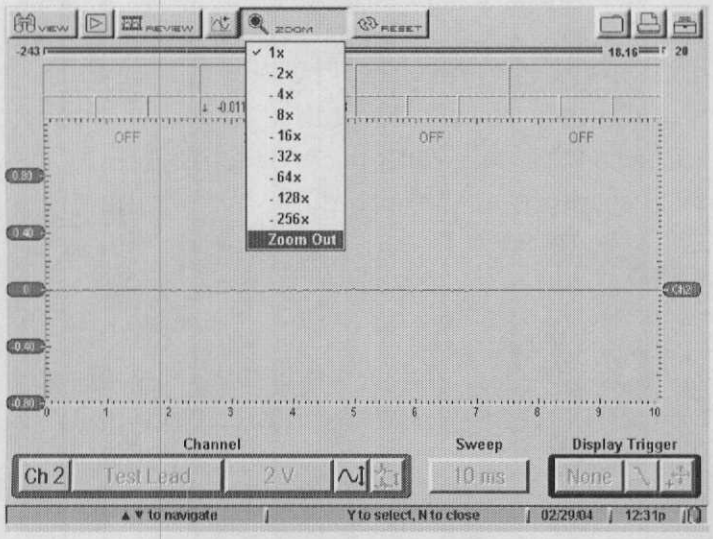


The right arrow is pointing to the zero reference point of the movie. As you scroll through the movie you will notice a second indicator bar scroll across the "Data Buffer Bar". This represents which frame in the movie you are viewing.

Zoom Function



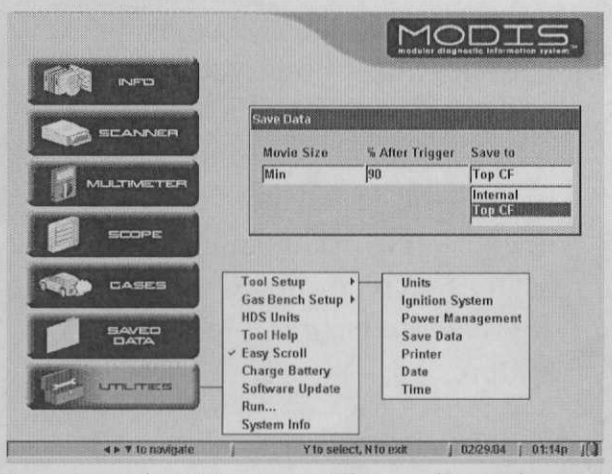
When you are viewing live data on the scope you will notice there is a "Snapshot" icon available on the top of the screen. Once you press the "Pause/Play" icon this changes to a "Zoom" icon. We will discuss the "Snapshot" function shortly.



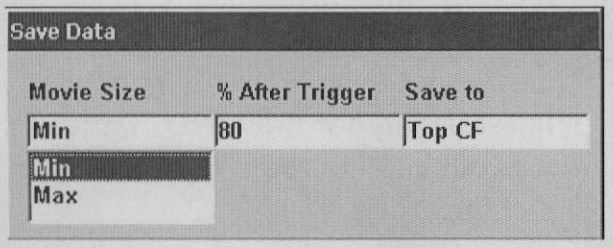
On previous versions, you had only one option for zooming in on the waveform. With the latest update, you now have the option of zooming in from 1x to 256x. When you use the "Zoom" function you are viewing more of the movie on the screen at one time. This is helpful when you are trying to find a specific event in the movie. Once you find the specific event you are looking for, you can "Zoom Out" to view the waveform in greater detail.

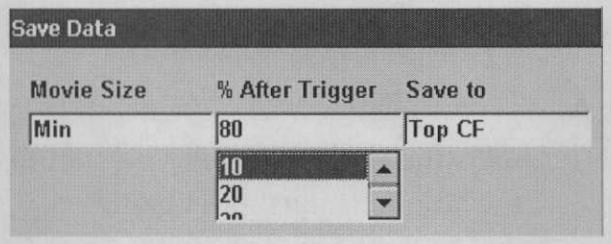
Snapshot

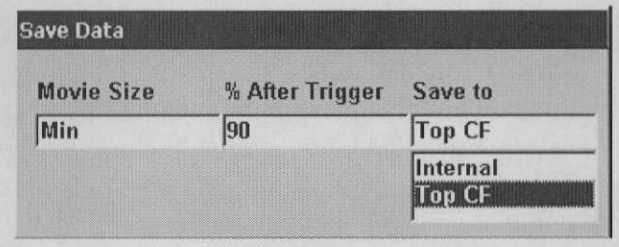
There are a few key features we need to discuss about the "Snapshot" function in the MODIS.



With version 4.1 you have a new option for saving your "Snapshots". You can now save them to a Compact Flash (CF) card. You can purchase these cards from any computer store. You will load this card into the same port on top of the MODIS that you use when performing a software update. You will need to go into the "Utilities" menu of the MODIS to setup the "Save to CF card" option. To enable this option, go under "Utilities", "Tool Setup" and "Save Data". Once you selected "Save Data" a new window, similar to the one above, should appear.



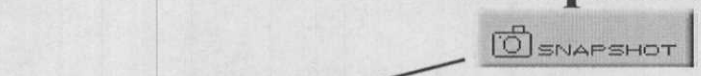


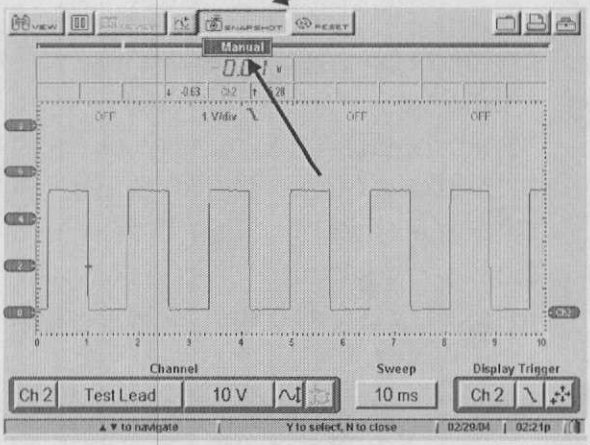


While in the "Save Data" section there are a few more items we need to mention.

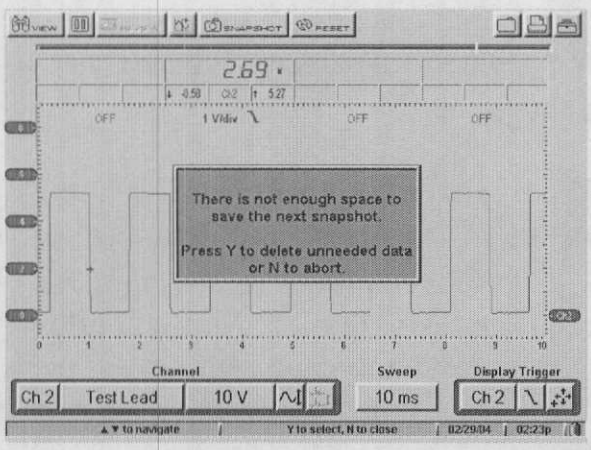
- **Movie Size:** Min will allow you to capture more events of the item you are viewing, but less total time. Max will allow you to capture more time, but less detail.
- **% After Trigger:** You have the option of adjusting the length of the movie to be recorded after the trigger is pressed.
- **Save To:** You have the choice of saving to a CF card or saving the movie internally.

Snapshot

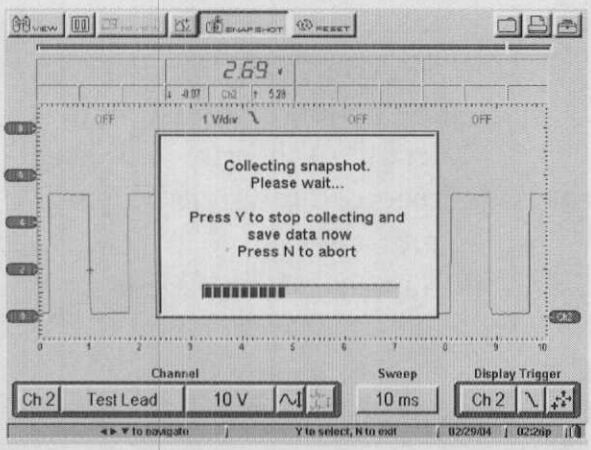




To activate the "Snapshot", highlight the icon and press the "Y" button. At this point you only have one choice—manual. Once you select manual by pressing the "Y" button, the "Snapshot" icon will begin to flash. This indicates that the MODIS is recording data. When you are ready to trigger, press the "Y" button.

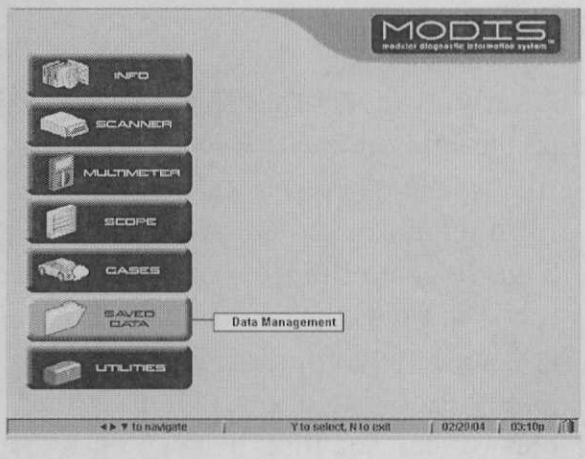


If your CF card is full or your MODIS does not have enough internal memory, you will see the message similar to the one on the left. In most cases you need to save a snapshot to a CF card. With the latest update for the MODIS, there was not enough room left for movie storage.

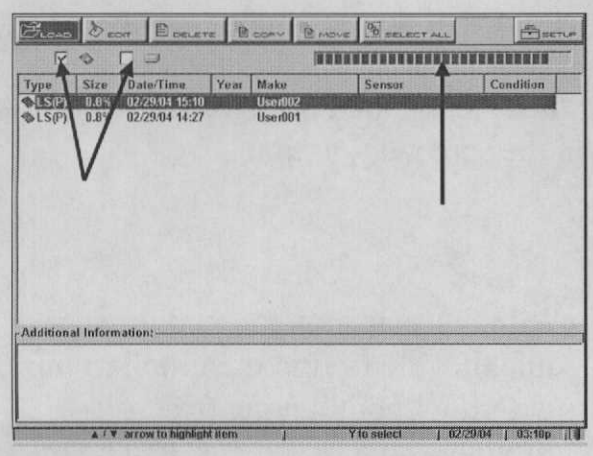


This is the typical screen you should see when the snapshot is being saved to your CF card. After the movie is saved you will see a confirmation screen pop up verifying the movie was saved to your CF card.

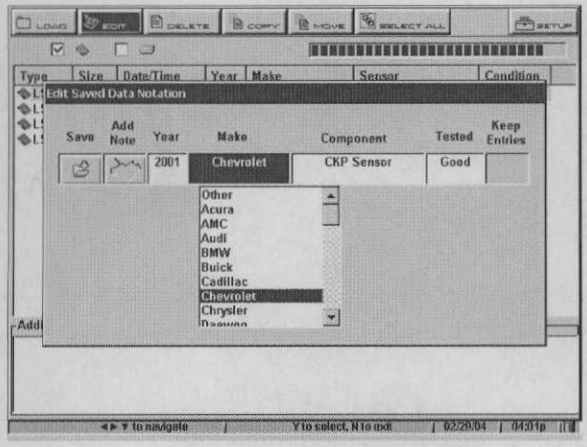
Reviewing a Movie



To review a movie you will need to access the "Data Management" section in the "Saved Data" section. Here you will find all the files you have saved. Remember, the CF card needs to be installed in the upper slot if your files are saved to the CF card.

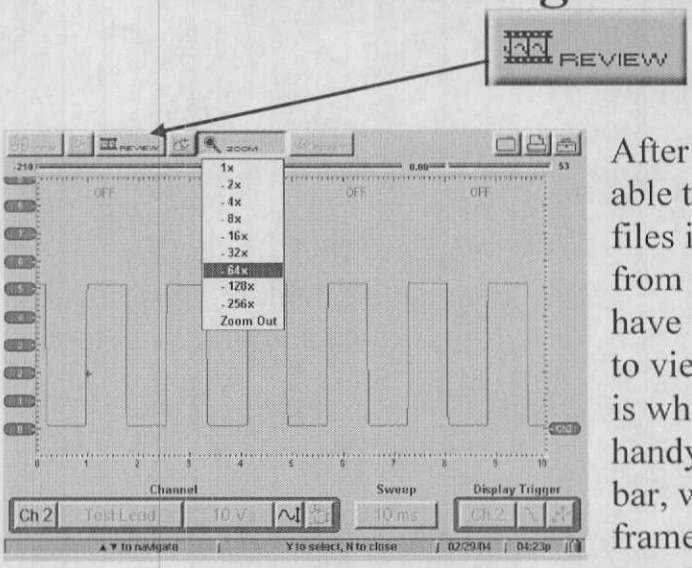


Under the "Data Management" section you have a variety of options to choose from to manage your files. You are able to delete, copy, edit, move or load your files in this section. The arrow on the right is pointing to the available storage reference indicator. The two arrows to the left are pointing to the storage location. If the left box is check marked, the files will be stored and accessed from the CF card. If the right box is check marked the files are stored and accessed from the internal memory.

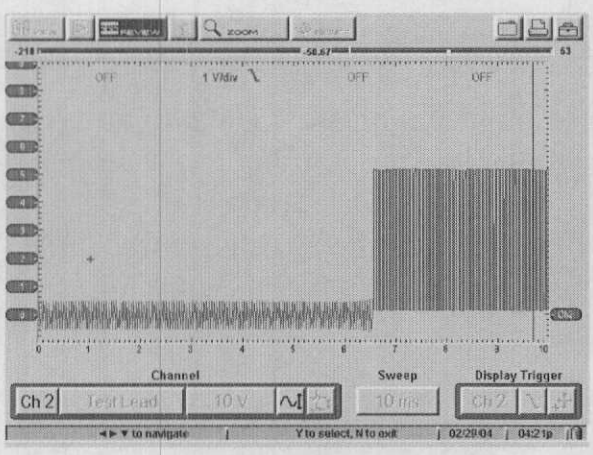


You also have the option of adding notes to your saved records. To add a note, highlight the correct box and press the "Y" button. A drop-down menu will appear similar to the one on the left. You then use the up and down button on the "Thumb Pad" to highlight your selection. Once you have made your selection press the "Y" button.

Reviewing a Snapshot

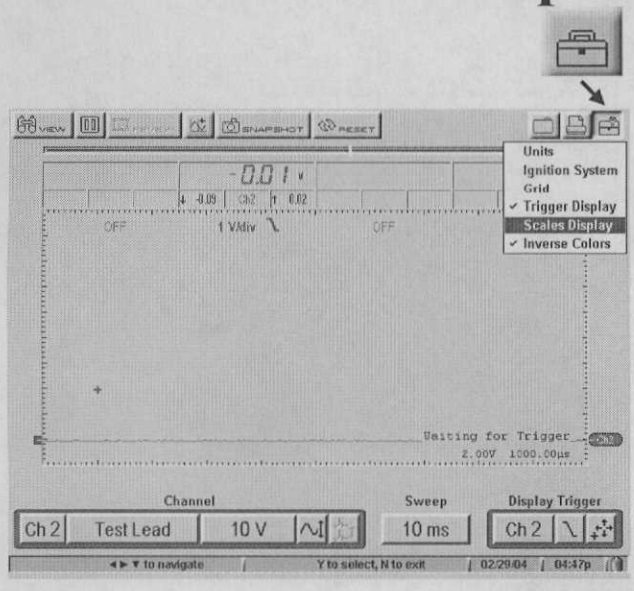


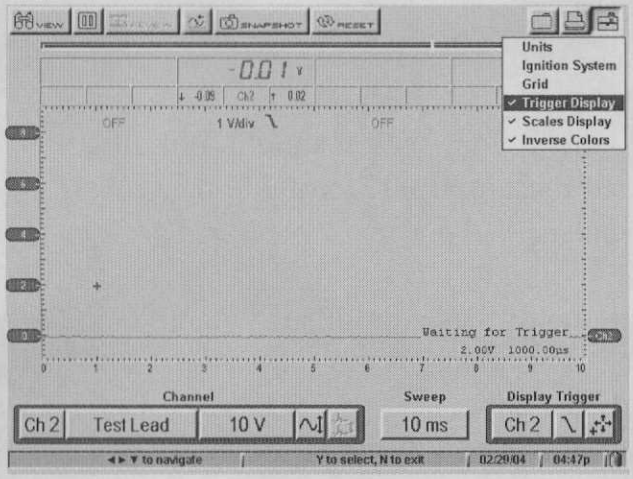
After you save a snapshot you are able to play it back. Access these files in the "Saved Data" section from the main screen. After you have selected the file you would like to view, press the "Y" button. This is where the zoom function comes in handy. Looking at our "Data Buffer" bar, we can see that there 263 frames of data to view. Now the question is where do I look to find what I am looking for? By highlighting the "Zoom" and pressing the "Y" button, we are able to view more data on the screen at on time.



With the snapshot zoomed in we are quickly able to find the glitch in our pattern without having to scroll through as many screens. Once you locate the problem area you can zoom back out to normal view.

Setup Menu

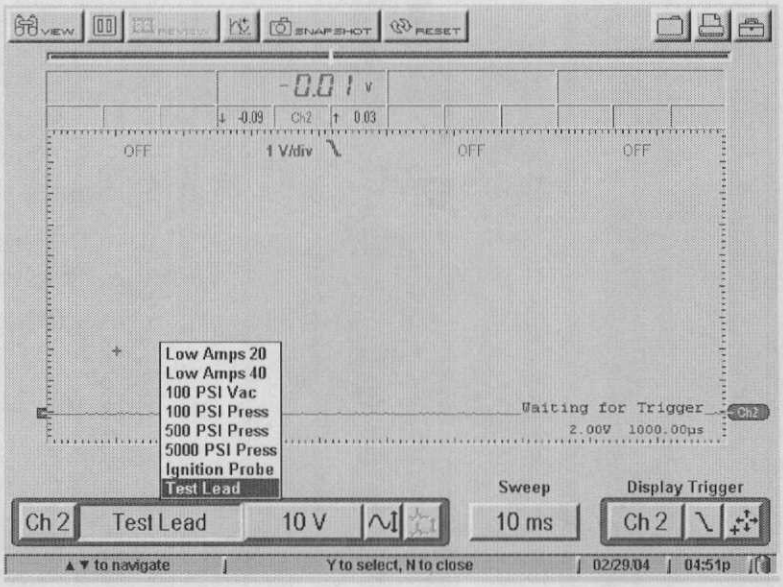




To the left we are viewing the setup menu.

- **Units:** Select this menu if you wish to change how vacuum, pressure and concentrations are displayed.
- **Ignition System:** Use this option to set the scope for the ignition system on the vehicle being tested.
- **Grid:** This option allows you to have a grid displayed on the screen. This can help you make measurements on the screen.
- **Trigger Display:** In the lower right corner of the screen you will notice the words "waiting for trigger". You can turn this option on or off. This represents the voltage level at which you've set the trigger at.
- **Scales Display:** This function will allow you to display your volts and time per division, as seen on the lower image, or you may turn them off, as seen in the upper image.
- **Inverse Colors:** This option will allow you to change the background color of the screen from black to gray.

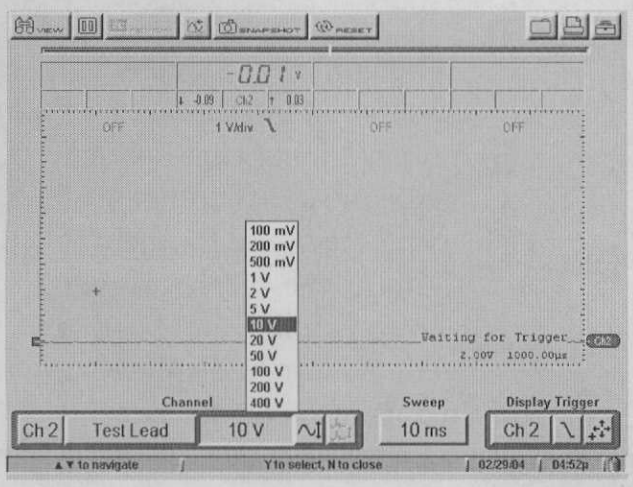
Test Lead Selection Menu



When you highlight the "Test Lead" menu your screen should look like the image above. You would select one of these options if you are using test leads, other than the normal meter leads.

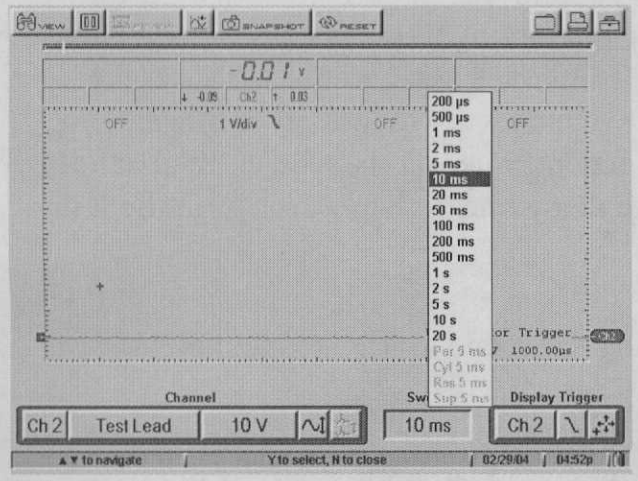
- **Low Amps 20 and 40:** Select one of these options if you are using a clamp on type low amps probe. This changes the scale from volts to amps, making it easier to read the scope.
- **100 PSI Vac, 100 Press, 500 Press or 5000 Press:** Select one of these options if you are using the Snap-on transducers.
- **Ignition Probe:** Select this option if you are using the secondary probe to view the ignition system.

Voltage Scale Menu



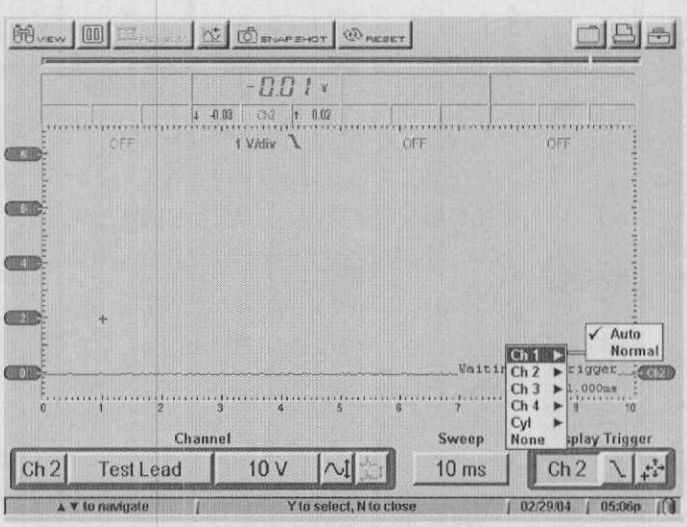
Observe the image on the left. We are now selecting our voltage settings. You have a choice of 100 mV to 400 V. You must always keep in mind that this setting is for the total screen voltage—not per division. So, if you chose 1 V, each division would equal 100 mV.

Time Sweep Menu



By using this next image we are viewing time sweep. As you can see, you now have the choices of 200 µs to 20 s. Again, this applies to total screen time—not per division. One addition to this menu in version 4.1 is the Ignition Time Sweep selections. These are fixed settings; this means the settings are non-adjustable. These choices are only available when you accessed the scope through the "Ignition Scope" from the main menu. If you select "Ignition Scope" from the "Test Lead" menu, you will not be able to access these settings. We will go into greater detail on the "Ignition Scope" section later in the manual.

Trigger Menu



When talking to technicians, I've found that setting up the proper trigger (for a pattern) is the most difficult part of using the scope for them. Without the correct trigger set-up you may not be able to get a pattern to display—or the pattern you are viewing will not be stable.

The MODIS has the option to trigger off channels 1 – 4, externally with the sync probe—or none. By choosing to trigger off channels 1 – 4 you are telling the scope not to start displaying until the pattern crosses a certain voltage level. For example, you are attempting to view a 5 V square wave on channel 1. First select channel 1 from the trigger menu. Next, set the trigger on negative or positive slope, whichever you prefer on this pattern. Then, set the delay and level. As a general rule, set the trigger level at half the voltage of the pattern and set the delay one division over from the left.

Trigger Options:

- **Channel 1 – 4:** You are telling the scope to trigger internally off of one of these channels.
- **Cyl:** You are telling the scope to trigger from one of the cylinders by use of the sync probe. The scope will wait until a pulse from the ignition to start the pattern.
- **None:** This is actually a free run mode. The scope will display any pattern, no matter what it is. The scope does not look at anything for a trigger.

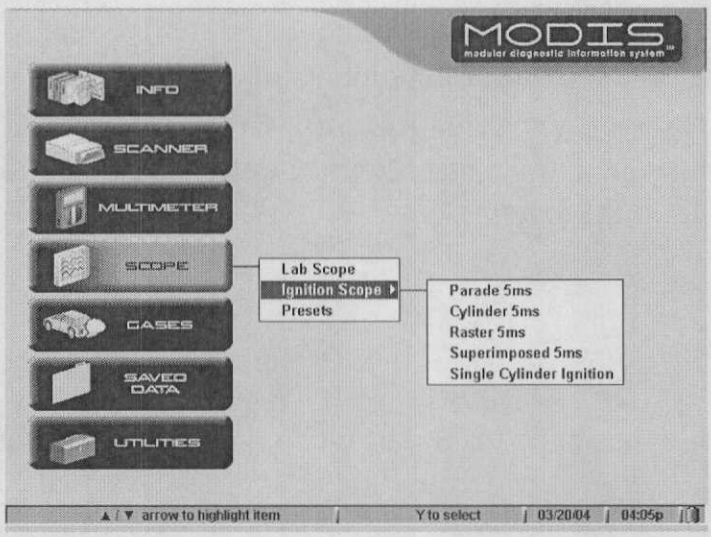
Trigger Level & Delay:

- **Trigger Level:** By setting a voltage level, you are telling the scope not to draw a trace until the voltage crosses this level.
- **Trigger Delay:** By moving the cross on the screen, you are now telling the scope not to start the trace until a certain amount of time has passed on the screen.

Trigger Slope:

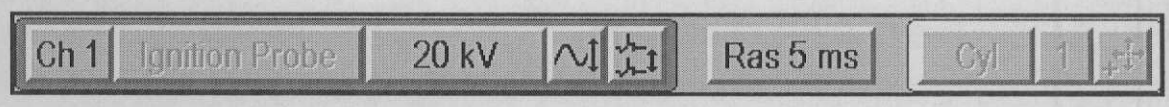
Trigger slope tells the scope to trigger when the pattern is going up or down. For example, let's say you were looking at a 5 V square wave, the slope was set on positive and the delay was set one division over from the left. The pattern would not start to display on your screen until the pattern went over one division, started its vertical rise and then crossed the voltage level that you had pre-set.

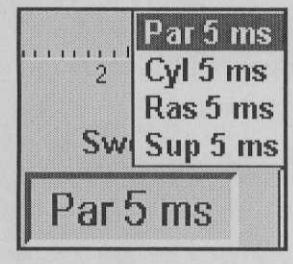
Ignition Module



With the addition of version 4.1 you now have Secondary Ignition capabilities. Unlike before, version 4.1 will now allow you to view secondary waveforms in: Parade, Superimposed, Single or Raster patterns.

Ignition Menu

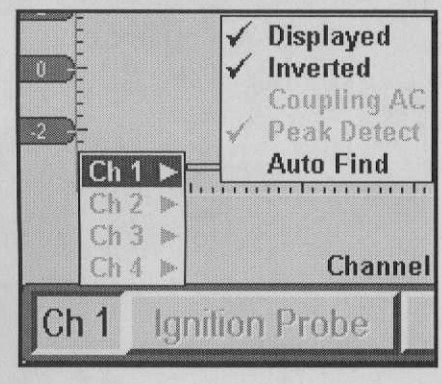




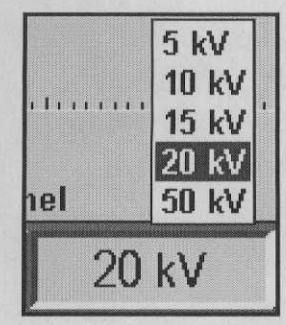
You have four different choices available under the selection menu:

- **Par 5 ms:** Parade 5 ms time sweep
- **Cyl 5 ms:** Single Cylinder 5 ms time sweep
- **Ras 5 ms:** Raster 5 ms time sweep
- **Sup 5 ms:** Superimposed 5 ms time sweep

All "Time Sweep" settings default at 5 ms and are non-adjustable. When viewing a secondary pattern you are viewing the first 5 ms of each firing event.

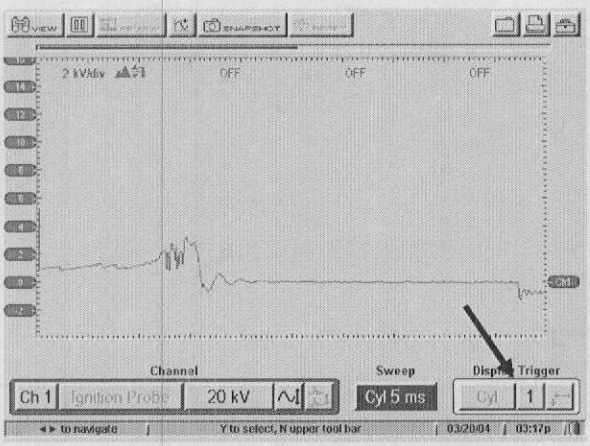


When you select "Ignition Scope" from the main menu, most of the settings will be selected for you. Notice channels two thru four are light gray; this indicates they are not selectable. Also note "Peak Detect" is light gray and has a check mark next to it. This indicates that "Peak Detect" is selected.

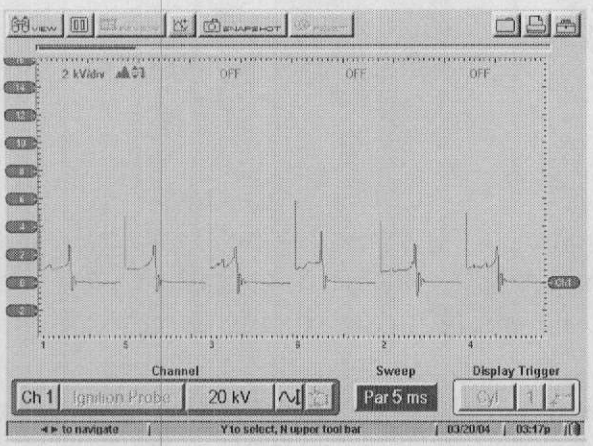


The next menu is the "Voltage Scale" adjustment. There are five choices available: 5 kV, 10 kV, 15 kV, 20 kV and 50 kV. Remember this indicates total screen voltage not voltage per division. If you select "Scales Display" from the "Utilities" menu you will see the voltage per division listed on the left of the screen.

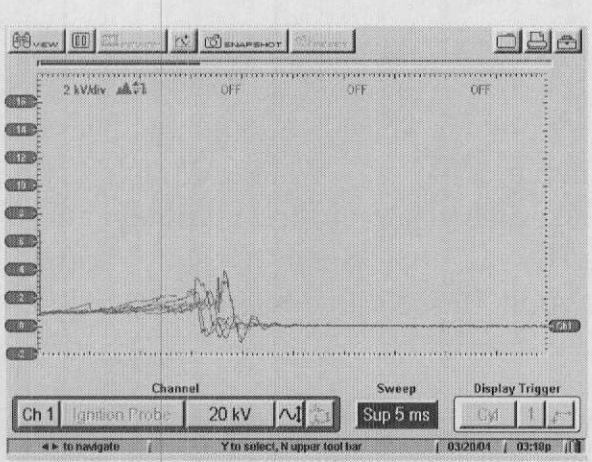
Ignition Module



Cyl 5 ms: You will be looking at one cylinder at a time when selecting this option. The pattern on the screen will be the one that the sync probe is clamped around. To view another cylinder, select that cylinder in the trigger menu.

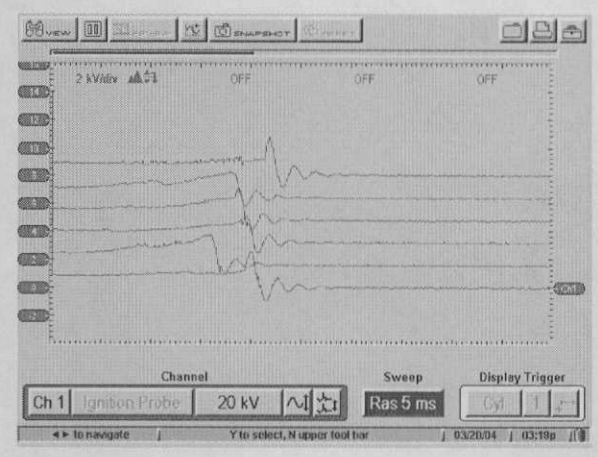


Par 5 ms: You will be looking at all the cylinders in parade form. The firing events will be displayed by the firing order. Notice you are only viewing the first 5 ms of the firing event.

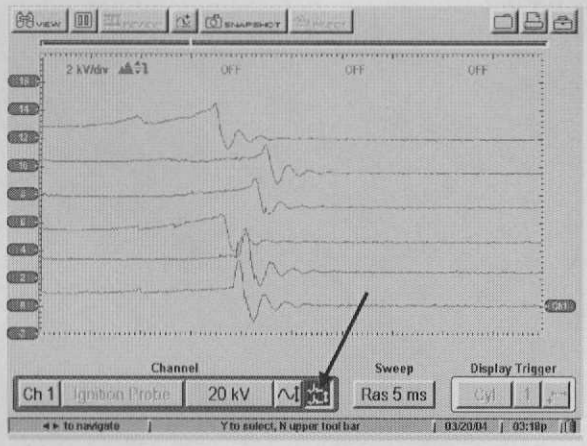


Sup 5 ms: You will be looking at all the firing events overlapping each other. Notice you are only viewing the first 5 ms of the firing event.

Ignition Module

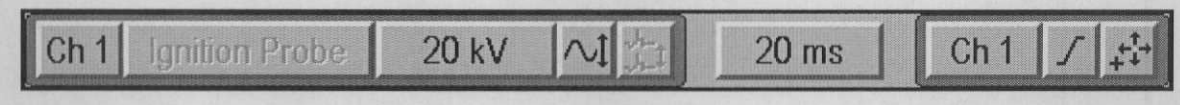


Ras 5 ms: You will be looking at all the patterns stacked vertically. When viewing the ignition in this manner, ignore the voltage scale on the left of the screen.



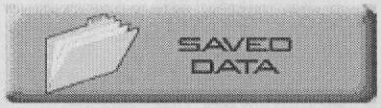
When viewing the patterns in "Raster" form, you have the options of moving the patterns. You can separate the patterns for better viewing by highlighting the pattern adjustment icon and pressing up or down on the "Thumb Pad". This is the only time you can use this icon.

Single Cylinder Ignition

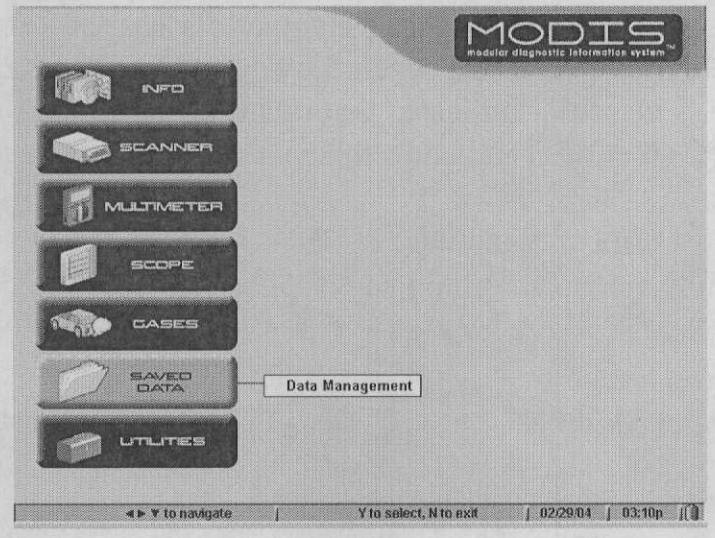


When you select "Single Cylinder Ignition" from the main menu you will have the option of adjusting trigger settings. You can choose to trigger from channel 1 or use the external sync probe to trigger the pattern. You also have the ability to position the pattern anywhere on the screen. You can also adjust the "Time Base" from 200 µs to 20 sec. of screen time. These settings are useful when you need to analyze an ignition pattern in greater detail.

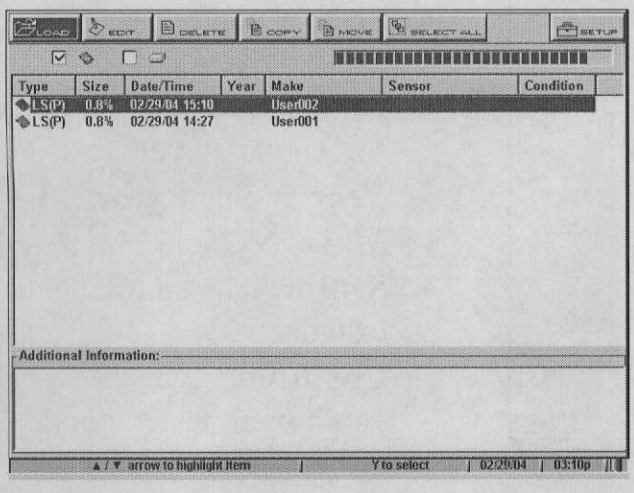
Section 4
Saved Data



In this section we will cover some of the basics functions under the Saved Data Menu.



When selecting the "Saved Data" menu a new submenu will be displayed that will allow you to restore, edit or delete a file. This function allows you to manage your saved files efficiently. Originally this function was ***only*** for use with the Lab Scope module, but now you have the option to save a screen shot in the Scanner and a movie or screen shot in the Multi-Meter or Vantage.



- **Load:** Select Load when you would like to view a saved file.
- **Edit:** Select Edit when you would like to edit a saved file.
- **Delete:** Select delete when you would like to delete a stored file.

When you select "Load" from the menu, you will see this screen. You can then use the "Thumb Pad" to scroll through the list and select the file to view.

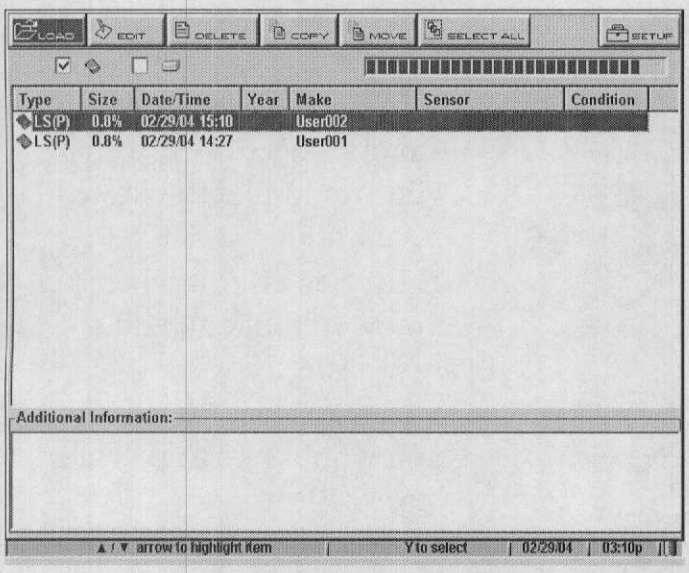
When a file is saved it is date and time stamped for easy reference later. You will also notice that under "Type" each file has a three letter identifier, such as LS(C). The LS identifier indicates that this file was captured in the Lab Scope and the (C) identifier indicates this is a scope preset.

Data Source Indicators may include:

- **MM:** Multi-meter (Graphing Meter only)
- **LS:** Lab Scope
- **IS:** Ignition Scope
- **SP:** Scanner Module

Data Type Identifiers may include:

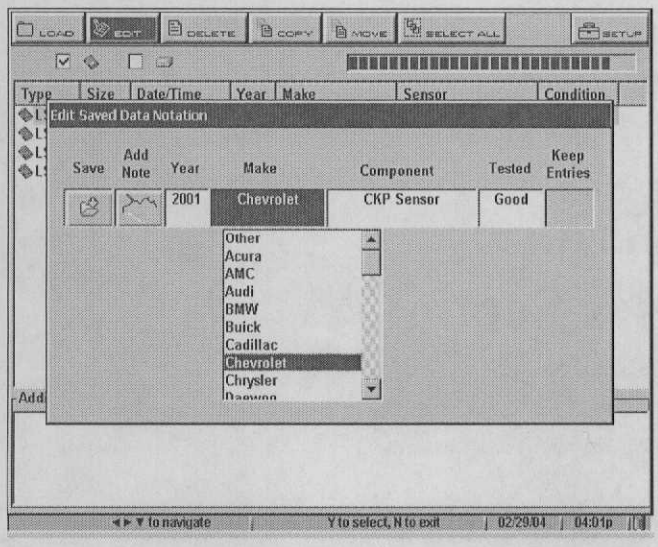
- **(C):** Preset
- **(M):** Movie
- **(P):** Snapshot
- **(S):** Screen



Let's cover the rest of the items across the top of the screen.

