Disclaimer of Warranties:

This manual contains test procedures and test information obtained by an ASE Certified Master Technician with known good test equipment on real vehicles, your tests may vary due to your equipment or technician procedures.

No warranty can be made from the ideas presented due to personal testing procedures, nor does the author or anyone connected with him assume 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.

Automotive Video, Inc.
6280 Arc Way
Ft. Myers, FL 33966
1-800-71-TRAIN (1800-718-7246)
fax: 1-239-561-9111
www.auto-video.com

TABLE OF CONTENTS

OVERVIEW

For this training session we will be discussing the Bosch MTS 5200 Lab Scope. Why is the use of a lab scope in your diagnostic strategy important? The answer is that a scan tool can only go so far. The Tech 2 for example is able to retrieve fault codes and provide you with diagnostic information that will point you in the right direction for your diagnostic process. However, if you have a code for a faulty TP sensor for example, the scan tool will tell you if the sensor is responding or whether or not you have voltage to the sensor. The scan tool will not tell you what the exact source of the problem is.

A lab scope, such as the MTS 5200, will help you to pinpoint the exact cause of the problem and verify fixes fast. Using the MTS 5200 you will be able to check the wires to the sensor to determine if the proper amount of voltage is being supplied, and also test for a proper ground signal. Then you can specifically test the sensor itself for proper usage and accuracy.

Designed for professional automotive technicians, the MTS 5200 is a high speed data acquisition product. The MTS 5200 utilizes a real-time operating system to run a RISC based computing environment, giving you lightning fast measurement capabilities. This hand-held state-of-the-art tester contains a number of diagnostic instruments providing automotive professionals with the tools required to diagnose sophisticated electrical and mechanical systems on today's modern vehicles. The tester supports multiple languages.

The MTS 5200 color touch screen user interface enables you to select from a number of different test modes such as 4-Channel Oscilloscope, Graphing Multimeter, DVOM, Vacuum Waveform, and Primary/Secondary Ignition. You can configure these functions to allow you to take charge of the diagnostic process and let you perform circuit testing down to a component level.

WHAT MAKES A GOOD LAB SCOPE?

A good lab scope needs to be designed for a technician to be able to use it on a regular basis. If you have ever purchased a lab scope and it was too complicated to use, you may not use it often enough to become comfortable using it in your diagnostic process.

The MTS 5200 is designed to be user friendly to the technician. All of the connections on the MTS 5200 are easy to find and well labeled. Also, the menu and navigation system can be mastered in a reasonable period of time.

There are other features to look for when buying a lab scope. One of those is the *refresh rate*. A good refresh rate for a lab scope is twice the speed of the sensor that you are testing. For most cases a lab scope that is reading at 1,000,000 samples per second is more than enough to capture anything under the hood of the vehicle.

This is actually one of the features that you don't want to get really concerned about. If you have a lab scope that is incredibly fast, but the screen that you have on the scope is not capable of showing those points, then it doesn't do you a lot of good. One of the advantages of the MTS

WHAT MAKES A GOOD LAB SCOPE? (CONTINUED)

5200 is that the refresh rate of the screen is 12 times per second, which is double of what the human eye can actually see.

Another feature that you want to make sure the lab scope has is a multi-channel connection. The MTS 5200 has four individual color coded channels, and each channel has their own analog to digital converter. This means that each one of the channels must be able to sample the data that is coming into it. By having four channels with each having their own analog to digital converter, you are far less likely to miss any fault events while sampling other data on one of the other channels.

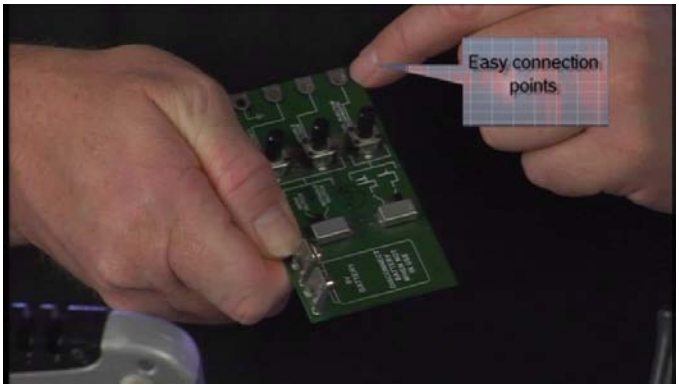
Another thing to look for in a good lab scope is how good the processor is. Traditionally, most lab scopes use an 8 bit processor. This means that the processor is going to use 850 dpi to draw the image on the screen. A better lab scope will use a 12 bit processor which will display the image at 4090 dpi resolution. The better the resolution, the better you will be able to view images such as secondary waveforms. The MTS 5200 uses a high end processor to give you the maximum capability for viewing images.

The MTS 5200 has bonus features that you may not find in most lab scopes such as the ability to record data & playback, store images and the ability to create a database of known good values for the vehicles you work on.

The ability to create a database of known good values is one of the best features of the MTS 5200. As you build this database over time, you will have data to compare problem vehicles with and be able to narrow down the cause of faults faster and more accurately.

HOW TO GET STARTED WITH YOUR LAB SCOPE

One of the best places to get started on with your lab scope is to read the manual that came with it. The MTS 5200 comes with an extensive 222 page manual that goes into great detail on the tools functions, how to navigate them and how to use them. Also included are examples of what the lab scope is capable of and how to apply it to real world situations. Later in the program we will show you how to download the manual from the manufacturer's website. Be sure to read it once you have downloaded it. Also, you will need to have to start learning to use the lab scope on your own time. This means that you should use training aids like a demonstration board to get started.



A demonstration board, pictured right, has very easy points to connect your lab scope. These types of boards will let you simulate the testing of injectors and sensors with the ability to simulate a fault during the test.

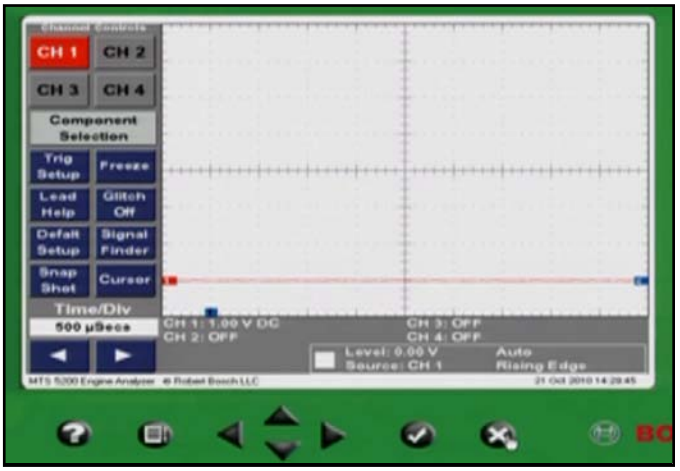
Congratulations on purchasing this course and taking the first serious step in learning how to use the MTS 5200 lab scope.

HOW TO GET STARTED WITH YOUR LAB SCOPE (CONTINUED)

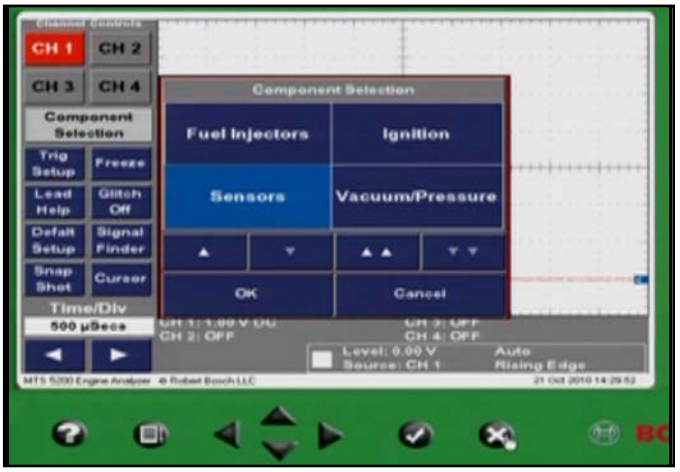
Another thing that you need to do is to use your lab scope to test known good vehicles. It is critical that you do this because if you don't, you will find that you will be trying to learn how to use your lab scope while attempting to fix vehicles under pressure. This is the worst thing you could possibly do. Take the time to practice with your lab scope on known good vehicles and really learn how to connect, navigate and test BEFORE you start using it to fix vehicles in your service bay.

While you are practicing on known good vehicles you should be documenting the actions that you are performing with the tool. Start with something easy like a TP sensor or an O2 sensor and keep good notes on how you test and the results you get. In the next few steps we will cover an O2 sensor as example of what we are discussing.

O2 Sensor Demonstration



In the screen capture to the left we have chosen the 4 channel oscilloscope from the main menu.



From the oscilloscope menu we have chosen the Component Selection option from the left side bar menu and the Sensors option from the main Component Selection menu from the center of the screen.

HOW TO GET STARTED WITH YOUR LAB SCOPE (CONTINUED)

O2 Sensor Demonstration

Once we have scrolled down to the O2 sensor and selected it, the tool automatically sets itself up to test O2 sensors.

From this screen you will be able to access information on how to connect the scope to the sensor, freeze the data on the screen, view example O2 sensor waveforms and diagnosing the signal.

NOTES

NAVIGATING THE MTS 5200

This portion of the presentation will cover how to navigate the MTS 5200 menu system and what the menus are used for. Later on in the presentation we will cover the outside connections of the lab scope and what they are used for.

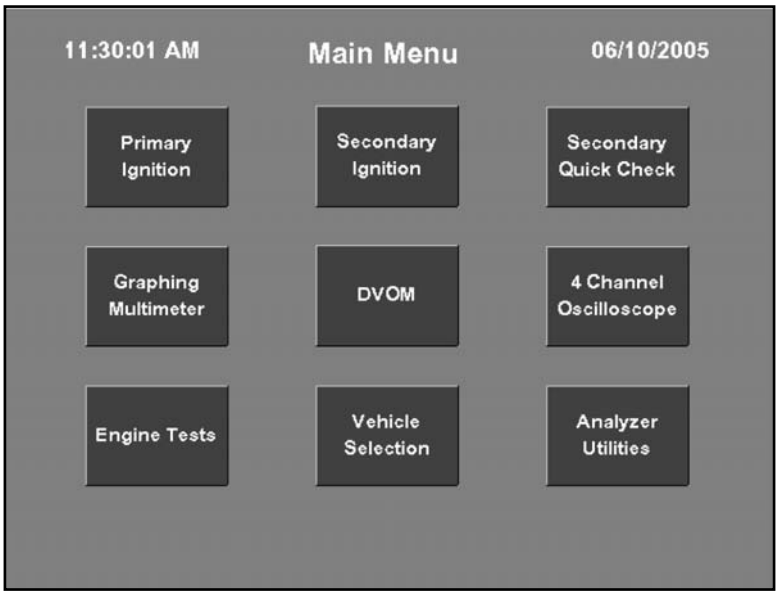
It is important to note at this point that all of the features of the MTS 5200 are covered in greater detail in the owners manual that came with the lab scope. Also, the manual can be downloaded from the Bosch website at:

http://www.boschdiagnostics.com/support/documentation/Pages/DiagnosticsDocumentation.aspx?type=UnderHood

For the training purposes of this DVD presentation the instructor will only be covering the high points for operation of the MTS 5200.

Primary & Secondary Ignition

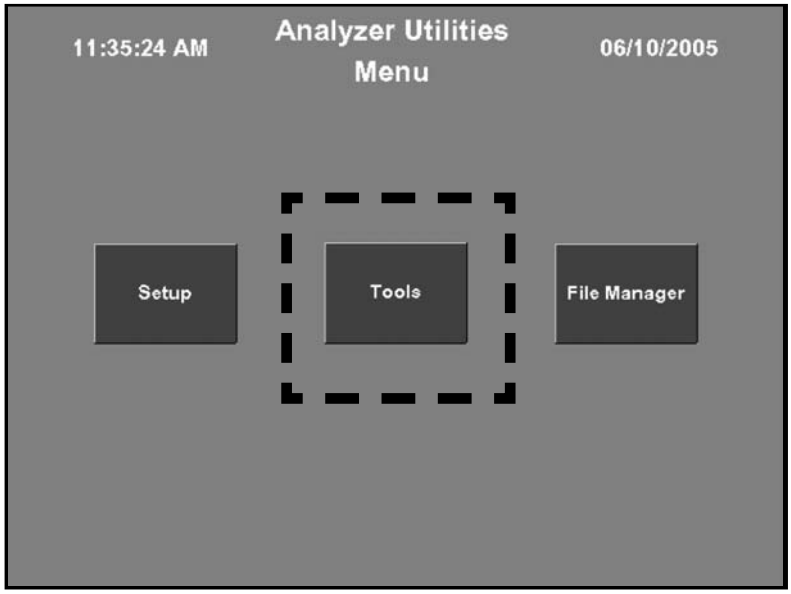
Main Menu



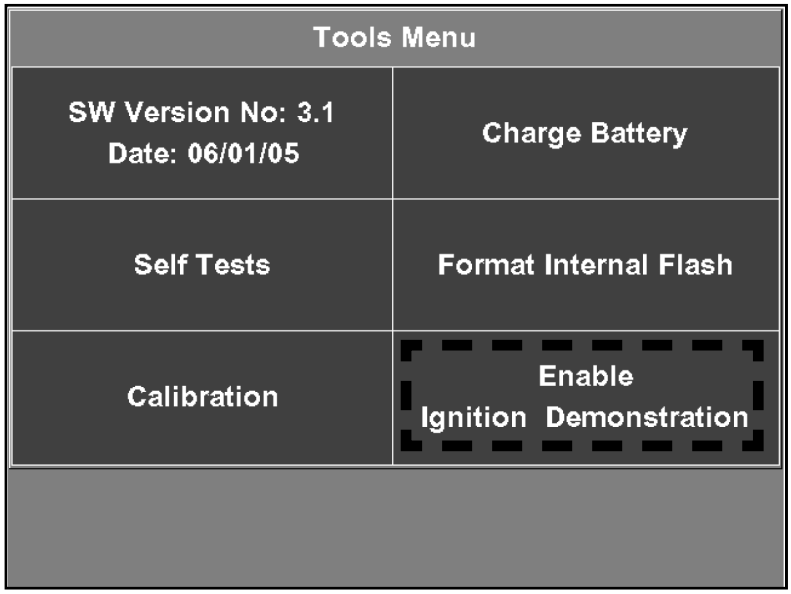
Pictured above is a screen capture of the main menu. You can see that you have the following options: Primary Ignition, Secondary Ignition, Secondary Quick Check, Graphing Multimeter, DVOM, 4 Channel Oscilloscope, Engine Tests, Vehicle Selection and Analyzer Utilities.

NAVIGATING THE MTS 5200 (CONTINUED)

Primary & Secondary Ignition



We have selected the analyzer utilities menu and you can see that there are three options available. Setup, Tools and File Manager.

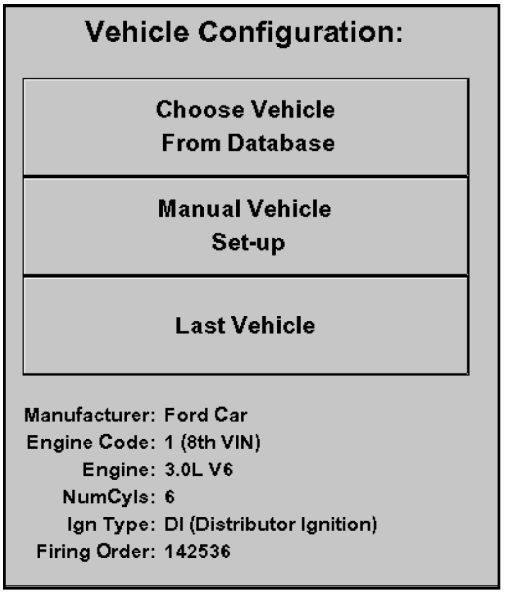


Once we have chosen the tools menu option, the Tools Menu will appear and as you can see in the screen capture above there are a few choices we can make here as well. For this portion of the demonstration we are going to choose Enable Ignition Demonstration.

The Enable Ignition Demonstration function allows for selection of a stored ignition waveform program. This program operates in DI Secondary Ignition, Secondary Quick Check, and Primary Ignition.