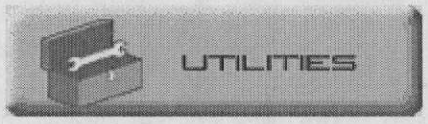
- **Size:** A percentage of the available storage space.
- **Date/Time:** When the screen was saved.
- **Year:** Vehicle year.
- **Make:** Vehicle Make.
- **Sensor:** The component tested.
- **Condition:** Was the component tested good or bad.

Note: Year, Make, Sensor and condition will be empty unless you entered data when saving the file.



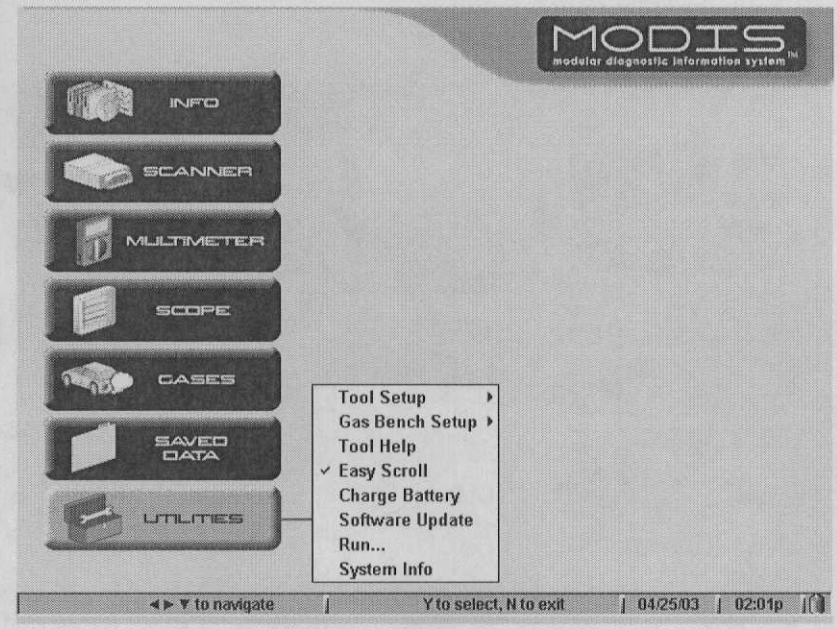
When you choose "Edit" from the menu a new window will appear. By using the "Thumb Pad" you are able to add notes about the saved file. Use the "Thumb Pad" to highlight the text box, scroll up and down to make the selection and press the "Y" button.

Section 5
Utilities Section



In this section we are going to discuss some of the key features and options available in the MODIS.

Utility Menu

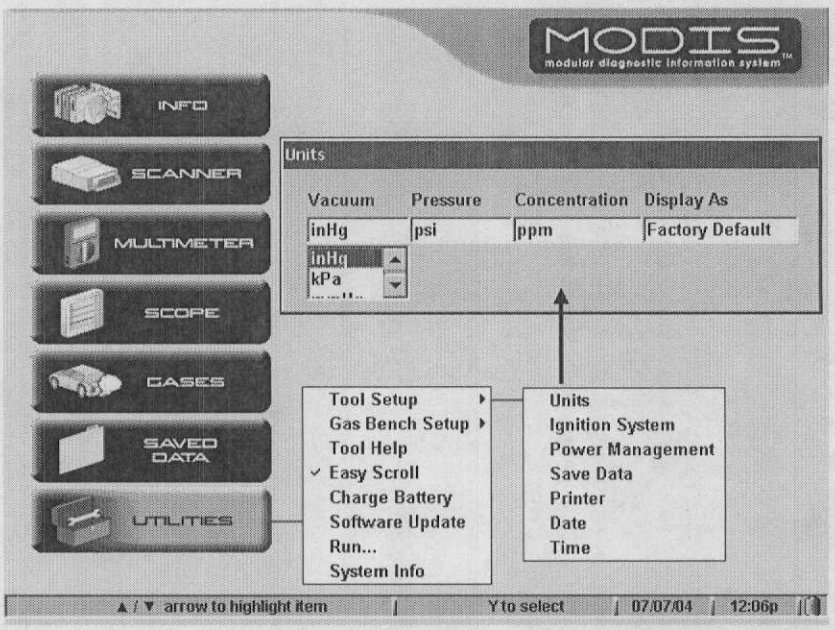


Above we are viewing the menu for the "Utilities" section. Within the "Utilities" menu is where you will find a variety of the setup adjustments for your MODIS. We will give you a brief overview below.

In this section you will find:

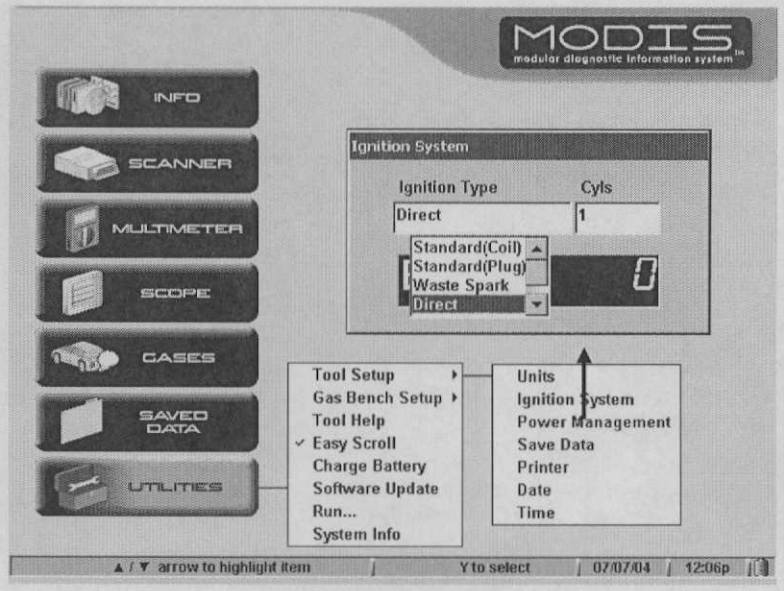
- **Tool Setup:** Under this section you find the settings for: Units, Ignition System, Power Management, Save Data, Printer, Date and Time.
- **Gas Bench Setup:** Under this section are the utilities for the Gas Bench Module.
- **Tool Help:** Under this section you will find a built in user manual.
- **Easy Scroll:** Enables the "Easy Scroll" option.
- **Charge Battery:** Enable the battery charging function by selecting this from the menu.
- **Software update:** Select this function from the menu when updating your MODIS software.
- **Run:** Select this function ***only*** when instructed to by Snap-on to perform updates or software patches.
- **System Info:** Specific software or hardware information is available in this section.

Now let's go more in-depth with each "Utilities" menu option.



When selecting the "Units" section in the "Tool Setup" menu, a new setup dialog box will appear—similar to the one above. Under this menu you have the option of selecting the displayed units of measurements for Vacuum, Pressure or Concentrations. These changes will only affect the Lab Scope or the Gas Module. Select a menu option by using the "Thumb Pad" to move to the left or right and highlight a unit. Then press the "Y" button to open a drop-down menu. Move the "Thumb Pad" up and down to highlight your selection and press the "Y" button.

Ignition System Menu

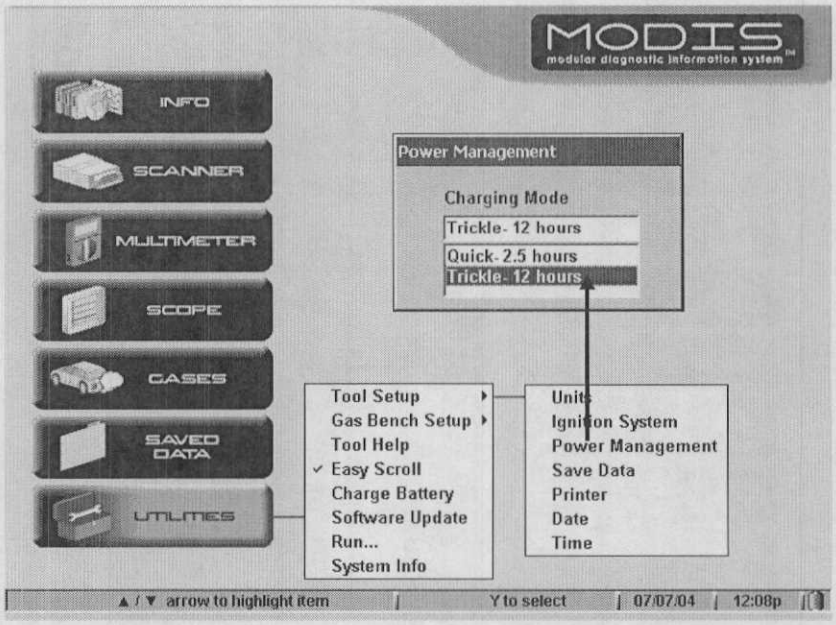


When selecting "Ignition System" under the "Utilities" menu, a new setup dialog box appears—similar to the one above. To properly calculate the RPM the MODIS needs to know what type of ignition system you are connected to. Under the ignition system dialog box you have the option of selecting Standard (Coil), Standard (Plug), Waste Spark, Direct or Other. These settings ***only*** apply to the Scope Module.

- **Standard (Coil):** Connect the pick-up to the coil wire on a distributor ignition system.
- **Standard (Plug):** Connect the pick-up to the spark plug wire on a distributor ignition system.
- **Waste Spark:** Connect the pick-up to a spark plug wire on a waste spark distributor ignition system.
- **Direct:** Connect the pick-up to a plug wire on a direct ignition system.
- **Other:** Use when the vehicle you are testing is not one of the above.

Under the "Cyls" submenu the options are: 1, 2, 3, 4, 5, 6, 8, 10 and 12. When "Other" is selected in the "Ignition Type" field, the "Cyls" field changes to RPM factor. The RPM factor is a multiplier that is applied to the displayed RPM for testing unique and unusual engine and ignition system designs.

Power Management

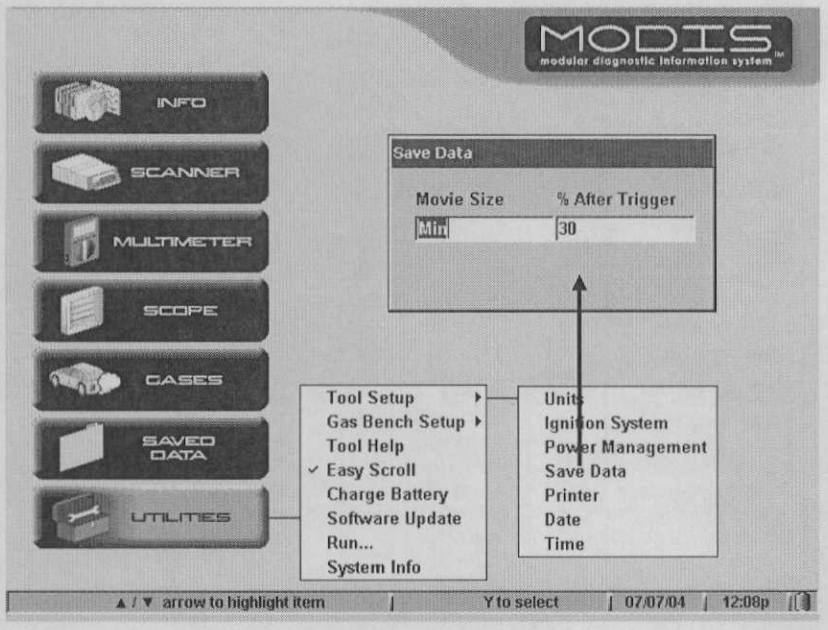


Under the "Power Management" menu you have the option of changing the battery charging speed. You have the option of Quick – 2.5 Hours or Trickle – 12 Hours. To select "Power Management", highlight by using the "Thumb Pad" and press the "Y" button. When the dialog box appears, press the "Y" button to open the drop-down menu. Press the "Thumb Pad" up or down and press the "Y" button to make the selection.

- **Quick – 2.5 Hours:** Charges the battery in 2 ½ hours, but will reduce the battery pack life.
- **Trickle – 12 Hours:** Charges the battery in 12 hours. Trickle charge will allow you to get the maximum life out of your battery pack.

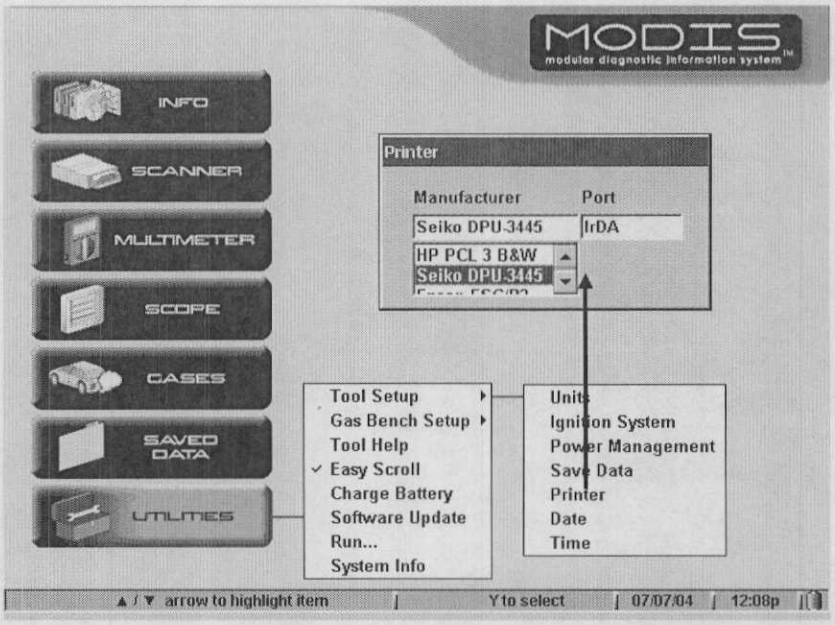
Tip: To avoid draining the battery when not in use for an extended period, remove the battery pack from the unit.

Save Data

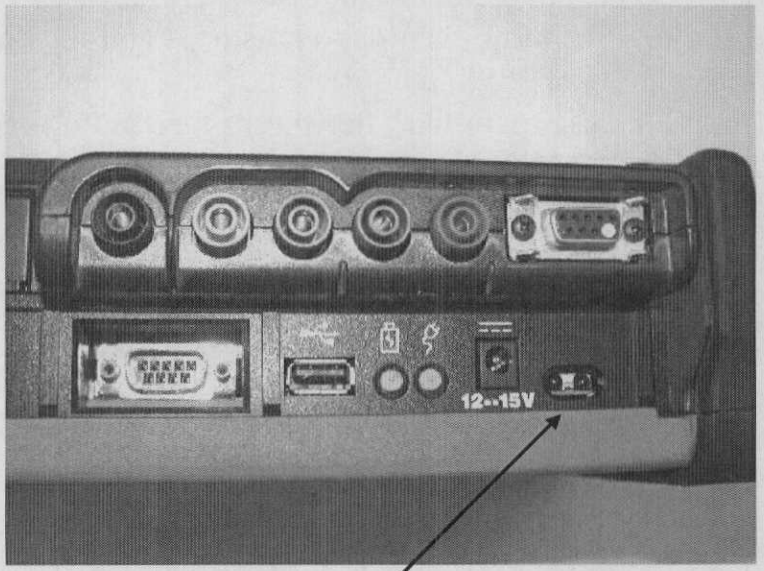


Under the "Save Data" you can adjust the amount of memory allocated for saved data and adjust the amount of data recorded after the trigger point when a snapshot is taken. This function only applies to the lab scope section. There are two options available under the "Movie Size"—Min and Max. The "Min" size will allow for more records to be stored and the "Max" size will capture the most data for each record. "% After Trigger" allows you to choose how much data is recorded after the trigger button is pressed. You have the option from 10 to 90 percent.

Printer

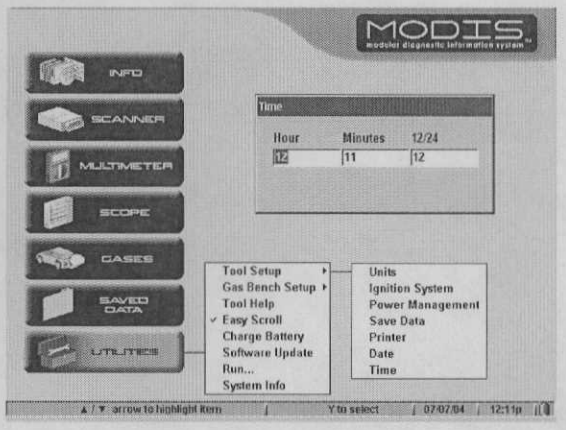


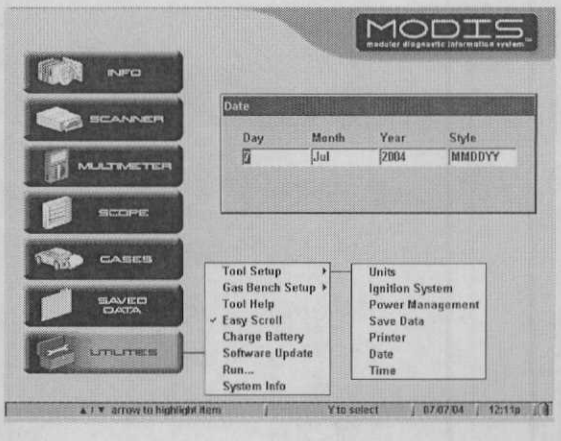
Selecting "Printer" from the menu allows you to change the settings for the printer you are using with the MODIS. AT this time your only option for printing is via an infrared port.



Infrared Port

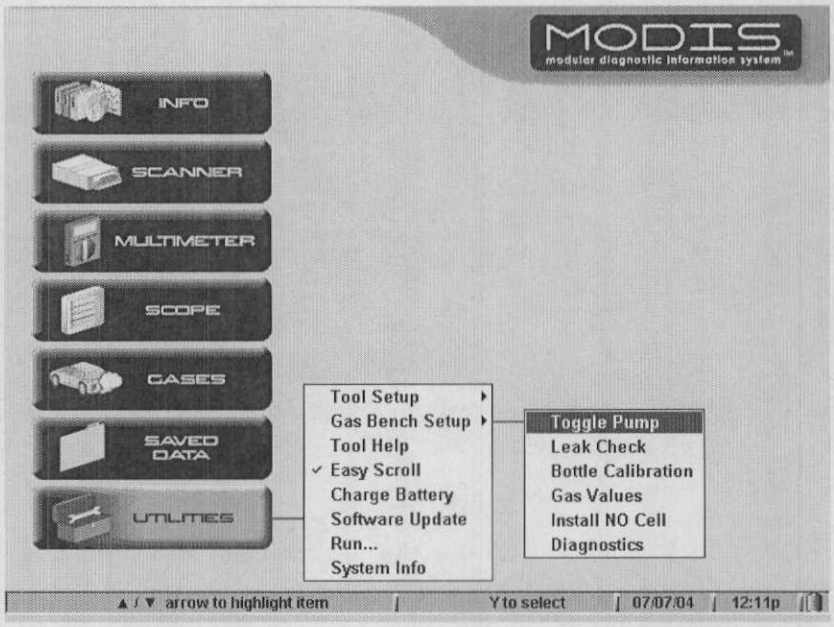
Date and Time





Under the "Date" and "Time" menus, you can adjust the date and time of your MODIS. You have the option of changing the order of the day, month and year. The 12/24 field allows you to select the standard 12-Hour clock style or the 24-Hour clock style.

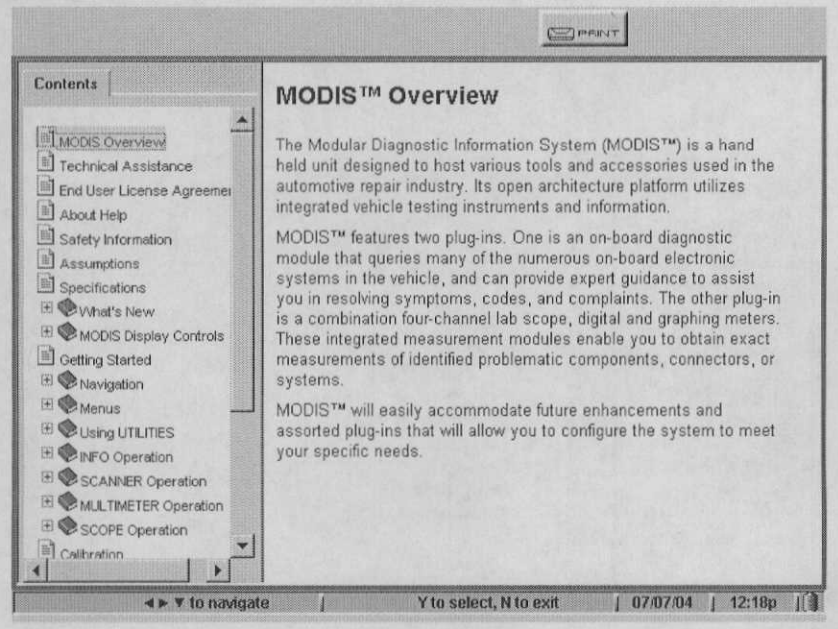
Gas Bench Setup



This function is only for use with the ***optional*** Flex Gas Analyzer.

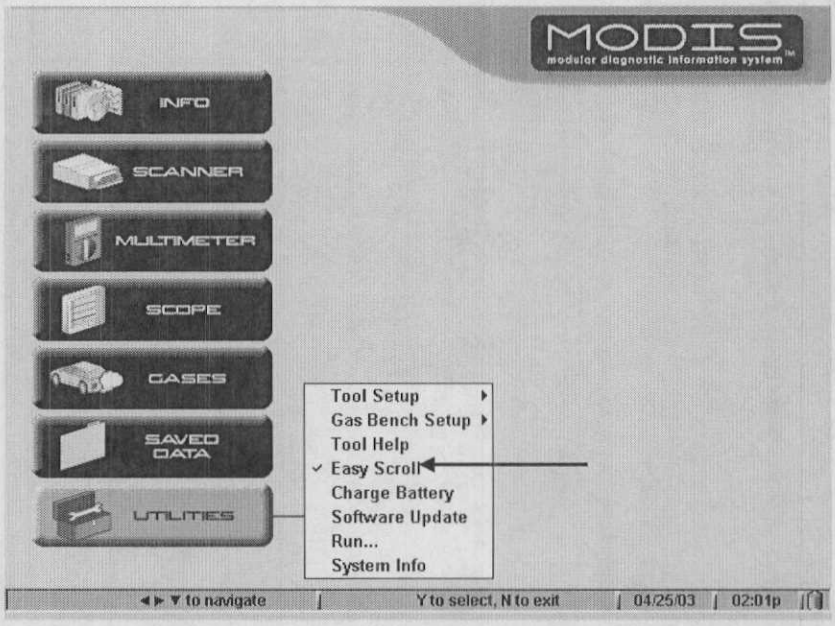
- **Leak Check:** This allows the user to check the gas sampling system for leaks.
- **Bottle Calibration:** This allows you to periodically perform a gas calibration against known standards.
- **Gas Values:** Use the Gas Value option to select the proper gas blend values for the calibration gas being used.
- **Install NO Cell:** Select this function after installing a new NO Cell. This is a specialized gas calibration that will initialize a new NO Cell.
- **Diagnostics:** This function is used when performing self diagnostics on the Gas Module.

Tool Help

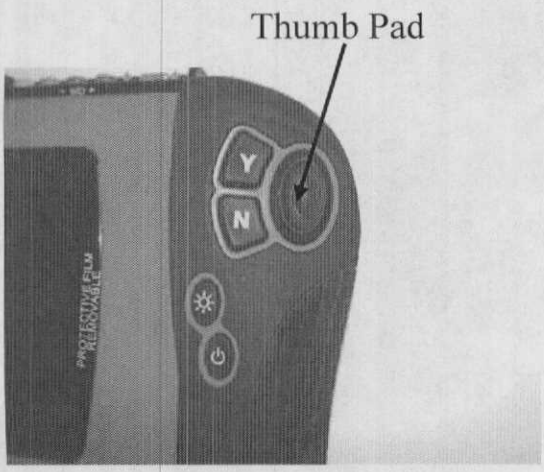


The "Tool Help" describes the general operation and navigation of the MODIS. This information is provided to familiarize you with the screens, toolbars, buttons and menus that allow you to access functions and tools within the system. There is also an overview provided for each plug-in module that is currently available for the MODIS. To navigate through the "Tool Help" section use the "Thumb Pad", "Y" and "N" buttons.

Easy Scroll

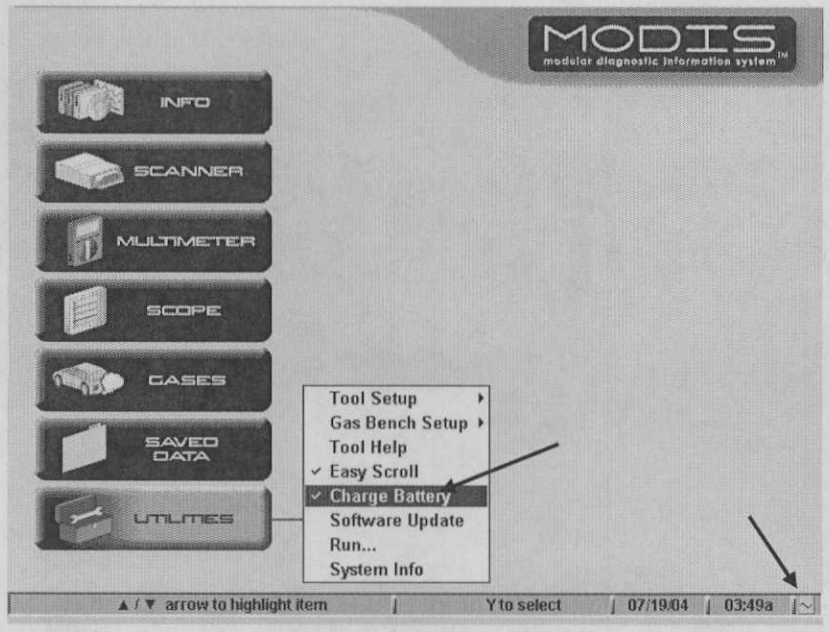


The "Easy Scroll" selection activates an alternative method of navigating through the menu selections of the MODIS. To activate the "Easy Scroll" option, highlight "Easy Scroll" and press the "Y" button. When you activate this option a check mark will appear next to it in the menu. In easy scroll mode, you can make menu selections only by the use of the "Thumb Pad".

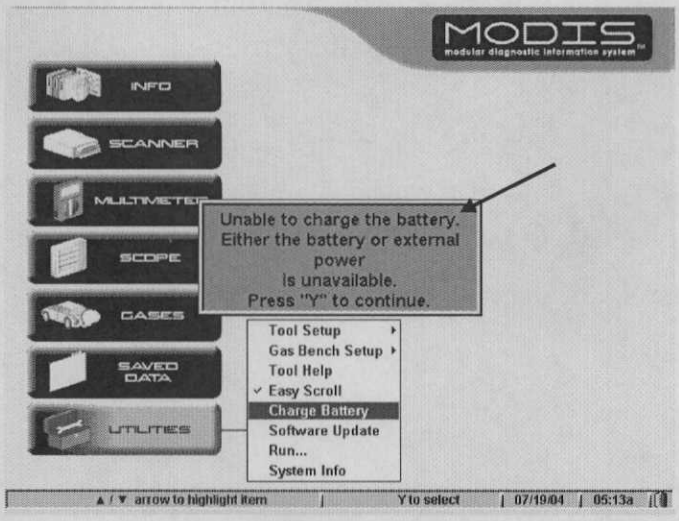


When the "Easy Scroll" option is activated, press up and down on the "Thumb Pad" to scroll through a menu selection…Press right for yes and press left for no. When you are in a menu, you may need to press the left arrow on the "Thumb Pad" multiple times to exit that section.

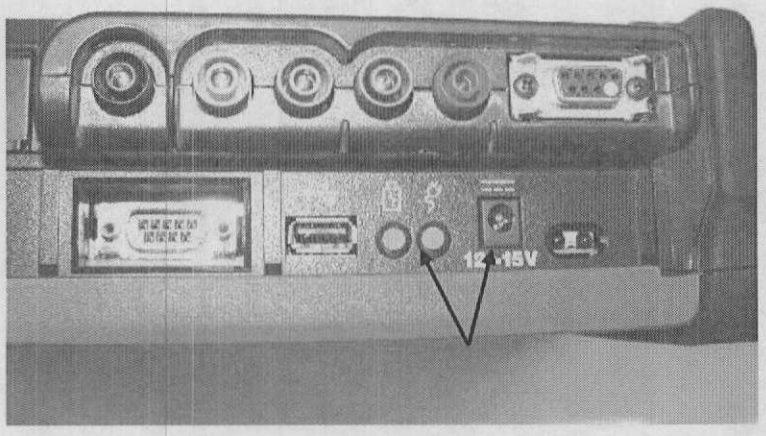
Charging the Battery



When the MODIS was first released there were many issues with charging the battery. Actually the problem was not with the MODIS itself, but rather with the procedure. The MODIS is a portable computer, and like most portable computers the unit must be turned on to charge the battery. To charge the battery plug the power cord into the port on top of the MODIS. Under the "Utilities" you ***must*** also select the charge battery function from the menu. As mentioned earlier, you can select the charge rate under the "Tool Setup" menu.



If you try to select the "Charge Battery" option when the external power supply cable is not connected, you will see a message displayed similar to the one in the image to the left.

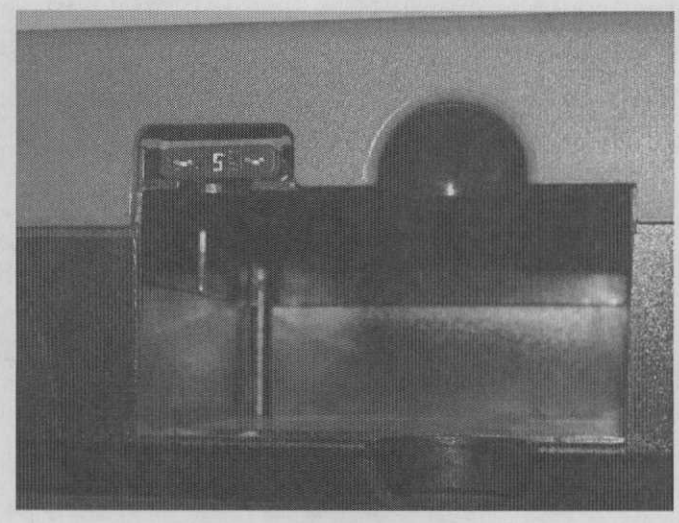


Connect the external power supply to the port labeled 12 – 15V. You will notice both LED lights illuminate to the left, indicating the MODIS is powered externally and the battery is charging.

Also available for the MODIS is an external battery charger. This accessory will allow you to always have an extra battery charged and ready to go. This will eliminate the need to worry about connecting the external power supply to charge the battery in the MODIS.

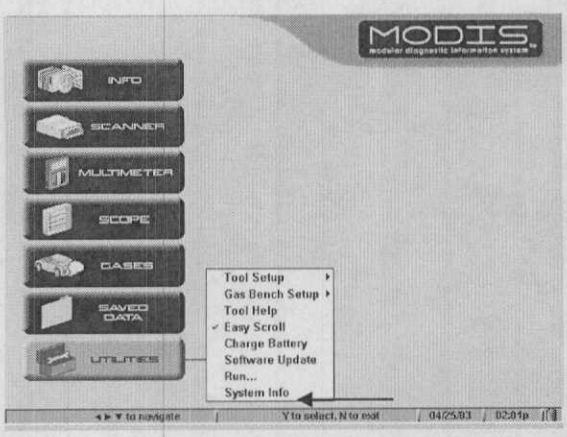
Battery Port

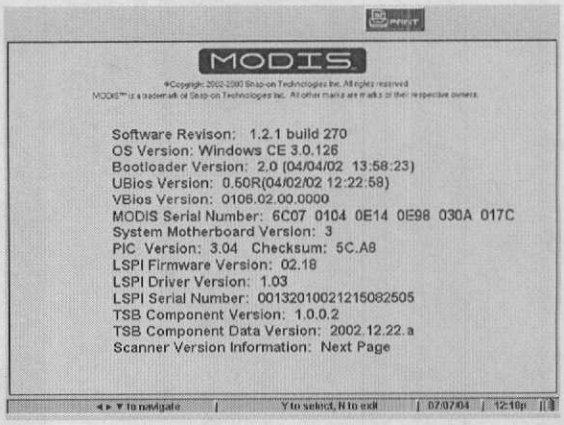
When Snap-on asked technicians what they would like to see in terms of the battery power from the MODIS, they indicated long life and easy replacement. Snap-on answered both requests. As you can see the battery is easily removed from the bottom of the MODIS and also has a longer charge life than any other tool on the market. When the battery is properly charged you can easily run the MODIS continuously for two hours, without recharging the battery.



Also notice in the battery port there is a standard 5 amp automotive fuse. Under normal use this fuse should never need replaced. If it does fail replace it with a standard automotive 5 amp fuse. **Note:** Never replace the fuse with a higher amperage rating.

System Information



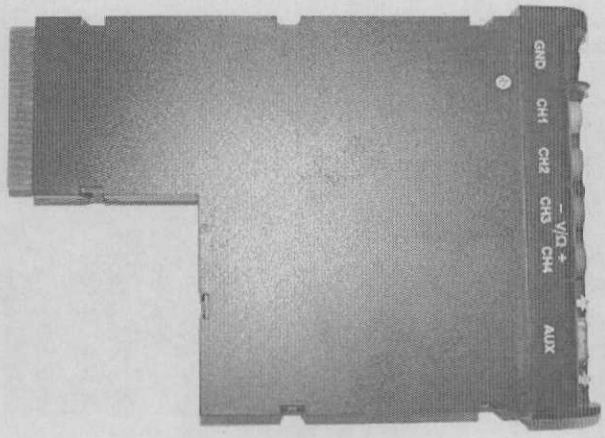


Under the "System Info" menu selection you will find pertinent information about the hardware and software that is installed in the MODIS. The only time you may need to access this section is when you are calling tech support.

Software Updates

You will select this from the menu when performing a software update or when performing a software patch that is released from Snap-on. A patch is released when there is a software issue that needs to be addressed. Normally this will be performed by a Tech Rep from Snap-on.

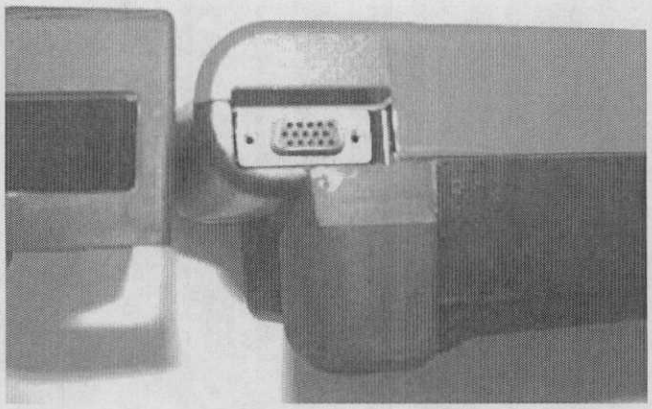
Lab Scope Module



Pictured above is the Lab Scope Module for the MODIS. This cartridge is removable from the unit, making it easy for replacement if for some reason the module would fail. Normally there is no other reason to remove this module.

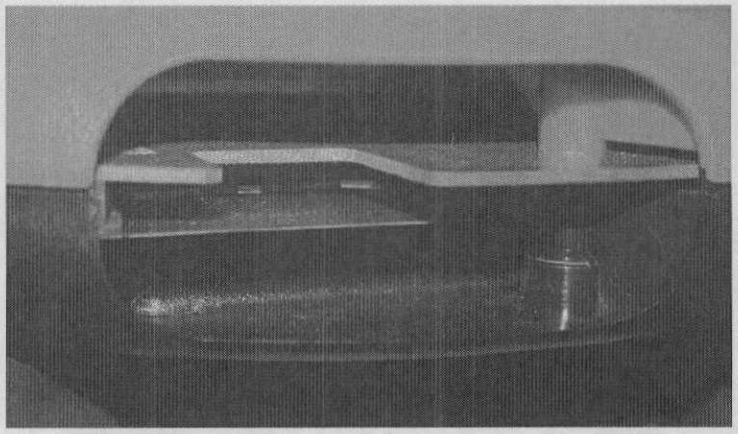
As you can see, this module is easily removed if needed.

Video Out Port



The MODIS also has a great feature that you may not know about. Under the left hand grip there is a "Video Out Port". You are able to connect a computer monitor directly to the MODIS and display the screen of your MODIS directly to a computer monitor.

Side Compact Flash Port

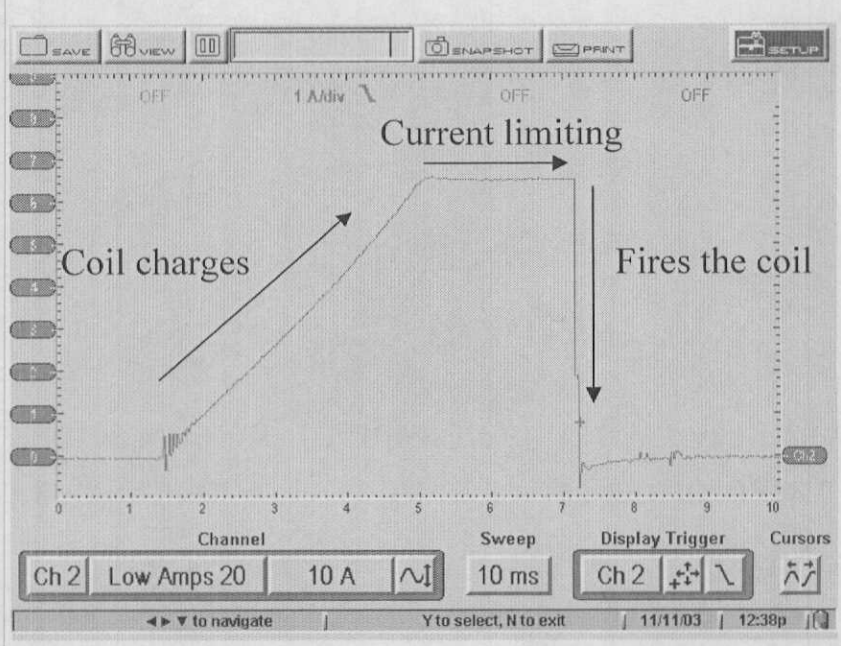


The MODIS also has an additional compact flash port under the left handgrip. This port is used with software version 4.2 or higher. The compact flash card remains in the port.

Section 6
Waveform Analogies

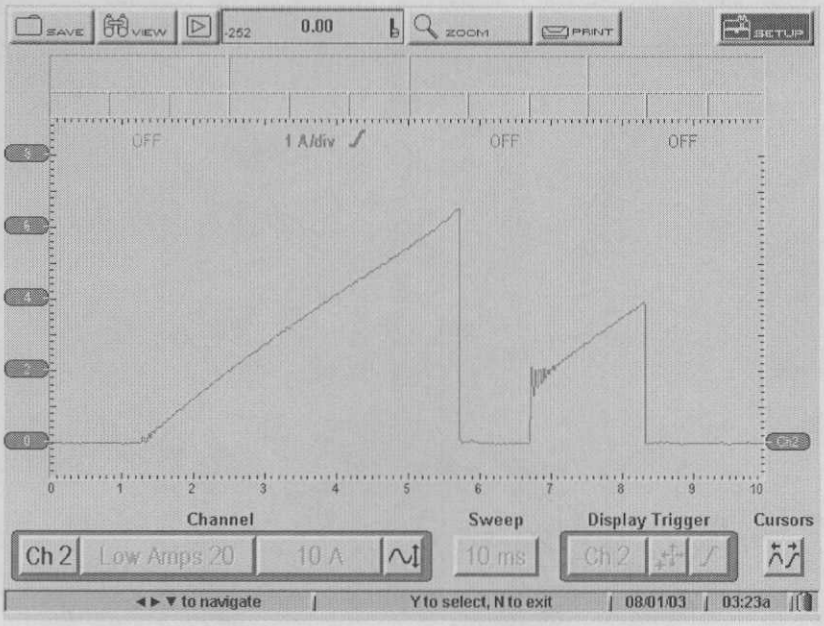
In this section we will cover some of the characteristics of different waveforms. Also, there will be numerous tips on what to look for in a pattern.