NAVIGATING THE MTS 5200 (CONTINUED)

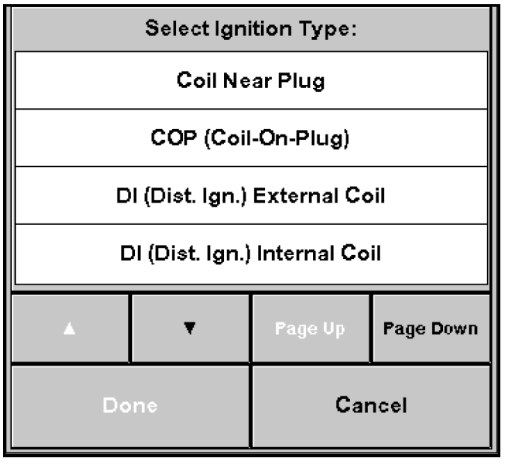
Primary & Secondary Ignition



This allows you to get better acquainted with the Engine Analyzer controls, allowing for smoother operation when hooked to a vehicle.

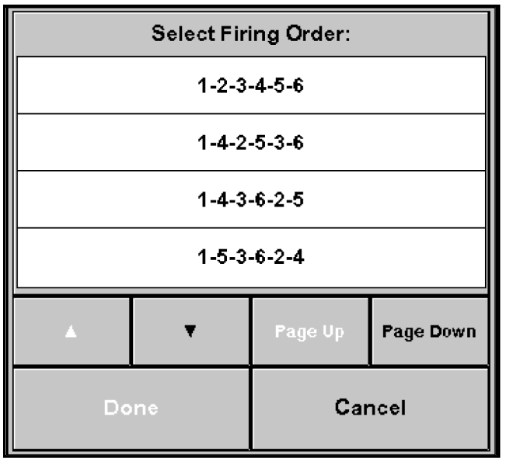
Once we have enabled the ignition demonstration we can back out to the main menu and select Primary Ignition. In the primary ignition function you will have the ability to Choose Vehicle From Database, Manual Vehicle Set-up and/or Last Vehicle.

For this demonstration we will be choosing Manual Vehicle Setup.



After selecting manual vehicle set-up we need to select the ignition type. For our demonstration we will be using DI (Dist. Ign.) External Coil. After making the selection remember to click on the Done option menu choice.

Next you want to Select the number of cylinders from the Select Number of Cylinders menu. Engines with 2 to 12 cylinders are supported.

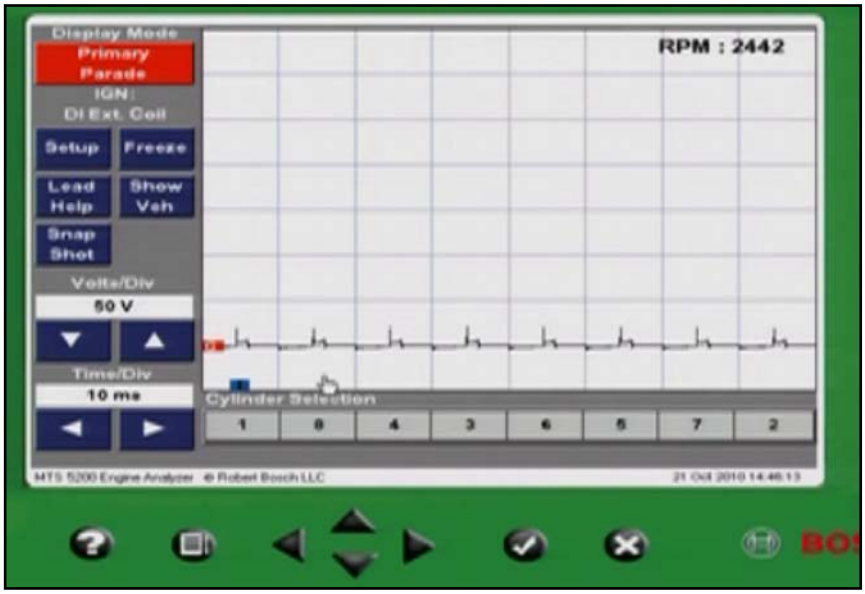


Select the correct firing order on the Select Firing Order pop-up menu. The Page Down and Page Up buttons move you one complete page at a time, allowing faster access to the firing order selections.

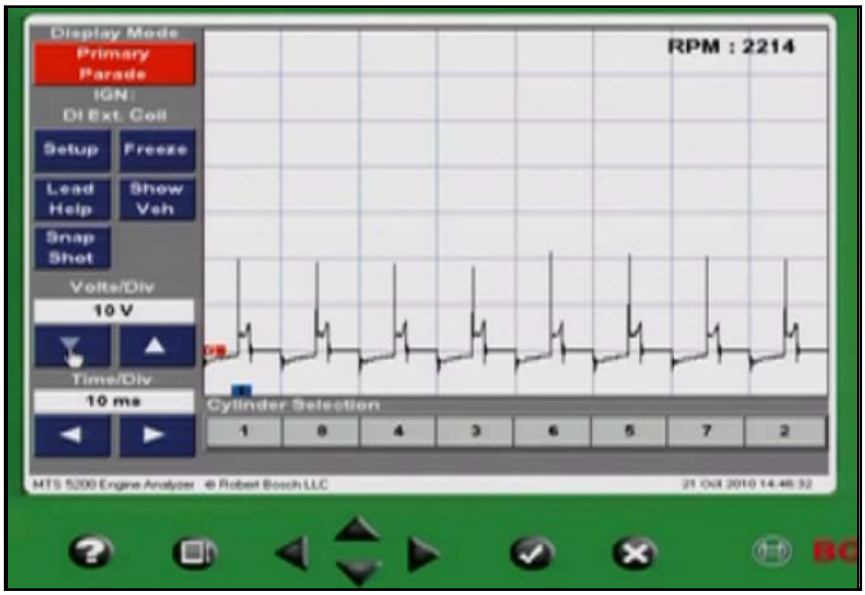
Choose firing order carefully, because selecting the incorrect firing order causes mislabeled cylinders to display incorrect data. Touch the Done button to complete the selection.

NAVIGATING THE MTS 5200 (CONTINUED)

Primary & Secondary Ignition



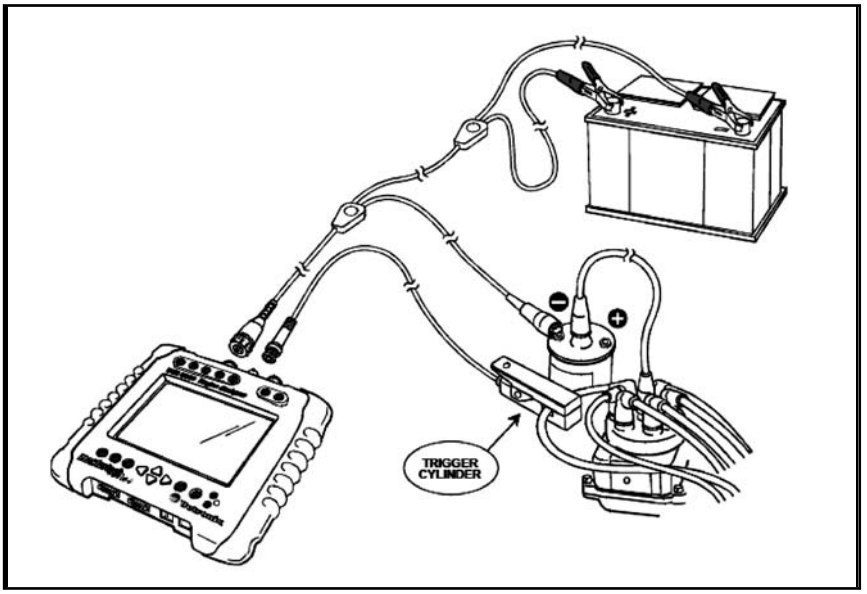
Once the firing order has been chosen, the ignition scope screen appears and is configured for primary ignition. Notice that all eight cylinders are displayed in the correct firing order across the bottom of the screen but the patterns for each cylinder are very small. This is because the division on the screen is set at 50 V.



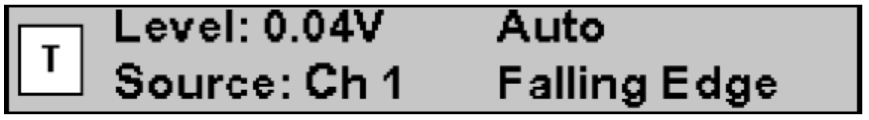
Pictured above is the same display but we have set the divisions to 10 V giving a more clear picture as to what the primary ignition waveforms look like.

NAVIGATING THE MTS 5200 (CONTINUED)

Primary & Secondary Ignition



If you are in doubt about how the connections from the tool to the vehicle should be made, click on the menu option “Lead Help” in the left sidebar of the screen. As you can see in the above screen capture, a detailed schematic will appear on the screen giving you good direction on how to make the connections.

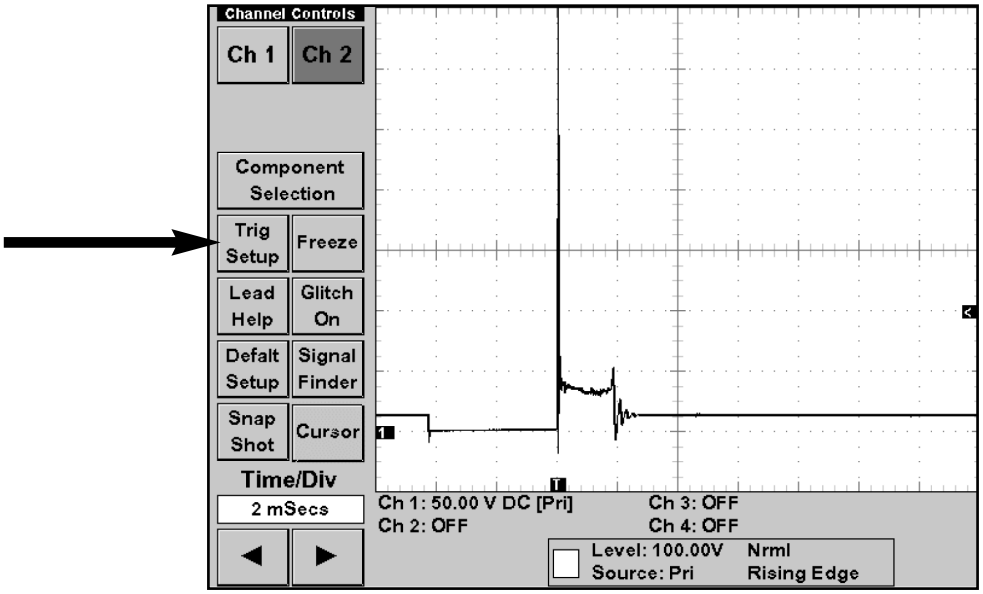


The MTS 5200 has a set of trigger controls that determine the exact instant the trace begins the sweep across the screen. If a trigger is set at a specific voltage level, and the signal being sampled achieves that trigger level voltage, then the MTS 5200 displays the signal. When triggering, a “T” appears in the small box at the left of the trigger settings box at the bottom of the touch screen display.

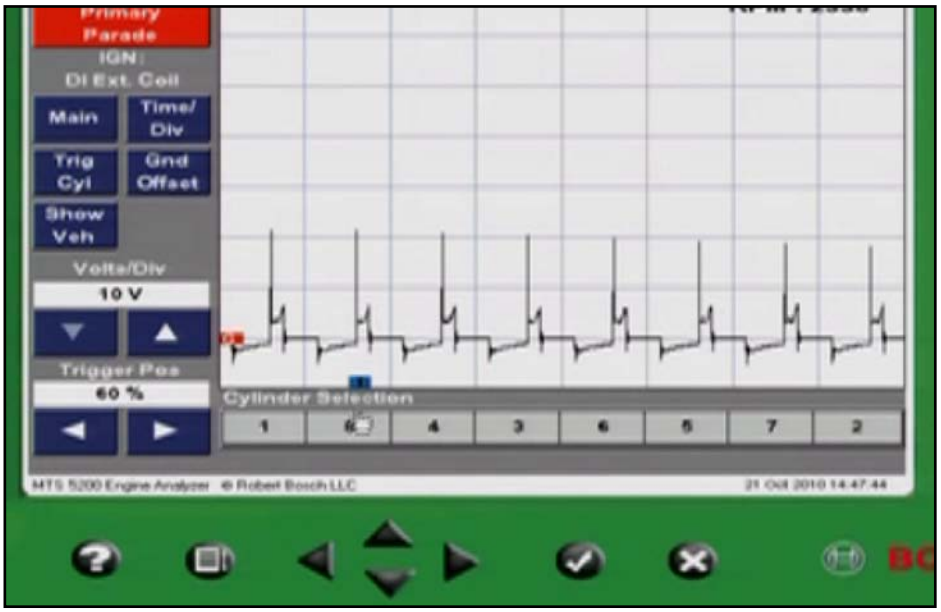
NAVIGATING THE MTS 5200 (CONTINUED)

Primary & Secondary Ignition

Trigger Set-Up



While viewing live data, you can access all trigger properties through the Trigger Setup touch screen display button to the left of the signal display area as illustrated in the screen capture above. The 4-Channel Oscilloscope has the ability to use any one of four channels as the trigger source.



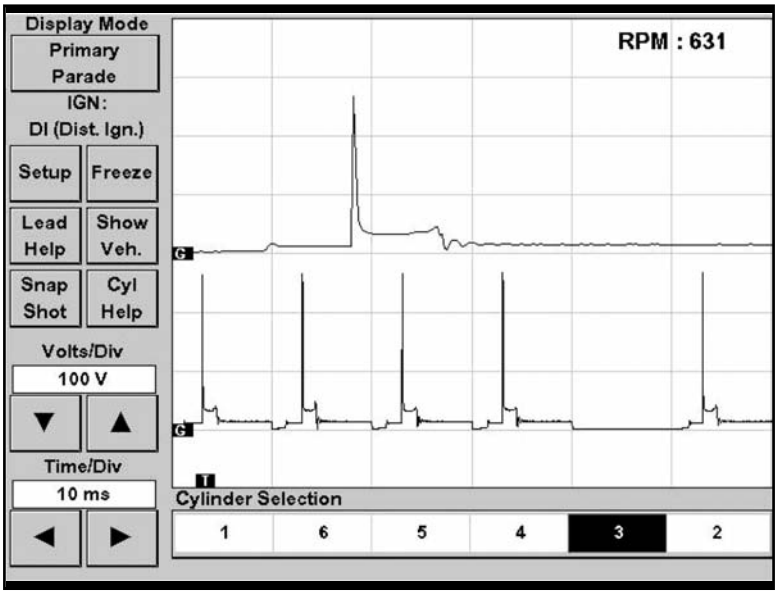
For our demonstration we have chosen to locate the trigger on cylinder #8 as indicated in the screen capture above.

NAVIGATING THE MTS 5200 (CONTINUED)

Primary & Secondary Ignition

Freeze

Also in the main menu is a menu option called “Freeze”. The Freeze button is available any time the MTS 5200 is collecting data in any of the display modes. The Freeze button stops the collection of live data and freezes the signal on the display, allowing you to analyze the frozen signal. Once the Freeze button is pressed, you are able to perform additional functions, such as Save the frozen signal to memory.



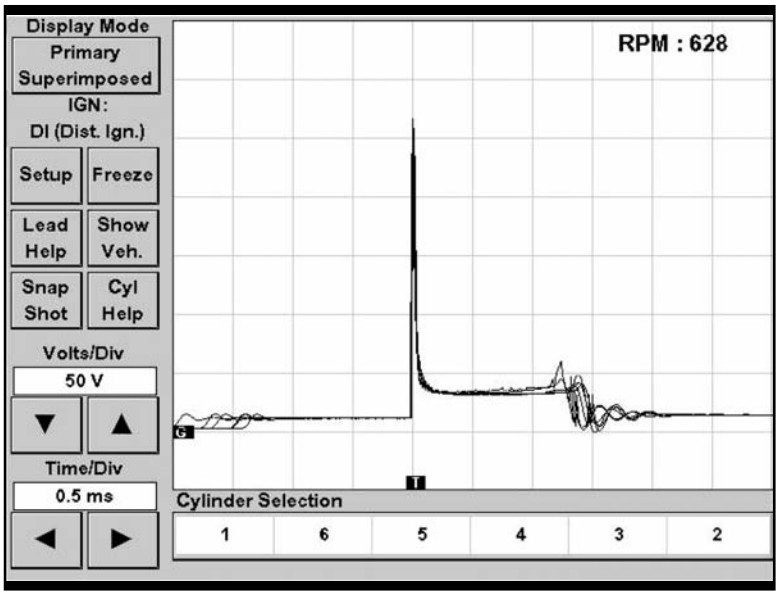
Another great feature of the MTS 5200 is that you have the ability to select one of the cylinders at the bottom of the screen and it will overlay the pattern above the firing patterns for the entire engine. As you can see in the screen capture above, we have chosen the #3 cylinder and the firing waveform has appeared above the parade pattern.

Selecting a single cylinder in this manner gives you the ability to get a closer look at the primary charge, secondary kick, burn time and the coil oscillation at the end.

NAVIGATING THE MTS 5200 (CONTINUED)

Primary & Secondary Ignition

Superimposed Display



Superimposed Display mode allows you to view the waveform of each cylinder in the firing order on a single screen, simultaneously. Each cylinder waveform is positioned beginning with the firing spike at the trigger position. The cylinder waveforms therefore overlap each other.

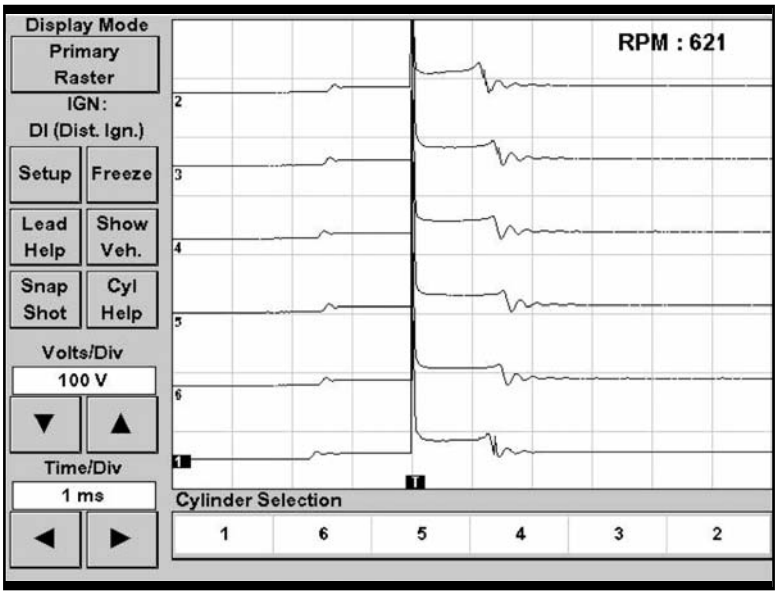
Selecting a cylinder from the Cylinder Selection buttons at the bottom of the touch screen display causes the MTS 5200 to hide or display the selected cylinder. You may choose to display any number of cylinders on the display at one time. Doing this will help you to identify the cylinder that is having the problem so you can further diagnose the fault.

NOTES

NAVIGATING THE MTS 5200 (CONTINUED)

Primary & Secondary Ignition

Raster Display



Raster Display mode allows you to view the waveform of each cylinder in the firing order on a single screen, simultaneously. Selecting a cylinder from the Cylinder Selection buttons at the bottom of the touch screen display causes the MTS 5200 to hide or display the selected cylinder.

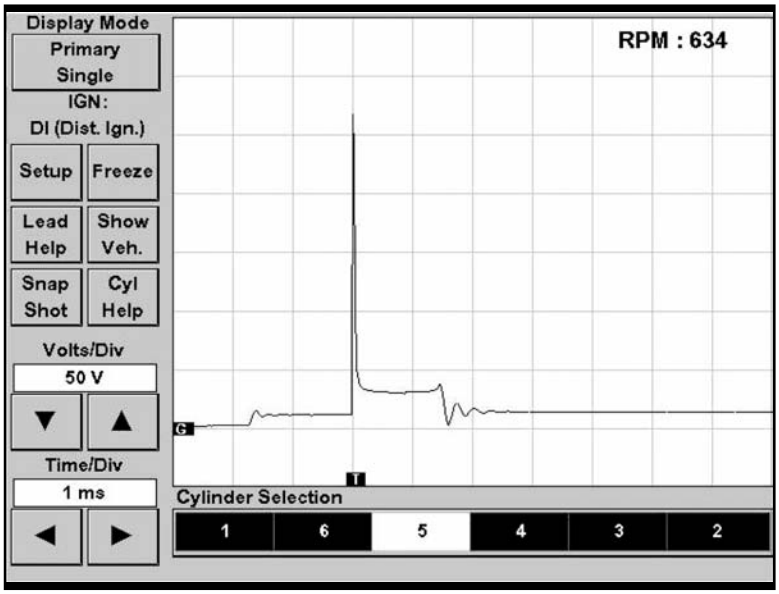
You may choose to display any number of cylinders on the display, but the MTS 5200 always takes into account the number of cylinders in the firing order and spaces the patterns so that all cylinders are displayed on a single screen. You may change the spacing between the cylinder waveforms using the Pattern Spacing touch screen button in the Setup menu. Pattern Spacing affects all cylinders in the firing order and is not specific to your selected cylinders.

NOTES

NAVIGATING THE MTS 5200 (CONTINUED)

Primary & Secondary Ignition

Single Cylinder Display



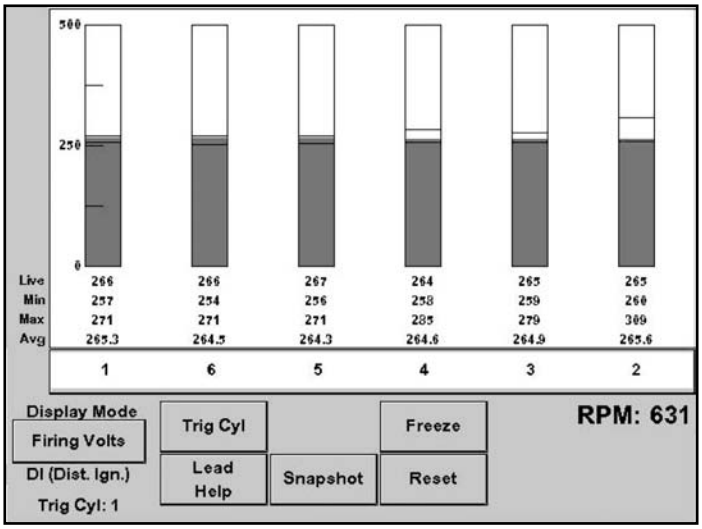
Single Cylinder Display mode allows you to view the waveform characteristics of a single cylinder in the firing order. By pressing the Cylinder Selection buttons at the bottom of the touch screen display, you have the ability to view each cylinder's waveform individually. Only one cylinder is displayed at any one time.

NOTES

NAVIGATING THE MTS 5200 (CONTINUED)

Primary & Secondary Ignition

Firing Volts Bar Chart Display



Bar Chart Display mode allows you to view the voltage levels of each cylinder in the firing order on a single screen. Each cylinder's primary voltage is displayed in Bar Chart format so it is easy to spot a cylinder voltage that does not compare with the others. All cylinders are displayed in the correct firing order at all times.

The Firing Volts Barchart displays a bar graph showing the primary voltage required for each cylinder. Live, Min (Minimum), Max (Maximum), and Avg (Average) values for each cylinder are displayed. The numeric units are displayed in volts. The cylinders are listed in firing order sequence.

- The Live data value is the same data displayed in the barchart format.
- The Min value is the lowest voltage value recorded for that cylinder.
- The Max value is the highest voltage value recorded for that cylinder.
- The Avg value is the average voltage value recorded for that cylinder.

Pressing the Reset button resets the Min/Max/Avg data.

It is important to note that the peak Kv firing line will be different for each cylinder and will change as the engine runs. This is because the fuel mixture for each cylinder is different and is being adjusted as the engine runs.

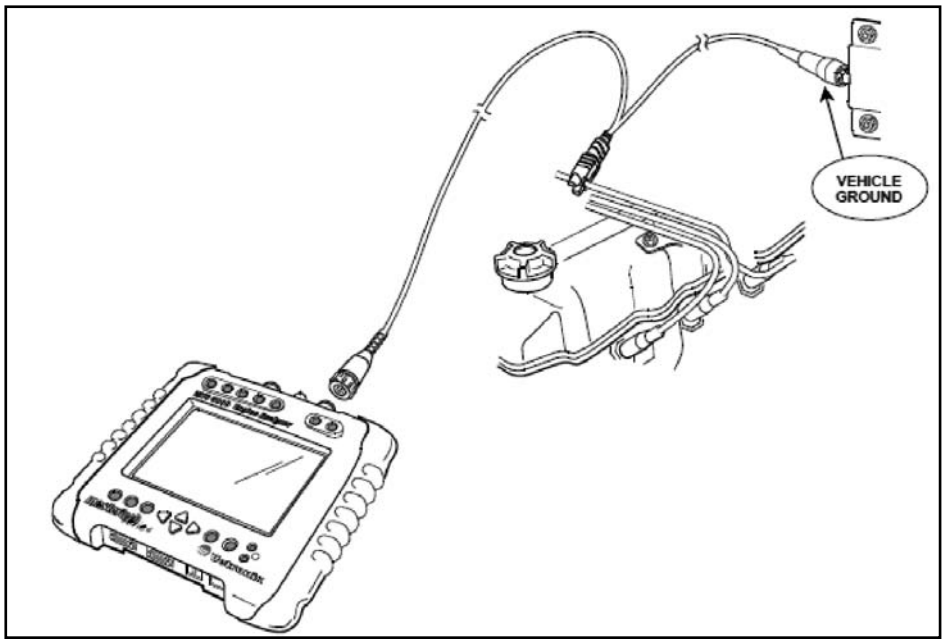
You want to keep an eye on the Avg. data. The Avg. is going to show you the average for all of the cylinders over time. If you see one that is significantly higher or lower than all of the others, this indicates that is the bad cylinder.

NAVIGATING THE MTS 5200 (CONTINUED)

Secondary Quick Check

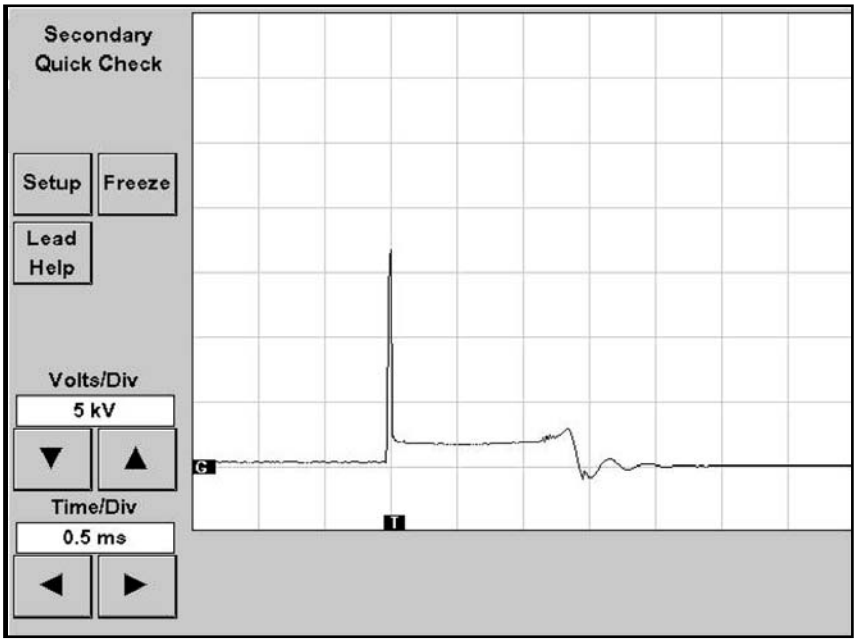
During diagnosis of a secondary ignition system you might encounter situations where you want to display information on one specific cylinder. A Diagnostic Trouble Code (DTC) such as a P0302 (cylinder #2 misfire) would direct you immediately to the cylinder. Secondary Quick Check gives you a quick and easy way to look at individual plug wires in the secondary ignition system by simply hooking up one lead. The Secondary Quick Check utilizes a pre-configured display based on the Secondary Ignition function.

The Secondary Ignition Lead is connected to the Sec Ign port on the tester and then clamped to the plug wire. Connecting this lead directly to a plug wire will give you a cylinder ignition output display on Distributor (DI), Distributorless (EI) and Coil-Near-Plug (CNP) systems. Be sure to connect the secondary probe shield to a good engine ground.



NAVIGATING THE MTS 5200 (CONTINUED)

Secondary Quick Check



Although the Secondary Quick Check is fully functional on Distributor Ignition (DI) systems, some applications filter the ignition signal as it passes through the distributor. This distorts the signal at the individual spark plug wires. For this reason, Bosch recommends using the Secondary Ignition Mode on Distributor Ignition (DI) vehicles.

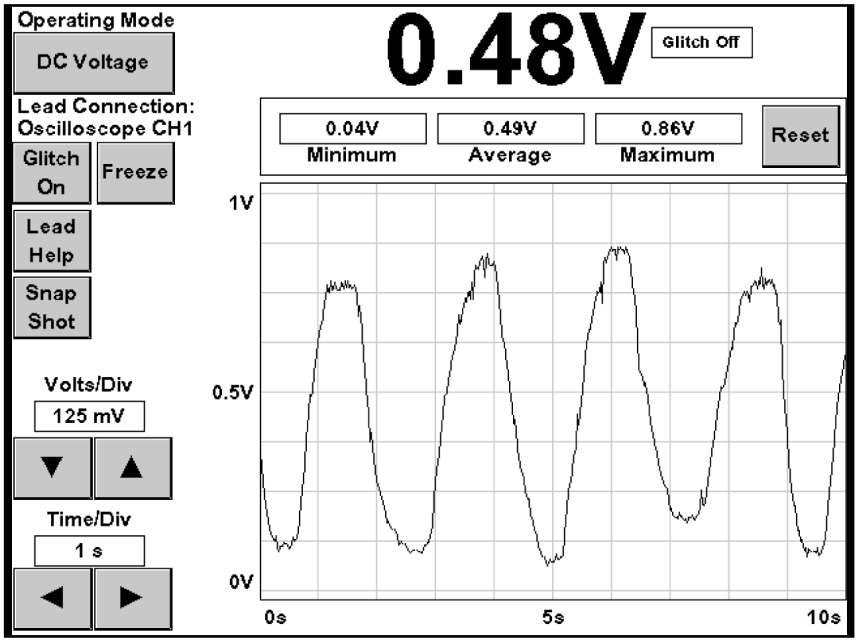
NOTES

NAVIGATING THE MTS 5200 (CONTINUED)

Graphing Multimeter

Graphing Multimeter is a powerful diagnostic tool that allows you to view circuit operation over extended periods of time. All measurements are plotted horizontally from left to right to show the measurement over time and vertically to display the measured value.

Depending on the operating mode selected, the graphing multimeter can read DC voltage, DC low current and DC high current, frequency, pulse width, duty cycle, RPM, temperature, vacuum, and pressure.