Known Good Coil Pack



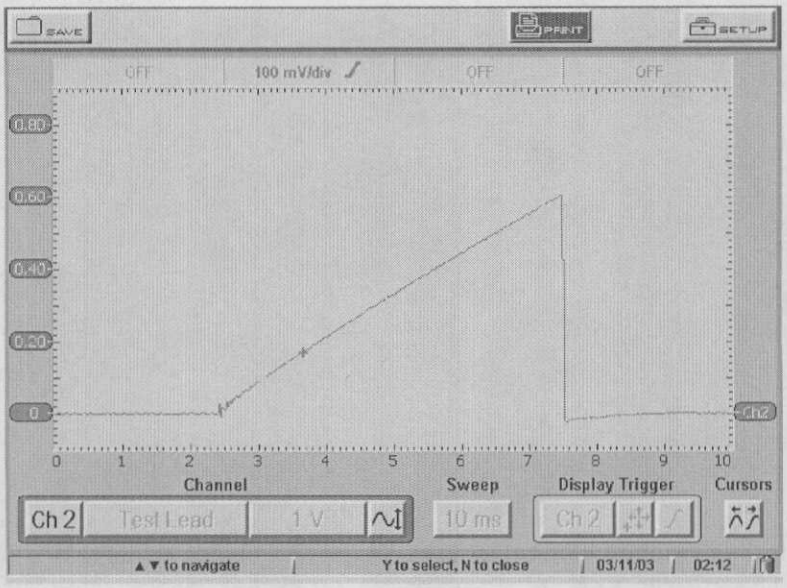
Above, we are looking at a typical ignition amperage waveform, sometimes referred to as "Current Ramping". At the beginning of the ramp you will notice oscillations; this is the start of the coil charge process. The amperage will continue to build up until the module goes into current limiting. At this point the module or PCM (depending on the vehicle you are working on) holds the charge until it is ready to fire the coil. This is the point where you will see the amperage pattern drop down to zero.

Ford Multi-strike Ignition



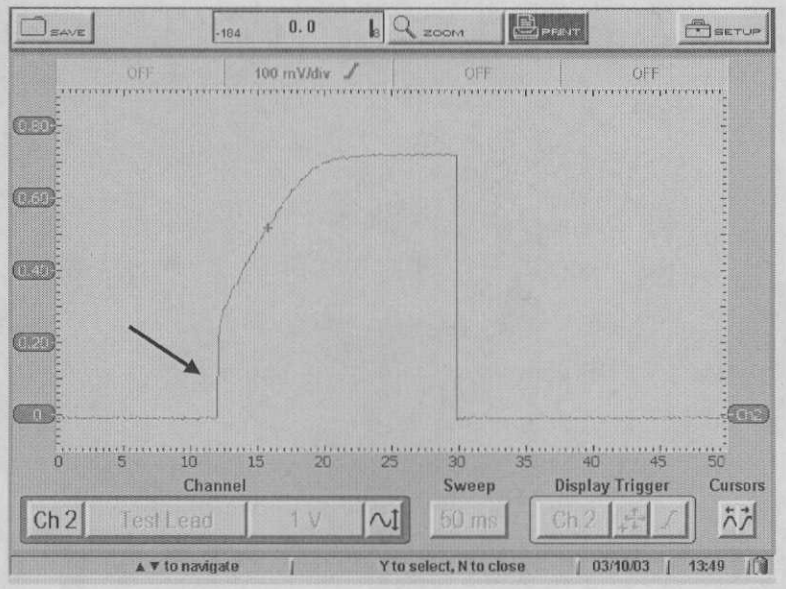
Ford uses a system called EDIS or sometimes referred to as "Multi-Strike" ignition. Above, you are looking at a firing event for one cylinder. Ford's EDIS system will fire one coil from two to four times beginning at an idle and up to 1200 RPM, depending on the vehicle model. The reason for this is for a smoother idle and better emission control.

Chrysler Ignition Amperage



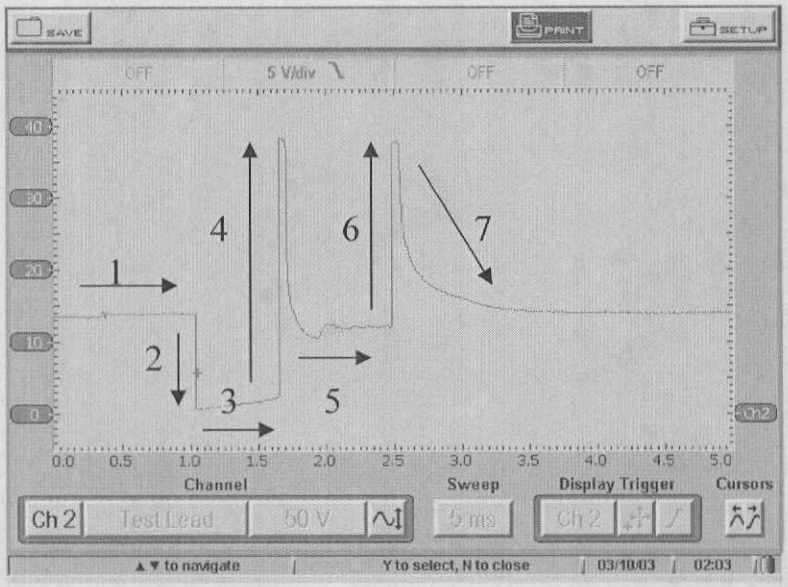
The ignition amperage pattern shown above was captured from a Chrysler vehicle. Right away you will notice something different about this pattern. There is no "Current Limiting" section. On most Chryslers, the PCM monitors and controls the ignition system. The PCM determines the amperage needed per firing event and charges the coil accordingly. If you were to watch this pattern on a running vehicle, you would see the amperage go up and down under different conditions.

Shorted Ignition Coil



We are again looking at an ignition amperage waveform. By using what we have learned about the last three waveforms, what do we see that is different? The initial rise of the slope instantly rises straight up, instead of the gradual slope that you normally should see. This "bad" waveform was caused by an internally shorted ignition coil.

Known Good Peak & Hold Injector



Above we're looking at a typical pattern for a peak and hold injector. At first glance, it appears that this injector opens and closes twice. Actually, this is all one event.

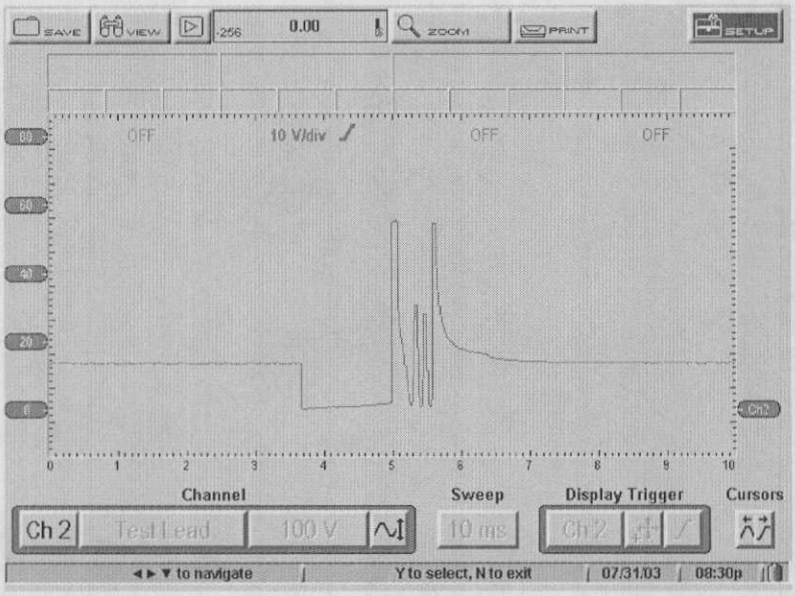
Lets break this pattern down so that we can completely understand what is happening.

1. **Supply voltage:** This voltage should be very close to battery run voltage.
2. **Command on section:** This is the point that the injector driver actually pulls the signal to ground.
3. **Peak section:** In this section the driver is holding the signal to ground. This is when the pintle is pulled off of its seat. Also, note that the pattern does not stay completely to ground. As amperage builds up, the pattern pulls further off ground. After the amperage reaches a certain point the driver is momentarily released from ground.
4. **First voltage spike:** This happens after the ground has momentarily released.

5. **Hold section:** The driver now pulls the signal back down, but not completely to ground. Notice that the voltage is still below battery voltage in this section.
6. **Second voltage spike:** This is when the injector is commanded off.
7. Notice now that when the voltage drops, it returns to battery run voltage.

If you were measuring amperage, you would notice that peak and hold injectors will peak at 4 amps and hold at 1 amp. We will cover the amperage waveform shortly.

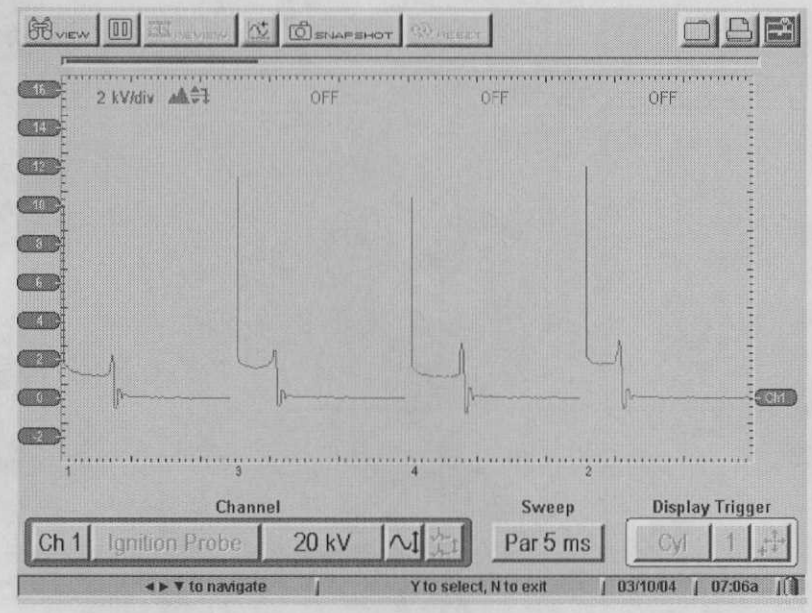
Peak & Hold Injector



Above we are looking at a peak and hold injector pattern. But, as you can see there is a problem in the hold section. This is referred to as injector ringing. This was a common problem on early GM TBI models, with the dual injector TBI, and was usually only on the right side injector. There are typically only a couple of noticeable problems associated with the ringing i.e. rough idle…a slight tip in hesitation on acceleration…or lower than normal fuel mileage. But, because this problem was there even when the vehicle was new, the owner may not even complain about it.

Although GM does not acknowledge that this is a problem, there is a fix for this. By soldering a 1.4 microfarad capacitor across the two terminals on the injector, you can eliminate the ringing. This will smooth out the idle, eliminate the hesitation and increase the fuel mileage.

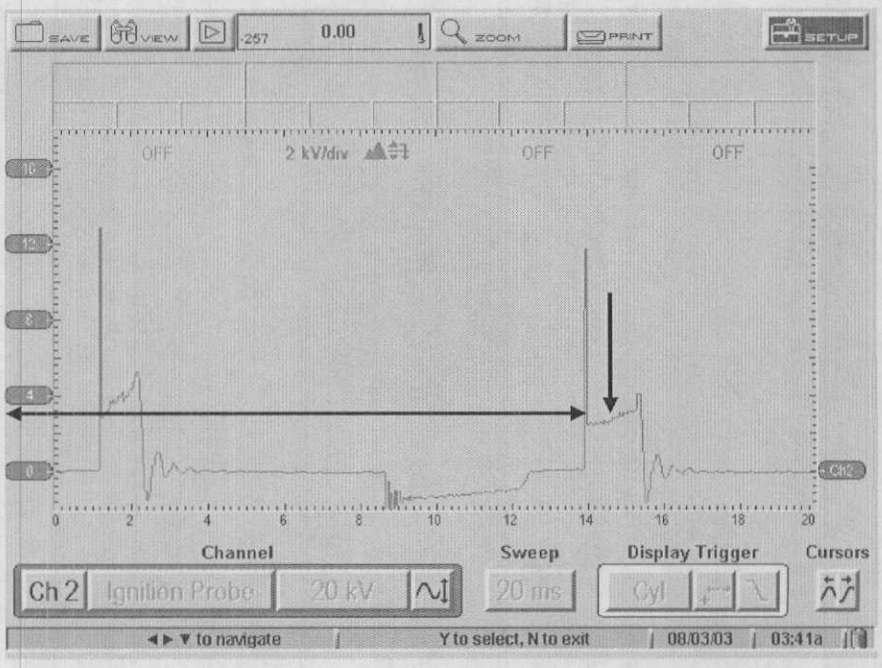
Secondary Parade Pattern



When testing secondary ignition, there are a few specifications that you should take into consideration.

- Your firing voltage (peak kV), should be within 3 – 4 kV of each other.
- The burn voltage intersect point should be very close to 1.5 kV and should be consistent on all cylinders.
- The burn time should be within 2 ms of each other.

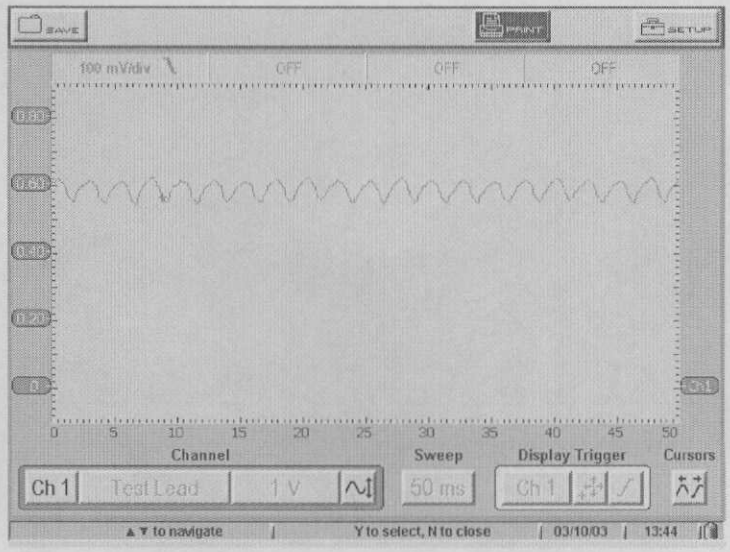
Secondary Ignition



Above, we are looking at a parade pattern from a secondary ignition system. I expanded the time base so that we could focus on the first two firing events. By using what we have learned on the previous page, what do you see wrong with the two patterns? There are actually two different problems. The secondary pattern on the right has no oscillations in the burn time section. The reason for this is that the spark was firing outside of the cylinder. Since it was firing outside, the spark was not being subjected to the compression or turbulence in the cylinder. Also note that on both patterns, the kV burn voltages intersect point is at 3 kV. This is double the allowable range. This was caused by high secondary resistance.

Fuel Pump Analysis

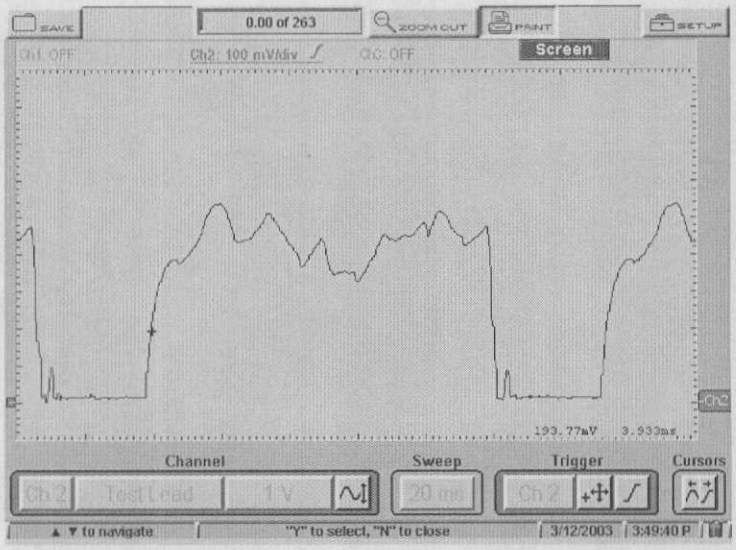
1995 Chevy Lumina 3.1 "m"



Is this a normal fuel pump amperage pattern above? Notice that we are set up at 100 mV per/div. On my amp probe, every 100 mV = 1 A. By looking at this pattern we can tell that this pump is drawing just over 6 amps. The speed of this pump, according to our calculations, is 3000 rpm's. So, the answer would be no. Although this pattern looks normal at first glance, the amperage is too high and the speed is too slow. Normal amperage would be around 4 amps and the speed should be around 4000 – 5000 rpm. This car had a plugged fuel filter.

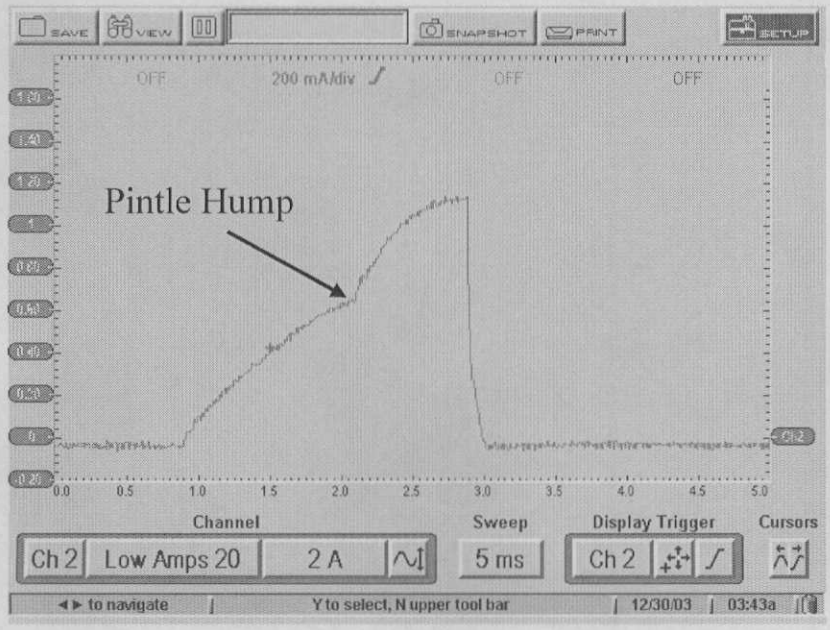
Keep in mind, an amperage test is a good test on any electrical fuel pump, but make sure you always get a total picture of everything. Make sure you test pressure and flow. Always check power and grounds on the circuit. Remember, the pump is not always bad just because the pattern is not normal.

Fuel Pump Amperage Pattern



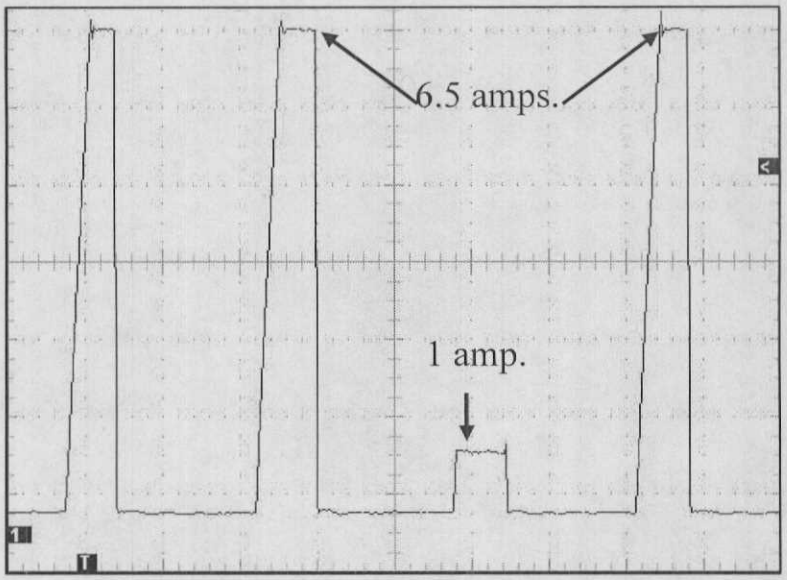
In this example, we can instantly see that there is a problem. Notice the low portion of the waveform. This was caused by burnt spots on the commutators in the fuel pump. Each time these bad spots would pass the brushes, you would see this drop out pattern. This vehicle would intermittently fail to start. The reason for this is, when the pump brushes stopped on these bad spots, they would not make contact and the pump would not run. This is why you can sometimes tap on a fuel tank and a vehicle will start.

Saturation Injector



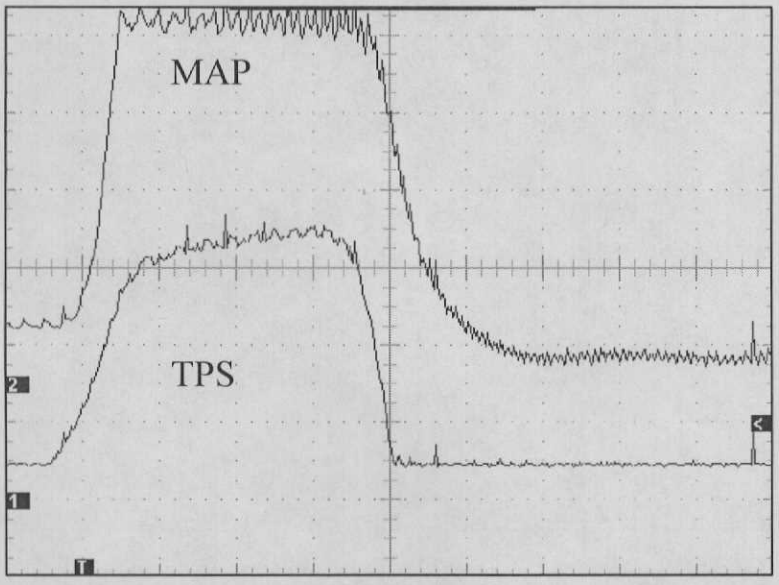
The above image is from a GM saturation type fuel injector. This is a normal pattern captured with an amp probe. Noted on the image is the pintle hump. This is the point when the injector is actually open. When the ramp begins to go upward the computer is commanding the injector to turn on, but no fuel will flow until the pintle is open. On some injectors you can see the pintle hump and others you cannot. Also notice, the pintle hump is approximately 75% up the ramp. This is where you should normally see it. When an injector starts to short internally, you will see the hump higher up the ramp. This should stay consistently in the same spot. If you were to have an injector that had a pintle that was not firmly seating each time it closed, you would notice it in this area. The pintle hump would float up and down the ramp as it closed, or you would see a double hump.

Failing Module

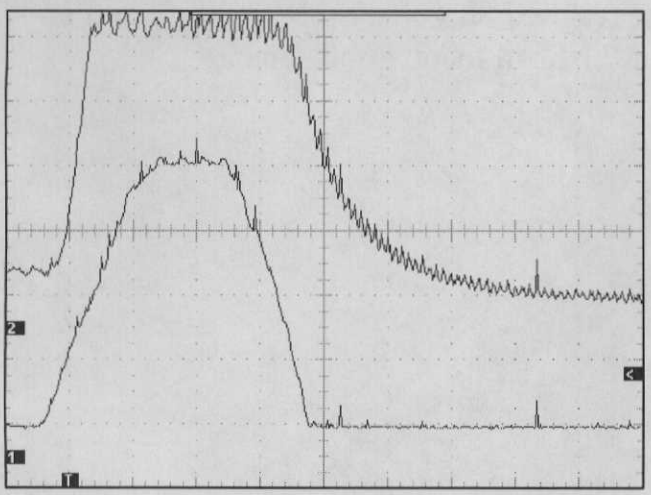


The image above was captured from a vehicle with a failing ignition module. As the module began the coil charging process, it would reach approx. 1 amp and then break down. This would cause a misfire on two cylinders, since this was an EI ignition system where two cylinders were fired from one coil pack.

MAP vs. TPS Comparison

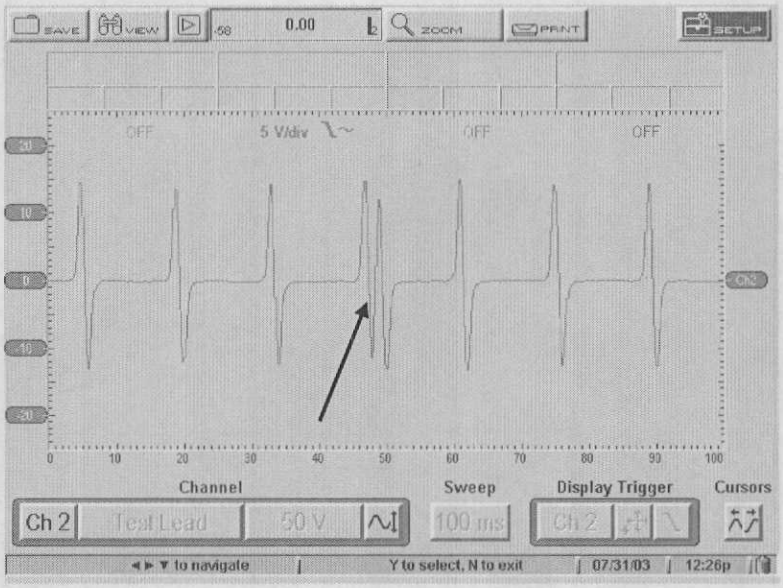


Here we're now showing you a comparison between the MAP and TP sensors. As you can see, they mirror each other very closely. On a normally operating vehicle, the MAP amplitude should be a little more vertical than the TPS. It should follow the TPS very closely on decel until it reaches the lower section. You will notice it return to idle voltage a little slower than the TPS. On a normally operating system, you should actually see the MAP voltage dip a little below its idle voltage on decel. This is a very good test to perform when looking for a restricted exhaust system.



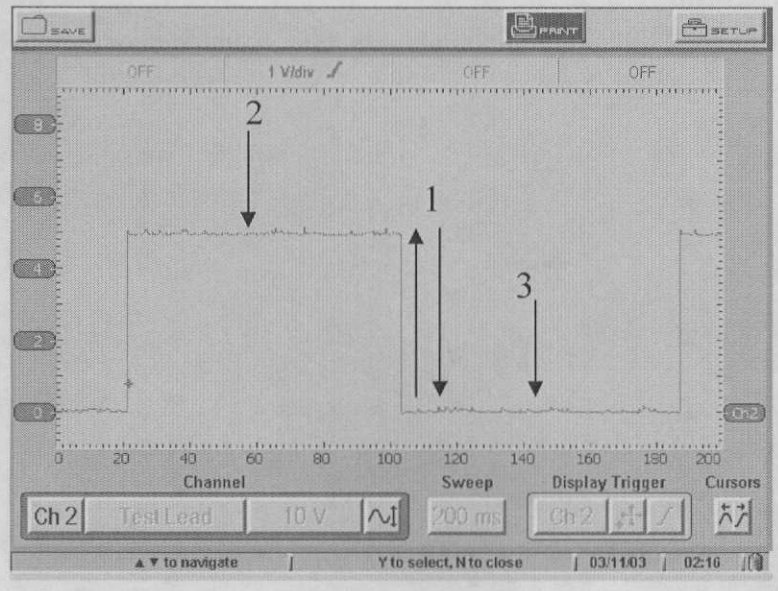
This is an example of a vehicle with a restricted converter. As you can see, the initial response of the MAP is very quick. But, when the engine would decel, the exhaust could not escape. This would cause the MAP to return to idle voltage very slowly.

Good or Bad Crank Sensor?



We are now viewing the crankshaft position sensor waveform on a GM 3100 engine. But, is this signal good or bad? Answer: good. At first glance, there appears to be a problem. In the center of the screen there is a double waveform. This is the sync section of the waveform. The PCM uses this section to determine where top dead center is. Next, by measuring the amplitude of the waveform what can we determine? We have a peak to peak voltage of negative 15 volts to a positive voltage of 15 volts. So the total amplitude is 30 volts, which would be a good output at idle. As the engine rpm was increased the total voltage reached 80 volts. So by looking at the total picture, we can determine that this is in fact a good sensor.

Digital Square Wave

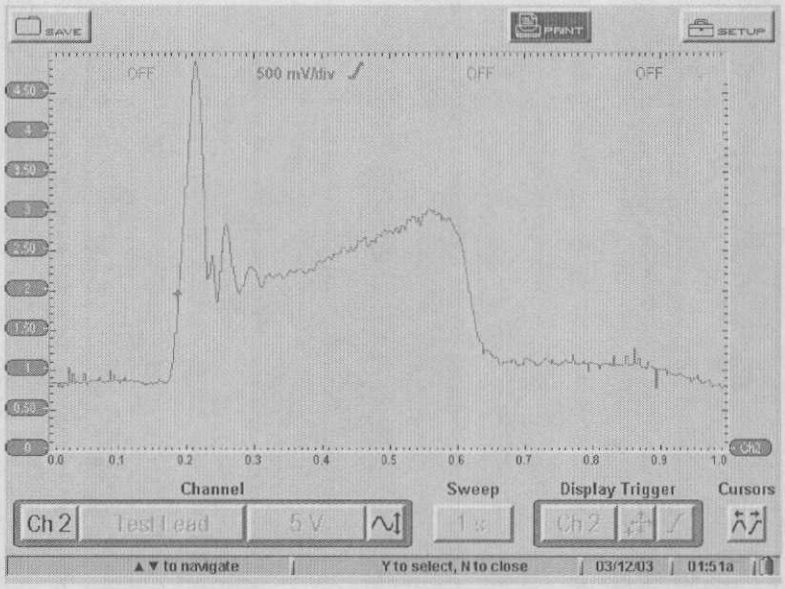


When looking at a square wave pattern, there are three specific sections you should always focus on.

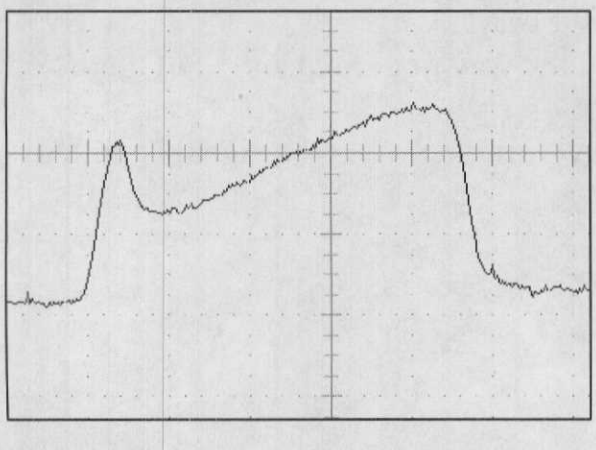
1. **Amplitude:** Are the positive and negative slopes vertical? In other words, do they rise and fall straight up and down, or do they taper off as they go either way.
2. **Peak voltage:** Does the pattern reach the required voltage? Once it does, is it holding steady or does it vary?
3. **Ground:** Does the signal pull all the way to ground and hold there?

You should not see more than a 200 mV variation when the signal is pulled to ground or at peak voltage.

Ford Mass Airflow Sensor



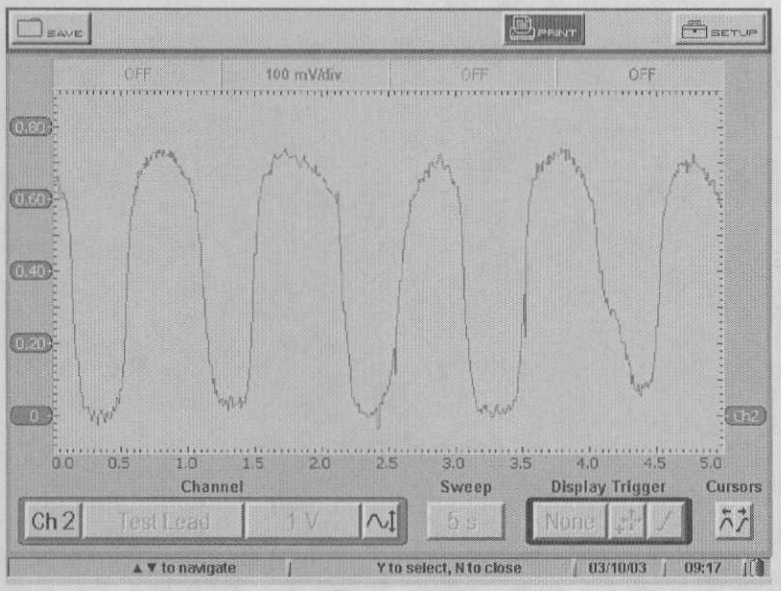
Above we are viewing an image of a snap throttle test on a mass airflow sensor. On a good sensor, you should see a minimum of 3.5 V on the initial rise of the pattern. As the voltage on the signal first starts to lower, you will notice the fluctuations in the pattern. This is normal, but there are no known specifications for this. I have also noticed that this varies from vehicle to vehicle. One thing I have noticed though is the closer the MAF is to the throttle body, the more fluctuations you will see in the pattern.



This is a great way to catch a contaminated sensor. When a sensor becomes contaminated the response becomes much slower. The peak voltage will be lower and you will also notice fewer fluctuations in the pattern.

The above image is of a contaminated sensor.

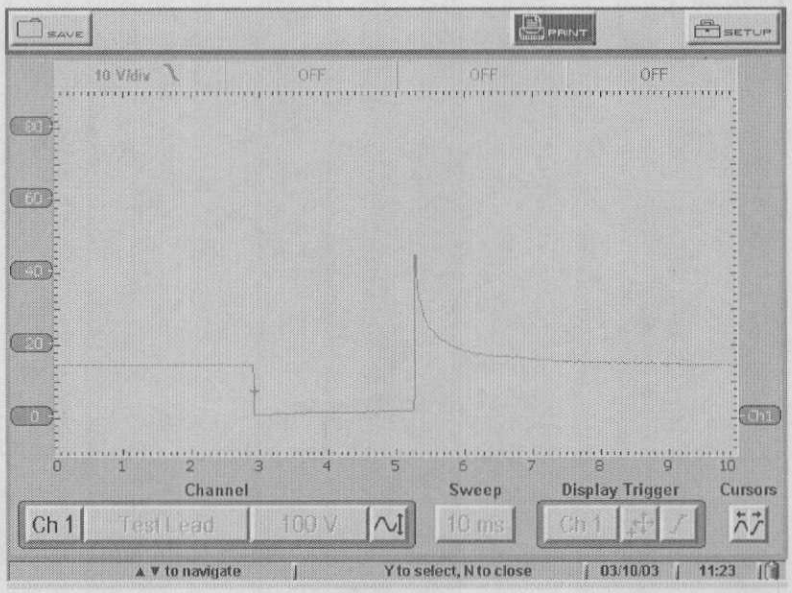
O2 Sensor



We will now discuss some characteristics of an O2 sensor. On vehicles equipped with OBDII, the O2 sensor has become a very important and closely monitored sensor. An O2 sensor will very quickly set a variety of trouble codes on an OBDII system. The two most important tests you will perform when monitoring an O2 sensor are…monitoring the rich to lean…and lean to rich switching times plus measuring the peak to peak amplitude.

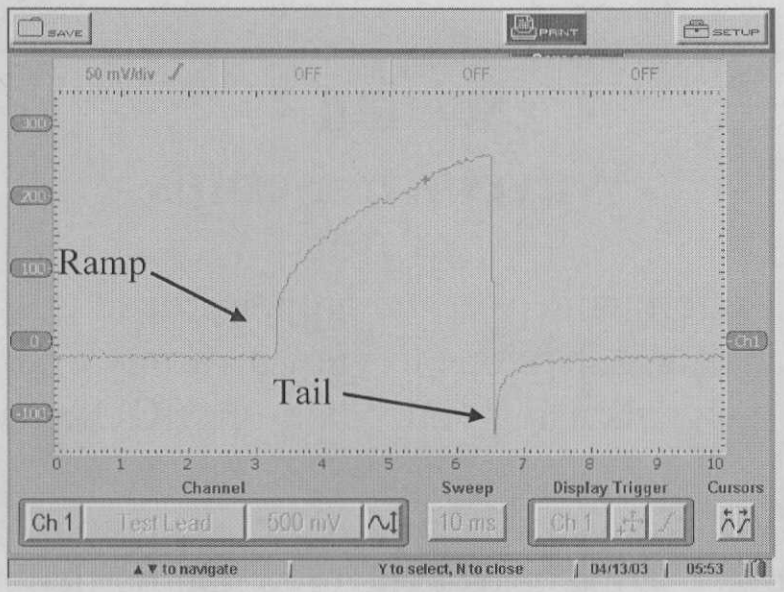
- **Rich to lean switch time:** When making this measurement the O2 voltage should go from above 800 mV to below 200 mV within 125 ms.
- **Lean to rich switch time:** The same applies, except the voltage should go from lean to rich.
- **Amplitude:** Can the sensor reach a minimum of 850 mV when forced rich and can it go below 125 mV when forced lean?
- **Amplitude @ 1000 rpm:** There should be a minimum of 600 mV difference between the highest and lowest point in the waveform. Keep in mind that the waveform should be going down to at least 200 mV and up to 800 mV. If you are going up to 950 mV and down to 350 mV you are not in fuel control, even though you are still reaching a range of 600 mV.

Shorted Saturation Injector



The above pattern is from a saturation type injector. These are typically found on port fuel injected vehicles. This example is from a shorted injector. Normally the voltage spikes amplitude would be much higher. A typical saturation injectors spike would peak out at around 70 to 100 V. There are exceptions, certain Fords and Chryslers use a diode to clamp the voltage @ 35 V. If you were to view a pattern that clamped the voltage at 35 V, you would also notice that the voltage spike was squared off at the top.

Shorted Saturation Injector



Here we're viewing a shorted injector using the amp probe. Using what we have learned earlier, is there anything wrong? Yes, first we notice the quick rise at the beginning of the ramp. Then, there is a tail at the end of the pattern. These are two typical characteristics of a shorted injector. Also note, the pintle hump is still there, but it is higher up on the pattern.

Section 7
Waveform Setups

The next section will cover the proper procedures for settings for your Lab Scope to view a variety of different automotive signals using your Snap-on MODIS scope.

On every waveform set-up page I made a note on where I hooked up my scope leads to acquire that particular pattern. I could not include the wire color, since that may change from year to year on certain vehicles. You need to refer to the wiring diagram on the particular vehicle you are working on to obtain this information.

Alternator Diode:

Scope Hook-up: The red lead is connected to the battery output of the alternator and the black lead is connected to the battery ground.

Set the voltage level to 1 V per/screen.

Set the sweep to 10 ms per/screen.

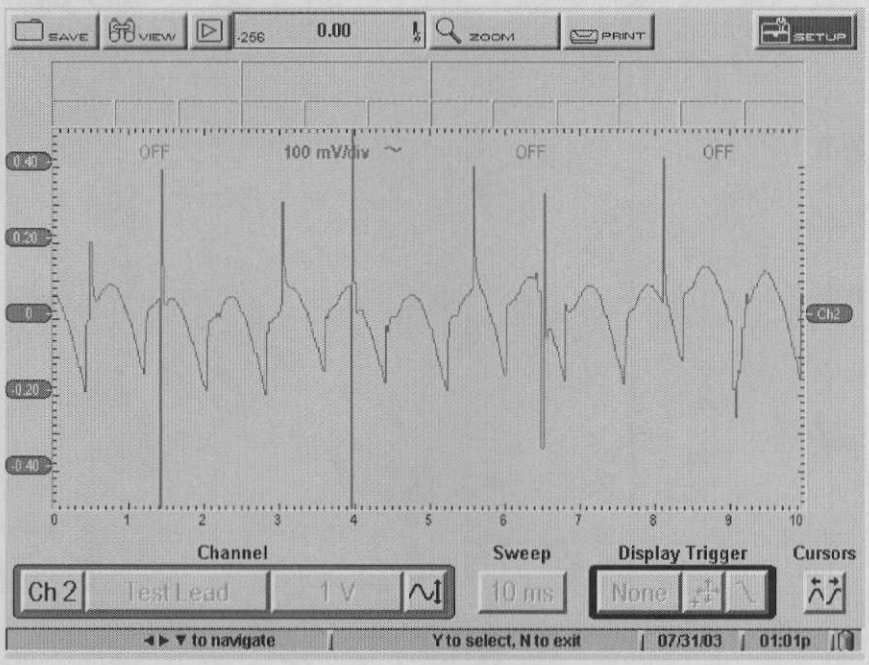
Set the scope to ac coupling (Coupling ac checked marked).

Move the ground indicator to the center of the screen.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 200 mV.



Cam Position Sensor – Ford 1.9 "p" & 2.0 "3"

Scope Hook-up: The red lead is connected to the signal positive wire and the black lead is connected to the signal negative wire.

Set the voltage level to 5 V per/screen.

Set the sweep to 500 ms per/screen.