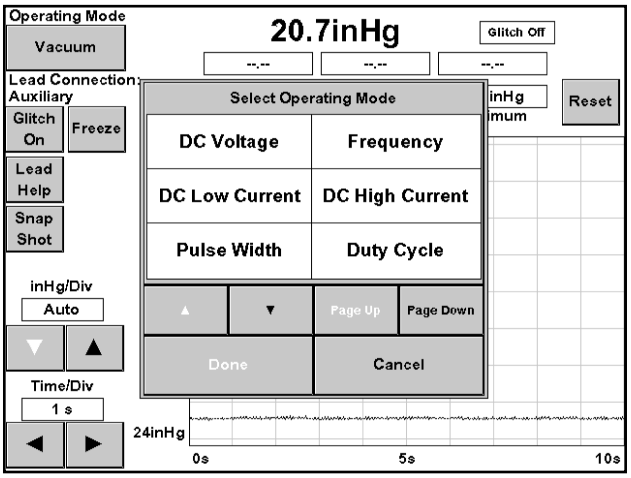


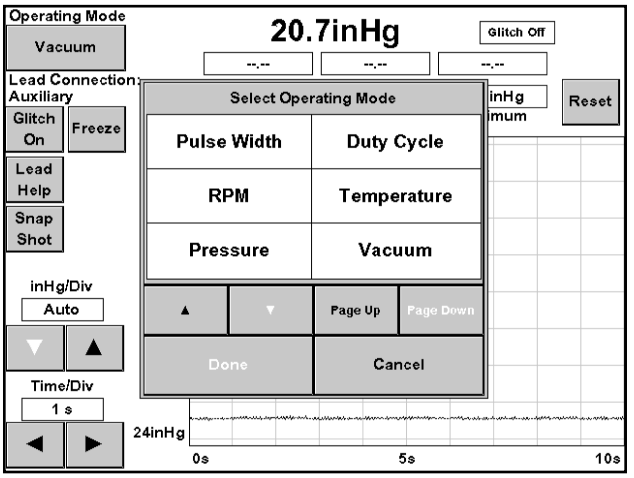
Graphing Multimeter displays data over extended periods of time giving you a better way to view the data or a fault condition. For intermittent problems, simply connect to the suspect circuit and monitor the plotted measurement by verifying glitches in the graph and/or look for higher than normal min/max readings.

Graphing Multimeter helps you accurately evaluate automotive signals such as O2 Sensors, MAF / MAP, IAT, Injector pulse width, EGR valve position sensor test, and TPS sweep test.

NAVIGATING THE MTS 5200 (CONTINUED)

Graphing Multimeter





DC Voltage Button

DC voltage mode measures and displays the DC voltage of a sampled signal. The MTS 5200 can measure DC voltages from 0 - 200 volts.

Frequency Button

Frequency mode measures and displays the frequency of the sampled signal. The MTS 5200 can measure frequencies from 1 Hz to 200 KHz.

DC Low Current Button

This mode measures and displays the DC low current value of the sampled signal. The MTS 5200 measures current at the low range of 0 mA to 30 Amps. Use the Low Current Probe for this measurement.

DC High Current Button

This mode measures and displays the DC high current value of the sampled signal. The MTS 5200 measures current at the higher range of 0 A to 1000 Amps. Use the High Current Probe for this measurement.

Pulse Width Button

This mode measures and displays the high/low time of a periodic signal. The MTS 5200 allows you to select high time or low time.

NAVIGATING THE MTS 5200 (CONTINUED)

Graphing Multimeter

Duty Cycle Button

This mode measures the ratio of the high/low portion of a signal period to the entire signal period and displays the results as a percentage of time. The MTS 5200 allows you to select either the percentage of high or low signal.

Temperature Button

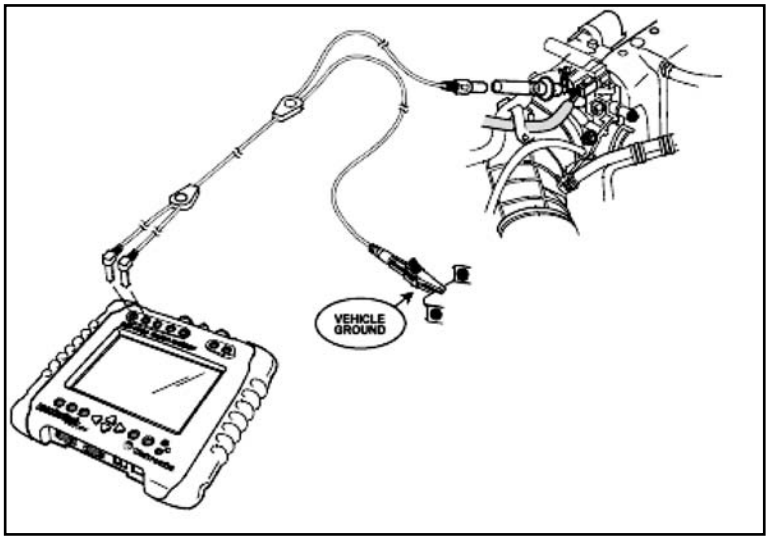
This mode displays the temperature measured by the Vetronix non-contact IR Temperature Probe. The probe has a temperature range of 32°F to 1000°F with a basic accuracy of 2% of reading and an output of 1mV DC per °F.

You can select either Celsius or Fahrenheit by going to Analyzer Utilities on the Main menu, selecting Setup, and Units of Measure.

Pressure Button

This mode displays the pressure measured by the Bosch Pressure Transducer. The Pressure Transducer has a measurement range of 0-300 psi. Three different units of measure selections can be used: psi, kPa, or bar. Units of measure are selected in the Units of Measure utility located in the Analyzer Utilities/Setup menu.

Lead Help Button



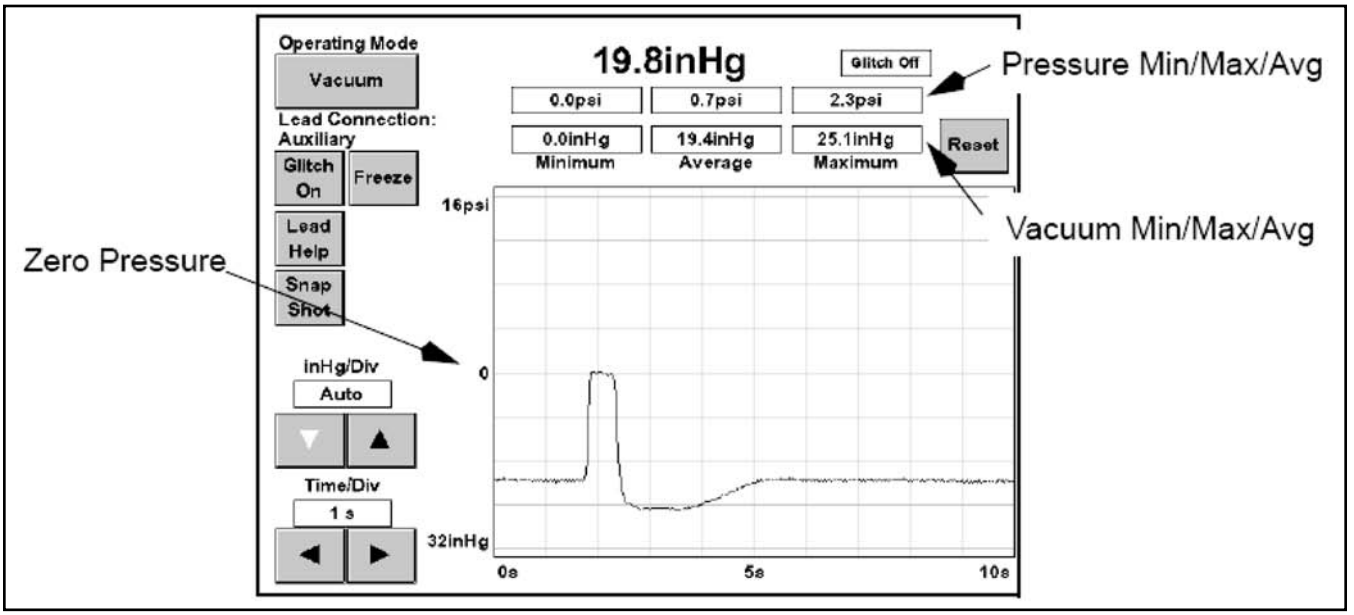
The Lead Help button is used to display an example of the connection of the leads for the tester's current Operating Mode.

NAVIGATING THE MTS 5200 (CONTINUED)

Graphing Multimeter

Vacuum Button

This mode displays the pressure measured by the Bosch Vacuum Probe. The Vacuum Probe has a measurement range of 30 inHg – 15 psi (0-30 psia). Two different units of measure selections can be used: inHg and mbar. Units of measure are selected in the Units of measure utility located in the Analyzer Utilities/Setup menu.



Using the Vacuum Operating Mode

- The Vacuum Operating Mode display uses a split screen. Vacuum is displayed below zero, and pressure is displayed above zero.
- Minimum, Maximum, and Average values for both pressure and vacuum are displayed.
- The live value is displayed at the top of the screen in units of either pressure or vacuum.
- Minimum, Maximum, and Average values remain blank until the sensor measures a pressure or vacuum.

NAVIGATING THE MTS 5200 (CONTINUED)

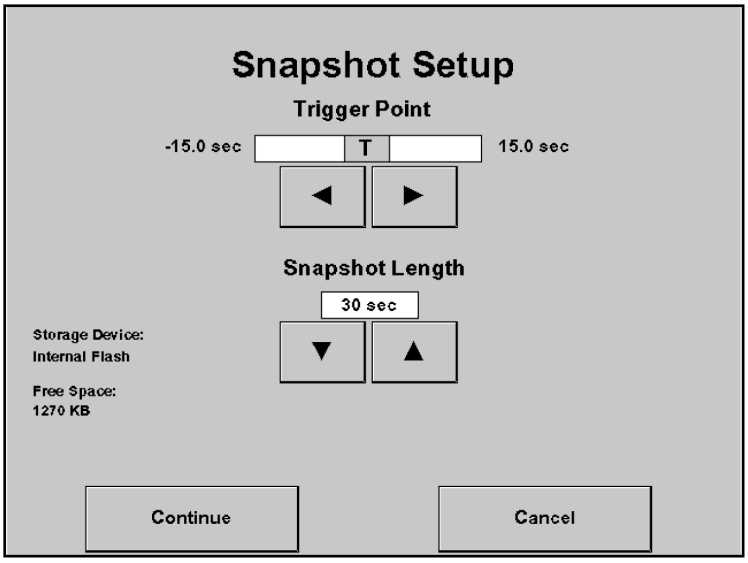
Graphing Multimeter

Capturing a Snap Shot

The Snapshot function gives you the ability to capture, save, and playback a length of data collected from a vehicle. When a snapshot is captured, the MTS 5200 collects data from the vehicle for a length of time you select. Snapshots can be played back in real time or carefully examined by scrolling through the snapshot manually.

Snapshots can be captured and played back in Secondary Ignition, Primary Ignition, 4-Channel Oscilloscope, Graphing Multimeter, and Vacuum Waveform modes. Snapshots that are captured in Primary/Secondary Ignition or Vacuum Waveform can be played back in any display mode you choose, thus allowing a great deal of flexibility when examining waveforms.

Before entering the Snapshot mode, adjust the settings so the waveform you are going to capture is easily viewable. Time/Div, Volts/Div, etc. are not adjustable while a snapshot is being captured.



SETTING UP A SNAPSHOT

When the Snapshot button is selected, the Snapshot Setup screen displays. On the Snapshot Setup screen you can configure the trigger point and the length of the snapshot.

TRIGGER POINT

Use the Trigger Point setting to identify the point in time that you want the tester to collect data. The MTS 5200 has an adjustable trigger point that allows you to capture as much pre- or post-trigger data as you want.

NAVIGATING THE MTS 5200 (CONTINUED)

Graphing Multimeter

Capturing a Snap Shot

Adjusting Trigger Point
Pre- and post-trigger times are adjusted with the “Right” and “Left” arrow buttons on either the touch screen or the keypad. The pre-trigger setting is displayed on the left side of the Trigger Point adjustment bar and is displayed in seconds. Negative values indicate pre-trigger. The post-trigger setting is displayed on the right side of the Trigger Point adjustment bar and is displayed in seconds. Positive values indicate post-trigger.

SNAPSHOT LENGTH
You can adjust the total length of the snapshot to be able to capture any type of problem. The available time differs depending on the Operating Mode in which you are capturing the snapshot. A Maximum selection is available which allows you to capture data until the tester runs out of storage space. Some types of snapshots require more memory than others. In some cases the available storage space is filled before the selected length is reached.

Adjusting Snapshot Length
Snapshot Length is adjusted with the “Up” and “Down” arrows on either the touch screen or the keypad.

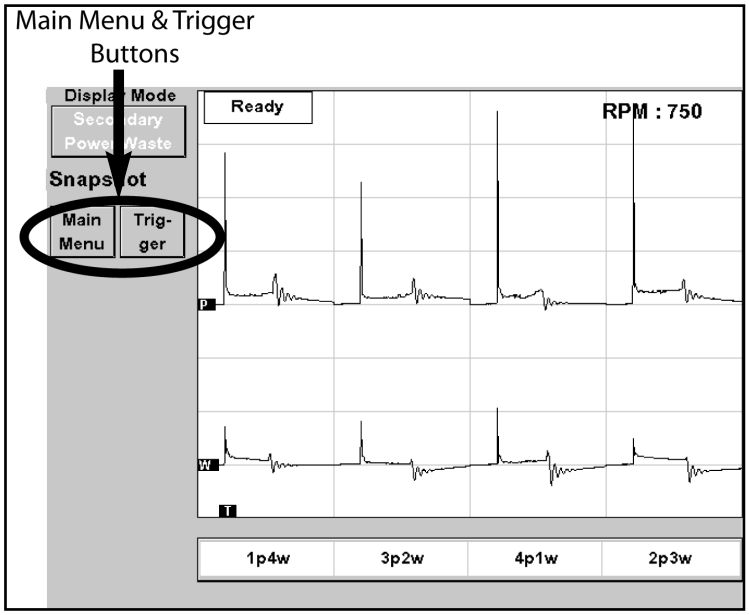
CONTINUE/CANCEL
When you have completed your Snapshot Setup options, touch Continue to proceed to the Snapshot mode where a snapshot can be captured. Touch Cancel to return to the previous screen and cancel any settings you may have just entered.

When the Snapshot menu is displayed, the keypad arrow buttons are disabled. Additionally, when the tester is recording or ready to record, operating mode display controls (such as Volts/Div, Time/Div, Display Mode, etc.) are either removed from the menu or disabled. No adjustment to the waveform is allowed during snapshot capture.

NAVIGATING THE MTS 5200 (CONTINUED)

Graphing Multimeter

Capturing a Snap Shot



SNAPSHOT CONTROLS

Main Menu
The Main Menu button returns you to the main menu of the operating mode from which you accessed Snapshot mode.

Trigger/Stop
This button toggles between Trigger and Stop. Touching Trigger marks the trigger point for the recording, which you have pre-selected in the Snapshot Setup screen.

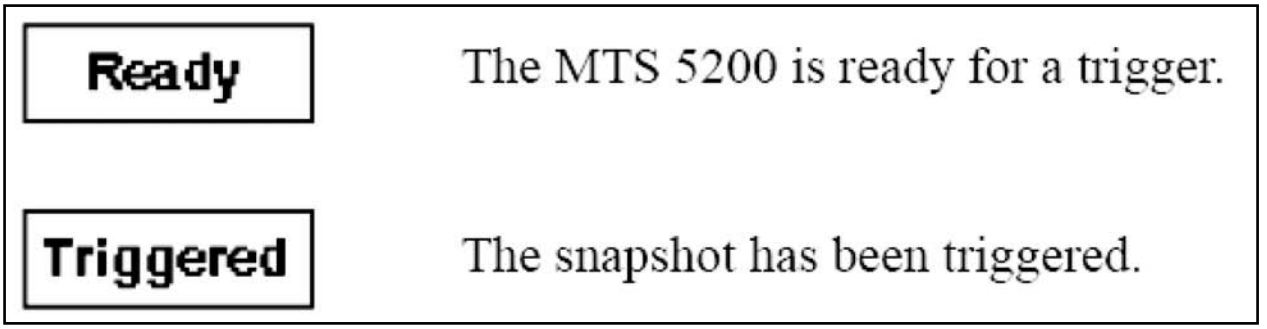
Once the recording is triggered, the button name changes to Stop. The recording continues for as long as the Snapshot Length time you pre-selected in the Snapshot Setup screen. However, you can use the Stop button to force the recording to stop before the selected time has expired.

The Enter button on the keypad activates the Trigger/Stop button. As soon as a snapshot has been captured, the tester enters the Playback mode.

NAVIGATING THE MTS 5200 (CONTINUED)

Graphing Multimeter

Capturing a Snap Shot



RECORDING INDICATOR
In the top left corner of the grid there is a text box that displays the status of the snapshot. One beep is sounded when a snapshot has been triggered. Two beeps are sounded when the recording is complete.

Playback Mode

PLAYBACK MODE
You view snapshots from Playback mode, which you enter when a snapshot has been captured, or when a saved snapshot file is selected for viewing from the File Manager.

Selecting File in Memory
If you use the File Manager to select a snapshot file located in memory, use the following procedure:

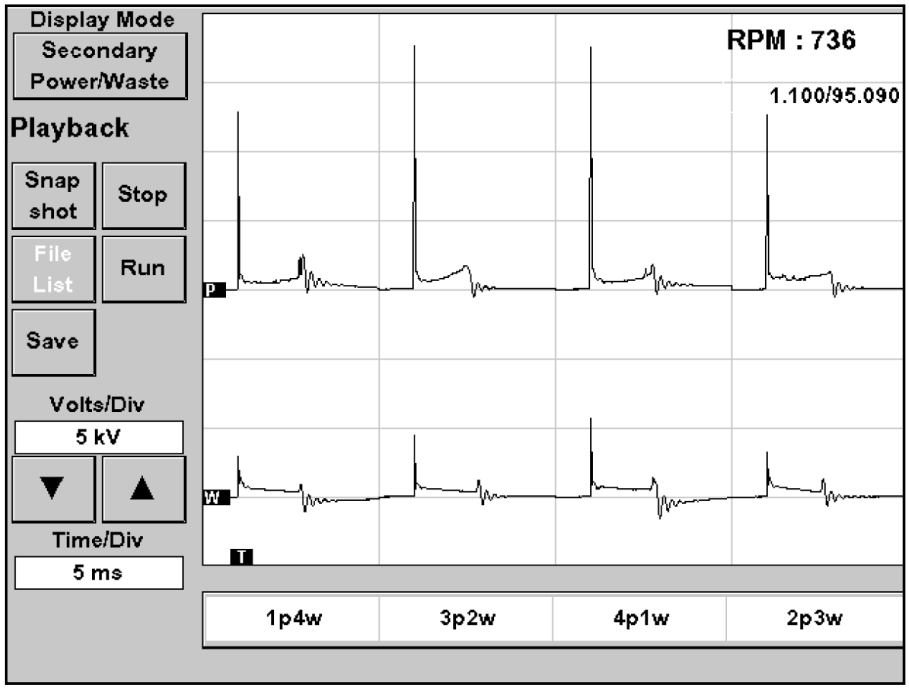
1. Touch Analyzer Utilities on the Main menu, then press File Manager or touch the File List button on the Playback menu.
2. Select the snapshot to be viewed. Once a snapshot is selected, the applicable operating mode is opened in Playback mode.
3. Touch the Exit keypad button or the File List button to display the snapshot section of the File Manager.

The Playback menu contains the control buttons for playing a snapshot.

NAVIGATING THE MTS 5200 (CONTINUED)

Graphing Multimeter

Playback Mode



Snapshot
The Snapshot button exits the Playback Mode and returns to the Snapshot menu where another snapshot can be captured. The Exit keypad button operates the Snapshot button as well. If an unsaved snapshot exists when the Playback Mode is exited, you are prompted to either save the snapshot to memory or disregard the snapshot.

Play/Stop
The Play/Stop toggle button starts and stops the real time playback of the snapshot. Once the Play button is pressed, the button changes to the Stop button. Touching the Play button starts the playback of the snapshot from the beginning of the file. The snapshot file plays back exactly as it was recorded.

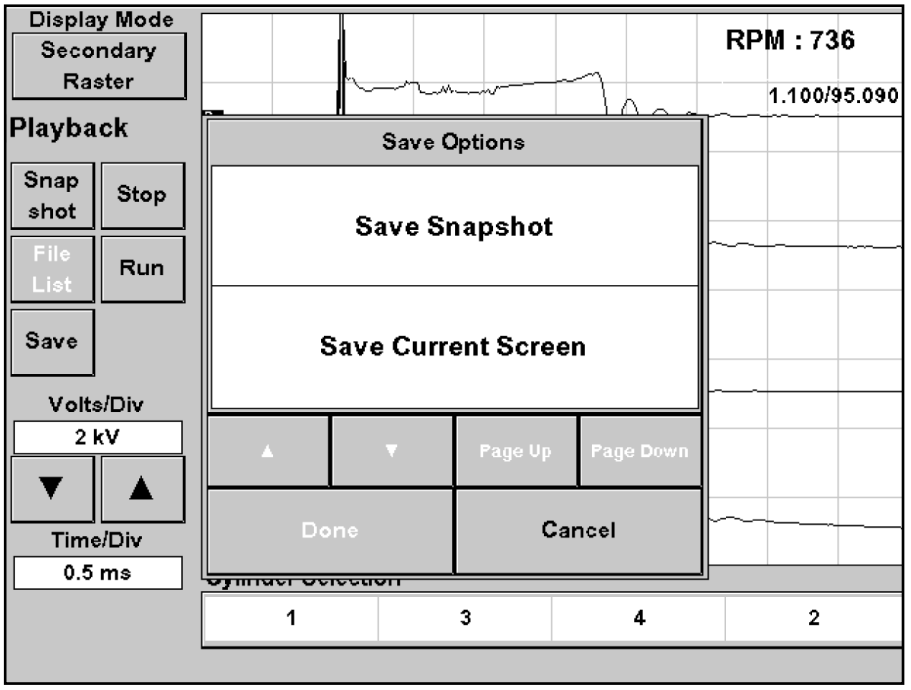
The Stop button stops the playback and returns the snapshot to the beginning of the file. When the Stop button is pressed, it changes back to the Play button.

Freeze/Run
This button toggles between Freeze and Run. During snapshot playback the Freeze button pauses the playback. When the Freeze button is touched, it changes to Run. Then touch the Run button to continue playback from the point at which it was paused. The Enter button on the keypad controls the Freeze/Run button.

NAVIGATING THE MTS 5200 (CONTINUED)

Graphing Multimeter

Playback Mode



Once the Save button is pressed, the Save Options menu is displayed (see Figure 11-4). This menu offers the following selections:

Save Snapshot
This selection saves the complete snapshot to memory where it can be recalled and viewed from the File Manager.

Save Current Screen
This selection saves the screen that the snapshot file is displaying at the current time. The screen capture is saved as a bitmap. When a snapshot or screen capture is saved, the Edit Notes screen is displayed, which allows the user to attach any notes about the file that is being saved. These notes are saved along with the file and can be viewed in the detail view of the File Manager.

NAVIGATING THE MTS 5200 (CONTINUED)

Digital Volt Ohm Meter (DVOM)

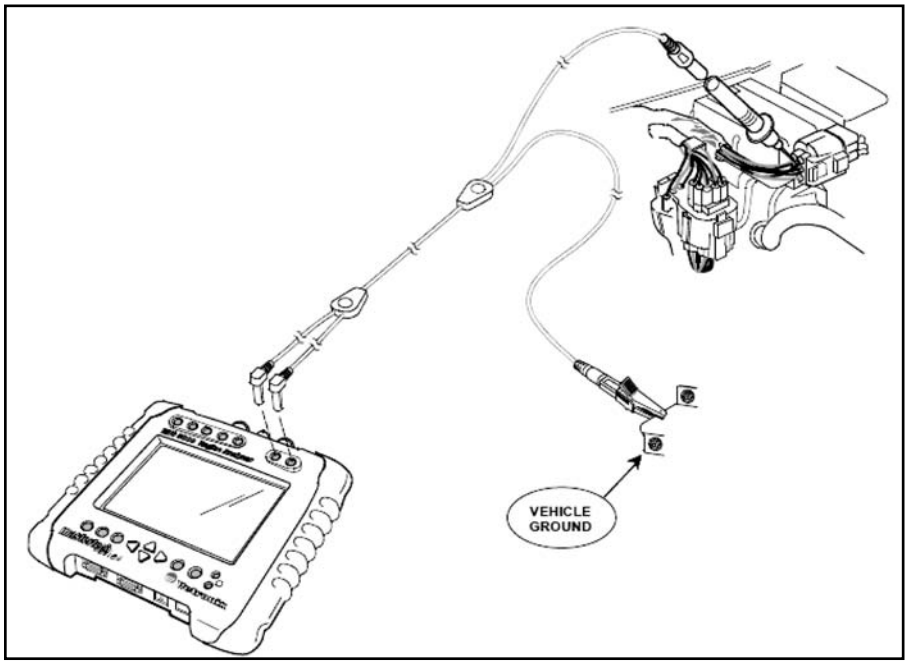
Overview

The Digital Volt Ohm Meter (DVOM) is a powerful diagnostic tool that allows you to determine specific values of different measurement modes. The DVOM modes include DC and AC voltages, resistance, continuity, and diode check. The DVOM's large display makes it ideal for measuring a variety of general signals as well as automotive signals.

CONNECTING THE LEADS

The DVOM +/- ports on the MTS 5200 are used for all of the DVOM modes. Connect the two-lead set with the black lead in the DVOM - port and the red lead in the DVOM + port (see Figure 10-1). Connect the black test lead tip to ground and the red test lead tip to the desired signal.

Once you select DVOM from the Main menu, a message appears reminding you to use the DVOM inputs. Always use the DVOM ports for the DVOM application.



CAUTION!

Make sure the leads are routed away from moving parts to avoid personal injury or damage to the MTS 5200. Be sure you use correct wire probing procedures to prevent damage to the connectors or wires in the circuit. The maximum DVOM voltage measurement is +/- 400v.

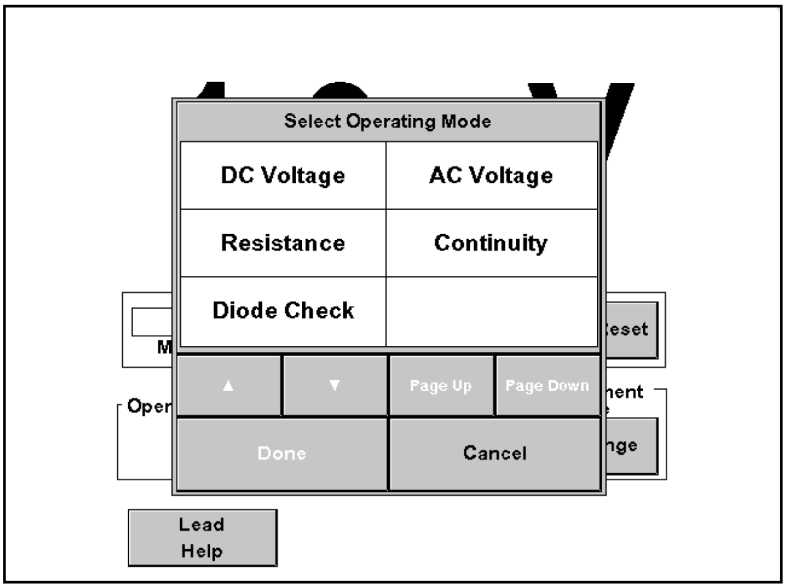
WARNING!

The MTS 5200 is not intended for testing 110V, AC electrical circuits. Do not plug the leads into an electrical wall socket. Damage to the tester or personal injury may occur.

NAVIGATING THE MTS 5200 (CONTINUED)

Digital Volt Ohm Meter (DVOM)

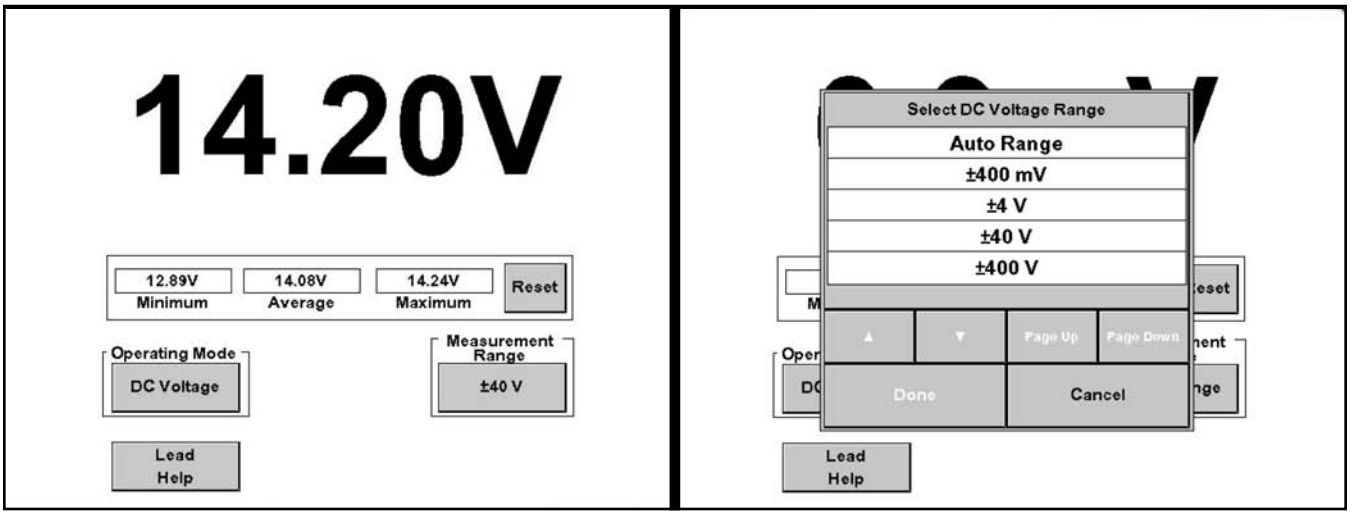
Operating Modes



There are five operating modes in the DVOM application.

DC VOLTAGE
DC voltage mode displays the DC voltage of a sampled signal in the DVOM. The MTS 5200 can measure DC voltage from 0 mV to ±400 V.

AC VOLTAGE
AC voltage mode displays the AC RMS voltage of a sampled signal in the DVOM. The MTS 5200 can measure AC RMS voltage from 0 mV to 400 V. The measured signal is a RMS voltage reading.



NAVIGATING THE MTS 5200 (CONTINUED)

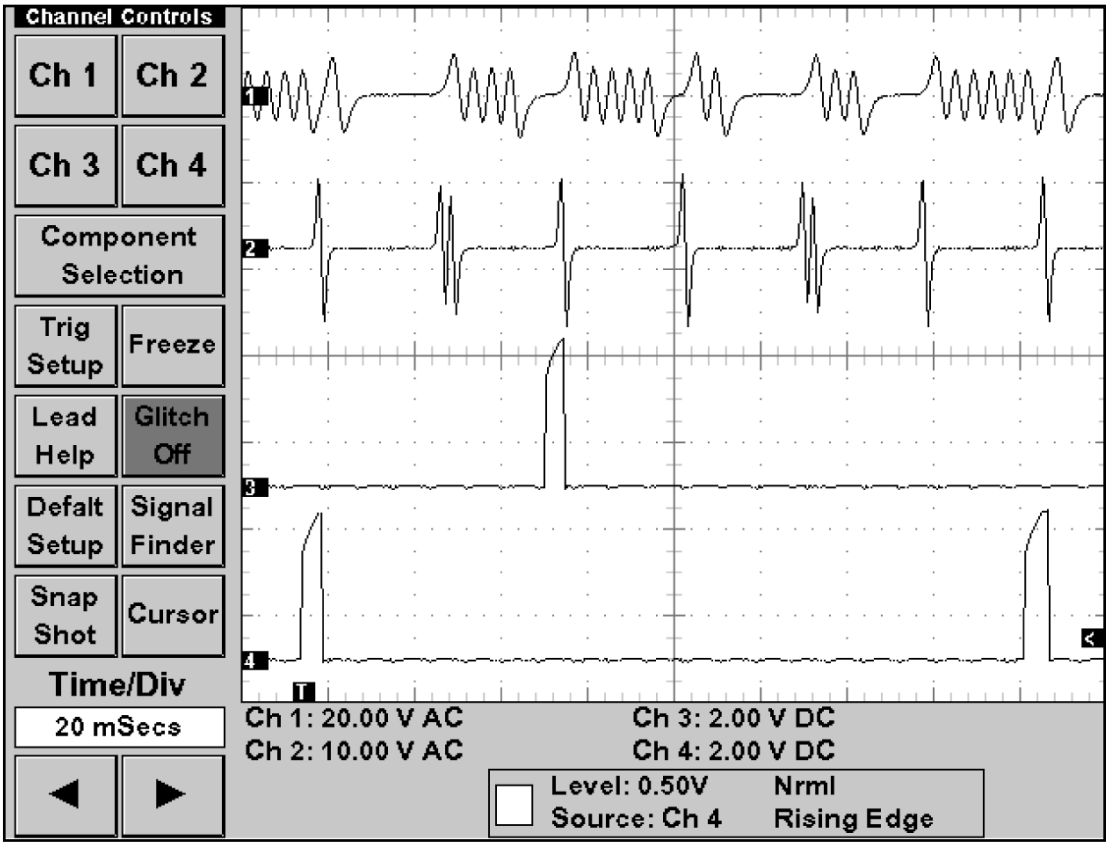
4-Channel Oscilloscope

Overview

The 4-Channel Oscilloscope is an easy-to-use and versatile tool that allows access to any automotive computer-controlled circuit. Once you are familiar with the oscilloscope layout and features, you can take full advantage of the most powerful tool in its class.