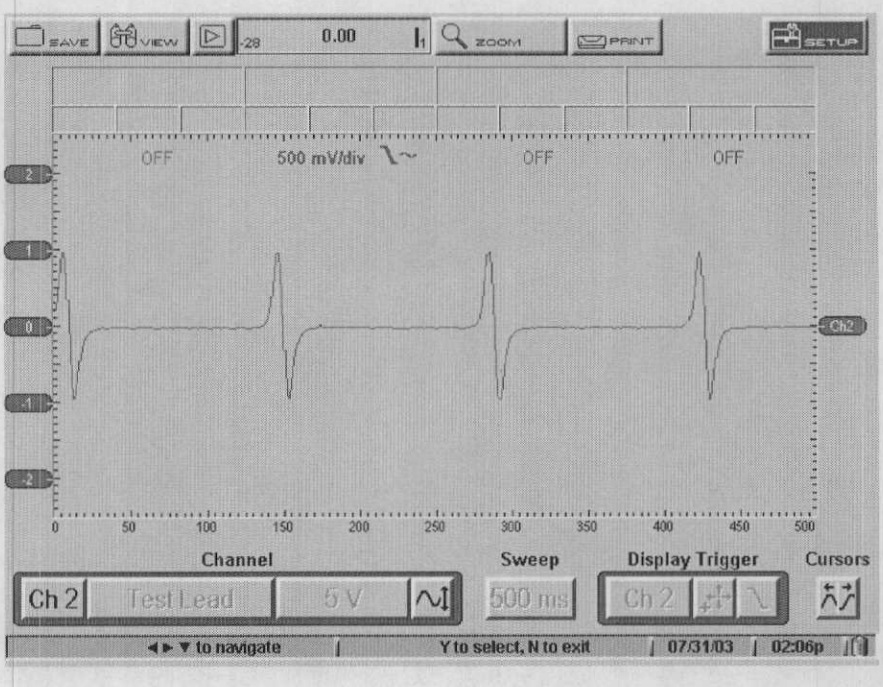
Set the scope to ac coupling (Coupling ac checked marked).

Move the ground indicator to the center of the screen.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 500 mV.



Note: The amplitude and frequency will vary with RPM.

Cam Position Sensor – Taurus 3.0 "s":
Scope Hook-up: The red lead is connected to the signal return at the sensor and the black lead is connected to the battery ground.

Set the voltage level to 20 V per/screen.

Set the sweep to 200 ms per/screen.

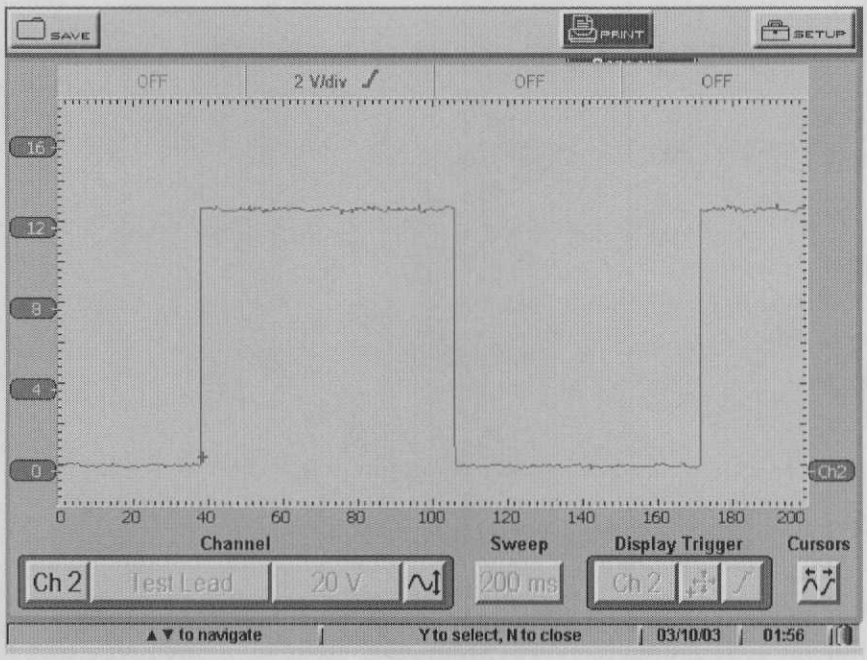
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 5 volts.



Note: The frequency will vary with RPM.

Cam Position Sensor – Distributor – Cadillac:
Scope Hook-up: The red lead is connected to the signal return and the black lead is connected to the battery ground. The signal was acquired at the distributor.

Set the voltage level to 20 V per/screen.

Set the sweep to 200 ms per/screen.

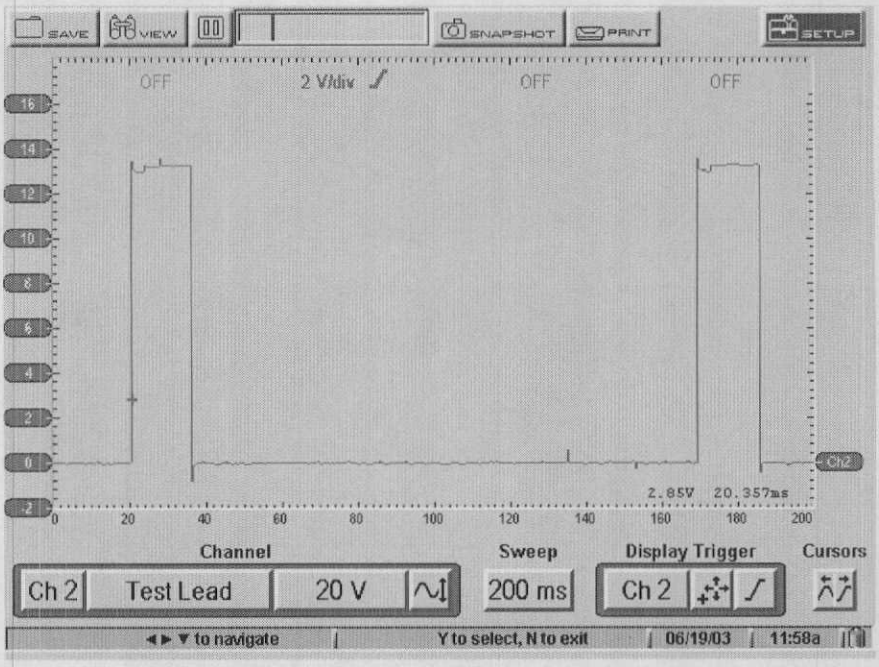
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 5 volts.



Note: The frequency will vary with RPM.

Cam Position Sensor – GM 3100 & 3400:
Scope Hook-up: The red lead is connected to the signal return wire and the black lead is connected to the battery ground terminal. The signal was acquired at the sensor harness located on the upper intake manifold.

Set the voltage level to 20 V per/screen.

Set the sweep to 200 ms per/screen.

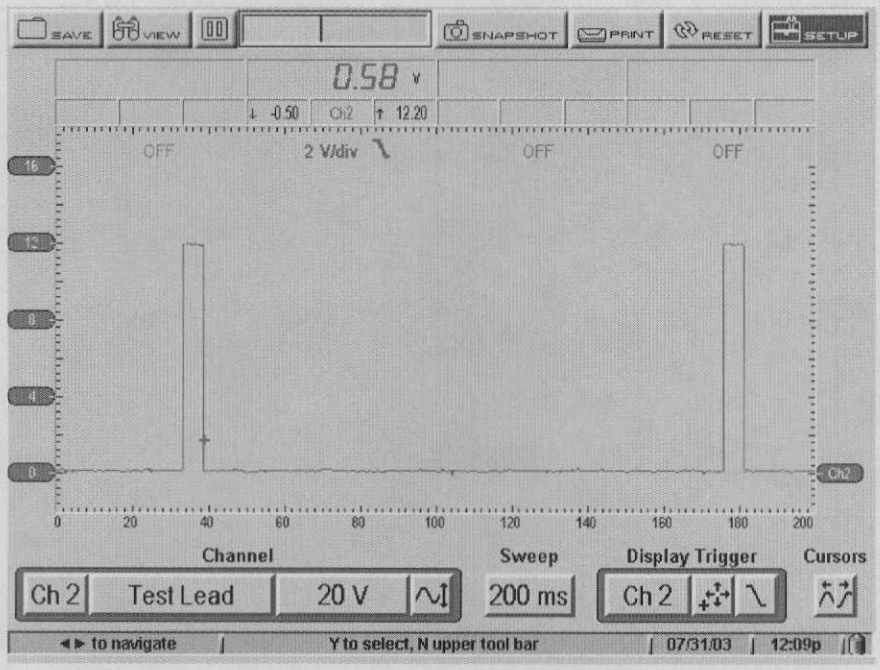
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 5 volts.



Note: The frequency will vary with RPM.

Cam Position Sensor – GM 3800:
Scope Hook-up: The red lead is connected to the signal return wire and the black lead in connected to the battery ground terminal. The signal was acquired at the sensor by the balancer.

Set the voltage level to 10 V per/screen.

Set the sweep to 500 ms per/screen.

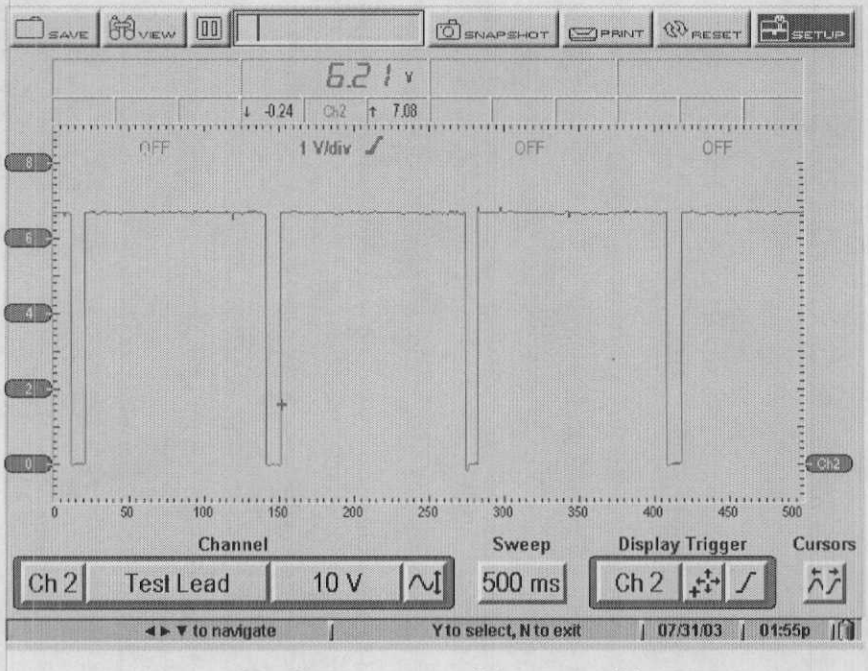
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 2 volts.



Note: The frequency will vary with RPM.

Cam Position Sensor – Jeep 4.0:
Scope Hook-up: The red lead is connected to the signal return wire and the black lead is connected to the battery ground terminal. The signal was acquired at the distributor.

Set the voltage level to 10 V per/screen.

Set the sweep to 200 ms per/screen.

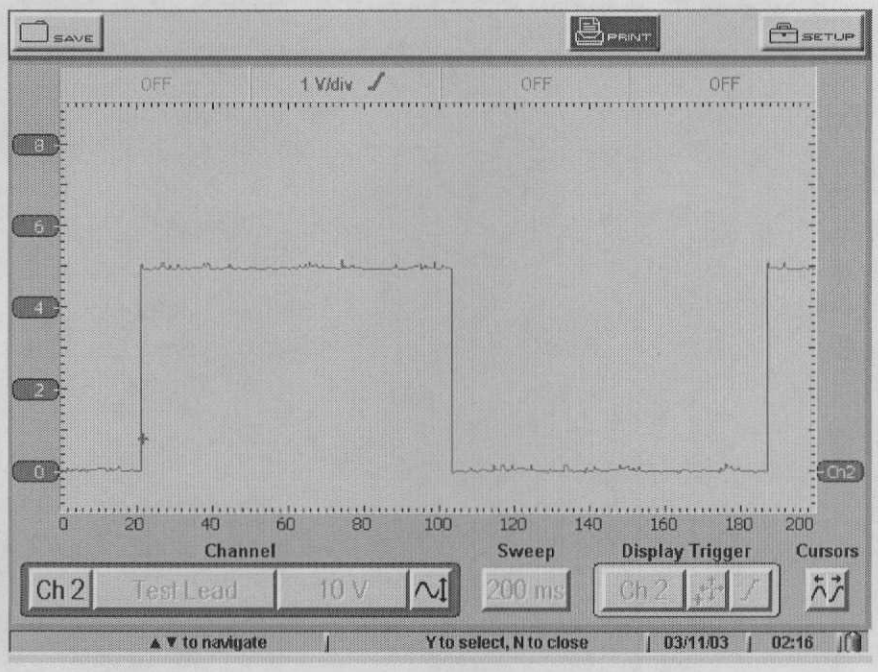
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 2 volts.



Note: The frequency will vary with RPM.

Crank Position Sensor – Idle – Gm 2.8, 3.1, 3100 & 3400:
Scope Hook-up: The red lead is connected to the purple wire and the black lead is connected to the yellow wire from the sensor to the module.

Set the voltage level to 50 V per/screen.

Set the sweep to 100 ms per/screen.

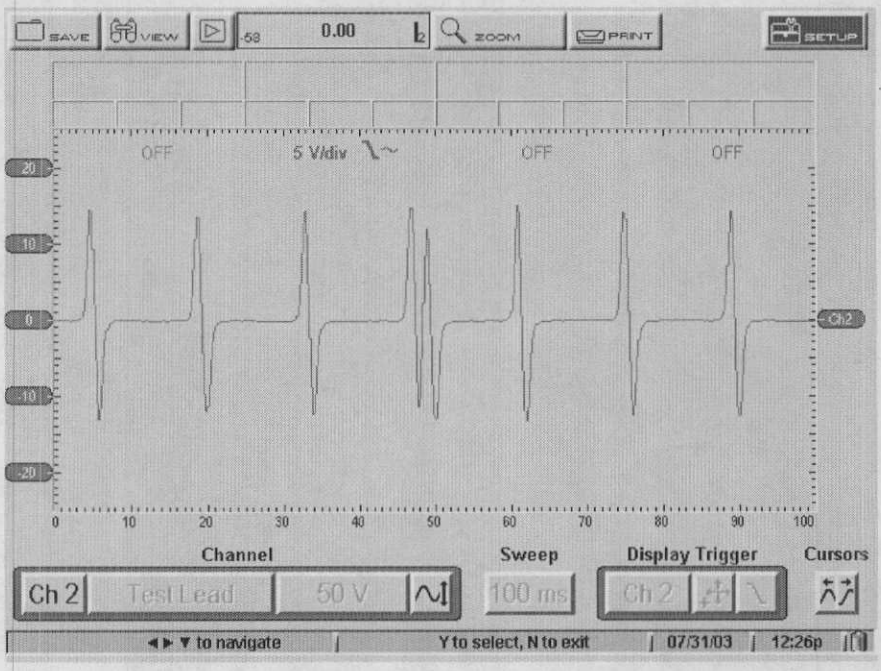
Set the scope to ac coupling (Coupling ac checked marked).

Move the ground indicator to the center of the screen.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 5 volts.



Note: The amplitude and frequency will vary with RPM.

Crank Position Sensor – 18x – GM 3800:
Scope Hook-up: The red lead is connected to the signal return wire and the black lead is connected to the battery ground terminal. The signal was acquired at the sensor by the balancer.

Set the voltage level to 10 V per/screen.

Set the sweep to 50 ms per/screen.

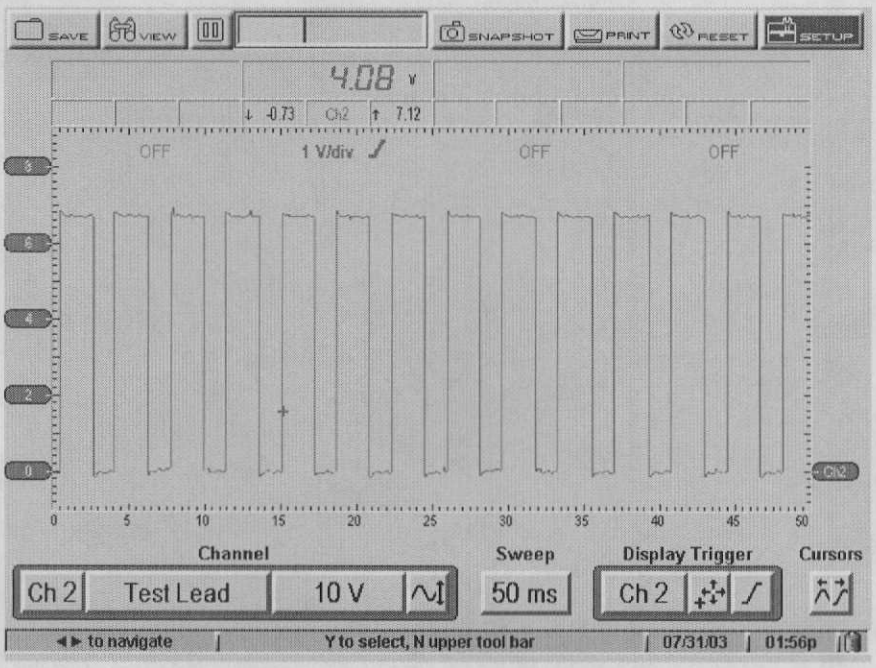
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 2 volts.



Note: The frequency will vary with RPM.

Crank Position Sensor – 24x – GM 3100 & 3400:
Scope Hook-up: The red lead is connected to the signal return wire and the black lead is connected to the battery ground terminal. The signal was acquired at the sensor by the balancer.

Set the voltage level to 20 V per/screen.

Set the sweep to 50 ms per/screen.

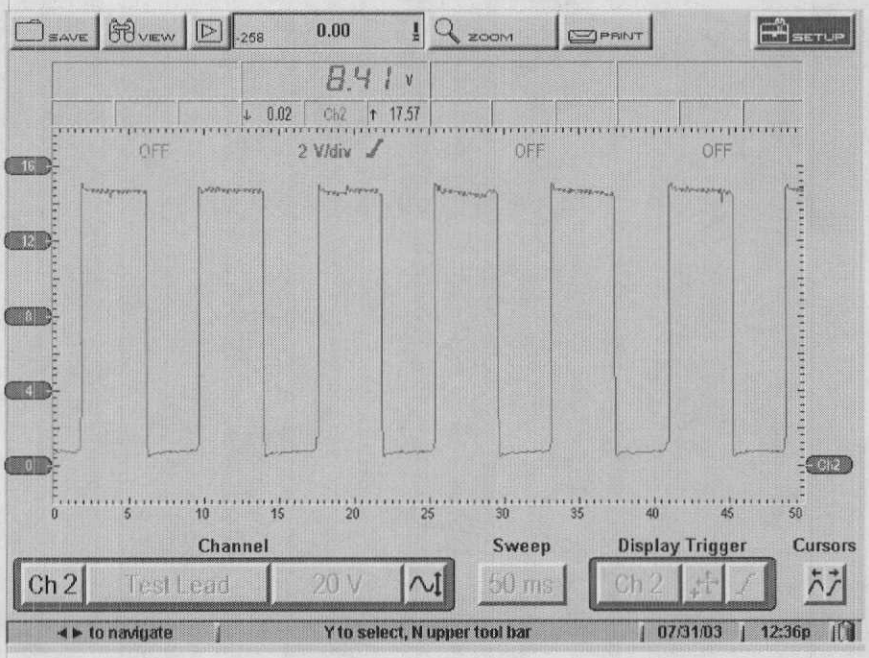
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 5 volts.



Note: The frequency will vary with RPM.

Crank Position Sensor – Jeep 4.0:
Scope Hook-up: The red lead is connected to the signal return wire and the black lead is connected to the battery ground. The signal was acquired at the sensor mounted in the transmission bell housing.

Set the voltage level to 10 V per/screen.

Set the sweep to 50 ms per/screen.

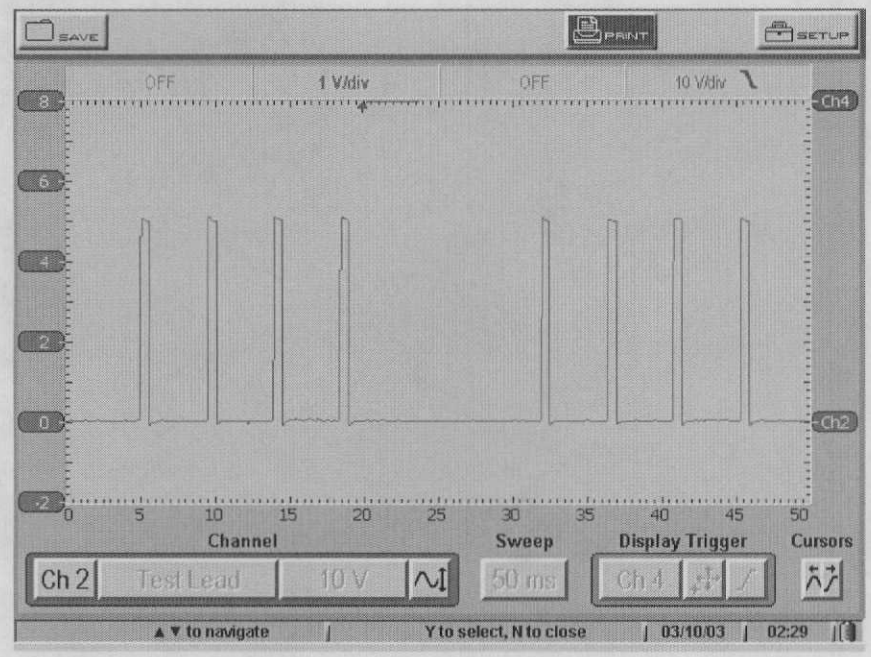
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 2 volts.



Note: The frequency will vary with RPM.

Crank Position Sensor – Ford 4, 6 & 8 cylinder EI engines:
Scope hook-up: The red lead is connected to the gray wire and the black lead is connected to the dark blue wire at the sensor by the crank pulley.

Set the voltage level to 50 V per/screen.

Set the sweep to 20 ms per/screen.

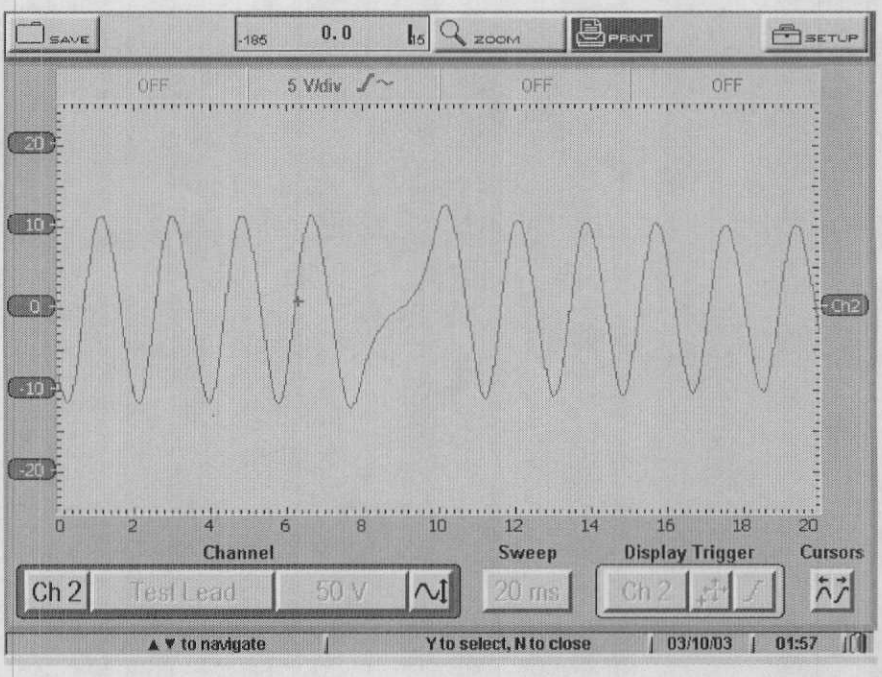
Set the scope to ac coupling (Coupling ac checked marked).

Move the ground indicator to the center of the screen.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 5 volts.



Note: The amplitude and frequency will vary with RPM.

Cylinder ID – Saturn:

Scope Hook-up: The red lead is connected to the signal return wire and the black lead is connected to the battery ground terminal. The signal was acquired at the module.

Set the voltage level to 10 V per/screen.

Set the sweep to 500 ms per/screen.

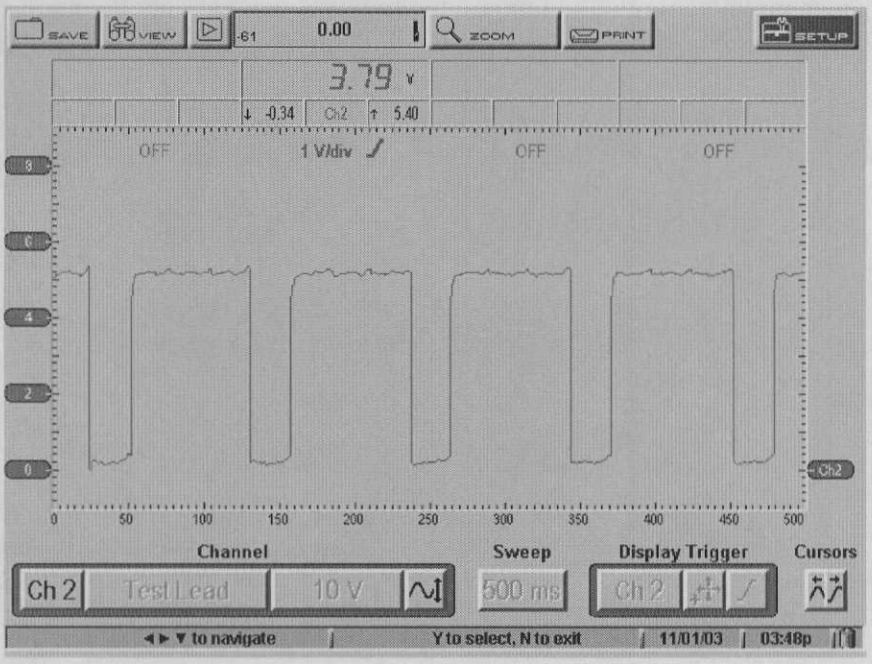
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 2 volts.



Note: The frequency will vary with RPM.

DPFE – Ford:

Scope Hook-up: The red lead is connected to the signal return at the sensor and the black lead is connected to the battery ground terminal.

Set the voltage level to 10 V per/screen.

Set the sweep to 1 sec per/screen.

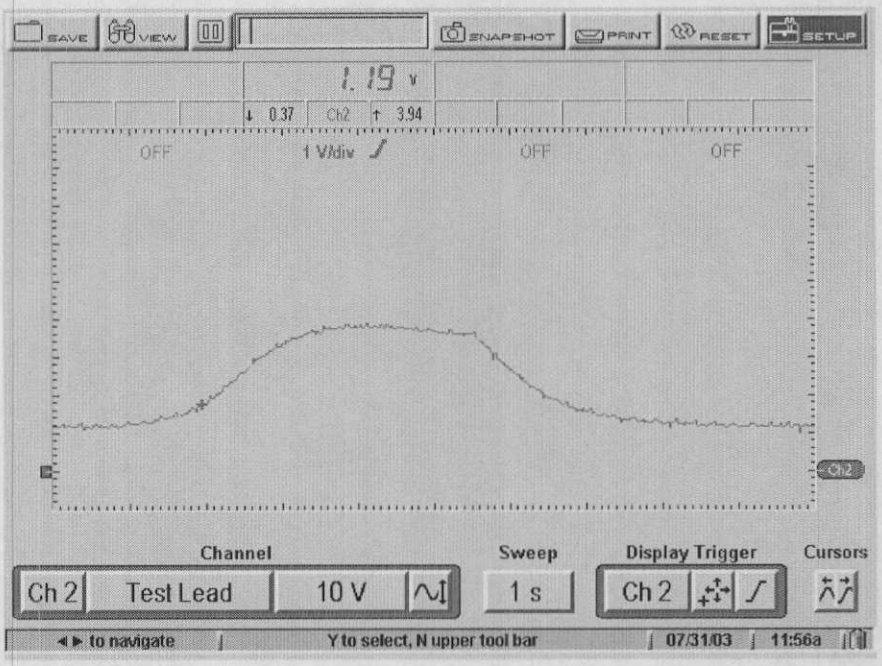
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 1.5 volts.



DREF – EI – GM:

Scope Hook-up: The red lead is connected to the purple/white wire out of the module and the black lead is connected to the battery ground terminal.

Set the voltage level to 10 V per/screen.

Set the sweep to 100 ms per/screen.

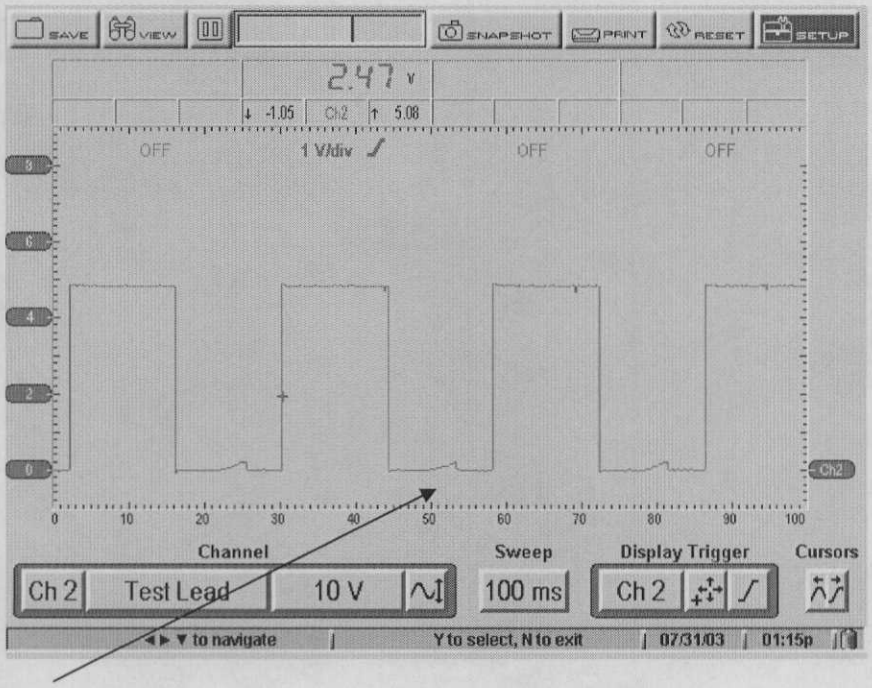
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 2 volts.



These humps on the low section of the pattern are normal. This is caused from the ignition coils charging & discharging

Distributor Reference (DREF) – EST Control – GM DI Ignition:
Scope Hook-up: The red lead is connected to the purple/white wire out of the module and the black lead is connected to the battery ground terminal.

Set the voltage level to 10 V per/screen.

Set the sweep to 100 ms per/screen.

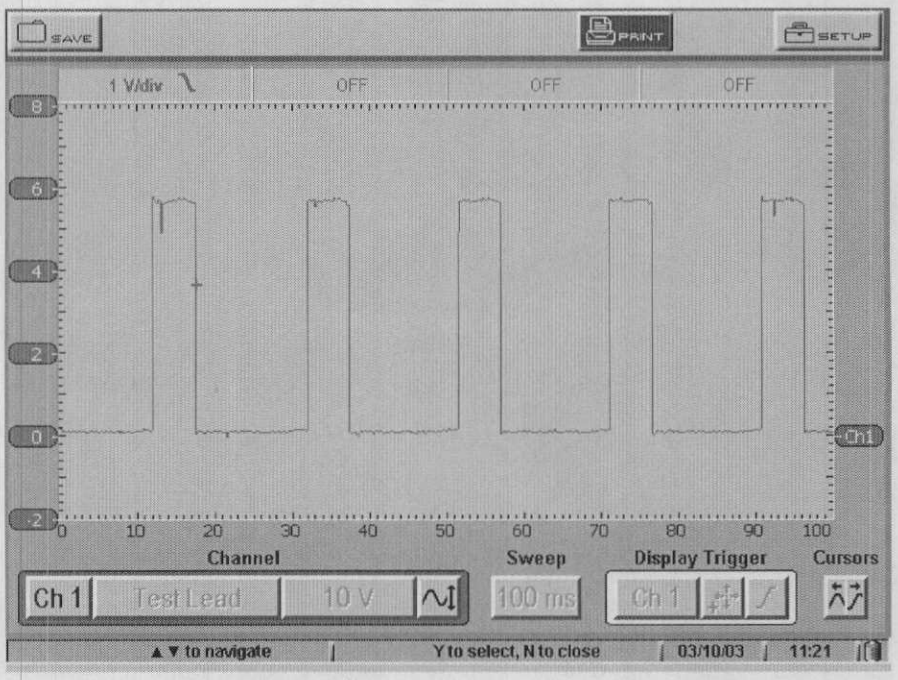
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 2 volts.



Note: The frequency will vary with RPM.

Distributor Reference (DREF) – By-Pass Mode – GM DI Ignition:
Scope Hook-up: The red lead is connected to the purple/white wire out of the module and the black lead is connected to the battery ground terminal.

Set the voltage level to 10 V per/screen.

Set the sweep to 100 ms per/screen.

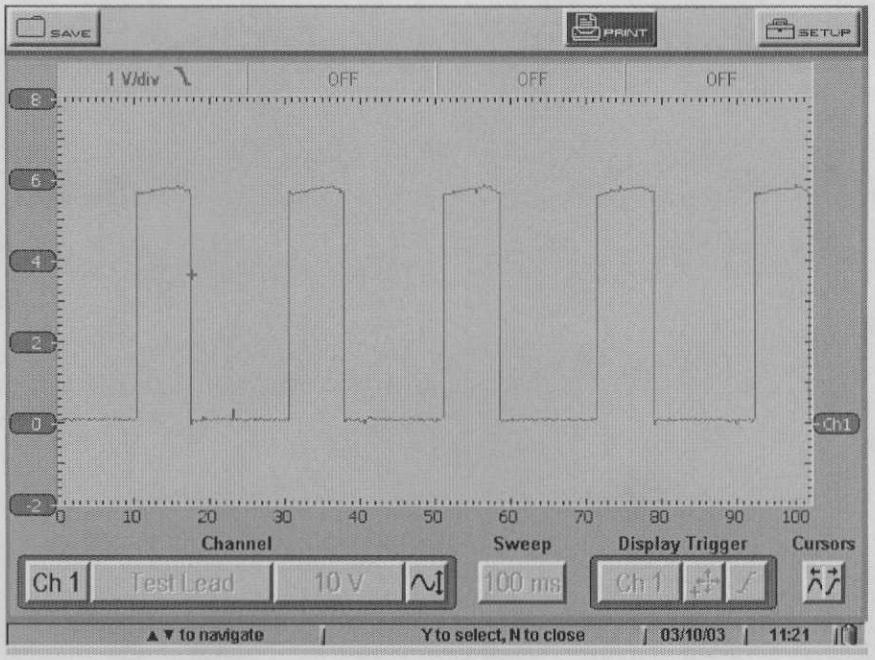
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 2 volts.



Note: The frequency will vary with RPM.

EGR Linear – GM:

Scope Hook-up: The red lead is connected to the signal return at the EGR valve and the ground lead is connected to the battery ground terminal.

Set the voltage level to 20 V per/screen.

Set the sweep to 50 ms per/screen.

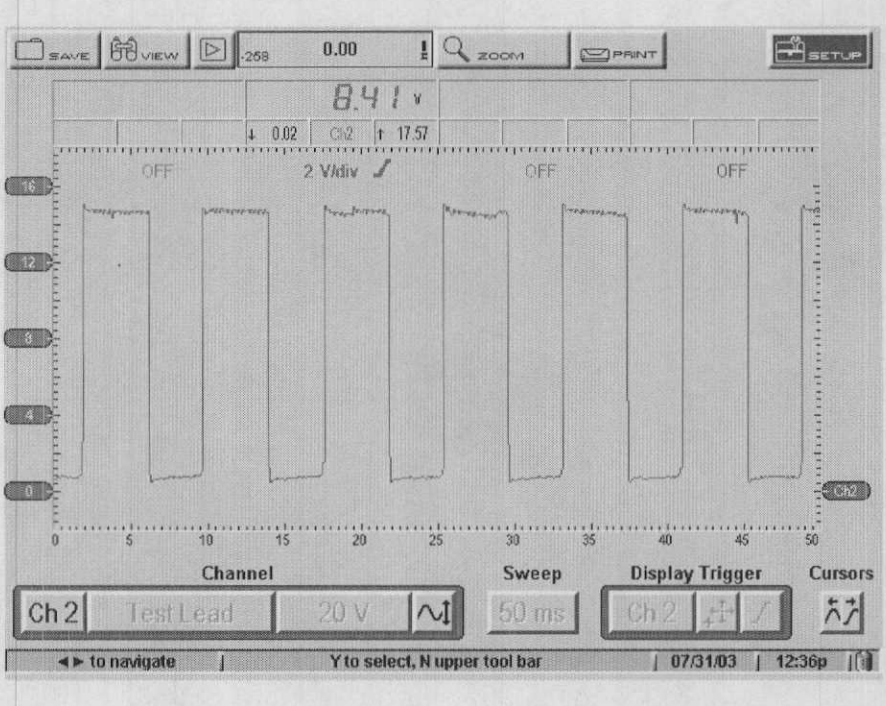
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 5 volts.



EGR Position Sensor – Linear EGR Valve – GM:

Scope Hook-up: The red lead is connected to the signal return wire at the EGR valve and the ground lead is connected to the battery ground terminal.

Set the voltage level to 10 V per/screen.

Set the sweep to 2 sec per/screen.

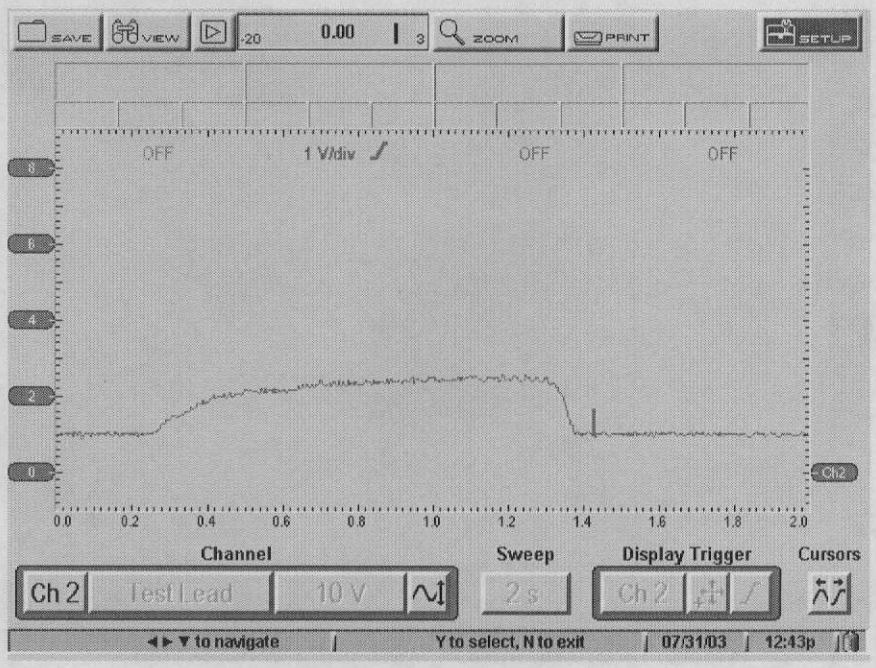
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 1.5 volts.



EST – Saturn:

Scope Hook-up: The red lead is connected to the signal return wire and the black lead is connected to the battery ground terminal. The signal was acquired at the module.

Set the voltage level to 10 V per/screen.

Set the sweep to 200 ms per/screen.

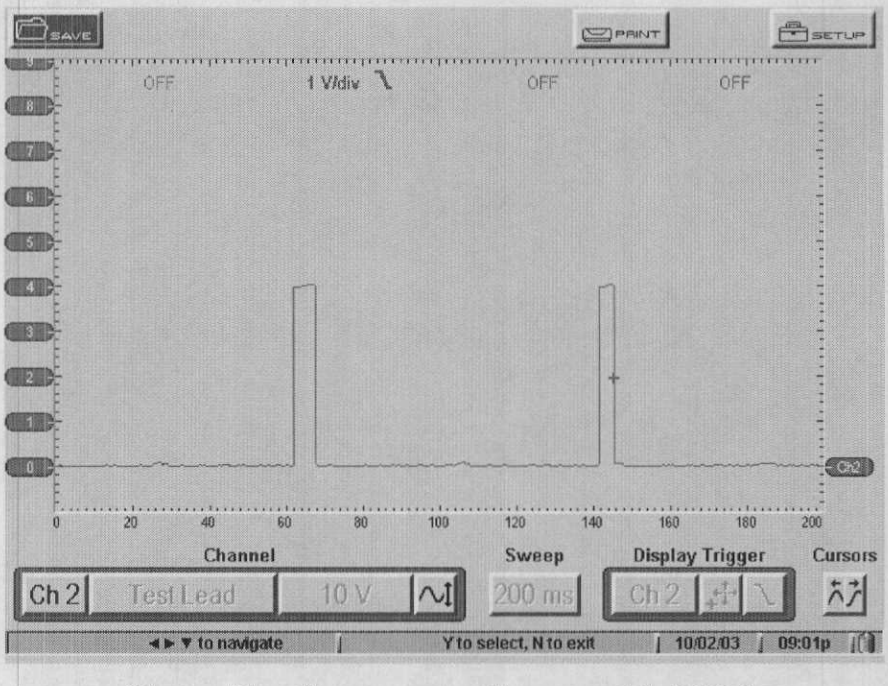
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 2 volts.



Note: The frequency will vary with RPM.

EST – DI (Distributor Ignition) – Late Model GM:
Scope Hook-up: The red lead is connected to the signal return wire and the black lead is connected to the battery ground terminal. The signal was acquired at the module.

Set the voltage level to 5 V per/screen.

Set the sweep to 50 ms per/screen.

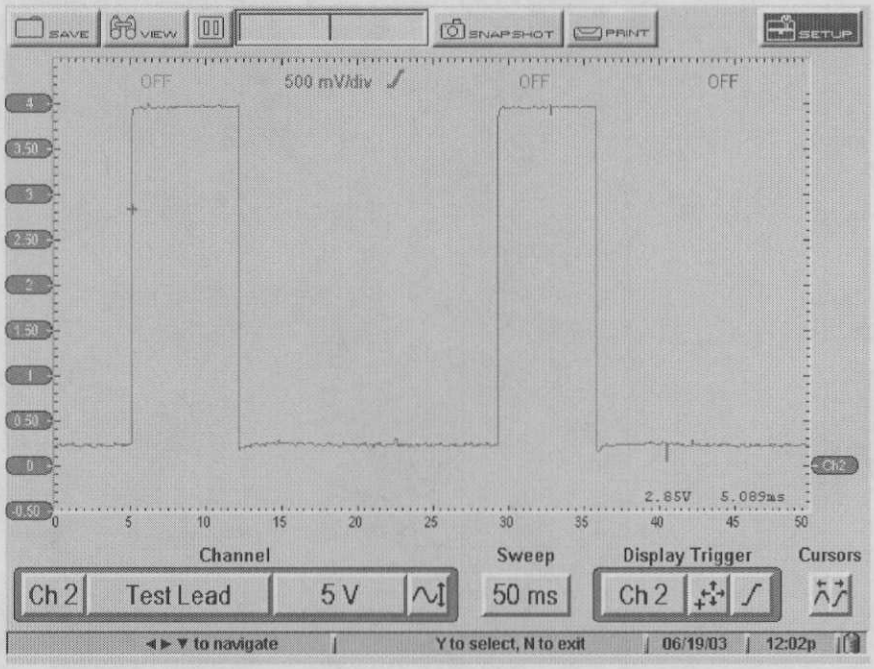
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 2 volts.



Note: The frequency will vary with RPM.

EST – EI (DIS Ignition) – GM:

Scope Hook-up: The red lead is connected to the signal return wire and the black lead is connected to the battery ground terminal. The signal was acquired at the ignition module.

Set the voltage level to 10 V per/screen.

Set the sweep to 50 ms per/screen.

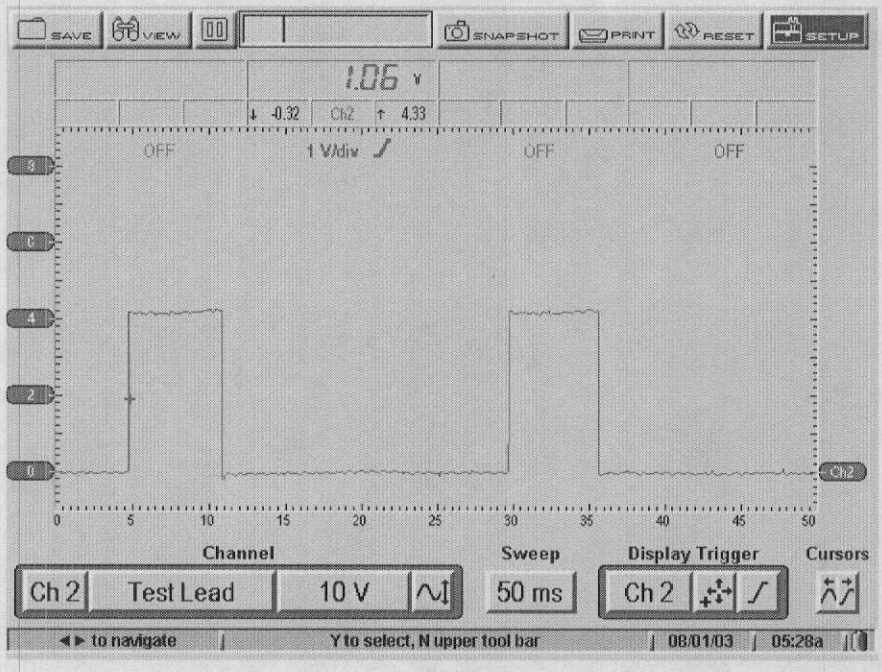
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 2 volts.



Note: The frequency will vary with RPM.

EGR Valve Position (EVP) – Ford:
Scope Hook-up: The red lead is connected to the signal return wire at the sensor on the EGR valve and the black lead is connected to the battery ground terminal.

Set the voltage level to 5 V per/screen.

Set the sweep to 2 sec per/screen.

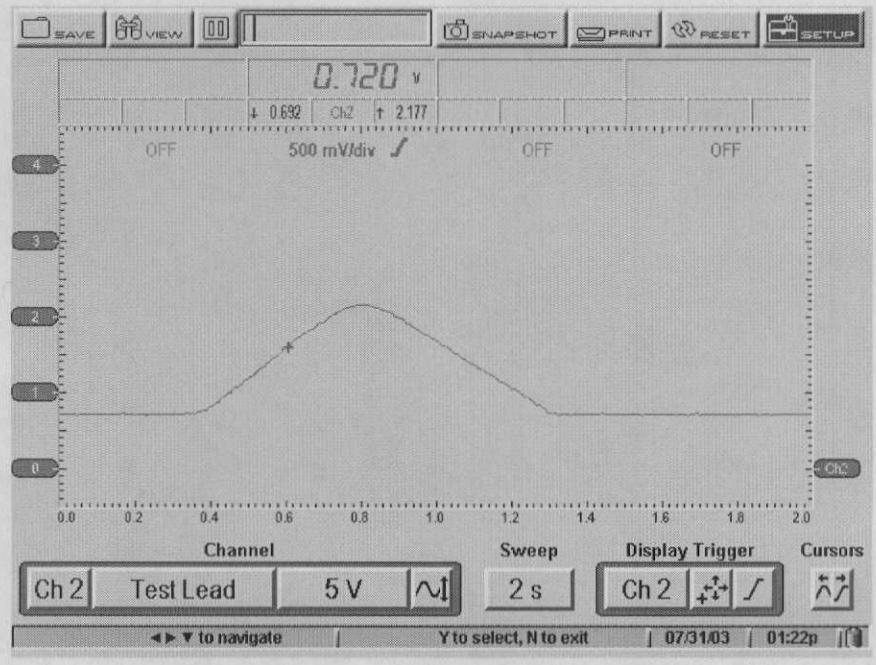
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position two divisions over from the left.
- Set the trigger level to positive 1.5 volts.



EDIS – Amperage – Ford: Using an Amp Probe

Scope Hook-up: Clamp the Amp Probe around the power wire at the coil. If the pattern is upside down reverse the probe.

Under the **Channel** menu select **Low Amps 20.**

Set the amperage level to 10 A per/screen.

Set the sweep to 10 ms per/screen.

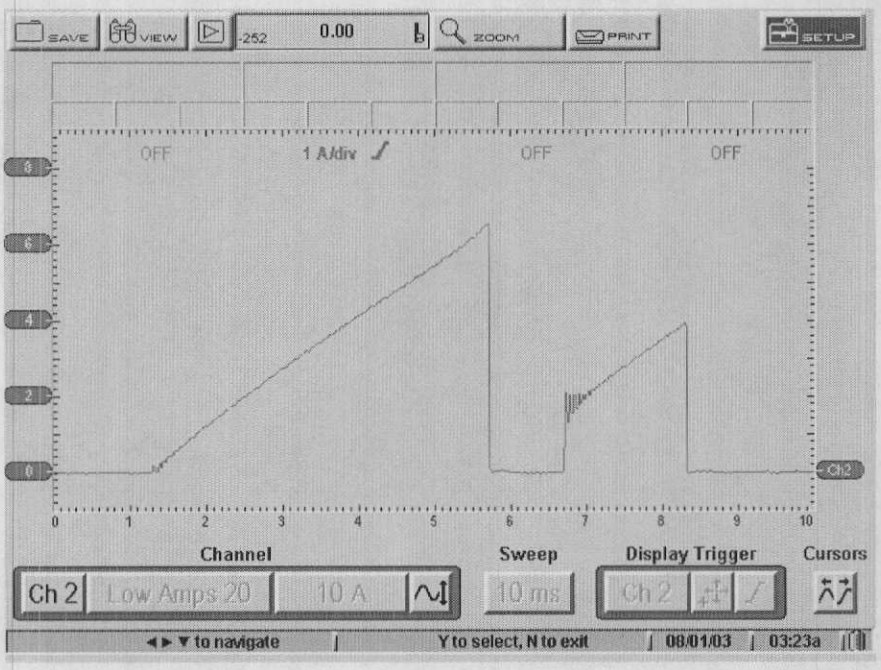
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position three divisions over from the left.
- Set the trigger level to positive 2 amps.



Fuel Pump Amperage – a/c: Using an Amp Probe

To look at the fuel pump in greater detail sometimes it is better to view it in the ac coupling mode on your scope. This will enlarge the waveform and give you much greater detail. **Note:** You cannot measure fuel pump amperage this way.

Scope Hook-up: Clamp the Amp Probe around the positive wire to the fuel pump. If pattern is upside down, reverse the probe and re-clamp.

Under the **Channel** menu select **Low Amps 20.**

Set the amperage level to 1 A per/screen.

Set the sweep to 100 ms per/screen.

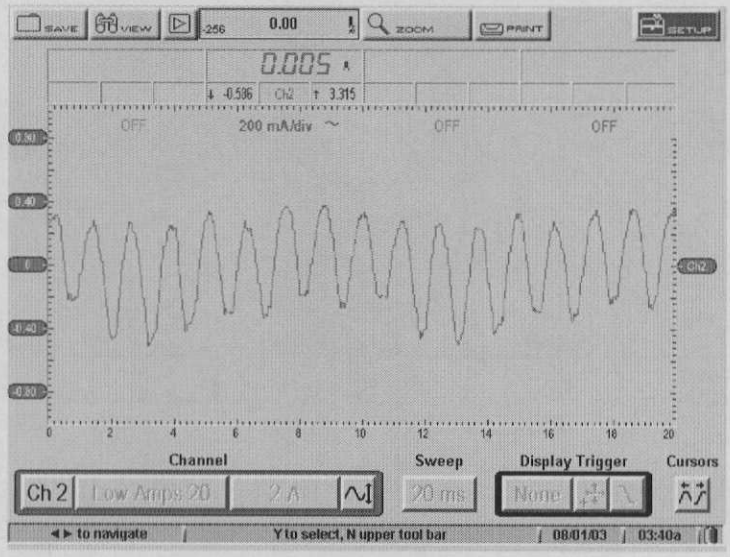
Set the scope to ac coupling (Coupling ac checked marked).

Move the ground indicator to the center of the screen.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 100 mA.



Fuel Pump Amperage – d/c: Using an Amp Probe

Scope hook-up: Clamp the Amp Probe around the positive wire going to the fuel pump. If the pattern is upside down reverse the probe and re-clamp.

Under the **Channel** menu select **Low Amps 20.**

Set the amperage level to 5 A per/screen.

Set the sweep to 20 ms per/screen.

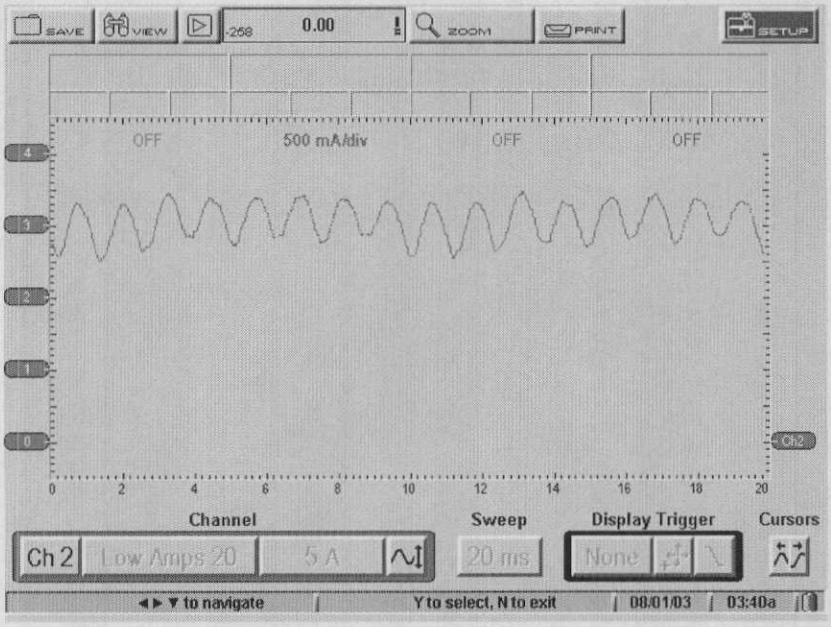
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 2 – 8 amps.



With most fuel pumps you want to see at least 8 humps on your screen at once. This will be one revolution of the pump.

Hall Effect – Idle – Chrysler:
Scope Hook-up: The red lead is connected to the signal return wire at the distributor and the black lead is connected to the battery ground terminal.

Set the voltage level to 10 V per/screen.

Set the sweep to 50 ms per/screen.

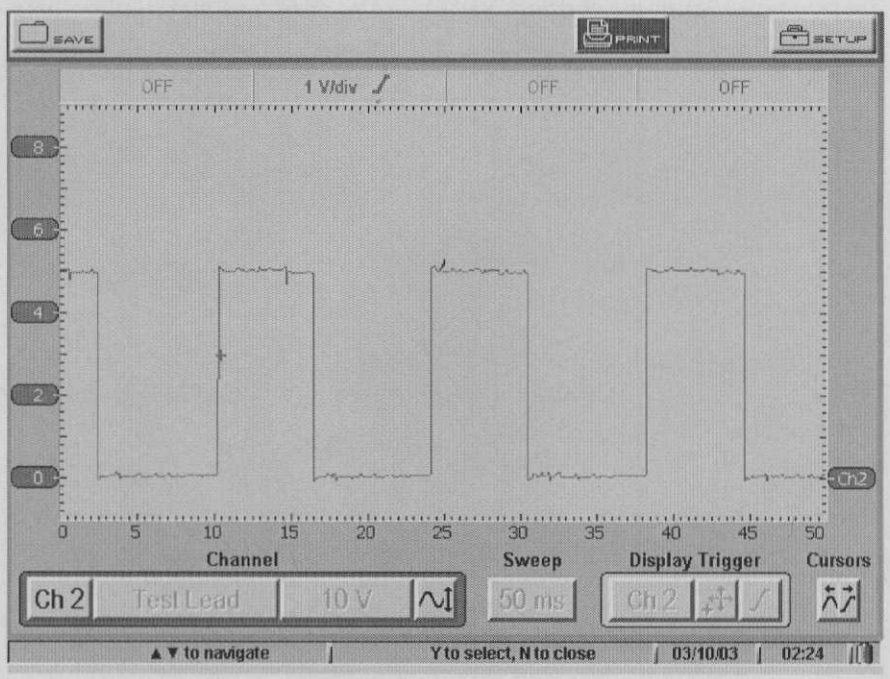
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 2 volts.



Note: The frequency will vary with RPM.

Hall Effect – Cruise – Chrysler:
Scope Hook-up: The red lead is connected to the signal return wire at the distributor and the black lead is connected to the battery ground terminal.

Set the voltage level to 10 V per/screen.

Set the sweep to 100 ms per/screen.

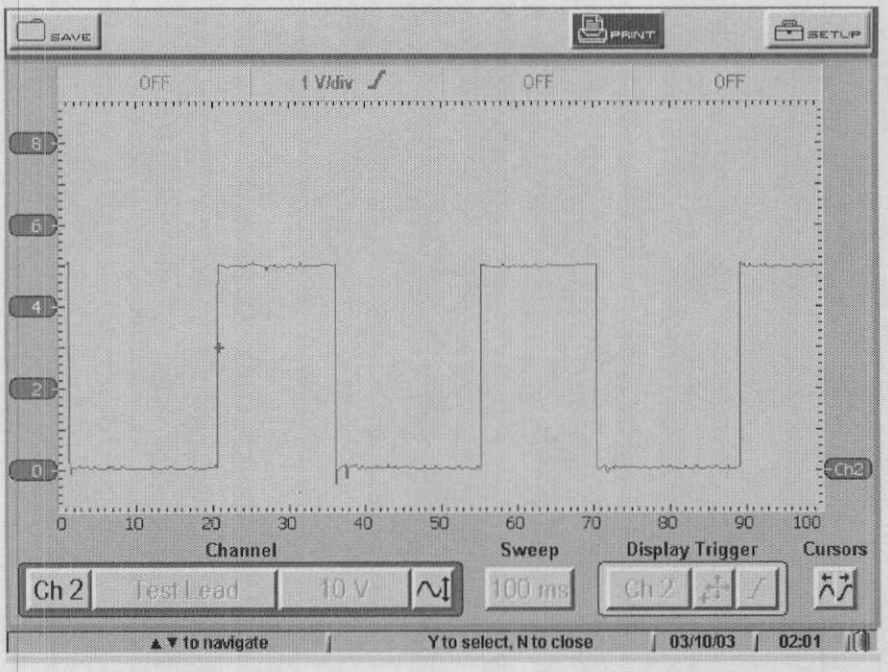
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 5 volts.



Note: The frequency will vary with RPM.

Idle Air By-Pass – Early Ford:
Scope hook-up: The red lead is connected to the IAB control wire and the black lead connected to the battery ground terminal. If you unplug the IAB connector with the KOEO, you can determine which wire is the control wire. The wire with no voltage is the control side.

Set the voltage level to 20 V per/screen.

Set the sweep to 50 ms per/screen.

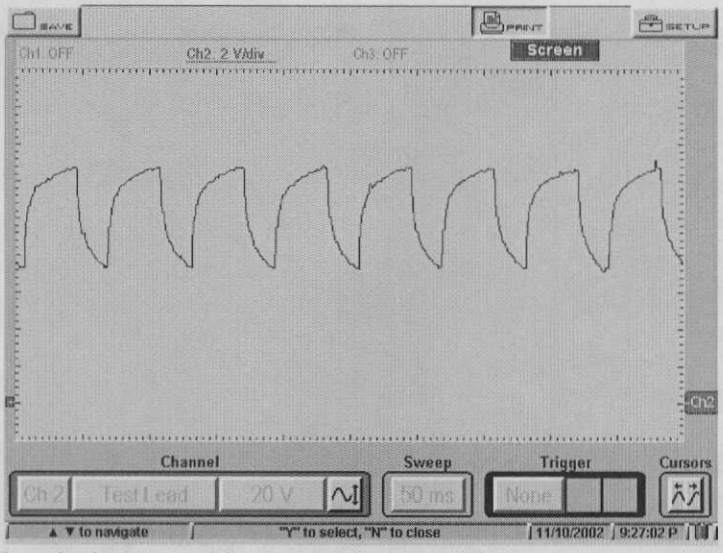
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 8 – 12 volts.



As the engine load changes, the waveform will move up and down the screen. The downward slope of the waveform is the "on time" or when the valve is commanded open.

Idle Air By-Pass – Late Ford:
Scope hook-up: The red lead is connected to the IAB control wire and the black lead is connected to the battery ground terminal. If you unplug the IAB connector with the KOEO, you can determine which wire is the control wire. The wire with no voltage is the control side.

Set the voltage level to 20 V per/screen.

Set the sweep to 5 ms per/screen.

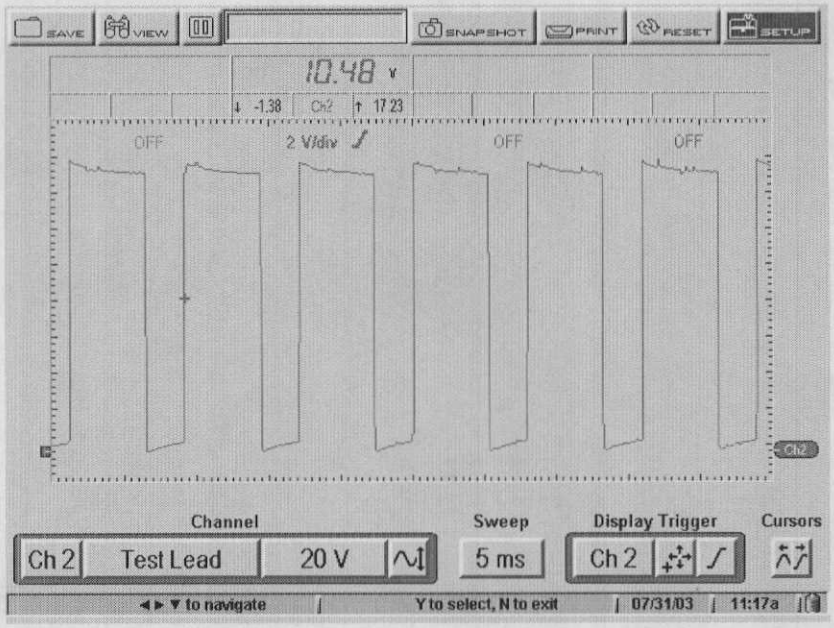
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 5 volts.



Idle Air Control – GM:

Scope Hook-up: The red lead is connected to the positive wire on one IAC coil and the black lead is connected to the negative wire on the same coil of the IAC. By doing this you can look at two drivers at once.

Set the voltage level to 50 V per/screen.

Set the sweep to 200 ms per/screen.

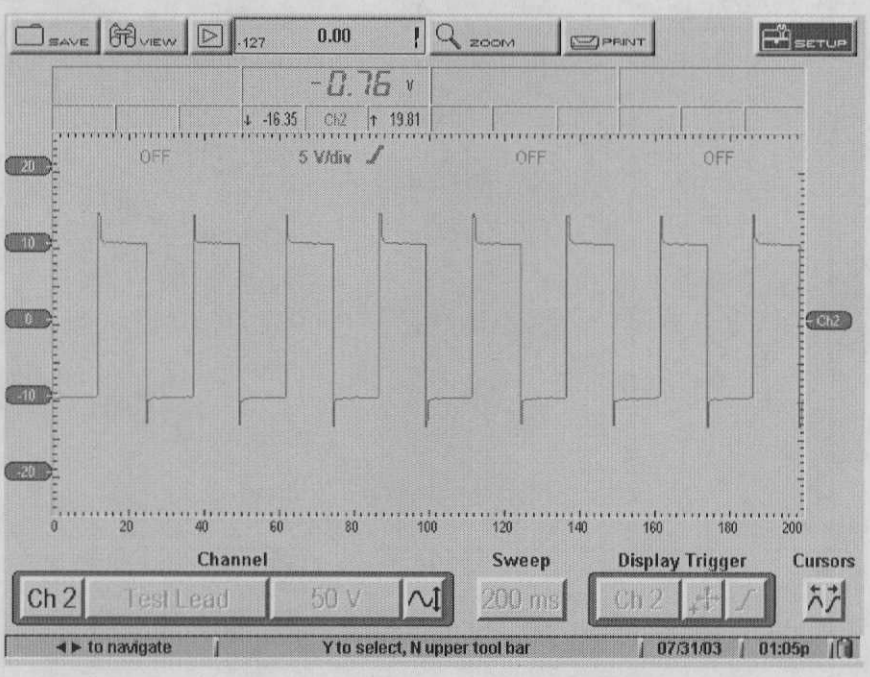
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator to the center of the screen.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 5 volts.



Idle Air Control – Chrysler:

Scope Hook-up: The red lead is connected to the positive wire on one IAC coil and the black lead is connected to the negative wire on the same coil of the IAC. By doing this you can look at two drivers at once.

Set the voltage level to 50 V per/screen.

Set the sweep to 200 ms per/screen.

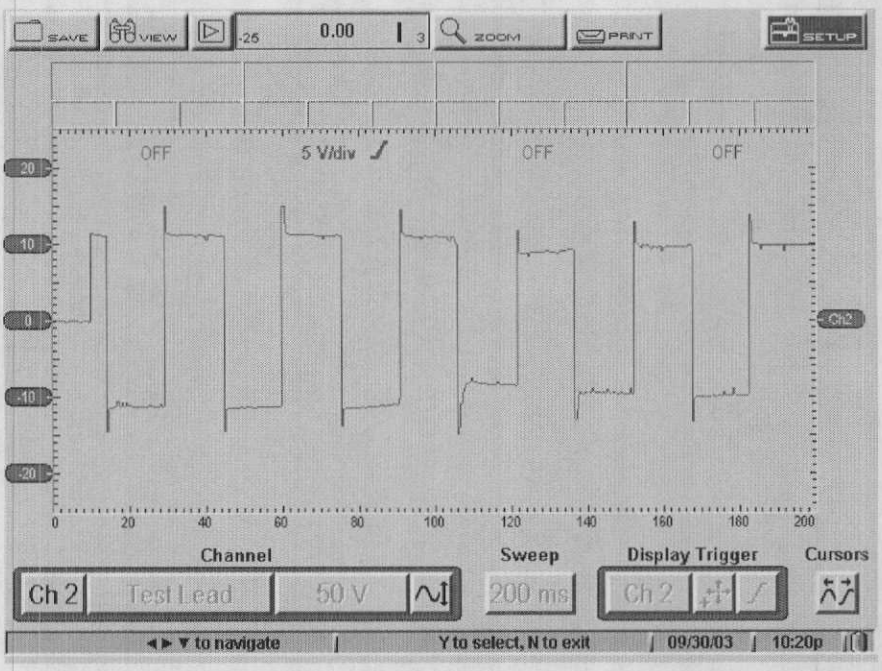
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator to the center of the screen.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 5 volts.



Ignition Amperage – Single: Using an Amp Probe

Scope Hook-up: Clamp the Amp Probe around the positive wire going to the module. If the pattern is upside down reverse the probe and re-clamp.

Under the **Channel** menu select **Low Amps 20.**

Set the amperage level to 20 A per/screen.

Set the sweep to 10 ms per/screen.

Set the scope to dc coupling (Coupling ac un-checked marked).

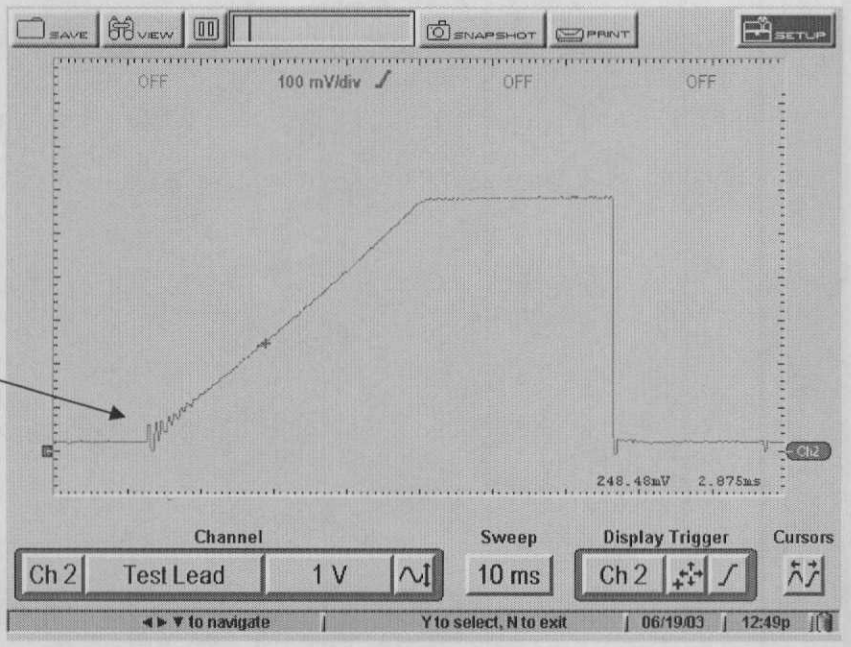
Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position three divisions over from the left.
- Set the trigger level to positive 2 amps.

These oscillations are normal. We will explain this in greater detail later in the manual.



Ignition Amperage – Parade: Using an Amp Probe

Scope Hook-up: Clamp the Amp Probe around the positive wire going to the module. If the pattern is upside down reverse the probe and re-clamp.

Under the **Channel** menu select **Low Amps 20.**

Set the amperage level to 20 A per/screen.

Set the sweep to 50 ms per/screen.

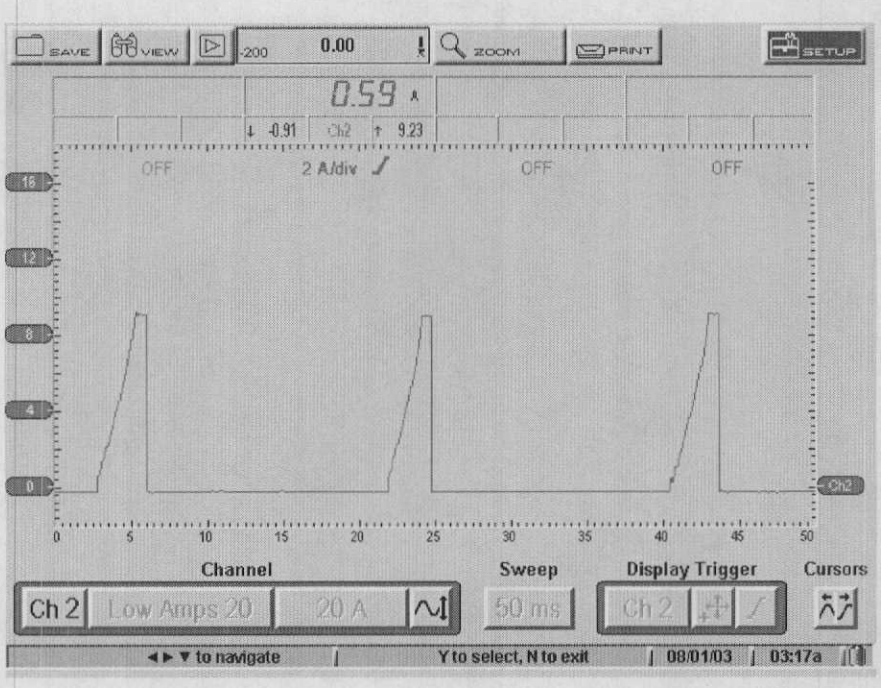
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 2 amps.



Ignition Amperage – EI – Ford: Using an Amp Probe

Scope Hook-up: Clamp the Amp Probe around the positive wire going to the module. If the pattern is upside down reverse the probe and re-clamp.

Under the **Channel** menu select **Low Amps 20.**

Set the amperage level to 10 A per/screen.

Set the sweep to 10 ms per/screen.

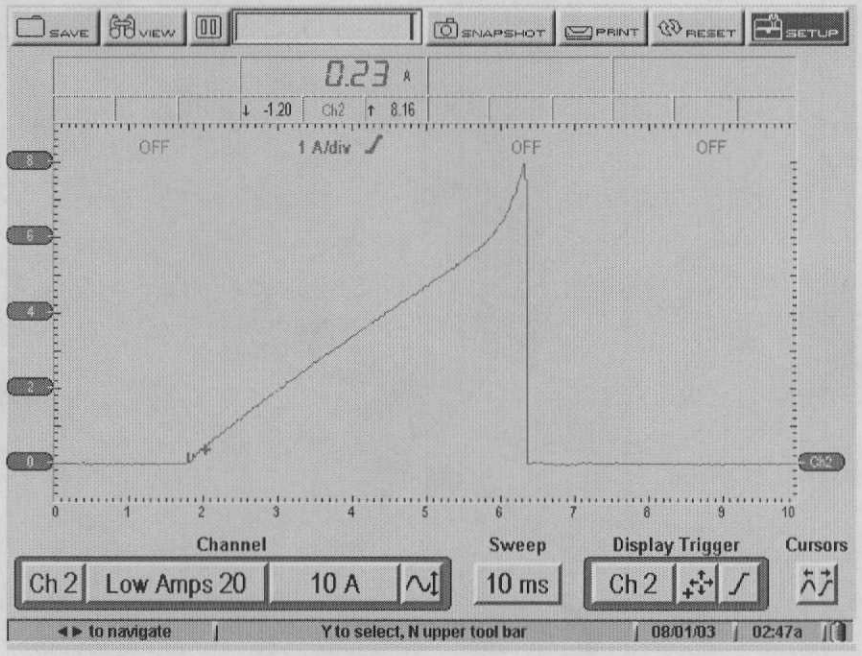
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position three divisions over from the left.
- Set the trigger level to positive 2 amps.



Ignition Amperage – EI – GM: Using an Amp Probe:
Scope Hook-up: Clamp the Amp Probe around the positive wire going to the module. If the pattern is upside down reverse the probe and re-clamp.

Under the **Channel** menu select **Low Amps 20.**

Set the amperage level to 20 A per/screen.

Set the sweep to 10 ms per/screen.

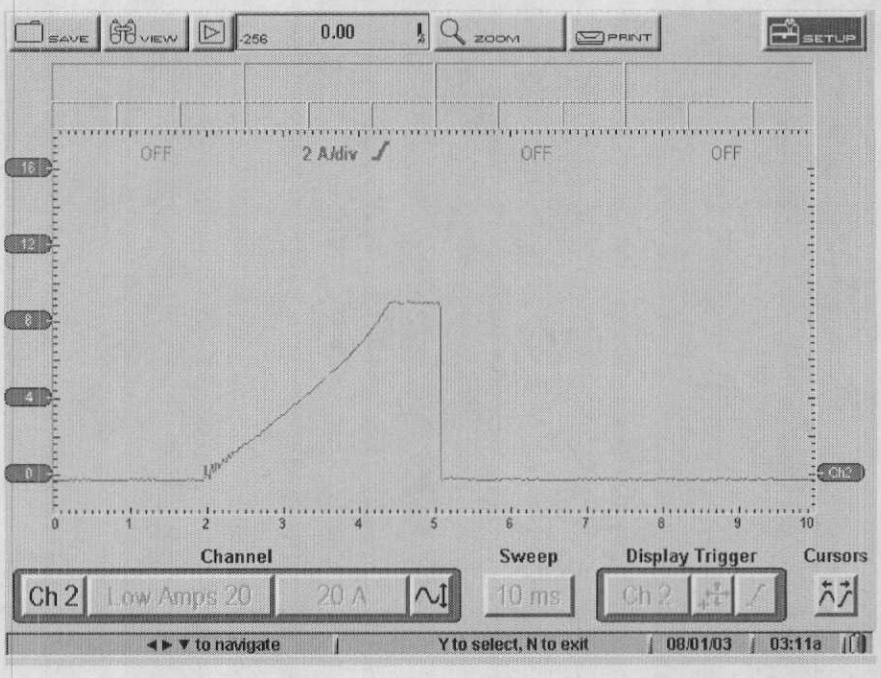
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position three divisions over from the left.
- Set the trigger level to positive 2 amps.



Ignition Amperage – External Coil – Chrysler: Using an Amp Probe
Scope Hook-up: Clamp the Amp Probe around the positive wire going to the module. If the pattern is upside down reverse the probe and re-clamp.

Under the **Channel** menu select **Low Amps 20.**

Set the amperage level to 10 A per/screen.

Set the sweep to 10 ms per/screen.

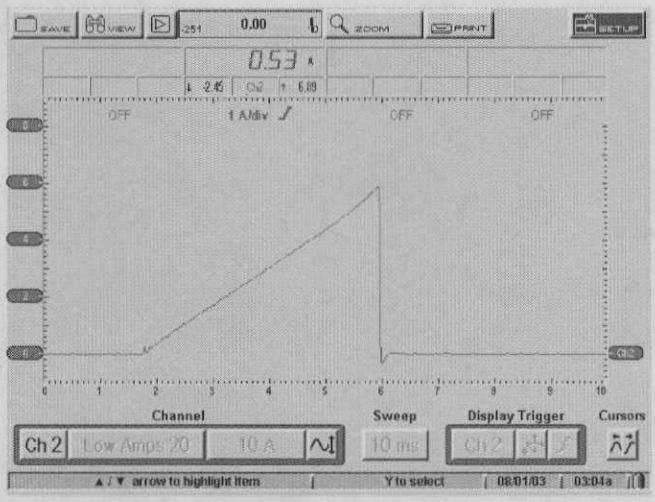
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position three divisions over from the left.
- Set the trigger level to positive 2 amps.



On this particular system the module functions are built into the computer. The computer shuts off the coil saturation process. This is why you do not see the normal current limiting section that you are familiar with. As you raise and lower the RPM you will notice that the amperage will increase or decrease…depending on the requirements of the ignition system.

Ignition Amperage – External Coil Canister Style – Chrysler:
Scope Hook-up: Clamp the Amp Probe around the positive wire going to the module. If the pattern is upside down reverse the probe and re-clamp.

Under the **Channel** menu select **Low Amps 20.**

Set the amperage level to 10 A per/screen.

Set the sweep to 20 ms per/screen.

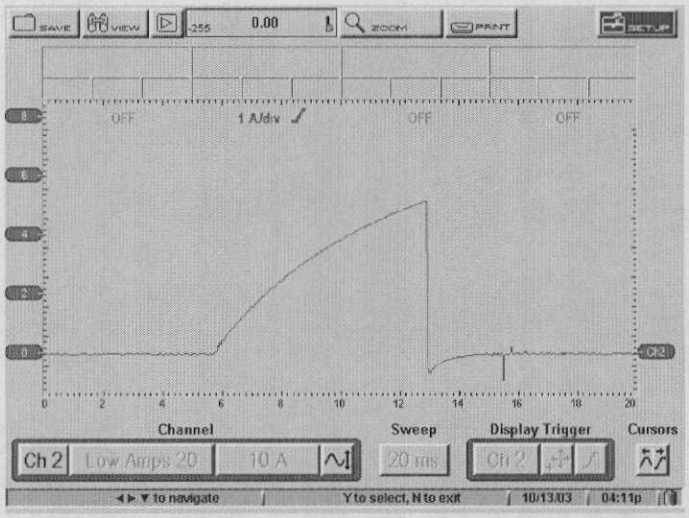
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position three divisions over from the left.
- Set the trigger level to positive 2 amps.



On this particular system the module functions are built into the computer. The computer shuts off the coil saturation process. This is why you do not see the normal current limiting section that you are familiar with. As you raise and lower the RPM you will notice that the amperage will increase or decrease…depending on the requirements of the ignition system.

Ignition Amperage – Ford TFI: Using an Amp Probe

Scope Hook-up: Clamp the Amp Probe around the positive wire going to the module. If the pattern is upside down reverse the probe and re-clamp.

Under the **Channel** menu select **Low Amps 20.**

Set the amperage level to 10 A per/screen.

Set the sweep to 20 ms per/screen.

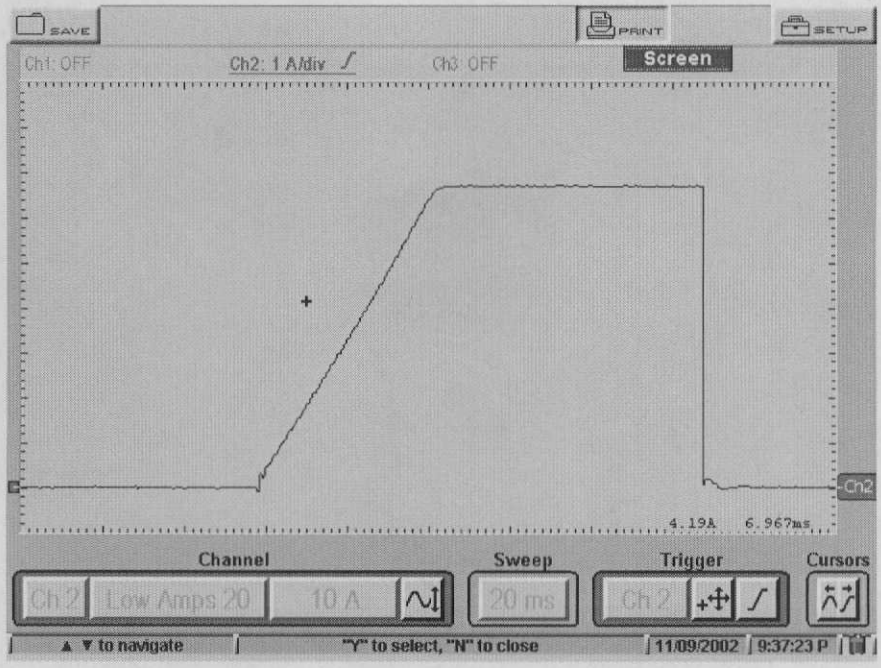
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position three divisions over from the left.
- Set the trigger level to positive 2 amps.



Ignition Amperage – DI – Jeep 4.0: Using an Amp Probe

Scope Hook-up: Clamp the Amp Probe around the positive wire going to the module. If the pattern is upside down reverse the probe and re-clamp.

Under the **Channel** menu select **Low Amps 20.**

Set the amperage level to 10 A per/screen.