All touch screen display buttons, keypad buttons, and test lead ports are clearly labeled on the front of your MTS 5200. Use the touch screen display (or, where available, the keypad buttons) to access all the features on the oscilloscope.

You can easily adjust the oscilloscope to a wide variety of voltage ranges and sampling speeds in order to view the most detailed waveforms. You can view up to four waveforms simultaneously allowing you to see the important relationship between different automotive input and output signals.



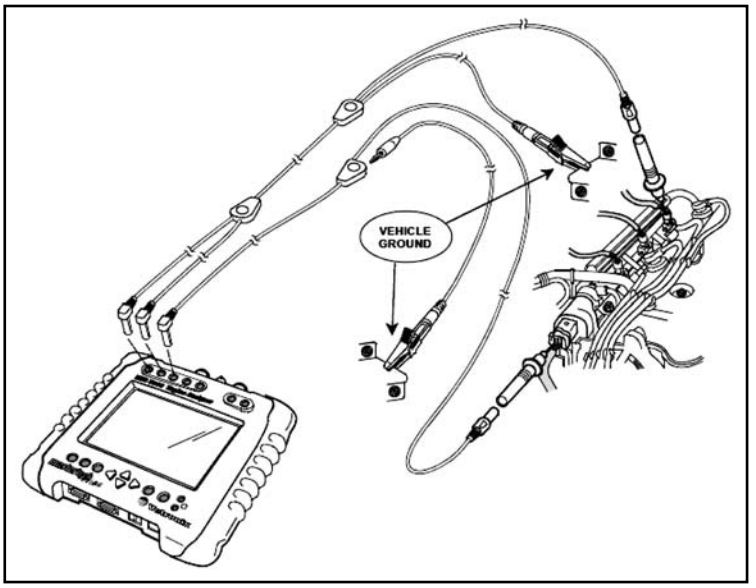
NAVIGATING THE MTS 5200 (CONTINUED)

4-Channel Oscilloscope

Connecting Leads

Before using the oscilloscope, connect your leads to the color-coded ports positioned above the touch screen display on the face of the MTS 5200. The oscilloscope leads are shielded to eliminate noise and interference from the vehicle. Be sure to connect the shielded ground leads for all oscilloscope channels that you are using.

Once the MTS 5200 is turned on and the oscilloscope selected, you can view a connecting lead diagram for an example configuration by touching the Lead Help button. Lead Help displays an example of a single channel configuration or a multiple channel configuration, depending on how many channels you have turned on.



WARNING!

The MTS 5200 is not intended for testing 110V, AC electrical circuits. Do not plug the leads into an electrical wall socket. Damage to the tester or personal injury may occur.

CAUTION!

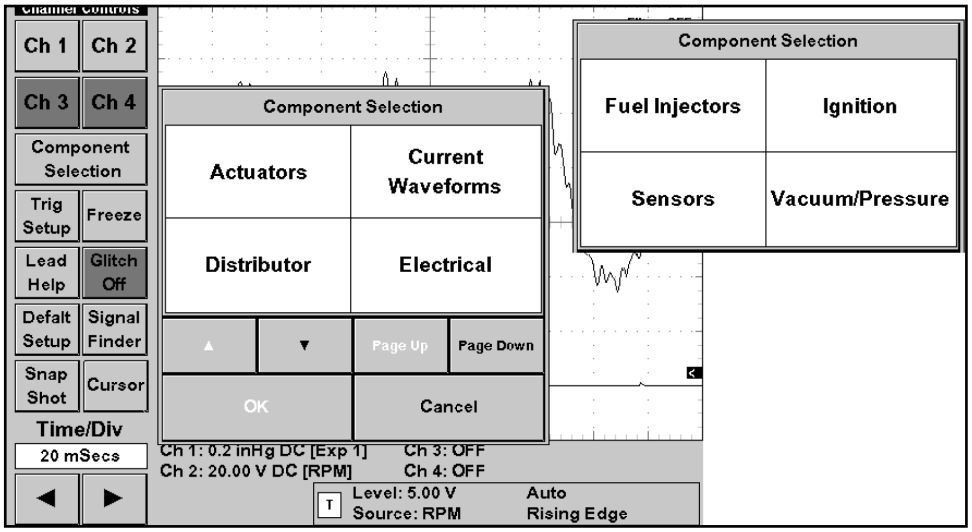
Route the leads so that they do not get caught in the fan. Be sure to use correct wire probing procedures to prevent damage to the connectors or wires in the circuit under test.

Inspect shielded ground leads, and replace any that are damaged or have exposed wires. They are dangerous and can result in poor readings.

NAVIGATING THE MTS 5200 (CONTINUED)

4-Channel Oscilloscope

Component Selection



When you choose Component Selection, the oscilloscope automatically configures itself for the vehicle component you designate. After touching the Component Selection button on the touch screen display, you see a menu of vehicle component categories from which to choose. These include:

- Actuators
- Current Waveforms
- Distributor
- Electrical
- Fuel Injectors
- Ignition
- Sensors
- Pressure/Vacuum

Within each of these categories you must choose specific components to view. Based on your selection, the oscilloscope automatically sets the scaling, trigger type, trigger level, time base, and coupling for the expected signal.

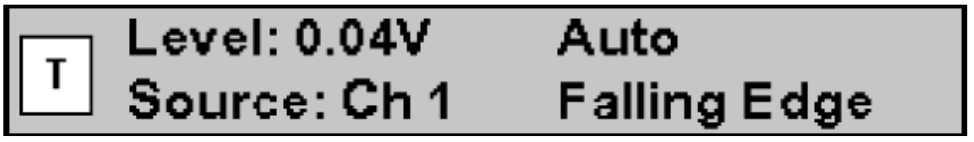
Component Selection determines the oscilloscope channel(s) to be used. Be sure your leads are correctly connected to the appropriate channels. Channel 1 is used for individual signals (such as TPS Voltage) while Channels 1 and 2 are used for multiple signals displayed simultaneously. Secondary Ignition pattern and Sync pattern are routed to Channels 1 and 2.

NAVIGATING THE MTS 5200 (CONTINUED)

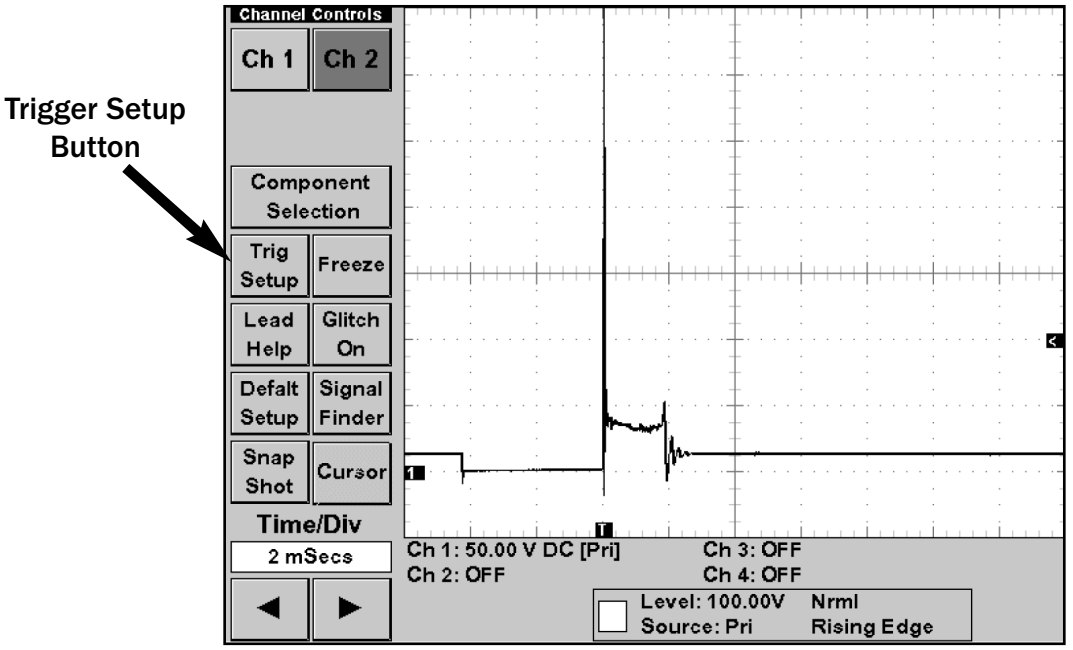
4-Channel Oscilloscope

Trigger Setup

The MTS 5200 has a set of trigger controls that determine the exact instant the trace begins the sweep across the screen. If a trigger is set at a specific voltage level, and the signal being sampled achieves that trigger level voltage, then the MTS 5200 displays the signal. When triggering, a T appears in the small box at the left of the trigger settings box at the bottom of the touch screen display.



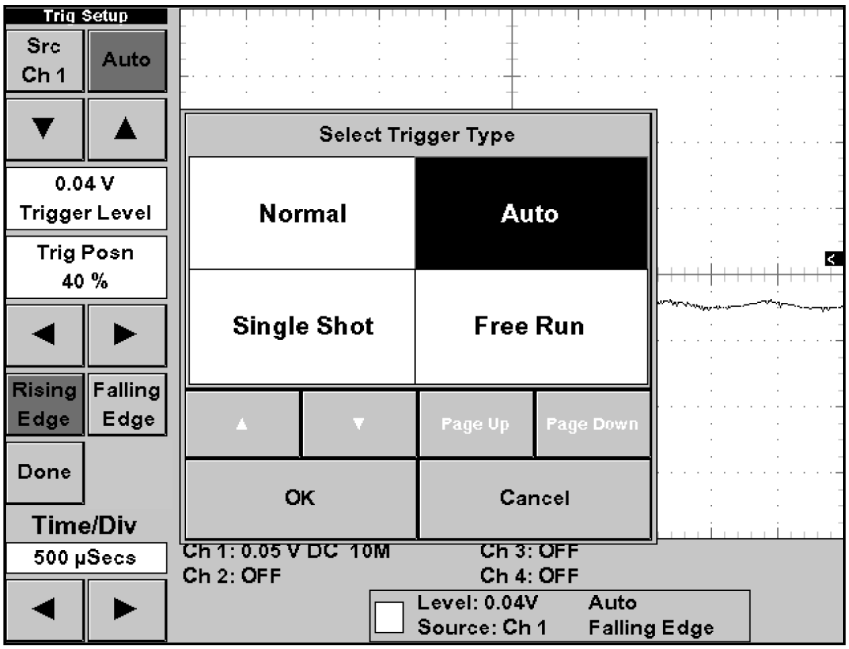
While viewing live data, you can access all trigger properties through the Trigger Setup touch screen display button to the left of the signal display area. The 4-Channel Oscilloscope has the ability to use any one of four channels as the trigger source.



NAVIGATING THE MTS 5200 (CONTINUED)

4-Channel Oscilloscope

Trigger Setup



Trigger Type
There are four different types of triggers to choose from when viewing a signal—Auto, Normal, Single Shot, and Free Run. Trigger type is available in the Trigger Setup menu. When the Trigger Type button is selected from the upper left corner of the Trigger Setup menu, a pop-up menu appears with the four trigger types to choose from. Your new trigger type is displayed on the Trigger Type button as well as in the trigger settings box below the signal display area.

Auto (Automatic) Trigger
Auto trigger is the easiest type of trigger to use when viewing an automotive signal. The MTS 5200 displays a signal that meets the trigger level at the trigger position. If the signal does not meet the trigger level condition, the MTS 5200 automatically displays any signal that is received as if it were in Free Run mode.

Once you see the signal, you can change the trigger level value to capture the waveform. Automatic trigger is the default trigger type on select vehicle components when using the Component Selection procedure to view a waveform such as Idle Air Control. Your last trigger type settings are saved in tester memory.

Normal Trigger
Normal trigger is a common trigger type and requires that you know the characteristics of the signal you are trying to display. The MTS 5200 displays a signal that meets the trigger level at

NAVIGATING THE MTS 5200 (CONTINUED)

4-Channel Oscilloscope

Trigger Setup

the trigger position. If the signal does not meet the trigger level condition, the MTS 5200 does not display a signal. If you lose the trigger condition while viewing a signal, the signal display area freezes and remains frozen until the signal reaches the trigger level. Normal trigger is the default trigger type on select vehicle components when using the Component Selection procedure to view a waveform such as fuel injector. Your last trigger type settings are saved in tester memory.

Single Shot Trigger
Single Shot trigger is used when you want to capture a certain characteristic of a known signal. If the signal under examination does not reach your trigger threshold setting, the MTS 5200 does not display any signal. Once you set up the trigger level and trigger position, arm the oscilloscope as follows:

Procedure: Arming the Oscilloscope
1. Select Single Shot from the Trigger Type menu in Trigger Setup mode.
2. Make your desired adjustments to Trigger Level, Trigger Position, Trigger Source, and Trigger Edge.
3. Touch Done to exit the Trigger Setup mode.
4. Press the Arm button, which appears below the Component Selection button.

Once the Arm button is pressed, the MTS 5200 waits to capture a single frame of the waveform that meets your trigger conditions.

The MTS 5200 displays the signal characteristic that meets your requirements and freezes the signal display area. Your last trigger type settings are saved in tester memory.

Free Run
Free Run trigger type is, in fact, a mode that eliminates the trigger function. In Free Run the MTS 5200 displays any signal that it receives. Free Run is generally used when viewing slower time base signals such as the Throttle Position Sensor signal. Free Run is the default trigger type on select vehicle components when using the Component Selection method to view a waveform such as TPS. Your last trigger type settings are saved in tester memory.

NAVIGATING THE MTS 5200 (CONTINUED)

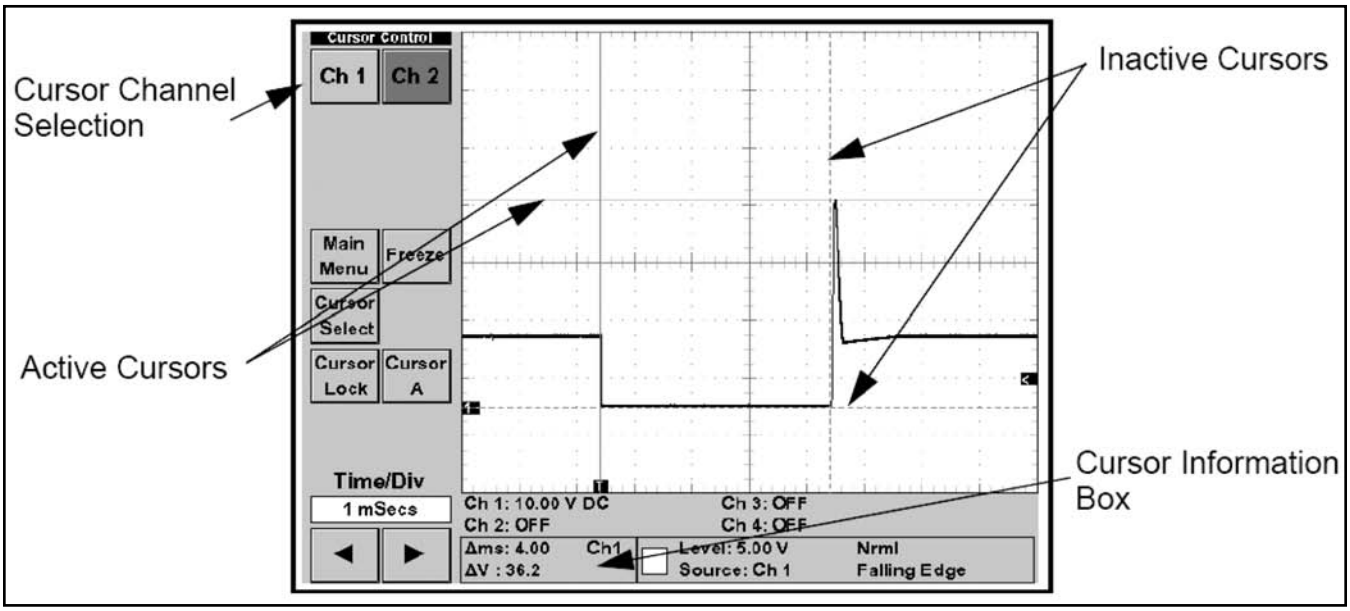
4-Channel Oscilloscope

Signal Finder

If you have correctly configured the oscilloscope but see no waveform on the touch screen display, Signal Finder provides a quick and easy way to find the signal and display it. Signal Finder examines the input signal and automatically adjusts the settings for your selected channels in order to display the signal. Be sure that the channel is ON and the test leads are connected to the correct test port.