Set the sweep to 10 ms per/screen.

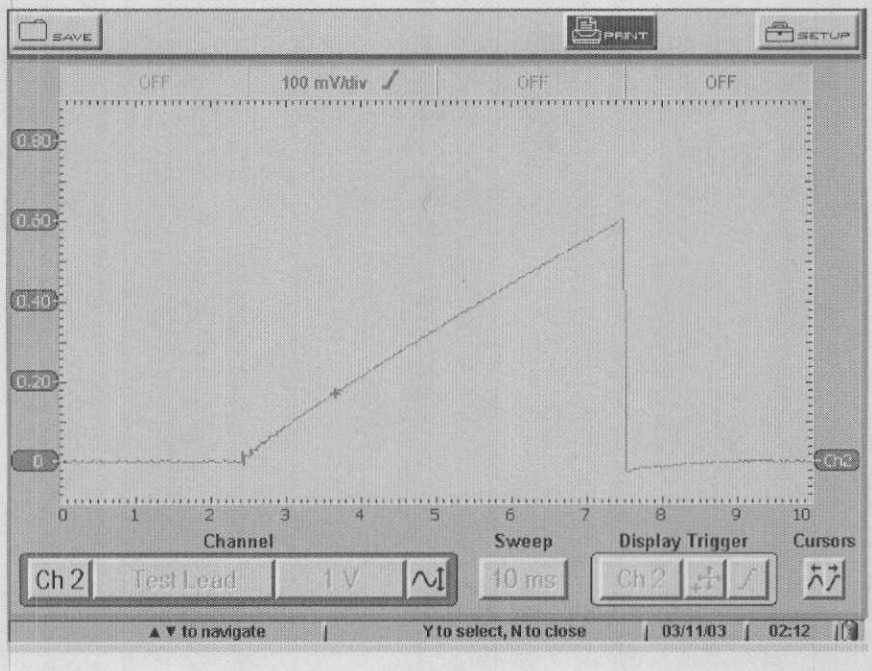
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position three divisions over from the left.
- Set the trigger level to positive 2 amps.



Injector Amperage – Saturation Type: Using an Amp Probe

Scope Hook-up: Clamp the Amp Probe around the positive wire going to the injector. If the pattern is upside down reverse the probe and re-clamp.

Under the **Channel** menu select **Low Amps 20.**

Set the amperage level to 2 A per/screen.

Set the sweep to 10 ms per/screen.

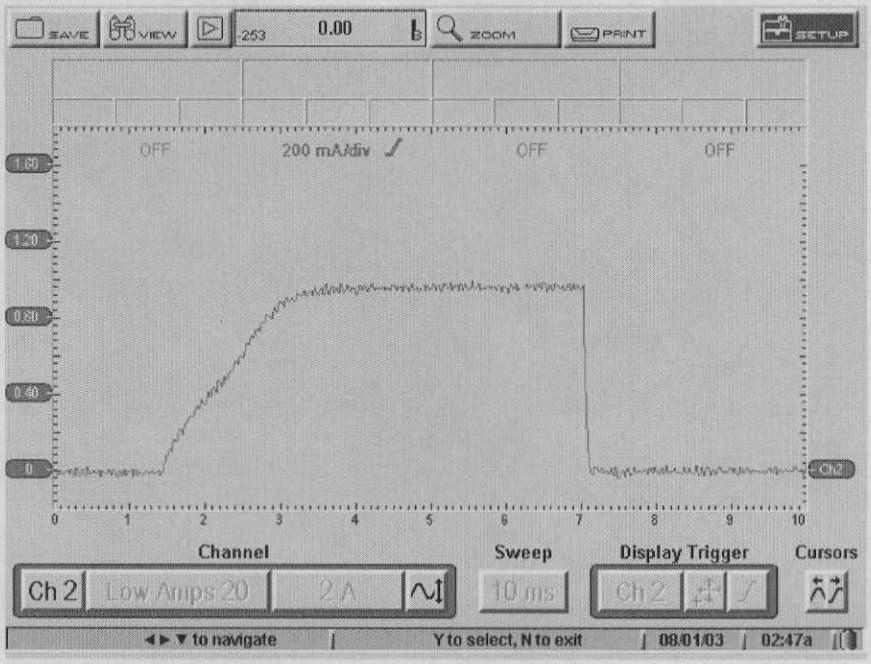
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position two divisions over from the left.
- Set the trigger level to positive 400 mA.



Injector Amperage – Peak & Hold: Using an Amp Probe

Scope Hook-up: Clamp the Amp Probe around the positive wire going to the injector. If the pattern is upside down reverse the probe and re-clamp.

Under the **Channel** menu select **Low Amps 20.**

Set the amperage level to 5 A per/screen.

Set the sweep to 5 ms per/screen.

Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position three divisions over from the left.
- Set the trigger level to positive 2 amps.

Injector Amperage – Capacitance – Mercury Villager or Nissan Quest:
Scope Hook-up: Clamp the Amp Probe around the positive wire going to the injector. If the pattern is upside down reverse the probe and re-clamp.

Under the **Channel** menu select **Low Amps 20.**

Set the amperage level to 2 A per/screen.

Set the sweep to 10 ms per/screen.

Set the scope to dc coupling (Coupling ac un-checked marked).

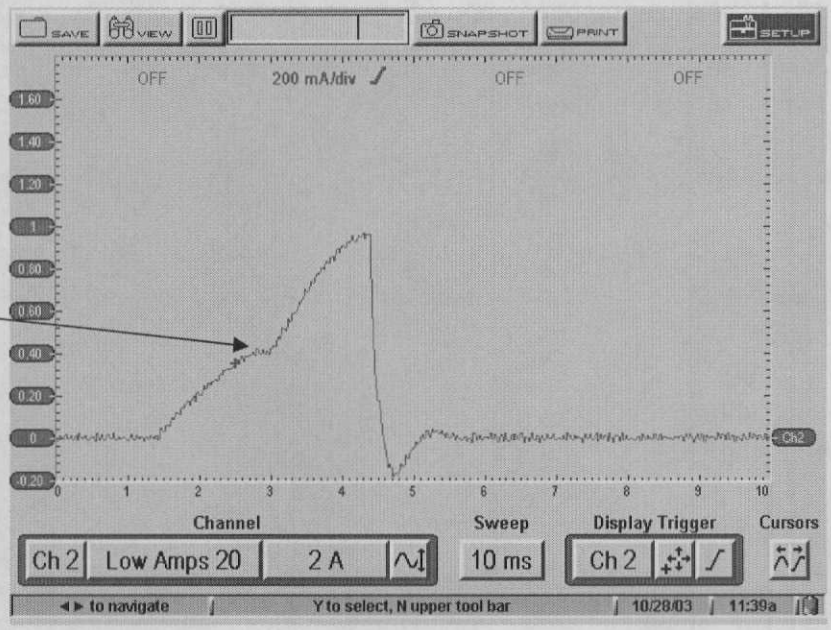
Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position three divisions over from the left.
- Set the trigger level to positive 400 mA.

This dip in the pattern is from the injector pintle opening.



Injector Amperage – Jeep 4.0: Using an Amp Probe

Scope Hook-up: Clamp the Amp Probe around the positive wire going to the injector. If the pattern is upside down reverse the probe and re-clamp.

Under the **Channel** menu select **Low Amps 20.**

Set the amperage level to 2 A per/screen.

Set the sweep to 10 ms per/screen.

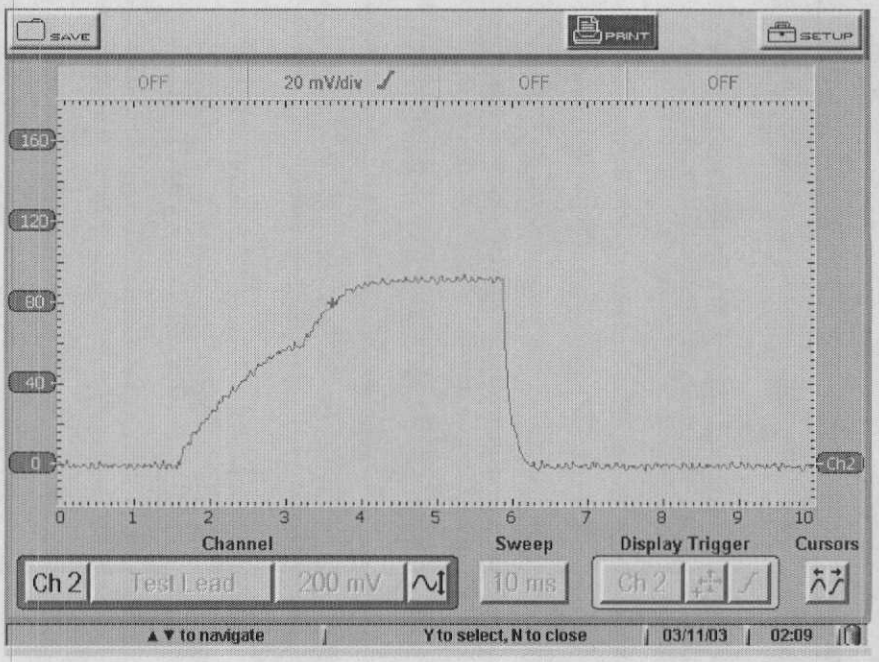
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position three divisions over from the left.
- Set the trigger level to positive 400 mA.



Injector Voltage – Peak & Hold:
Scope Hook-up: The red lead is connected to the control side of the injector and the black lead connected to the battery ground terminal.

Set the voltage level to 100 V per/screen.

Set the sweep to 10 ms per/screen.

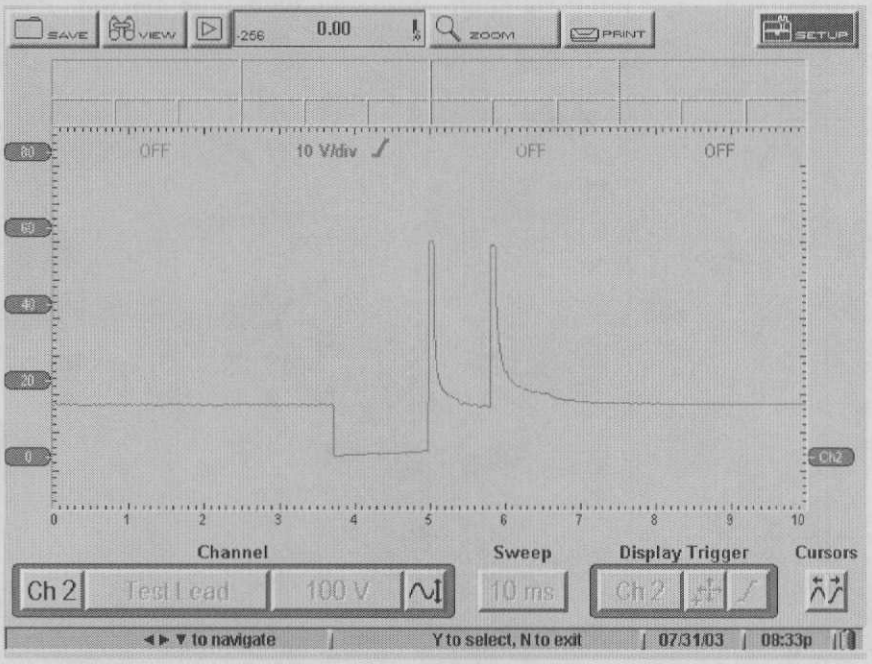
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the falling slope.
- Move the trigger position three divisions over from the left.
- Set the trigger level to positive 5 volts.



Injector Voltage – Saturation Type:
Scope Hook-up: The red lead is connected to the control side of the injector and the black lead is connected to the battery ground terminal.

Set the voltage level to 100 V per/screen.

Set the sweep to 10 ms per/screen.

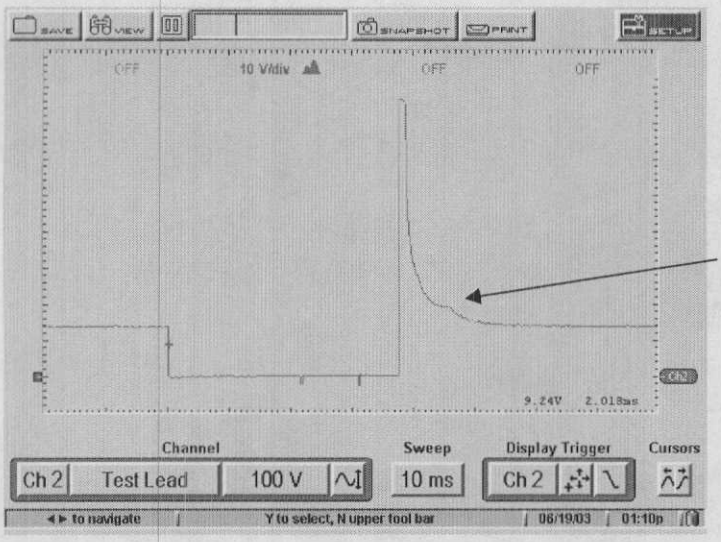
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the falling slope.
- Move the trigger position three divisions over from the left.
- Set the trigger level to positive 5 volts.



This hump is caused by the pintle going closed.

Injector Voltage – Capacitance – Mercury Villager or Nissan Quest:
Scope Hook-up: The red lead is connected to the control side of the injector and the black lead is connected to the battery ground terminal.

Set the voltage level to 200 V per/screen.

Set the sweep to 20 ms per/screen.

Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the falling slope.
- Move the trigger position three divisions over from the left.
- Set the trigger level to positive 5 volts.

Injector Voltage – Jeep 4.0 Voltage clipped @ 35V:
Scope Hook-up: The red lead is connected to the control side of the injector and the black lead is connected to the battery ground terminal.

Set the voltage level to 50 V per/screen.

Set the sweep to 10 ms per/screen.

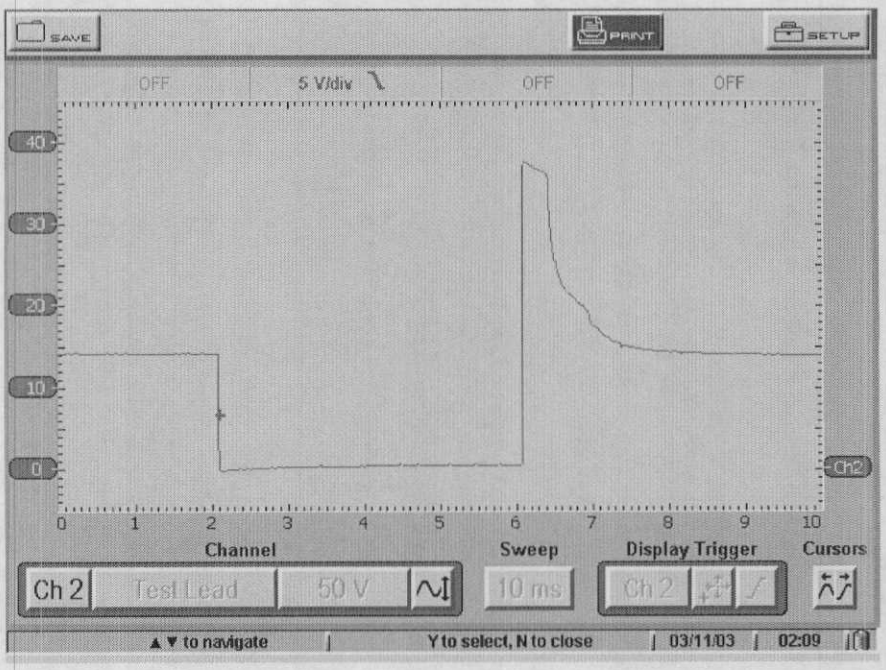
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the falling slope.
- Move the trigger position two divisions over from the left.
- Set the trigger level to positive 5 volts.



Injector Voltage – Peak & Hold Clipped @ 40 V:
Scope Hook-up: The red lead is connected to the control side of the injector and the black lead is connected to the battery ground terminal.

Set the voltage level to 50 V per/screen.

Set the sweep to 5 ms per/screen.

Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the falling slope.
- Move the trigger position two divisions over from the left.
- Set the trigger level to positive 5 volts.

Injector Voltage – Close-up of the Pintle:
Scope Hook-up: The red lead is connected to the control side of the injector and the black lead is connected to the battery ground terminal.

Set the voltage level to 50 V per/screen.

Set the sweep to 10 ms per/screen.

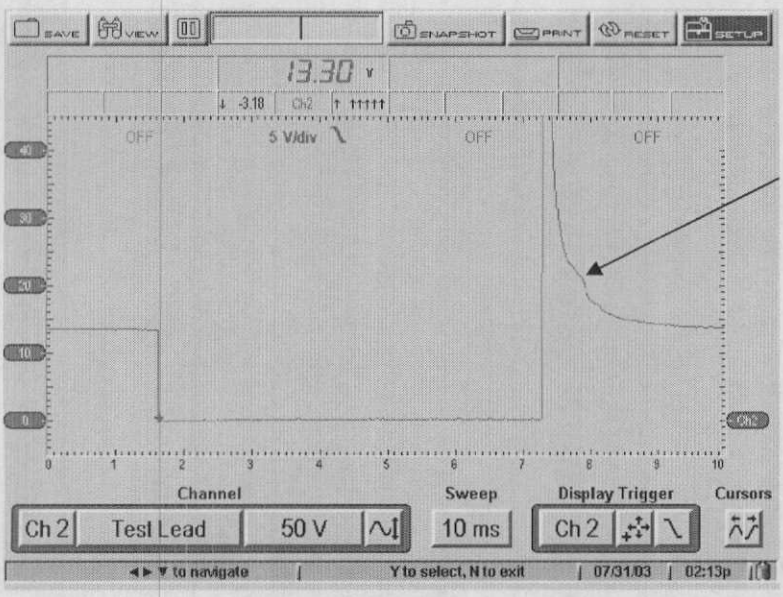
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the falling slope.
- Move the trigger position two divisions over from the left.
- Set the trigger level to positive 5 volts.



Pintle hump: This is the point when the injector actually closes.

Knock Sensor – GM:

Scope Hook-up: The red lead is connected to the signal return wire and the ground lead is connected to the battery ground terminal. The signal was acquired at the sensor on the side of the engine block.

Set the voltage level to 5 V per/screen.

Set the sweep to 10 ms per/screen.

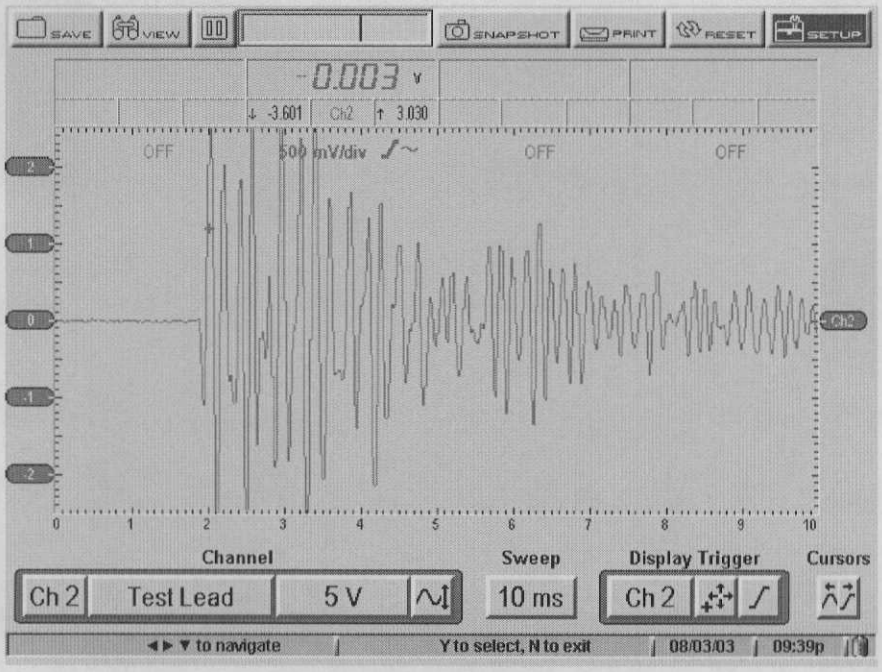
Set the scope to ac coupling (Coupling ac checked marked).

Move the ground indicator to the center of the screen.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 1 volt.



MAP Sensor:

Scope Hook-up: The red lead is connected to the signal return wire at the sensor and the black lead in connected to the battery ground terminal.

Set the voltage level to 10 V per/screen.

Set the sweep to 1 sec per/screen.

Set the scope to dc coupling (Coupling ac un-checked marked).

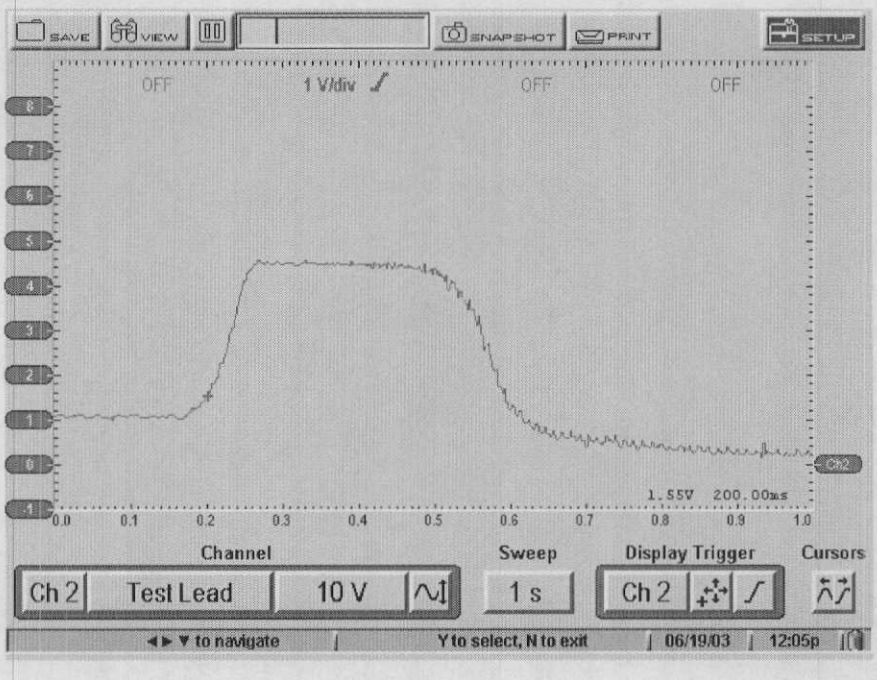
Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position two divisions over from the left.
- Set the trigger level to positive 1.5 volts.

CAUTION: Do not over rev the engine.



Mass Air Flow Sensor – Analog:
Scope Hook-up: The red lead is connected to the signal return wire at the sensor and the black lead is connected to the battery ground terminal.

Set the voltage level to 5 V per/screen.

Set the sweep to 1 sec per/screen.

Set the scope to dc coupling (Coupling ac un-checked marked).

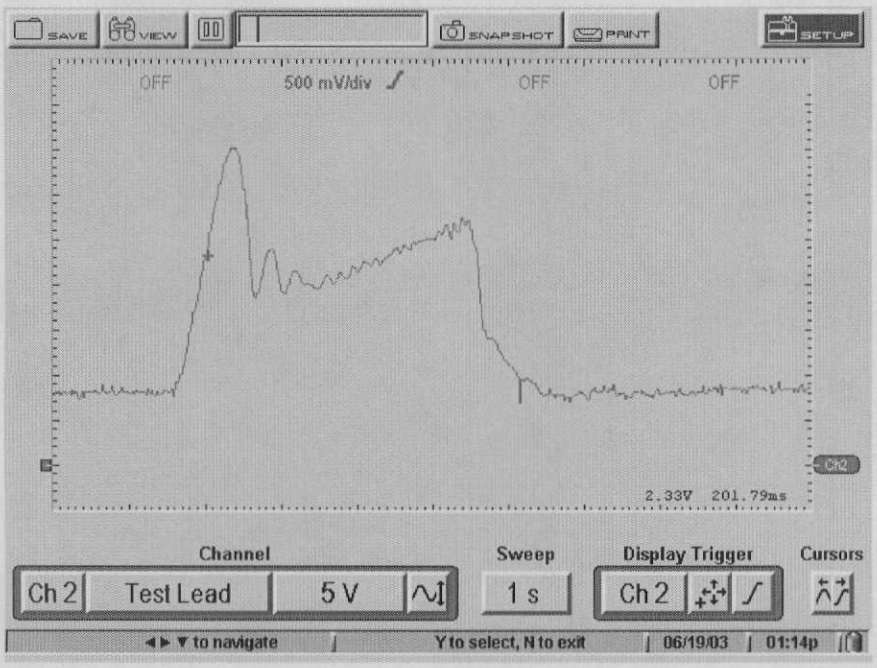
Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 1.5 volts.

CAUTION: Do not over rev the engine.



Mass Air Flow Sensor – Digital Hitachi – KOEO – GM:
Scope Hook-up: the red lead is connected to the signal return wire at the sensor and the black lead is connected to the battery ground wire.

Set the voltage level to 10 V per/screen.

Set the sweep to 50 ms per/screen.

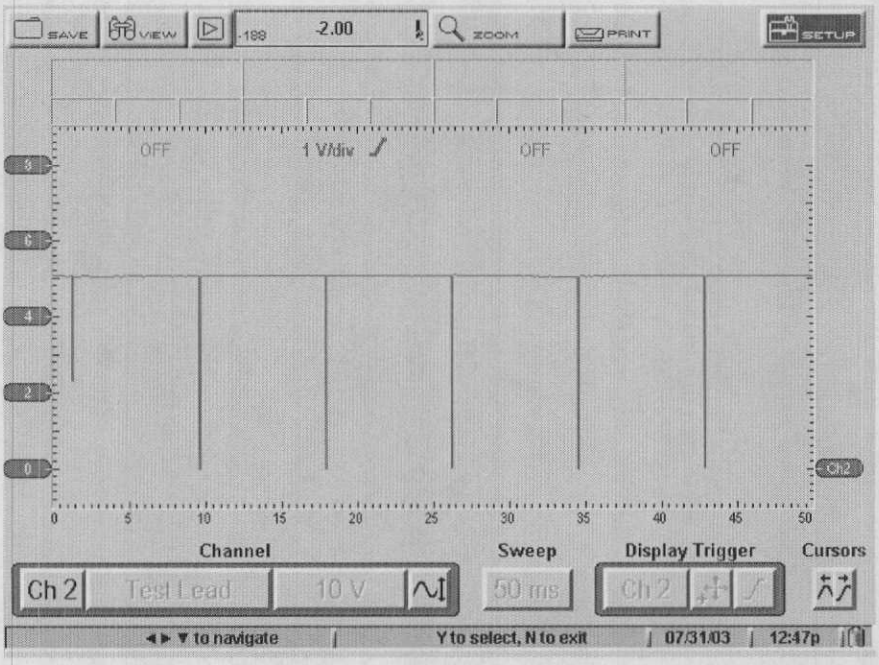
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 2 volts.



Mass Air Flow Sensor – Digital Hitachi – Idle – GM:
Scope Hook-up: the red lead is connected to the signal return wire at the sensor and the black lead is connected to the battery ground wire.

Set the voltage level to 10 V per/screen.

Set the sweep to 5 ms per/screen.

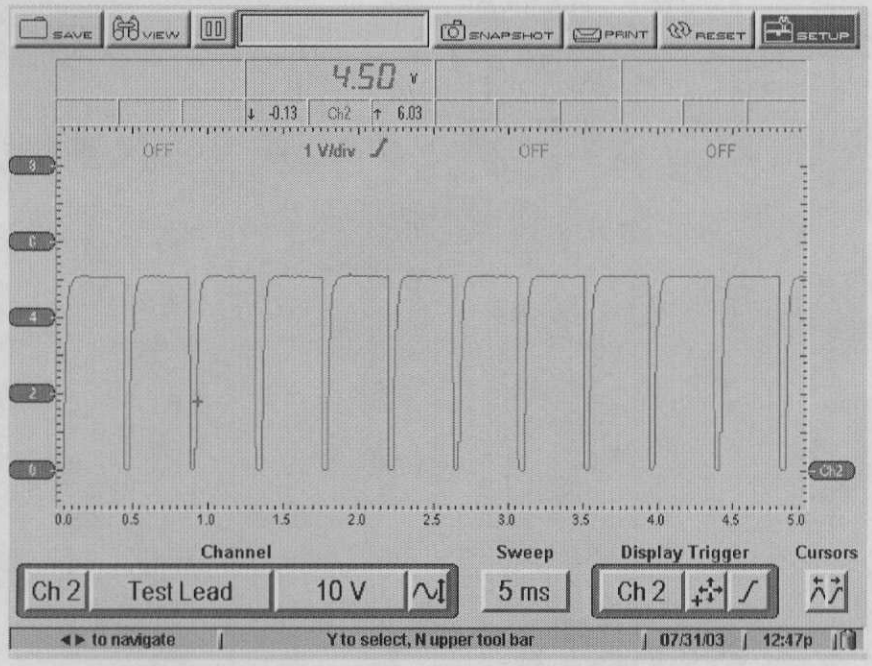
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 2 volts.



Mass Air Flow Sensor – Digital Hitachi – Cruise – GM:
Scope Hook-up: The red lead is connected to the signal return wire at the sensor and the black lead is connected to the battery ground wire.

Set the voltage level to 10 V per/screen.

Set the sweep to 5 ms per/screen.

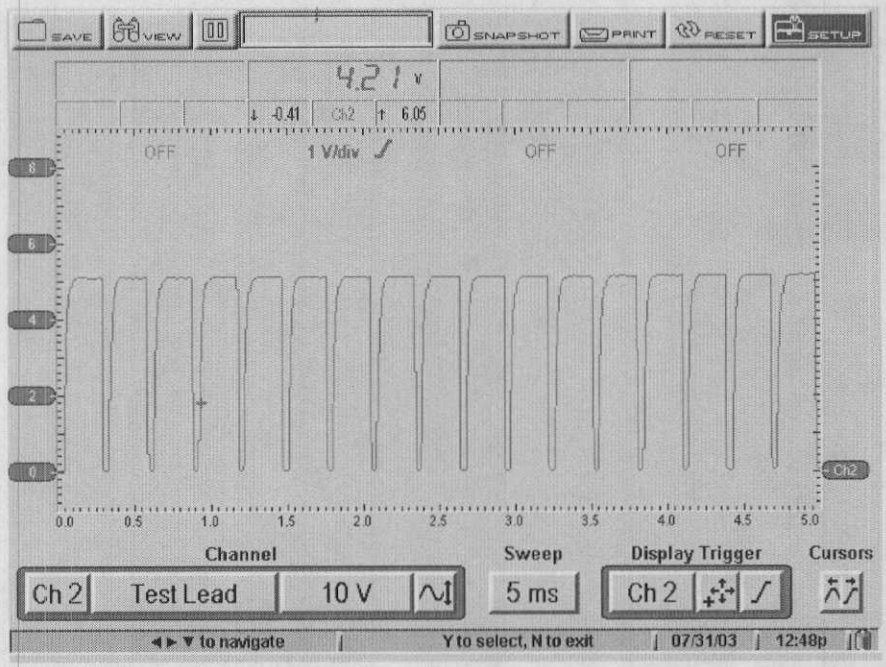
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 2 volts.



Mass Air Flow Sensor – Digital Hitachi – Snap Throttle – GM:
Scope Hook-up: The red lead is connected to the signal return wire at the sensor and the black lead is connected to the battery ground wire.

Set the voltage level to 10 V per/screen.

Set the sweep to 5 ms per/screen.

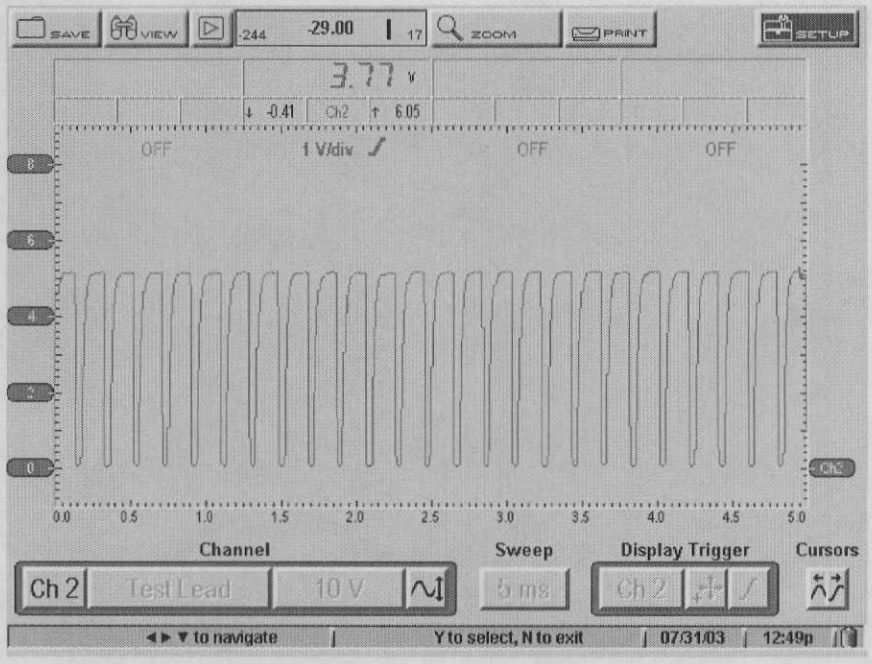
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 2 volts.



Oxygen Sensor:

Scope Hook-up: The red lead is connected to the signal return wire and the black lead is connected to the battery ground terminal.

Set the voltage level to 1 V per/screen.

Set the sweep to 5 sec per/screen.

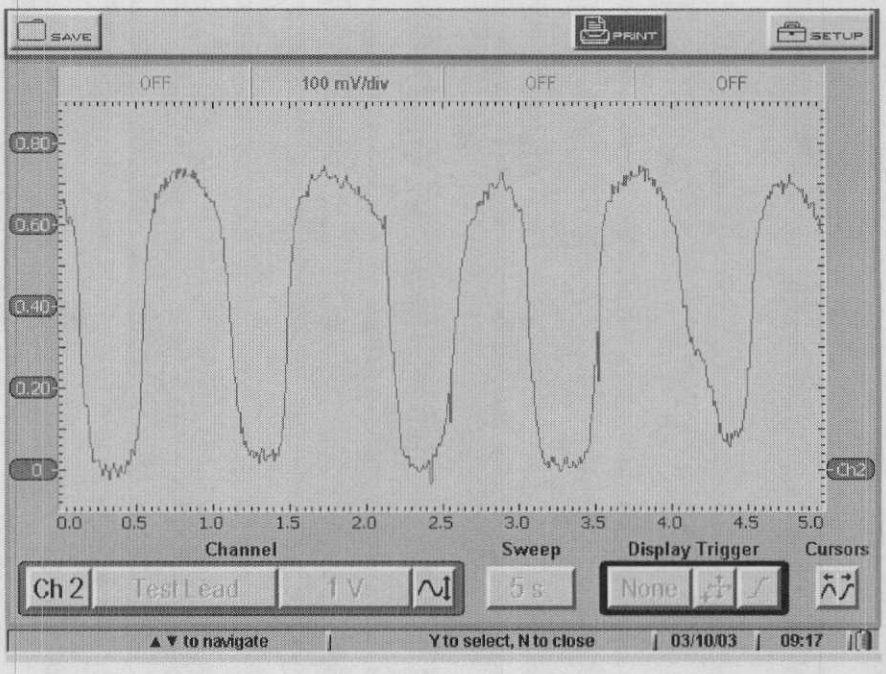
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 500 mV.



Pick-up Coil – Cranking:

Scope Hook-up: The red lead is connected to the green wire on the pick-up coil and the black lead is connected to the other wire to the pick-up coil.

Set the voltage level to 5 V per/screen.

Set the sweep to 500 ms per/screen.

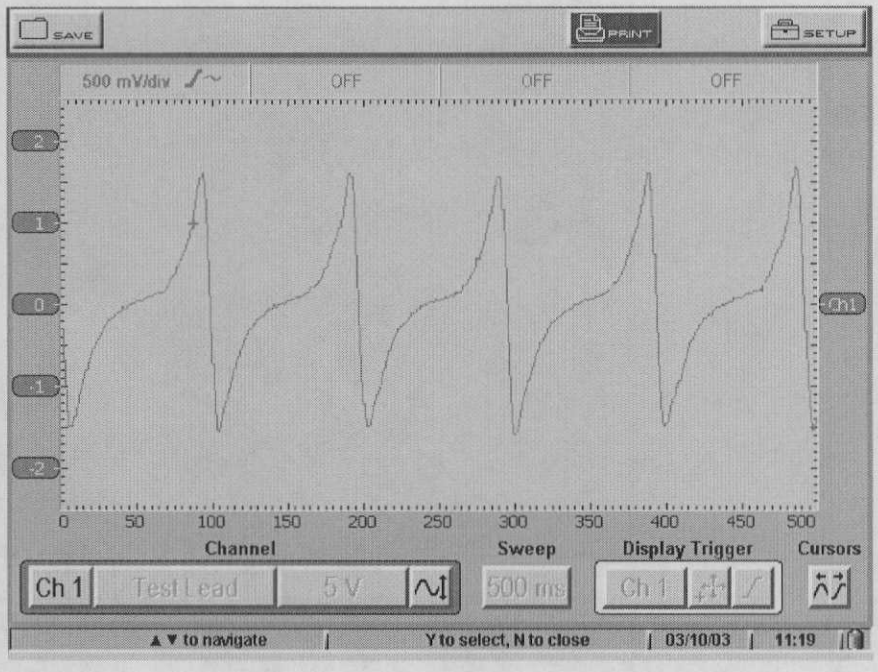
Set the scope to ac coupling (Coupling ac checked marked).

Move the ground indicator to the center of the screen.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 1 volt.



Profile Ignition Pick-up (PIP) – Ford EI & DI – Sequential FI

Scope Hook-up: The red lead is connected to the PIP wire out of the module and the black lead is connected to the battery ground terminal.

Set the voltage level to 20 V per/screen.

Set the sweep to 100 ms per/screen.

Set the scope to dc coupling (Coupling ac un-checked marked).

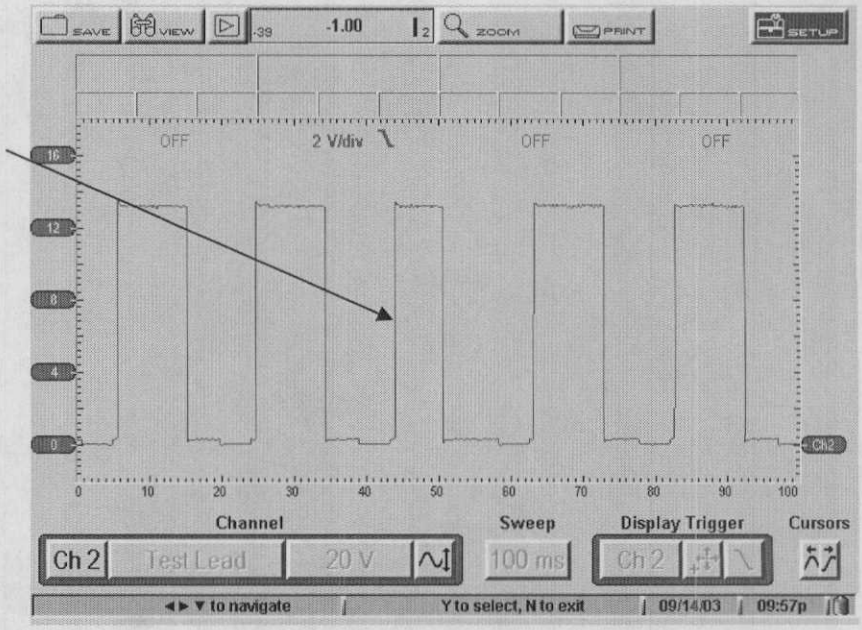
Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 5 volts.

You will only see this Sync notch on port fuel injected engines.



Primary Ignition:

Scope Hook-up: The red lead is connected to the negative terminal on the coil and the black lead is connected to the battery ground terminal.

Set the voltage level to 400 V per/screen.

Set the sweep to 20 ms per/screen.

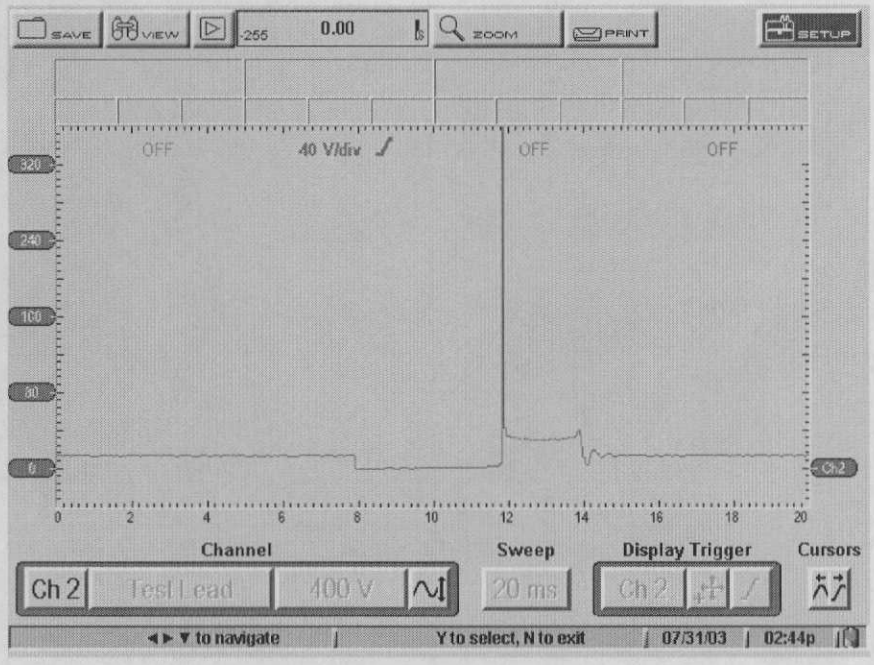
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position three divisions over from the left.
- Set the trigger level to positive 100 volts.



Primary Ignition – Close-up View:

Scope Hook-up: The red lead is connected to the negative terminal on the coil and the black lead is connected to the battery ground terminal.

Set the voltage level to 100 V per/screen.

Set the sweep to 10 ms per/screen.

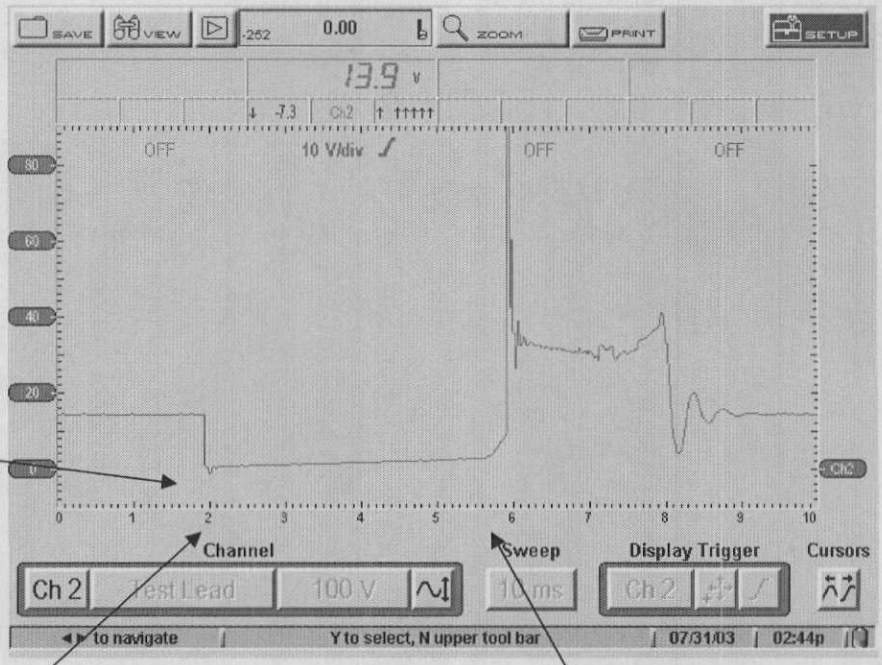
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position three divisions over from the left.
- Set the trigger level to positive 50 volts.



Supply Voltage

Pulls to ground to begin saturating the coil

Releases to discharge the coil

Spout Signal – Ford EI & DI – Sequential FI:
Scope Hook-up: The red lead is connected to the Spout wire at the module and the black lead is connected to the battery ground terminal.

Set the voltage level to 20 V per/screen.

Set the sweep to 100 ms per/screen.

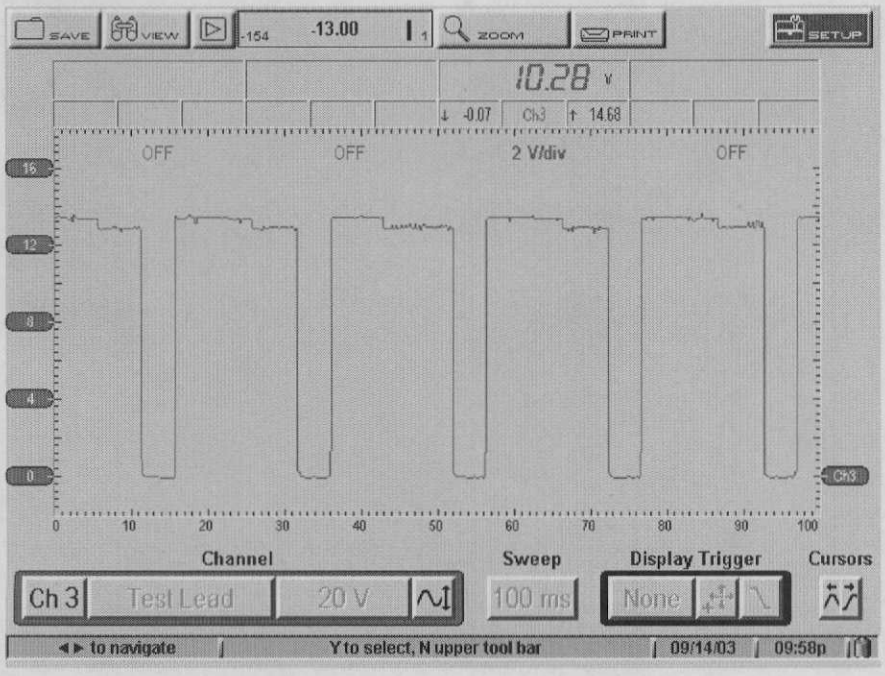
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 5 volts.



Throttle Position Sensor:

Scope Hook-up: The red lead is connected to the signal return wire at the sensor and the black lead is connected to the battery ground terminal.

Set the voltage level to 10 V per/screen.

Set the sweep to 2 sec per/screen.

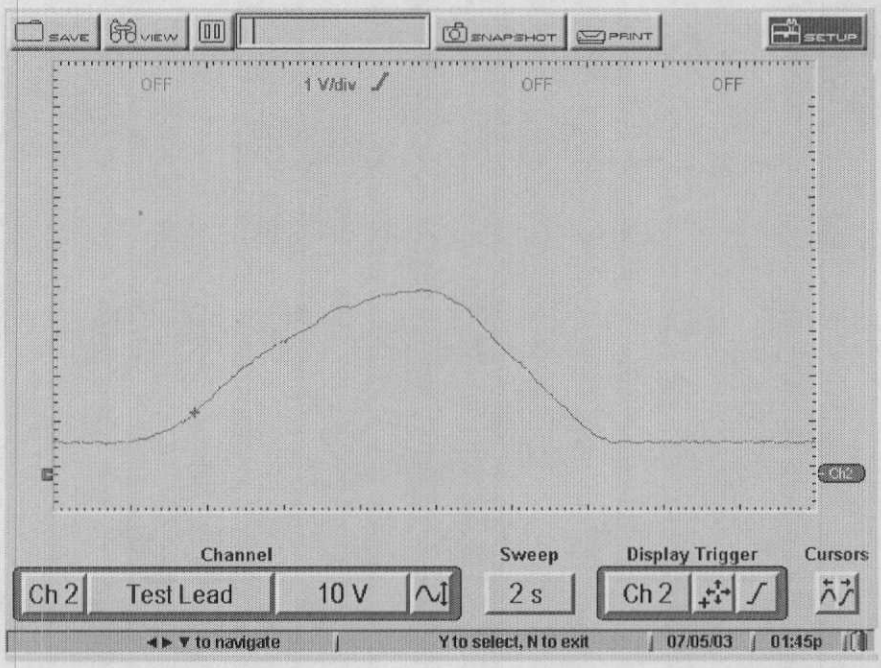
Set the scope to dc coupling (Coupling ac un-checked marked).

Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 1.5 volts.



Throttle Position Sensor – Close-up View:
Scope Hook-up: The red lead is connected to the signal return wire at the sensor and the black lead is connected to the battery ground terminal.

Set the voltage level to 5 V per/screen.

Set the sweep to 2 sec per/screen.

Set the scope to dc coupling (Coupling ac un-checked marked).

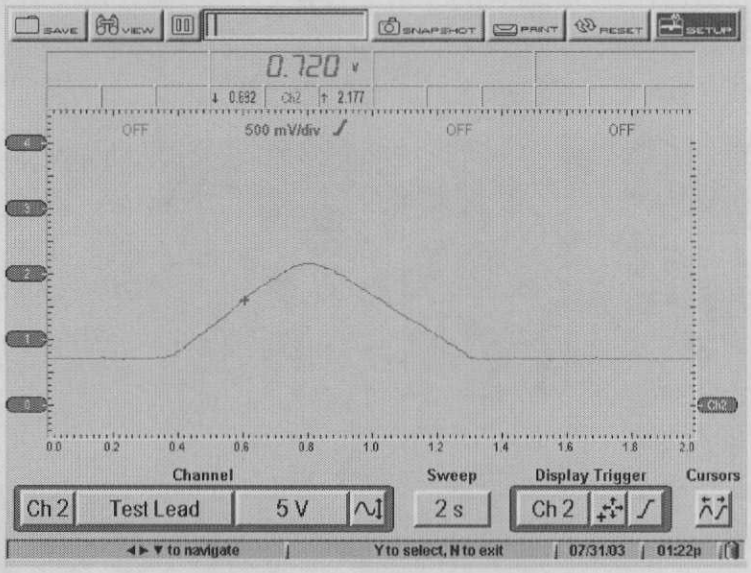
Move the ground indicator one division up from the bottom.

Make sure the peak-detect function is **OFF** (un-checked marked).

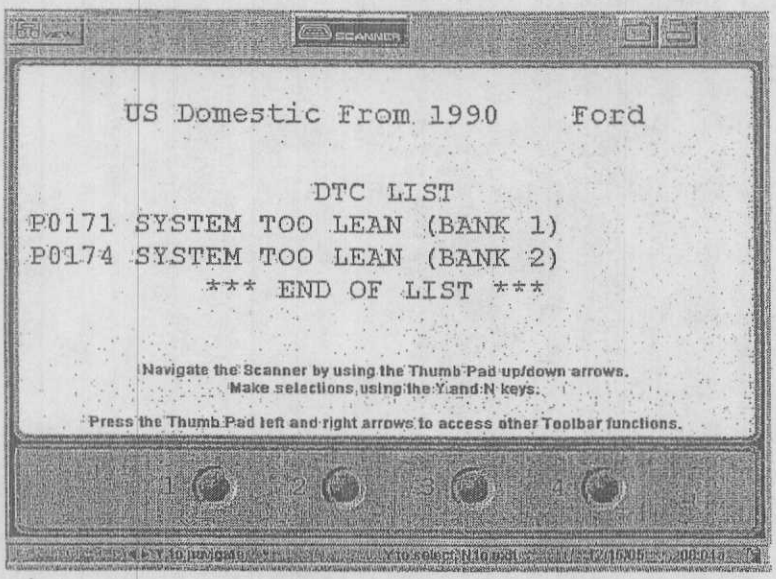
Under the **Display Trigger** Menu:

- Set the trigger source to the channel you are using.
- Make sure the trigger mode is on **Normal** (checked marked).
- Set the scope to trigger on the rising slope.
- Move the trigger position one division over from the left.
- Set the trigger level to positive 1.5 volts.

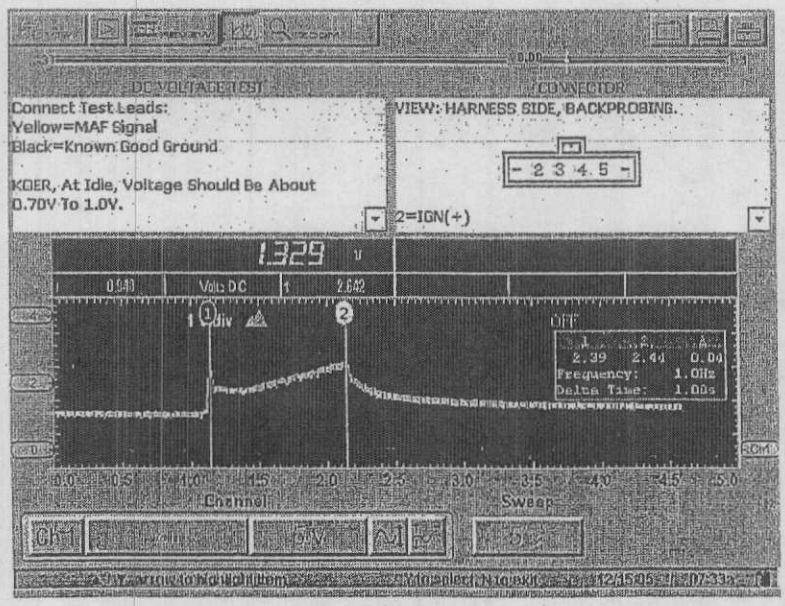
By setting up your scope in this manner you are not able to move the TPS through its full range. But, you are focusing on the lower third of the TPS, which is where the problems will normally occur.



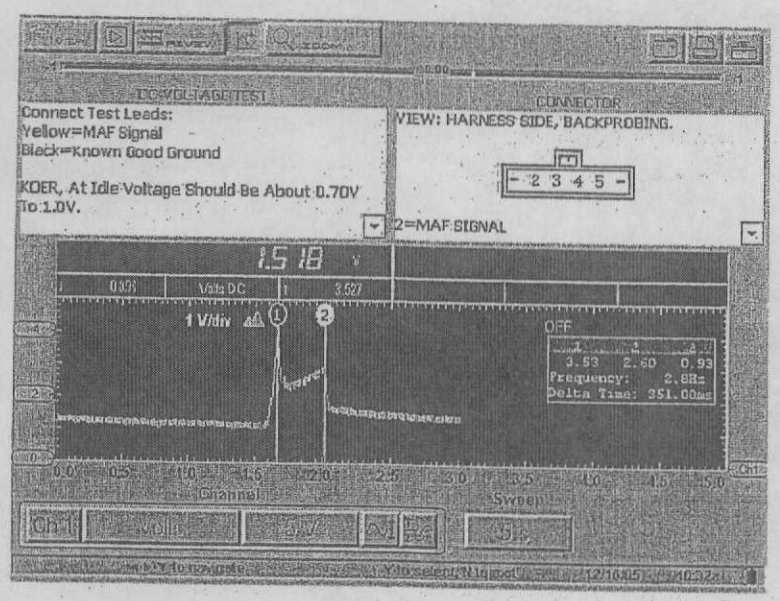
1996 Ford Thunderbird 4.6
Complaint: MIL on and lacks power



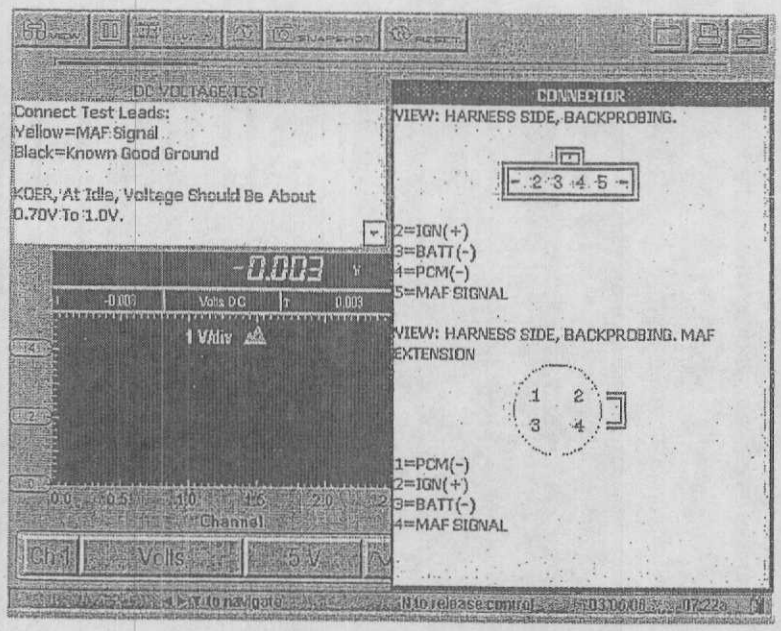
Our first step, since the MIL is on, would be to retrieve the trouble codes. If you refer to the image on the left you can see we have two code stored in memory—**P0171 System Lean Bank 1** and **P0174 System Lean Bank 2**. Our next step would be to access the scan data and verify that both **Oxygen Sensors** are operating properly. We did this and both sensors passed the tests. Now we must ask "What other sensors could be causing this problem". Because it has the most impact on fuel mixture, I decided that the **Mass Airflow Sensor** should be tested next.



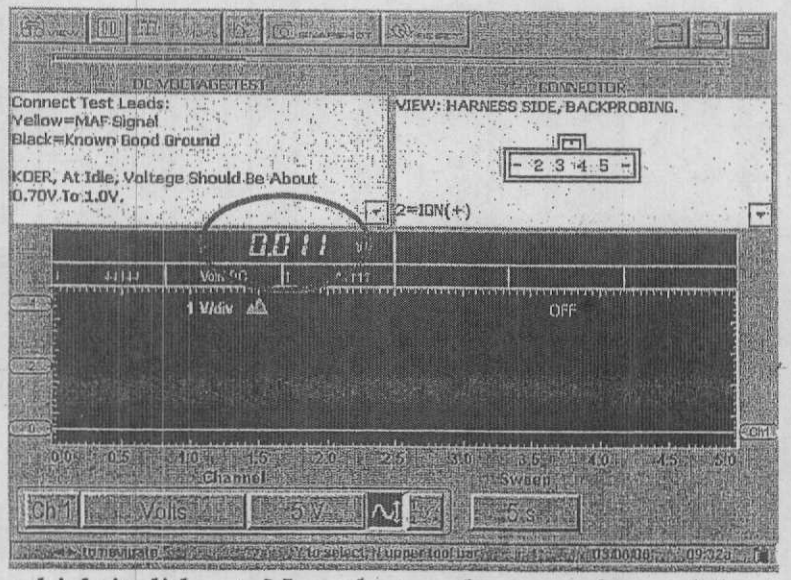
We are going to perform this test in the **Vantage** section of the **MODIS**. Once we entered the vehicle information we selected **MAF Sensor** from the test menu. Now unlike our previous case study, we do have a signal from this sensor when we accelerate the vehicle. However the sensor is not reaching proper voltage levels.



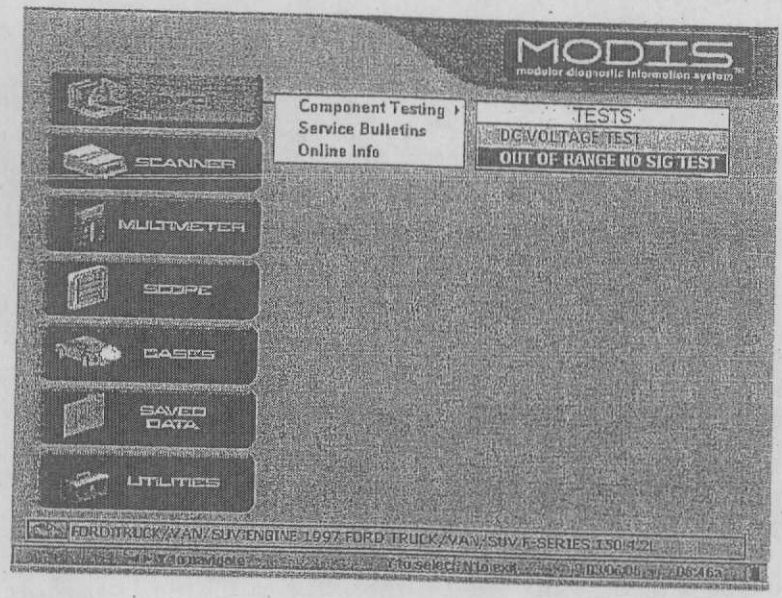
We have replaced the sensor and are now going to retest our vehicle to verify repair. If you refer to the image on the left you can see the sensor is now responding when we accelerate the engine. We should now test drive the vehicle and verify that no codes return. We have done this and no codes returned and also the vehicle did run noticeably better. We can now confidently release this vehicle back to the customer.



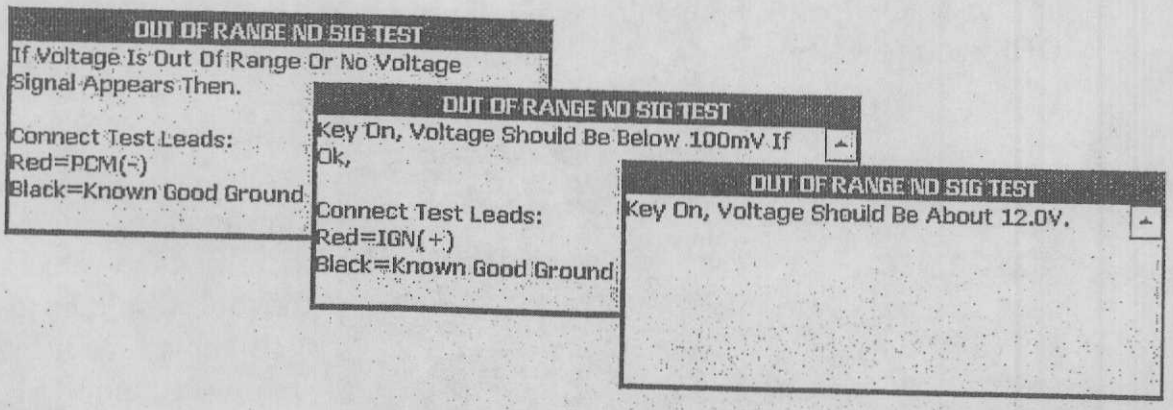
Before we move on to the next section I need to point out one more thing. If you are not sure which terminals to connect your test leads to you could highlight the right box and press the "Y" button. If you refer to the image on the left you can see a new pop-up window has appeared. You are then able to refer to this section to identify the terminals.



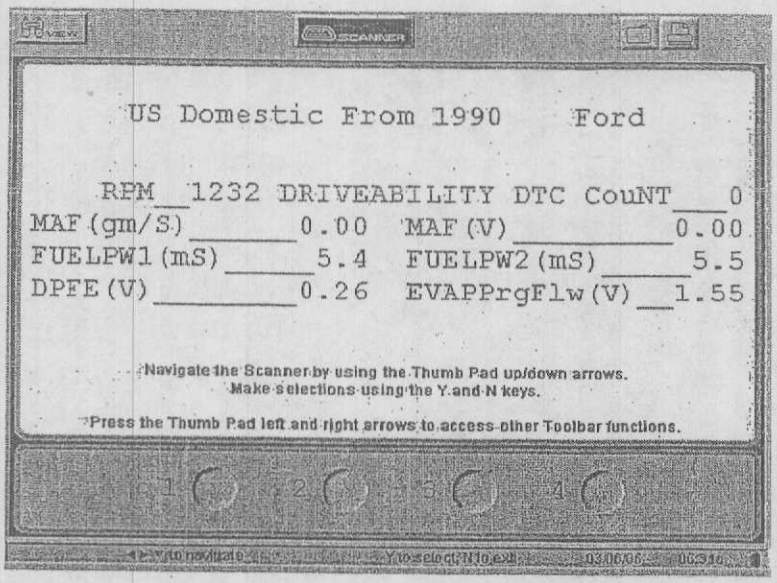
We have now connected to the signal wires and as you can see the sensor is not producing a signal—as indicated by the circle in the left image. Typically you should see between 500 mV to 1 V at idle. Next we would accelerate the engine to see if the voltage changes—which it did not. Now that we have performed the tests we, can confidently say the sensor is bad and needs to be replaced.



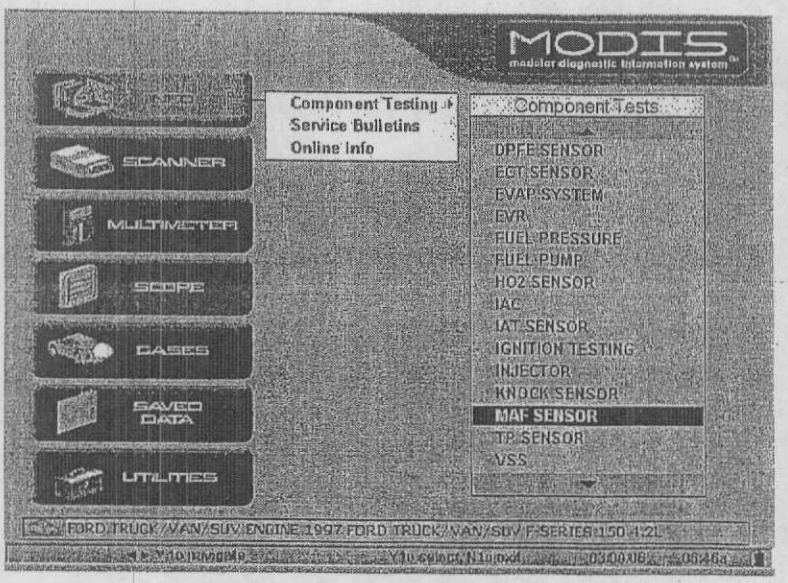
The next screen you will see is the **Test** menu selection. Under this area you see two different choices: **DC Voltage Test** and **Out of Range No Signal Test**. Which item should we start with? Since we have no output from our sensor we should start with the **Out of Range No Signal Test.**



If you refer to the images above you will see we are guided step-by-step on how to perform the "Pin Point" tests. The first step is to test the integrity of the ground circuit. Then we test for proper voltage to the sensor. We have performed both of these tests and verified that there was a proper ground and that there is twelve volts at the sensor. We can now back out of this section and perform the **DC Voltage Test.**



Once we have determined which code we need to focus on first, we need to look at scan data and see if the sensor is responding. If you refer to the image on the left you can see the **MAF** sensor PID is reading zero volts. Our next step would be to accelerate the vehicle and see if there is a change in voltage. We also did this and the voltage still remained at zero volts. Before we go condemn the sensor we need to perform some "Pin-Point" tests. Our next step would be to refer to our **Info** section of the MODIS and perform a few specific tests on the sensor.

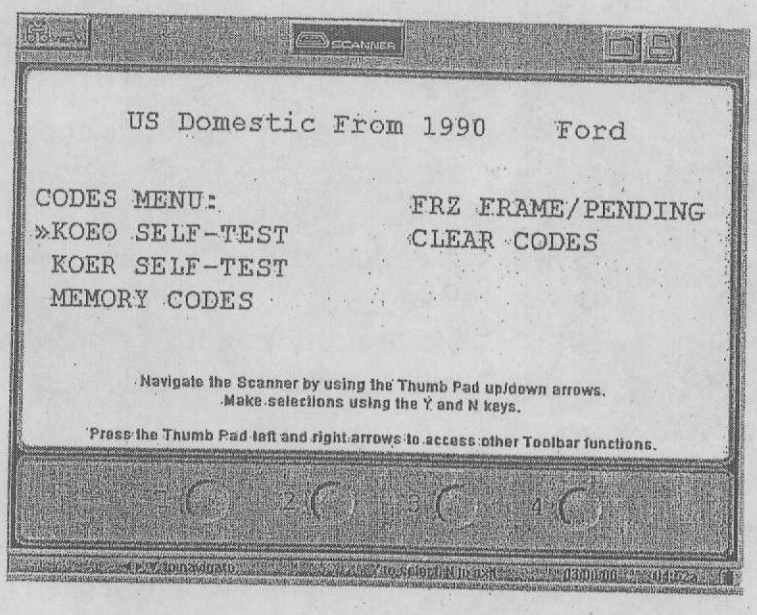


Our first step, after we identified the vehicle in the tool, would be to scroll down the list until we found **MAF Sensor** in the menu. Press the "Y" button and another menu will appear.

"Real-World" Case Studies

1997 Ford F-150

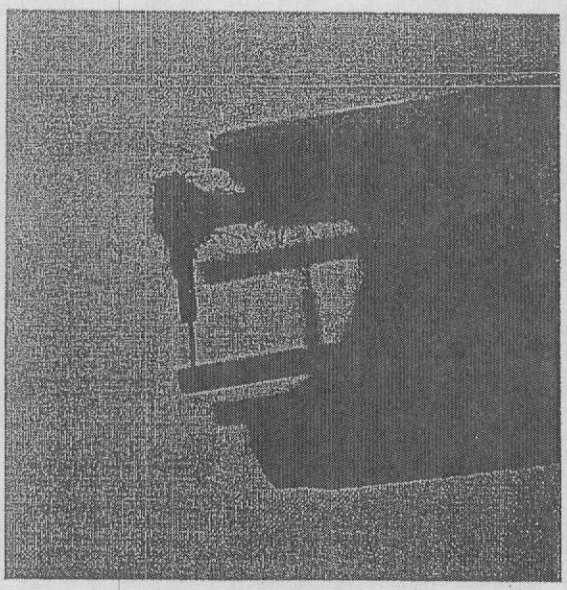
Complaint: MIL on with a severe hesitation

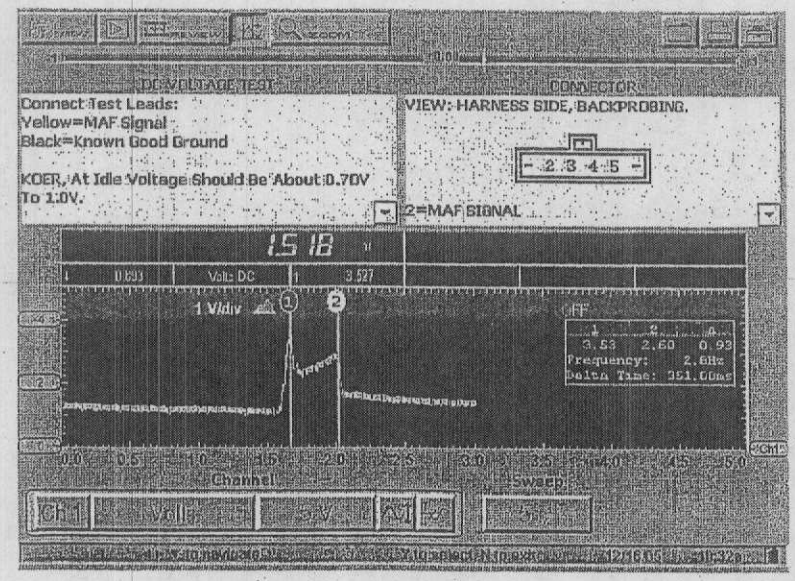


Our first test would be to access the code section. As you can see we have a variety of choices. Because we have a check engine light on we are going to access the **Memory Code** section. If we did not have a check engine light on at this time we would access the **KOEO Self-Test** or the **KOER Self-Test** sections.

When we accessed the code section we had three codes in memory—**P0102 MAF CKT Low Input, P0303 Cyl three Misfire Detected** and **P1000 OBDII System Checks Incomplete.** The **P1000** code will set after the memory codes have been cleared, so we are not going to be concerned about it. The **P0303** code could possibly set if there is a **Mass Airflow** problem, so we are going to first turn our attention to the **P0102** code.

Typically on a snap acceleration you should see at least 3 ½ volts on the initial voltage peak. If you refer to our pattern you can see it is only reaching approximately 2.4 V. We have two possible causes for the low output—either a bad sensor or the sensing wires in the sensor could be contaminated. Our next step would be to remove the sensor and inspect the sensing wires. We did this and if you refer to the image on the left you can see the sensor is heavily contaminated. At this point we have two options. We can either replace the sensor or clean it. We opted to clean the sensor first and retest.

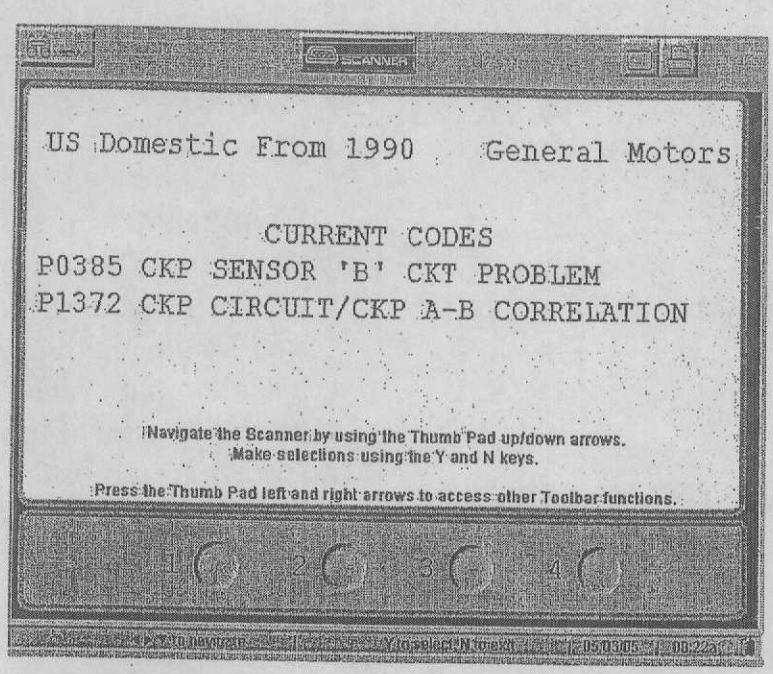




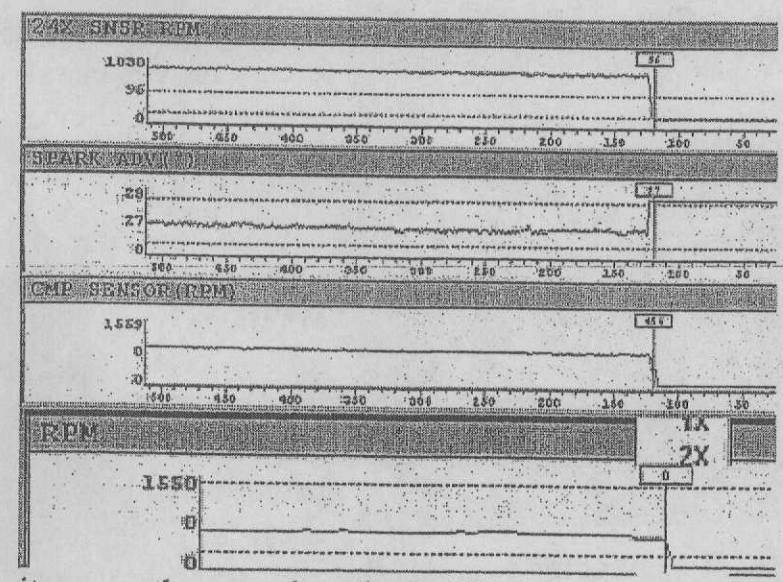
After we cleaned the sensor we retested it. If you refer to the image on the left you can easily see that there is a large improvement over the first test. We are now reaching 3 ½ volts—which is what we typically like to see on a good sensor. Our next step would be to clear the codes and perform a test drive to make sure the vehicle performs properly and also make sure no codes return. We did this and none of the problems did return. We can now return this vehicle back to the customer with the confidence of knowing we repaired this correctly.

2000 Olds Intrigue 3.5 "h"

Complaint: MIL on and would intermittently stall

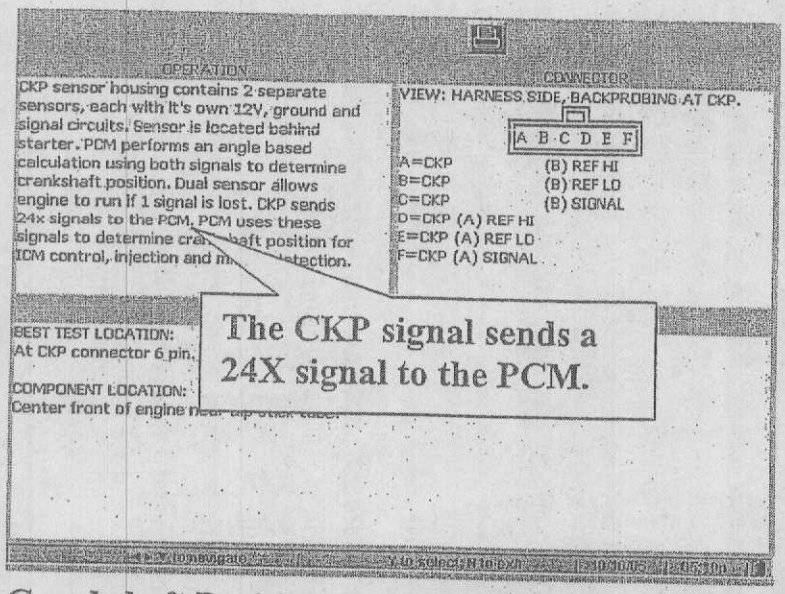


On first step, since the MIL is on, would be to retrieve the trouble codes. When we did this we saw that there were two codes in the PCM—**P0385 CKP Sensor "B" Circuit** and **P1372 CKP Circuit/CKP A-B Correlation**. After we obtained the codes our next step is to try and duplicate the problem while viewing the scan data.

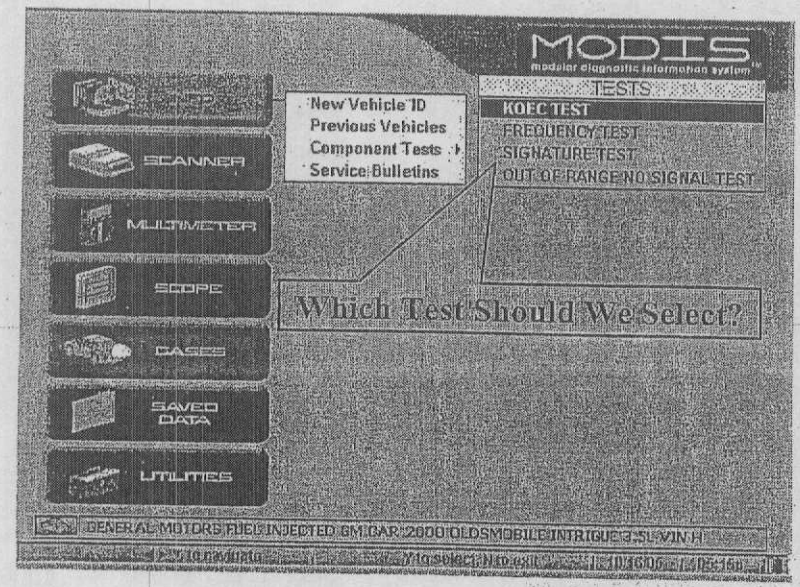


When I accessed the scan data I could not find a PID that specifically applied to the crankshaft sensor. I decided to view **RPM**, **Cam Sensor**, **Spark Advance** and **24X Sensor**. When I drove the vehicle I was able to duplicate the stalling problem. Now I want to point out a few key items on the scan data that will help us head in the proper direction to diagnose this vehicle. The first is: when we look at the lower three PID's we can see that those signals were still present as the vehicle was stalling. When we focus on the **24X Sensor** we can see it was dropping off before the vehicle completely stalled. Our next step is to determine what the 24X signal

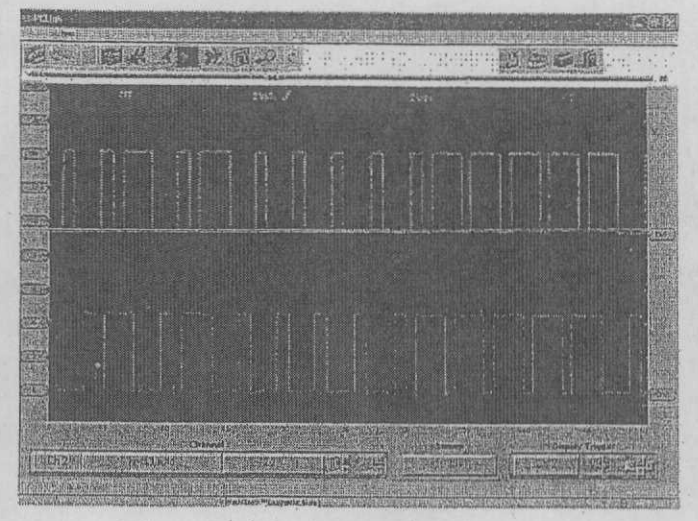
represents. Is it actually the Crankshaft Sensor signal or is it just a calculated value that the PCM is sending to the scanner?



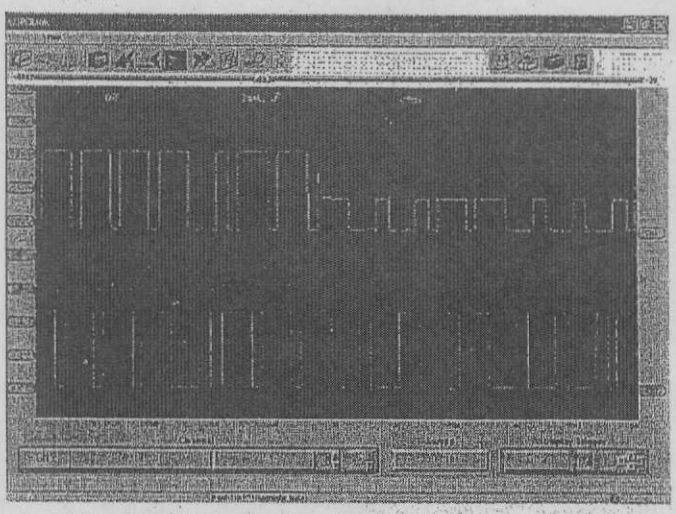
My next step was to access the **Vantage** section of the **MODIS** and see if I can find out more about the **Crankshaft Sensor**. If you refer to the image on the left you can see that I have highlighted a section out of the operation area of the screen. It tells us the **24X Signal** is the **Crankshaft Position Sensor Signal**. Now that we know this, we can be confident we are heading in the right direction.