Signal Finder adjusts the Volts/Div, Ground Offset, and Trigger Level settings to the signal. The Trigger Edge, Trigger Mode, Trigger Source, and Trigger Position settings are not adjusted but set to default values.

Cursors



In the oscilloscope live mode, Freeze mode, and Playback mode you can enable two horizontal and two vertical cursors to make precise measurements of waveforms displayed on the grid. You can turn the cursors on and off, and lock them so that they move together to maintain their relative delta measurements.

The active cursors are displayed as solid horizontal and vertical lines extending the entire height or width of the waveform display area. The inactive cursors are displayed as dashed horizontal and vertical lines.

NAVIGATING THE MTS 5200 (CONTINUED)

4-Channel Oscilloscope

Cursors

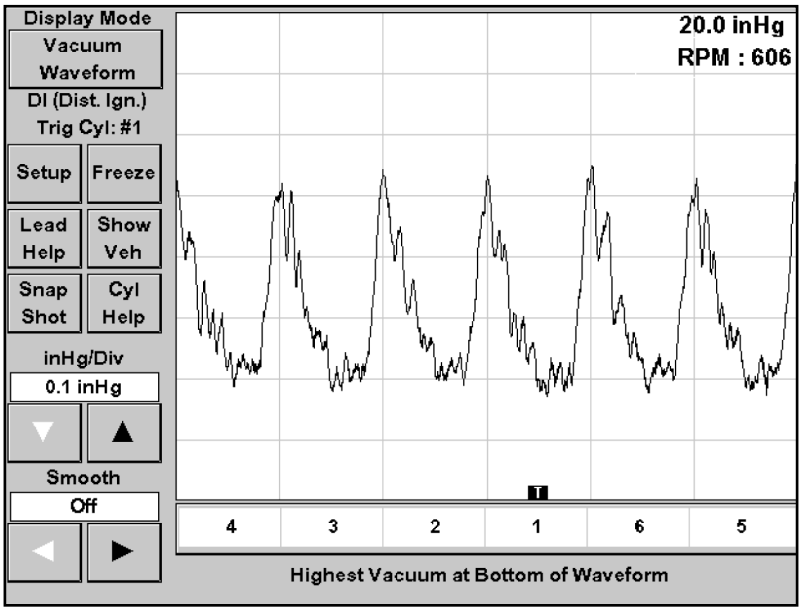
When the cursors are activated, a Cursor Information Box appears at the bottom of the display showing the delta measurement between the cursors. Cursor information appears in the units of measure that are applicable to the channel that is selected for cursor measurement (i.e., the same units that are displayed in the Time/Div and Volts/Div selection boxes).

Because each oscilloscope channel can potentially be set to different Volt/Div settings, the vertical cursors can only display the units of measure for one channel at a time. In other words, the information in the Cursor Information Box is only applicable to the selected cursor channel. If a screen is saved while the cursors are displayed, the cursors and cursor information are saved as part of the screen. Full cursor operation is also available when playing back a scope snapshot.

Other Functions

Vacuum Waveform

The Vacuum Waveform diagnostic test mode is a test of the engine's mechanical health. This test measures the amount of vacuum created by each cylinder of the engine and displays this information as either a high resolution waveform or a percent vacuum per cylinder barchart display. The vacuum information is presented in a crank angle based display with the cylinder numbers displayed at the bottom of the screen in order of the engines intake events. High vacuum (low pressure) is displayed as a downward slope and Low vacuum (high pressure) is displayed as an upward slope.



NAVIGATING THE MTS 5200 (CONTINUED)

Cranking kV Test

The Cranking kV Test allows you to perform a quick diagnosis of the secondary ignition system's ability to produce spark at cranking engine speed. This test gives you a simple pass/fail result along with detailed information about the health of the secondary ignition system.

Cylinder Tests

The Cylinder Balance mode enables you to test and rate each cylinder on vehicles with DI systems. This test mode intrusively deactivates cylinders using either a manual or automated test. When the test completes, you can review the results in a barchart format to determine which cylinders are not performing equally to the rest of the cylinders.

If each cylinder contributes to the overall engine RPM, then the elimination of one (or more) cylinder's ignition firing reduces the engine RPM proportional to the eliminated cylinder's contribution. Thus, a cylinder's performance can be measured by comparing the engine's rotational speed with all cylinders "enabled" (ENA) and with one (or more) cylinder "disabled" (DIS).

As an optional feature you can test the DC vacuum difference between the enabled and disabled states. The DC vacuum is measured at a central port in the intake manifold, and the data is captured at the same time the RPM difference data is captured.

The MTS 5200 Engine Analyzer provides two methods of disabling an internal combustion engine's primary ignition for evaluating each cylinder's contribution to the overall engine RPM:
- Manual mode, where you select the cylinder(s) to disable.
- Automated mode, where the Analyzer disables cylinders sequentially through the firing order.

Vehicle Selection

After turning on the MTS 5200 you can select Vehicle Selection on the Main menu to designate the specific vehicle for diagnosis. (The same menu appears after you select Primary Ignition or Secondary Ignition on the Main menu.)

The Vehicle Configuration menu is the means for selecting the vehicle. Any one of three methods may be selected:

- choosing the vehicle from the tester's database
- choosing the vehicle manually
- choosing the last vehicle selected.

In all cases, the tester uses the selected vehicle parameters to properly configure the test mode.

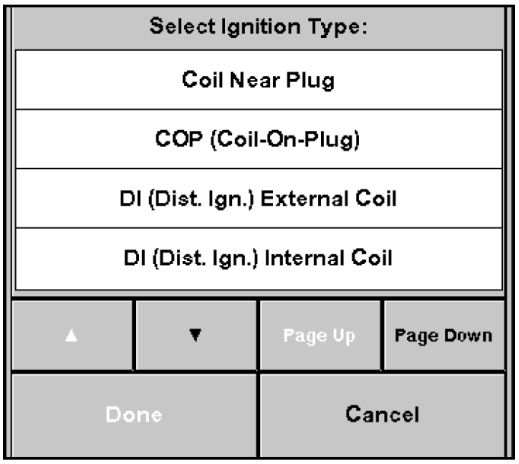
NAVIGATING THE MTS 5200 (CONTINUED)

Vehicle Selection

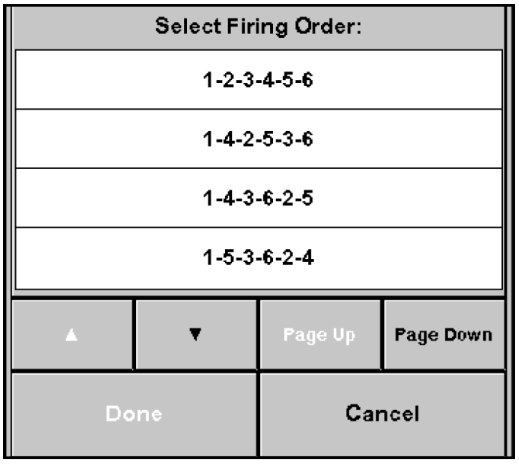
You must use the manual setup if you wish to select a vehicle with a Coil Near Plug (CNP) or Coil On Plug (COP) ignition system. CNP and COP vehicles are not currently included in the vehicle database.

Manually Selecting Test Vehicle

1. Select the Vehicle Selection button from the Main menu.
2. Touch the Manual Vehicle Set-up button from the Vehicle Configuration menu. (The Vehicle Configuration menu also appears the first time you select Primary Ignition mode or Secondary Ignition mode after turning on the MTS 5200.)
3. Select the type of ignition from the Select Ignition Type pop-up menu and touch Done.



4. Select the number of cylinders from the Select Number of Cylinders menu. Engines from 2 to 12 cylinders are supported.



NAVIGATING THE MTS 5200 (CONTINUED)

Vehicle Selection

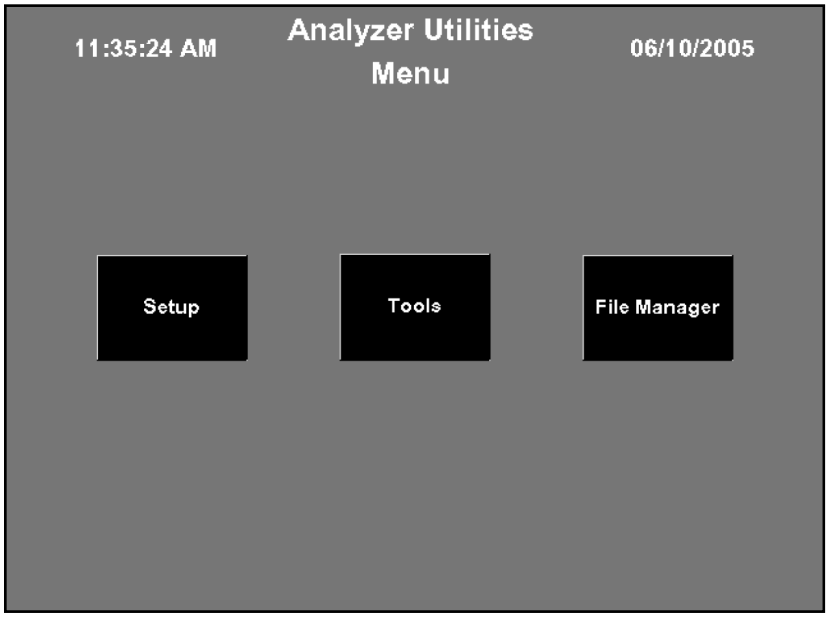
5. Select the correct firing order on the Select Firing Order pop-up menu. The Page Down and Page Up buttons move you one complete page at a time, allowing faster access to the firing order selections. Choose firing order carefully, because selecting the incorrect firing order causes mislabeled cylinders to display incorrect data. Touch the Done button to complete the selection.

6a. For engines with EI: The Lead Hook-up screen appears on the tester display. Follow the lead connection information on the display to connect the tester to the vehicle. Press the Continue button to begin testing.

6b.For engines with DI: The tester presents the Display Mode screen. Press the Lead Help button for lead connection information. Begin testing once the leads have been properly connected.

Analyzer Utilities (Setup)

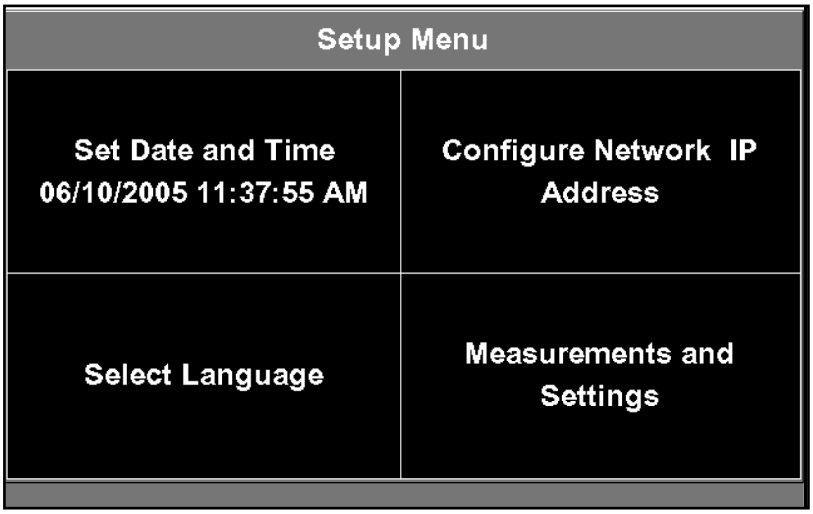
Analyzer Utilities allow you to view and adjust the system settings, perform diagnostic self tests of the software and hardware, manage battery charging, and various other functions. From the Main menu touch the Analyzer Utilities button. This brings up the Analyzer Utilities menu which has three selections: Setup, Tools, and File Manager.



Analyzer Utilities allow you to view and adjust the system settings, perform diagnostic self tests of the software and hardware, manage battery charging, and various other functions. From the Main menu touch the Analyzer Utilities button. This brings up the Analyzer Utilities menu which has three selections: Setup, Tools, and File Manager.

NAVIGATING THE MTS 5200 (CONTINUED)

Analyzer Utilities (Setup)



SET DATE AND TIME
The MTS 5200 utilizes a date and time function in memory as part of its software function. Date and time are used to put a time stamp on files that are recorded and saved. To set the time and date, simply touch the Set Date and Time button, bringing up the Set Date/ Set Time menu.

Touch the month and you will notice that fonts start to blink on and off. Touch the < > to move forward or backward one month at a time, or you can touch the << >> to make larger jumps forward or backward. All the settings in the Date/Time function follow the same procedure.

When you have finished the setup, touch the Save button to save the settings to memory. Touching the Revert button will set the Time/Date function back to the original setting when the unit was powered up. Once you have set the date and time, press the EXIT keypad button to return to the Setup menu.

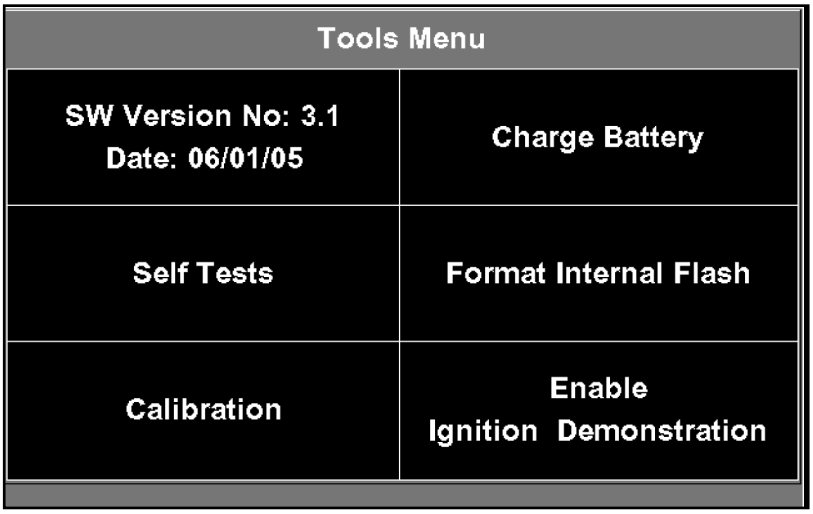
SELECT LANGUAGE
The Select Language option displays the available languages in a list box, on which you select the desired language by touching its name. Once you select a language, the analyzer continues to display that language, even after the tester is turned off and back on, until another is selected.

CONFIGURE NETWORK IP ADDRESS
The IP Address and the IP Mask are used for configuring Shop Foreman.

MEASUREMENTS AND SETTINGS
The Measurements and Settings screen allows you to select Units of Measure and settings for the Cranking Test and the Ignition Disable Duration.