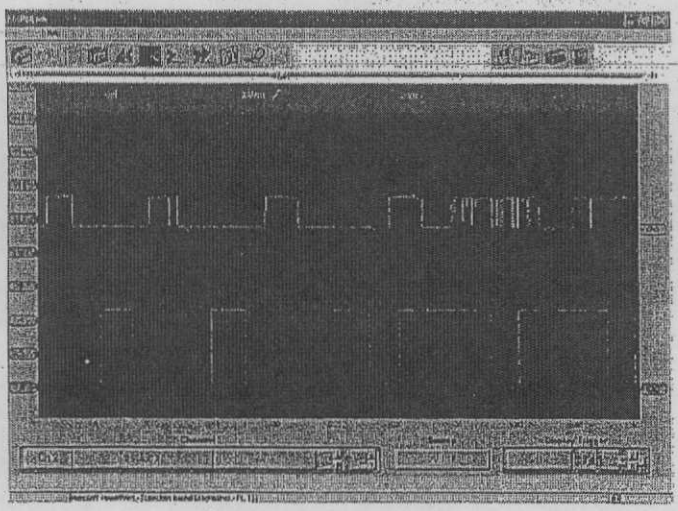


We are now viewing the **Test** section in the menu. As you can see we have four choices, but which test should we select? Since the vehicle does run we are able to quickly eliminate two of the tests—**KOEC Test** and the **Out of Range No Signal Test**. This leaves us with two choices—**Frequency Test** and **Signature Test**. We are going to select the **Signature Test** from the menu. We selected this test because it will give us the most information when the problem does occur. When the vehicle does stall we will be able to quickly determine if we have lost the voltage or ground for the sensor or if the sensor is failing.

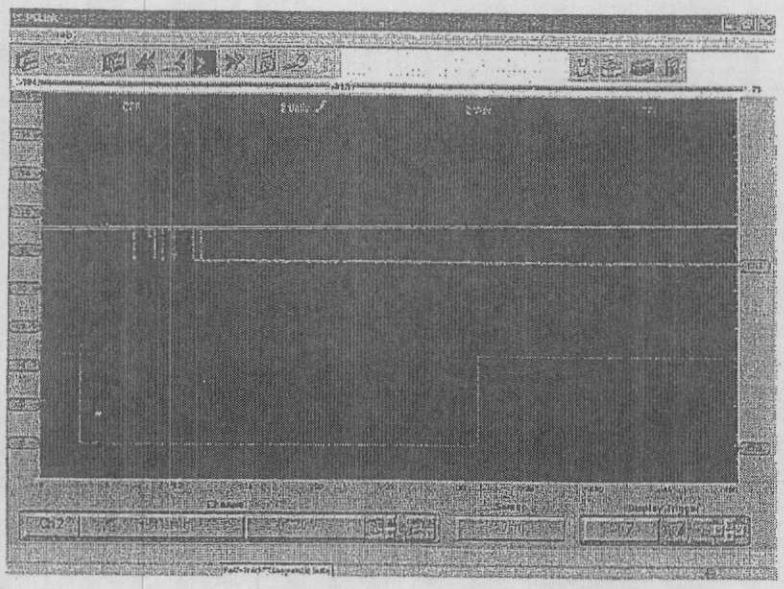


For the purpose of the manual I am showing you the next few images from my **PC Link** program from my computer. The upper waveform is from **Crankshaft Sensor B** and the lower is from **Crankshaft Sensor A**. While the vehicle is idling you can see that both waveforms look normal. If we look at the next image we can see that **Crankshaft Sensor B** began to drop out. At this time the engine did not stall, but the **MIL** did illuminate.





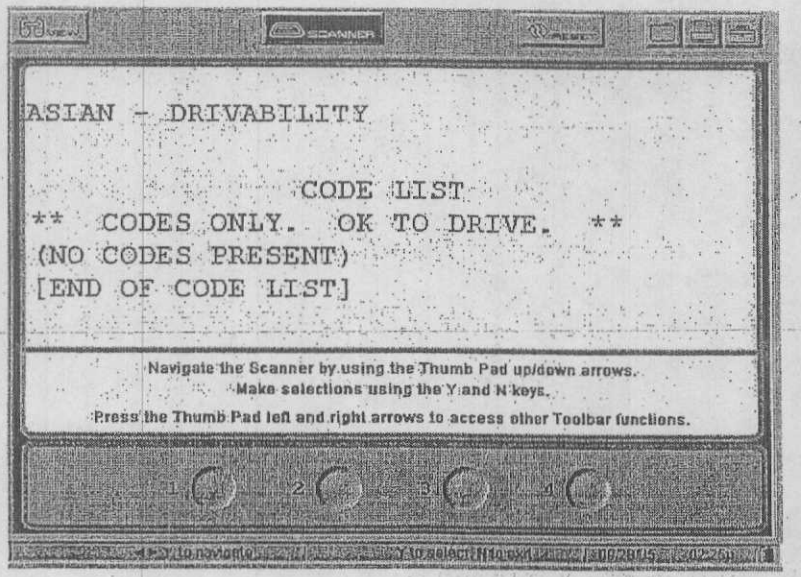
When we refer to the image to the left we can see there are some drop-outs in the upper waveform. At this time the vehicle did begin to stumble, but still did not stall.



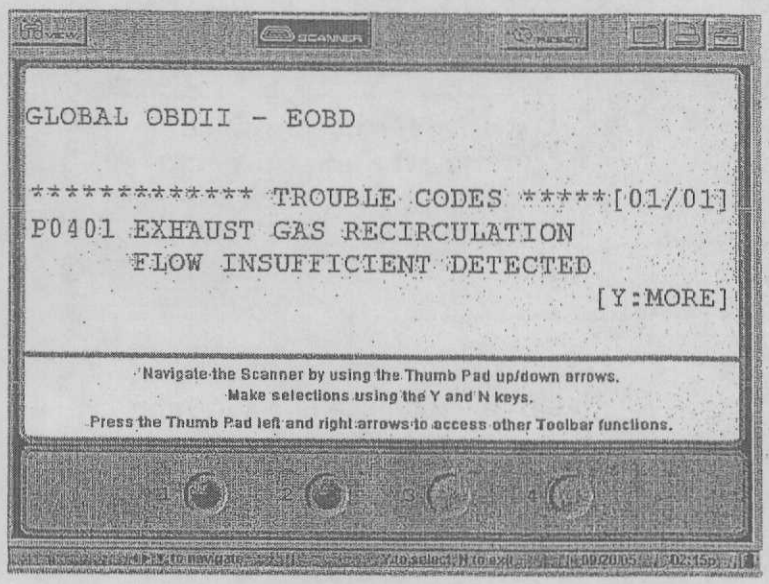
This is our last image of the sensor and as you can see the upper waveform did drop off completely. At this point the vehicle did stall. So now we can confidently say it needs a **Crankshaft Position Sensor.**

1998 Honda Accord 2.3

Complaint: MIL on with no drivability issues

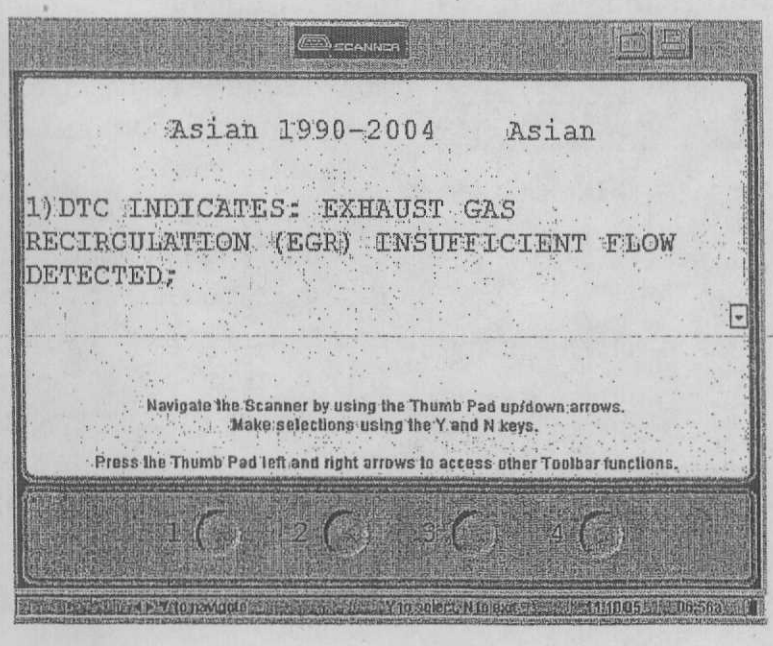


Our first step when a MIL is on typically would be to retrieve the codes from the PCM. When we tried to do this on the Honda it showed us that there were no codes present. We know there has to be a code in the memory due to the fact that the light is on at this time.

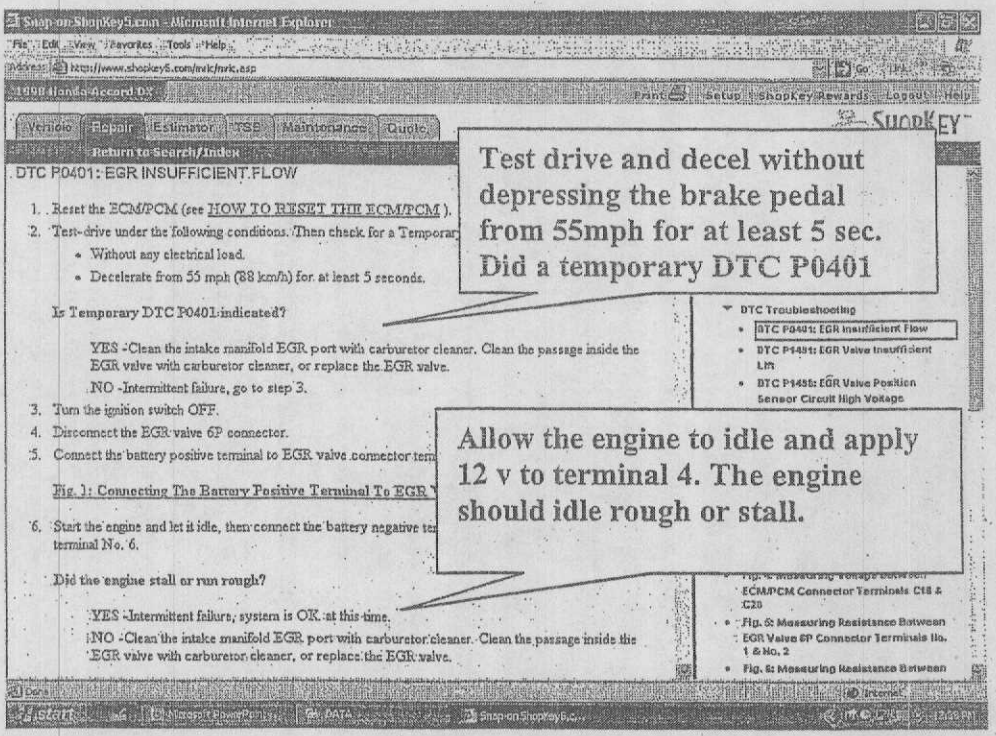


I decided to back out of the **Enhanced** side of the scanner and access the **Global OBDII** side to see if I saw anything different. If you refer to the image on the left you can see that we now have a **P0401** code for **Exhaust Gas Recirculation Flow Insufficient Detected**.

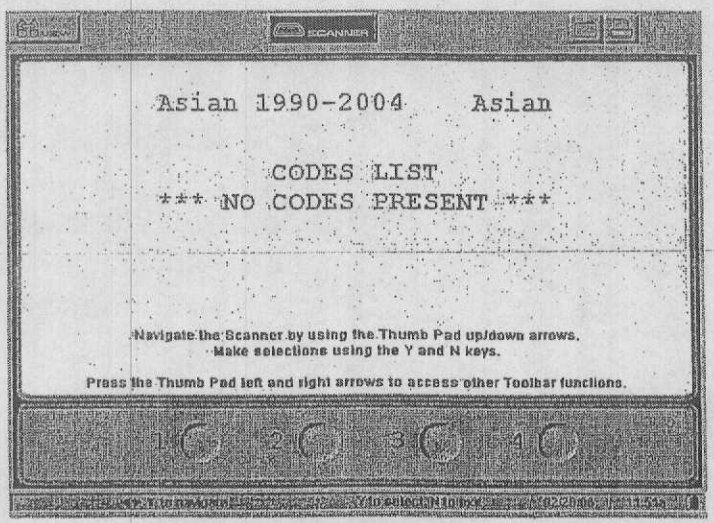
Now that we know which code has triggered the light we can go back into the **Enhanced** side of the scanner. There are a couple of things I would like to show you before we move on to far.

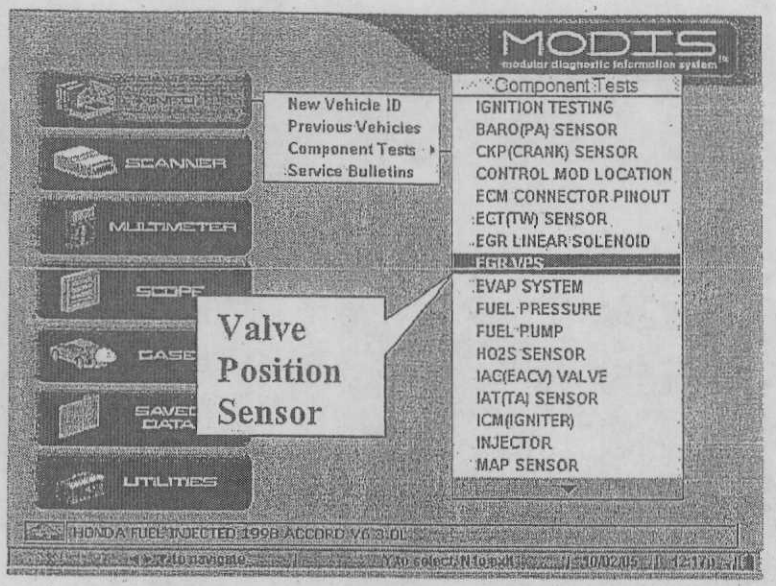


When we go under the **Enhanced** side of the scanner there is a section called **Troubleshooter**. Under this section you will find useful information to help aid you in your diagnosis. Information such as: Code Description, Component Location, Component Terminal Identification, etc.

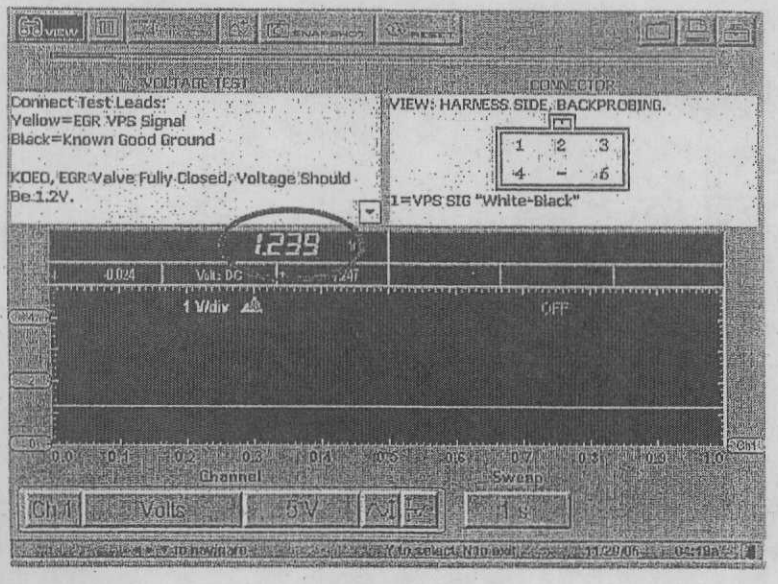


Our next step, after **Troubleshooter**, would be to go ahead and check our service information. Our first step is to test drive the vehicle and reach a speed of at least 55 mph. Once this is accomplished we are instructed to decelerate for at least five seconds without depressing the brake pedal. We did this, and as you can see by the image on the left, the code did not return. Are we done now? Are we going to ship the vehicle out and hope the problem does not return? I decided to investigate farther. The next step instructs us to allow the engine to idle and to apply twelve volts to terminal four. The engine should then either run rough or stall. When I performed this test the vehicle did run slightly rough, but was it a problem? I decided to continue with my tests.

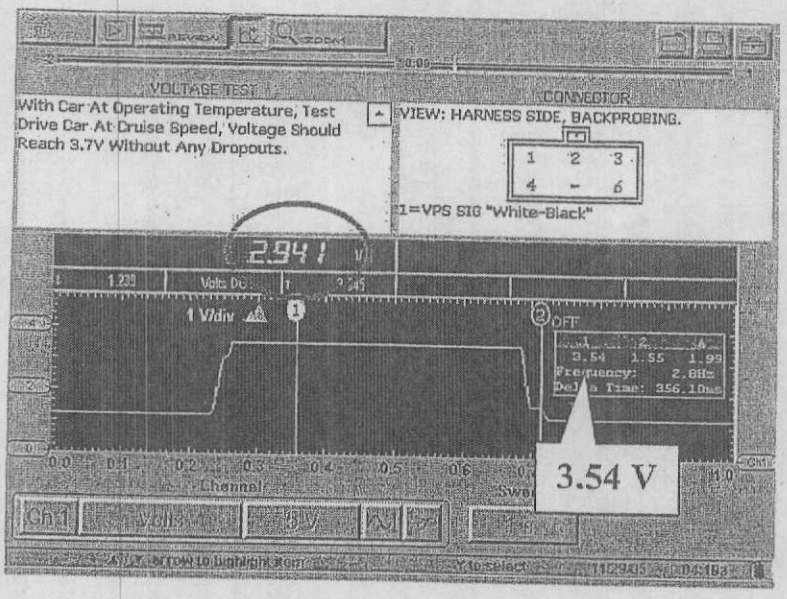




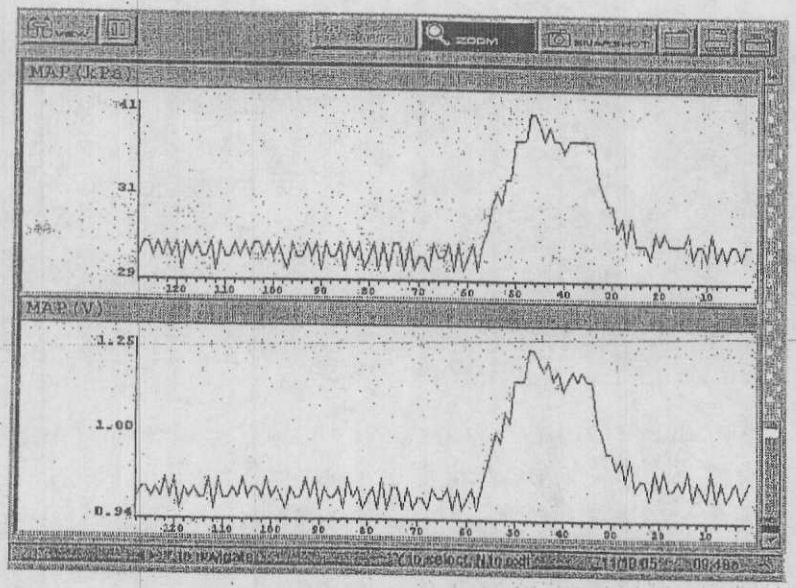
Our next step was to access the **Vantage** section and start to perform a few pin point tests. We are going to access the **EGR VPS** section of the tool.



We are first instructed to connect our yellow test lead to terminal number one and connect our black lead to a known good ground. Once we do this we should turn the ignition to the run position with out the vehicle running. We should see approximately 1.2 volts when the EGR is closed. If you refer to the digital section on our screen you can see we are displaying 1.239 volt when the EGR is closed. Our next step would be to open the EGR by applying 12 volts to terminal number four.



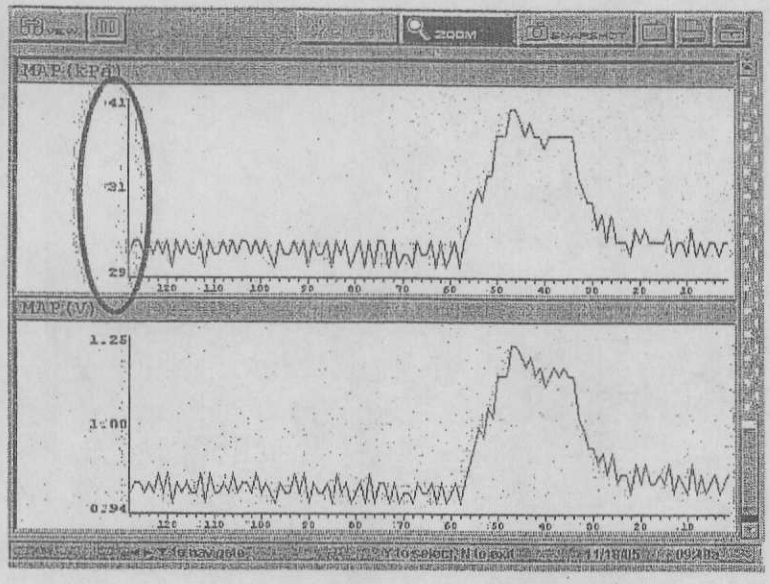
When we open the EGR we should see close to 3.7 volts without any glitches or drop outs in the signal. If you refer to the image on the left you can see the pattern does appear clear without any glitches. Also if you refer to the box to the right of the pattern you can see we did reach 3.54 volts, which is acceptable. Also note that above the pattern you see a digital reading of 2.941 V. That reading was obtained the last time the meter updated the display before I paused the screen.



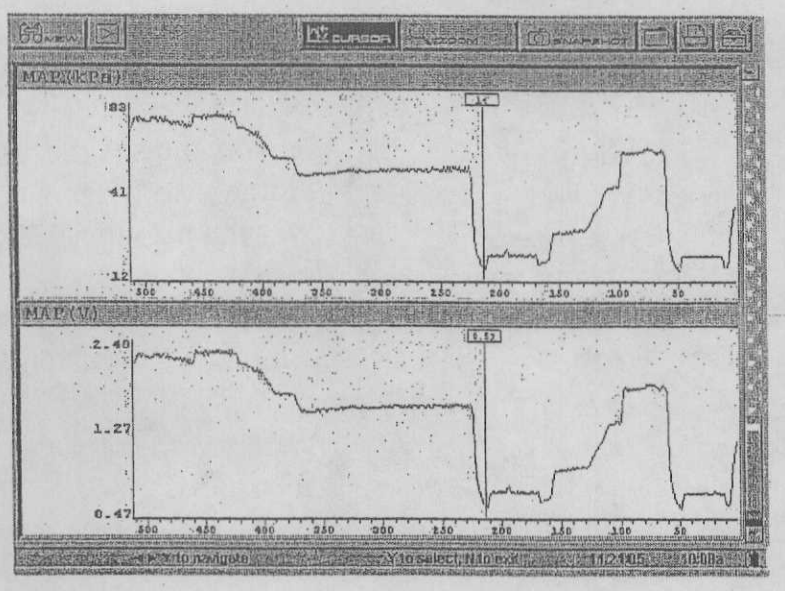
My next step was to go back to my scan data look at the **MAP Sensor** voltage. In my past experiences the PCM looks at the **MAP Sensor** to determine if the EGR system is operating correctly. When I opened the EGR Valve you can see the MAP voltage does shift, but is it enough? I decided to access my Honda Service Information to see if it would give me anymore insight into this question.

Honda Info

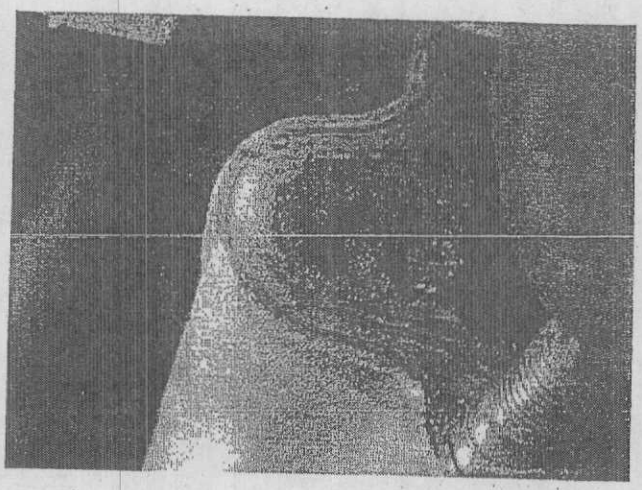
- Reach a steady speed between 35 to 55 mph
- ECM will run a self test on decel between 2500 to 1200 rpm
- The ECM needs to see at least a 4 kPa change on the MAP Sensor



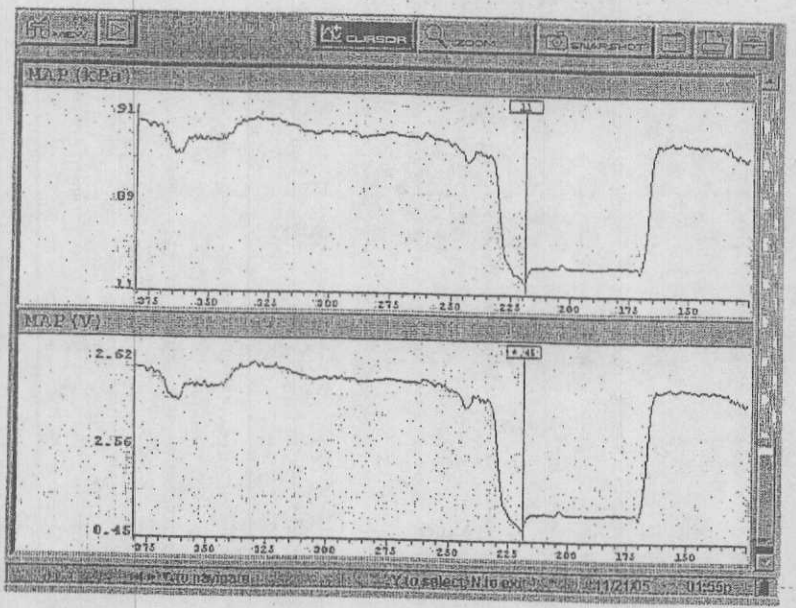
If we refer to our previous slide we can see that we did exceed the 4 kPa range the PCM was looking for, but remember I ran this test at idle. The test needs to be run on decel. Our next step would be to take the vehicle on a test drive and watch the MAP Sensor.



We went on out test drive and watched the self test run. The test began at the point of the vertical line. At that point the MAP reading was 14 kPa. When the test ran the maximum reading was 19 kPa. The reading did exceed the level needed to pass the test, but we must ask if that is enough or is it going to cause an intermittent problem. I opted to go ahead and remove the manifold and check the passages.



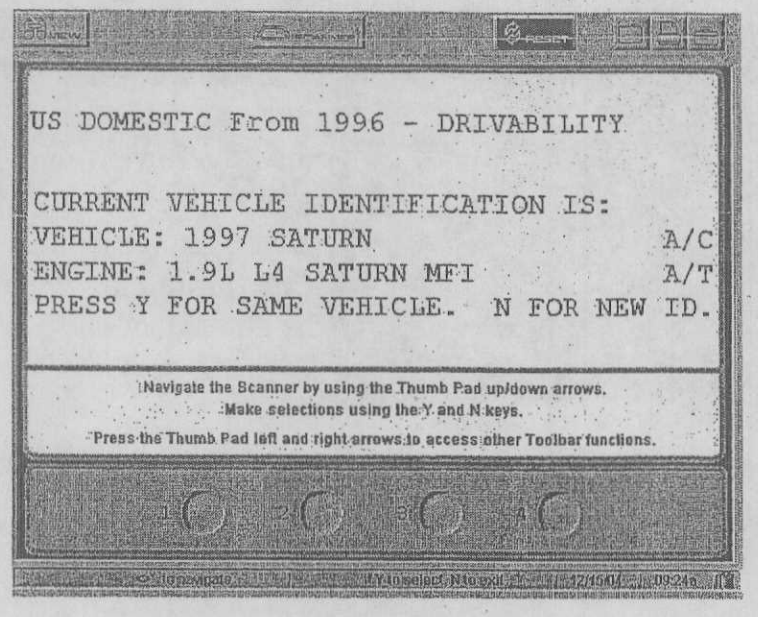
Once I removed the manifold I could easily see the passage was partially restricted. Now that we see the passage is restricted all we needed to do was clean it.



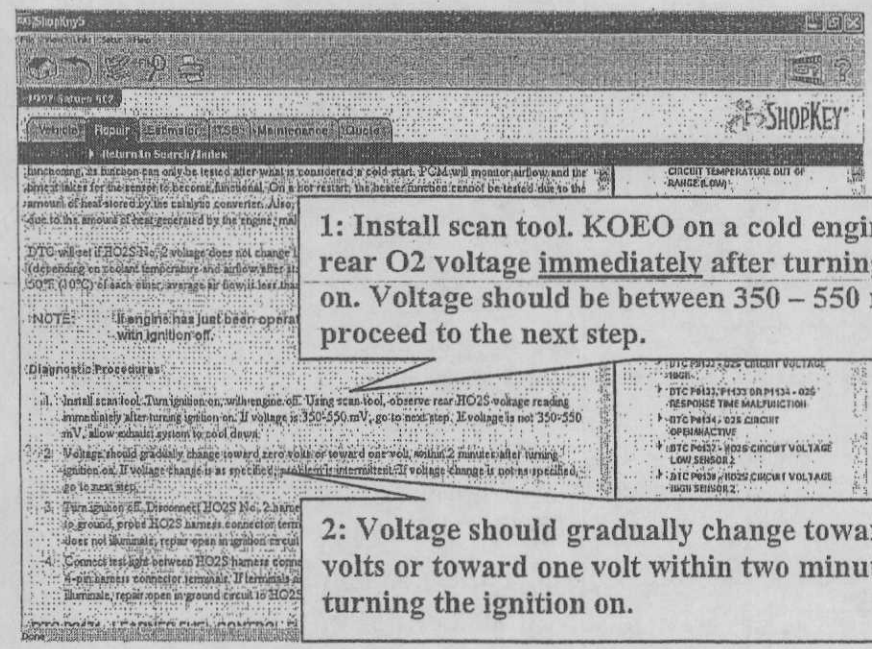
After cleaning the passages and re-installing the intake, I reran the self test. At the point of the cursor the MAP was reading at 11 kPa. When the self test ran the MAP reading went to 21 kPa. As you can see there is a large improvement over the previous self test. We can now confidently return this vehicle to the customer.

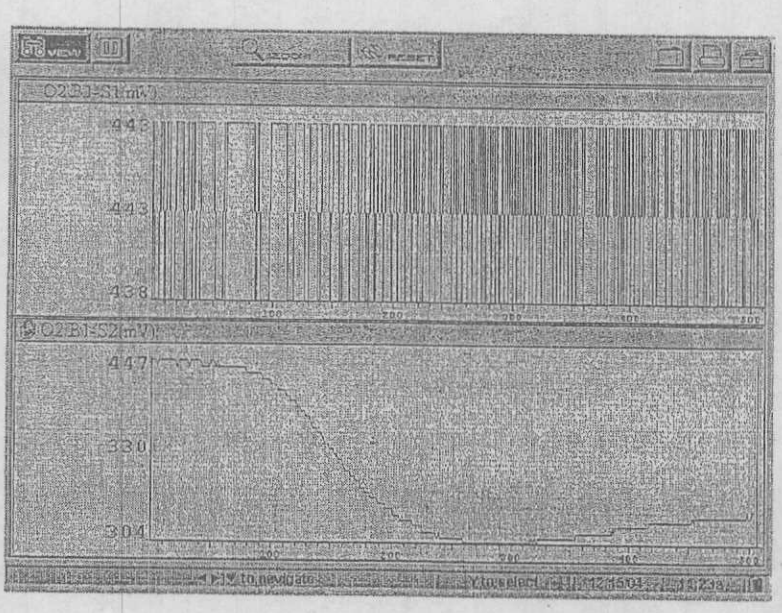
1997 Saturn SC1 1.9

Complaint: MIL on with no driveability issues

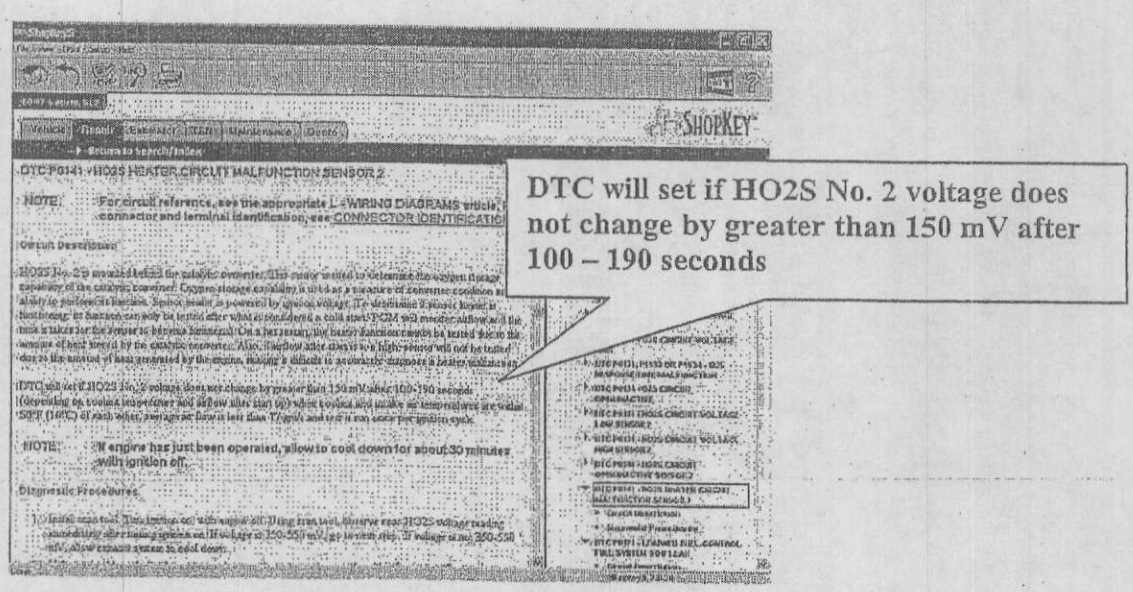


Our first step, since we have a MIL on, would be to access the codes in the memory. There we found a code for **P0141 O2 Heater Circuit Bank 1 Sensor 2** failure. Now that we have retrieved the trouble code we will access our service information. Now follow the first two steps in the next image.



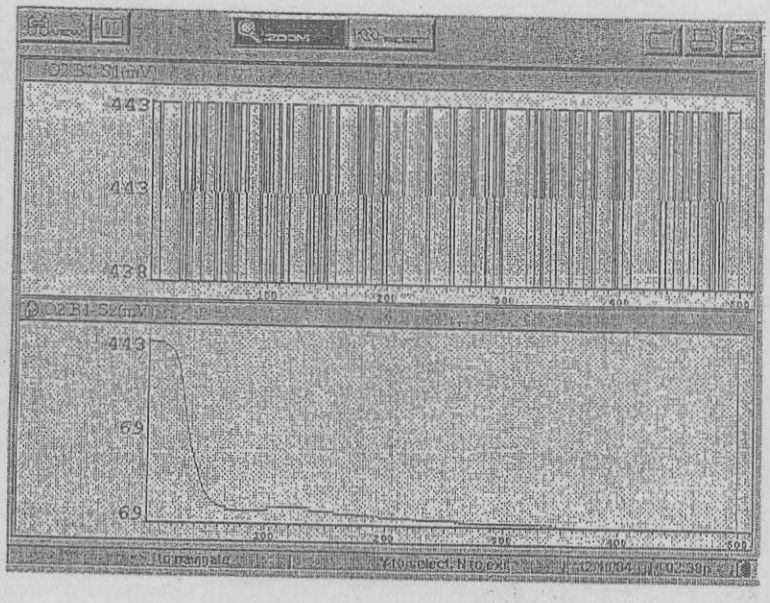


When we performed the test we could see the voltage did decrease as instructed. According to our service information the test should be passing, however every time I ran the vehicle the MIL came on immediately. Therefore I know there is a problem.



DTC will set if HO2S No. 2 voltage does not change by greater than 150 mV after 100 – 190 seconds

If we refer back to our service information and look under the **Circuit Description** section we find a very helpful paragraph. It tells us the voltage must change greater than 150 mV within 100 – 190 seconds after the ignition is turned on. Now that we know this we can quickly make a diagnosis. If we refer back to our original scanner graph we can see the voltage did not exceed the 150 mV requirement. The fix for this vehicle was to replace the rear **Oxygen Sensor**.



After we replaced the **Oxygen Sensor** we are able to quickly see a large improvement. The voltage immediately went down close to 70 mV. We can now confidently return this vehicle to the customer.

MODIS Post Test Questionnaire

1: What does the term "Time Sweep" on the MODIS refer to?
A: The amount of time from the bottom to top
B: The amount of time from the top to bottom
C: The amount of time on the screen from right to left
D: The amount of time on the screen from left to right

2: What does the term "Voltage Scale" refer to?
A: The amount of voltage per screen, starting with the lowest at the top
B: The amount of voltage per screen, starting with the lowest at the bottom
C: The amount of voltage per screen, from right to left
D: The amount of voltage per screen, from left to right

3: What does the term "Trigger Level" refer to?
A: The voltage level the trace has to cross before the pattern will begin
B: The time that has to elapse before the pattern will begin
C: Neither
D: Both

4: What does the term "Trigger Delay" refer to?
A: The voltage level the trace has to cross before the pattern will begin
B: The time that has to elapse before the pattern will begin
C: Neither
D: Both

5: How many divisions of time are there on the MODIS screen?
A: 6
B: 8
C: 10
D: 12

6: How many divisions of voltage are there on the MODIS screen?
A: 6
B: 8
C: 10
D: 12

MODIS Post Test Questionnaire

7: When you hear the term "Square Waveform" what is being referred to?

A: A dc waveform
B: A waveform that goes from zero volts to, for example, 5 volts
C: A waveform that is typically squared off at the corners
D: All the above

8: When you hear the term "AC Waveform" what is being referred to?

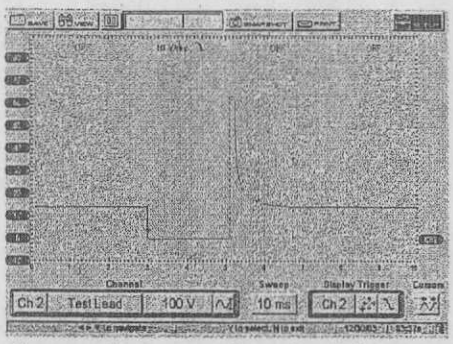
A: An Alternating Current waveform
B: A waveform where the voltage travels positive and negative
C: Neither
D: Both

9: When you are viewing a pattern on the MODIS and you can not get stable pattern (the waveform appears to be walking across the screen), what is the most likely problem?

A: The "Voltage Scale" is improperly adjusted.
B: The "Time Sweep" is improperly adjusted.
C: Your "Trigger Level" is adjusted to high or low
D: Your "Trigger Delay" is improperly set.

10: When you hear the term "Current Ramping" what is being referred to?

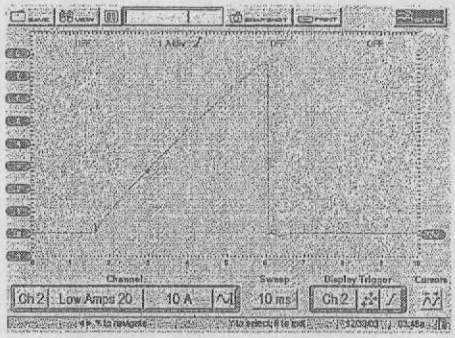
A: A way of measuring amperage with a Lab Scope and amp probe
B: A pattern that ramps up and is measured with an amp probe & scope
C: An amperage pattern of an Ignition Coil or Fuel Injector
D: All the above



11: Looking at the waveform above, what is this waveform from? We are referring to a particular component, not a vehicle.

A: Injector Voltage
B: Secondary Ignition Voltage
C: Primary Ignition Voltage
D: None of the above.

MODIS Post Test Questionnaire



12: Looking at the waveform above, what is this waveform from? We are referring to a particular component, not a vehicle.

A: Injector Amperage
B: Ignition Coil Amperage
C: Solenoid Amperage
D: None of the above

13: What does the term "Trigger Slope" refer to?

A: The upward slope that the scope triggers on
B: The downward slope that the scope triggers on
C: Neither
D: Both

14: What does the term "Cursors" refer to on a Lab Scope?

A: Buttons on the scope used to make the adjustments
B: Adjustable lines on a screen used to measure either time or voltage
C: The divisions on the scope screen
D: None of the above

15: How many scope channels does the MODIS have?

A: 2
B: 3
C: 4
D: 5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