NAVIGATING THE MTS 5200 (CONTINUED)

Analyzer Utilities (Tools)



SOFTWARE VERSION NUMBER

Software Version displays internal MTS 5200 software information. The internal software version number and release date are displayed on the SW Version button. Once pressed the following information is displayed in the S/W Version Information screen:

- Application: Displays the version number, the release date, and release time of the software containing all features and functions.
- Boot: Displays the version number, the release date, and release time of the software that is used to start up the tester.
- DVOM: Displays the version number, the release date, and release time of the software that is used in the Digital Voltage Ohm Meter.
- Ethernet Address
- Language: Version number and release date of each language on the tester.

SELF TESTS

This feature allows for testing of the LCD display, touch screen, and communication ports. To use the Self Tests, touch the Self Test button bringing up a sub menu displaying the Self Tests functions.

CALIBRATION

This feature allows you to perform calibrations of the Vacuum Probe, Pressure Transducer, Touch Screen, and the Auxiliary port. To use the calibration feature, touch the Calibration button, which brings up a submenu displaying the Calibration Functions.

NAVIGATING THE MTS 5200 (CONTINUED)

Analyzer Utilities (Tools)

CHARGE BATTERY

To charge the battery pack, connect the tester to a 12 VDC power source such as the vehicle battery or the 12-volt AC/DC power supply. You must select Start Battery Charging from the Analyzer Utilities/Tools/Charge Battery screen to start battery charging. It is important that you let the MTS 5200 complete its battery charge cycle every time the battery is charged; this will extend the life of the battery pack.

It takes approximately 20 minutes to fast charge the battery pack to 85% of full charge, and approximately 2 hours to top off the battery pack to 100% charged. In order for the battery to charge, the external power supply voltage needs to be between 8 and 16 volts DC.

TIP: To keep the battery refreshed as much as possible, once a month perform the "Start Discharge of Battery" procedure. Make sure you do this at the end of the work day and not the beginning. This procedure will slowly discharge the battery until it reaches its lowest point, then begin to charge it again.

FORMAT INTERNAL FLASH

This button allows you to format the internal Flash memory and erase all files. You are warned that formatting causes all saved files to be lost.

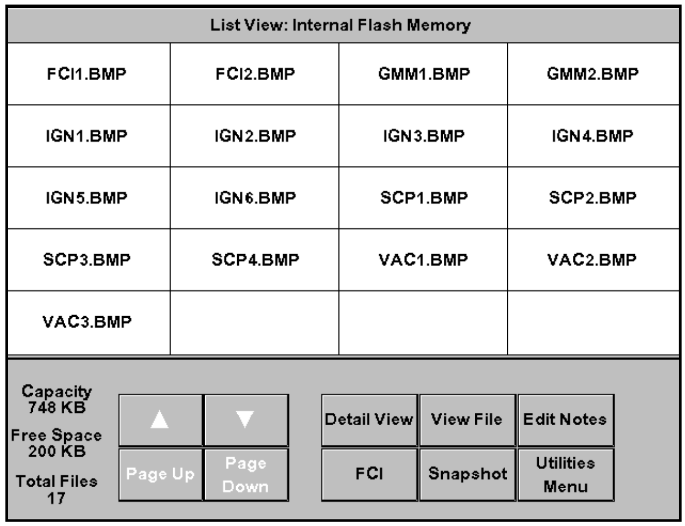
NAVIGATING THE MTS 5200 (CONTINUED)

Analyzer Utilities (Tools)

ENABLE IGNITION DEMONSTRATION

The Enable Ignition Demonstration function allows for selection of a stored ignition waveform program. This program operates in DI Secondary Ignition, Secondary Quick Check, and Primary Ignition. This allows you to get better acquainted with the Engine Analyzer controls, allowing for smoother operation when hooked to a vehicle. Access the stored waveform by selecting Analyzer Utilities on the Main menu, then touching the Tools button.

Touch Enable Ignition Demonstration, and the waveform program is made available to DI Secondary Ignition, Secondary Quick Check, and Primary Ignition. Press the Exit button twice to return to the Main menu, then access the operating mode you want. A sample, ideal waveform is displayed, and you are able to access the different functions in the selected operating mode and see the effect on the waveform. To turn the Ignition Demonstration off, press Disable Ignition Demonstration.



FILE MANAGER

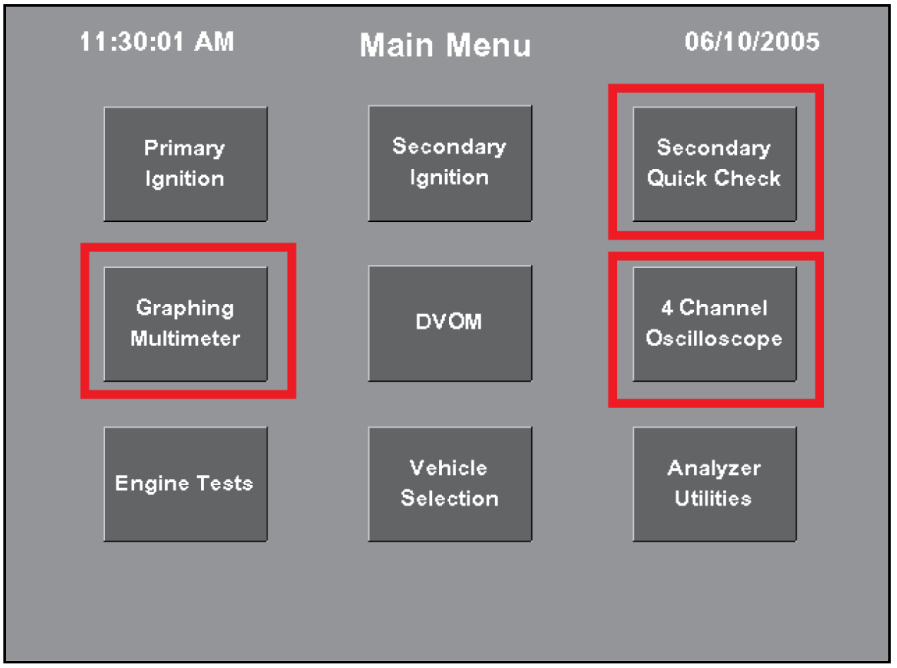
The file management system of the MTS 5200 allows you to view and manipulate saved images, snapshots, and text files by using the following functions:

- Viewing saved files
- Deleting one or multiple files
- Viewing detail information about a file
- Adding information about a file
- Formatting internal Flash
- Searching files for key words
- Upload screen captures (bitmaps) and FCI test log files to a PC

You access the file management system by touching Analyzer Utilities on the Main menu and selecting File Manager.

NAVIGATING THE MTS 5200 (CONTINUED)

Conclusion On Navigating The MTS 5200



This concludes the broad overview on navigating the MTS 5200. As stated at the beginning of this section, a more detailed description of the navigation process can be found in the owners manual included with the MTS 5200 and is also available for download at:

http://www.boschdiagnostics.com/support/documentation/Pages/DiagnosticsDocumentation.aspx?type=UnderHood

One thing that we need to point out right now is that the three most common buttons you will be using on your lab scope are the Secondary Quick Check, Graphing Multimeter and the 4-Channel Oscilloscope buttons. Once you become proficient in using these functions, the rest of the functions of the lab scope will start to fall into place for you.

THE GRAPHING MULTIMETER

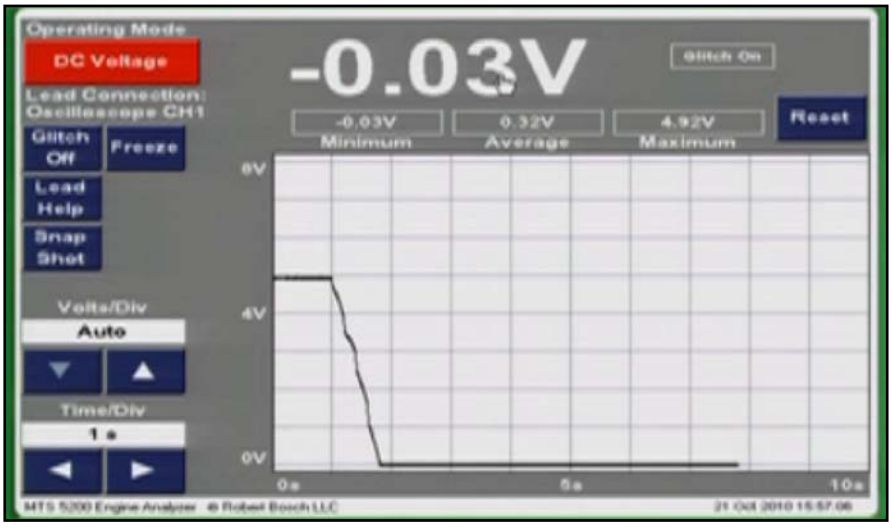
Throttle Position Sensor (TPS)

In this portion of the presentation we are going to go a little deeper into the Graphing Multimeter function of the MTS 5200.

Pictured right you can see that we have connected the lab scope to a demonstration board. This particular demonstration board will be used to simulate a TPS signal.

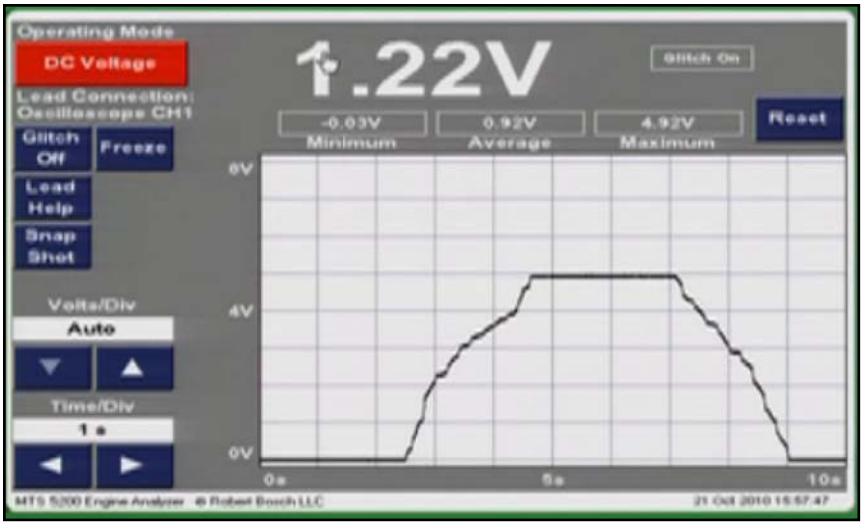
Once you have the board connected to the lab scope and you are receiving a signal on the screen, you need to reset the auto scaling on the tool.

Pictured below you can see that we have rotated the center knob of the demonstration board and the signal on the screen has gone from high to low simulating the accelerator pedal going from WOT to closed.



THE GRAPHING MULTIMETER

Throttle Position Sensor (TPS)



A normal TPS sensor will have a low voltage with the throttle released and voltage going higher as the throttle is depressed. Pictured above is a waveform captured from the screen of the lab scope. This screen capture shows that as the knob on the demonstration board is rotated (simulating the accelerator pedal being depressed), the voltage increases.

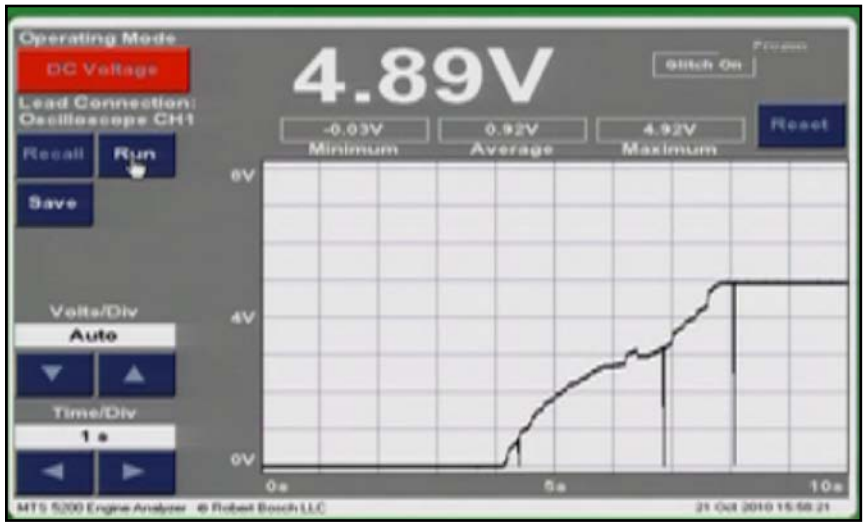
As the knob on the demonstration board is rotated in the opposite direction (simulating the accelerator pedal being released), the voltage decreases.

The waveform above is an example of what a normal functioning TPS would look like. Next we will use the demonstration board to add a glitch to the pattern simulating a fault with the TPS.

NOTES

THE GRAPHING MULTIMETER

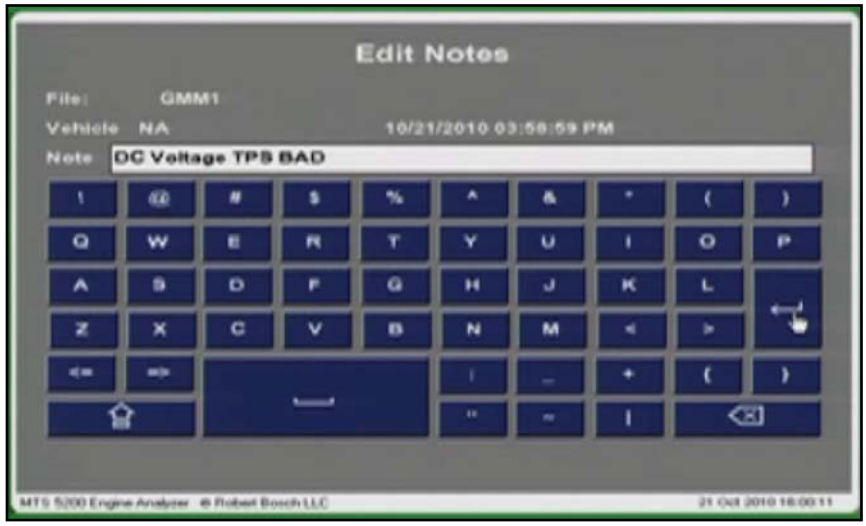
Throttle Position Sensor (TPS)



Pictured above is the same waveform from the demonstration board but the glitch switch on the board has been turned ON. Note that the pattern now has three distinct drops in voltage indicated by the three lines going down in the pattern.

This glitch is simulating an open in the TPS circuit. This would be something you would see if the customer complaint is a hesitation.

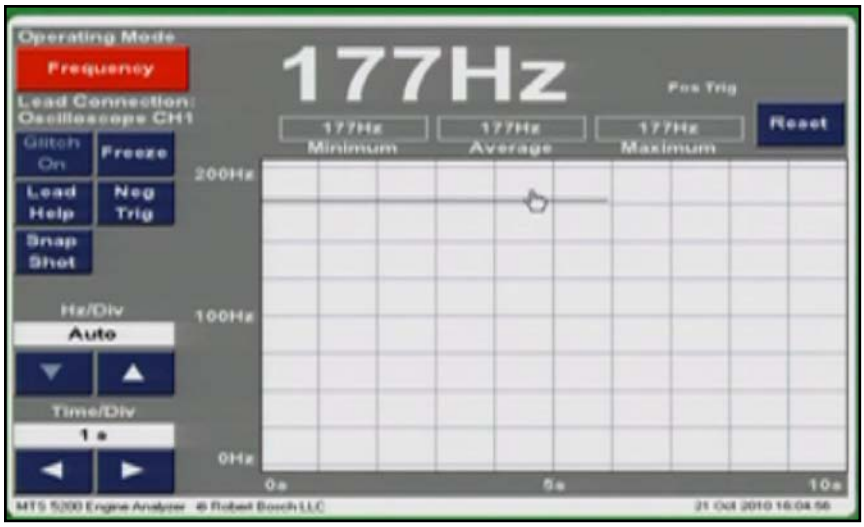
Keep in mind that the lab scope is set to “Glitch On”. If the scope was not set up to see glitches, the chances of catching this type of problem in the pattern would be almost 0%.



From here we can save this pattern into a database that we can use for future reference, to verify the repair or we can even print it out and give to the customer to aid in explaining what was wrong with their vehicle and what we did to diagnose the problem.

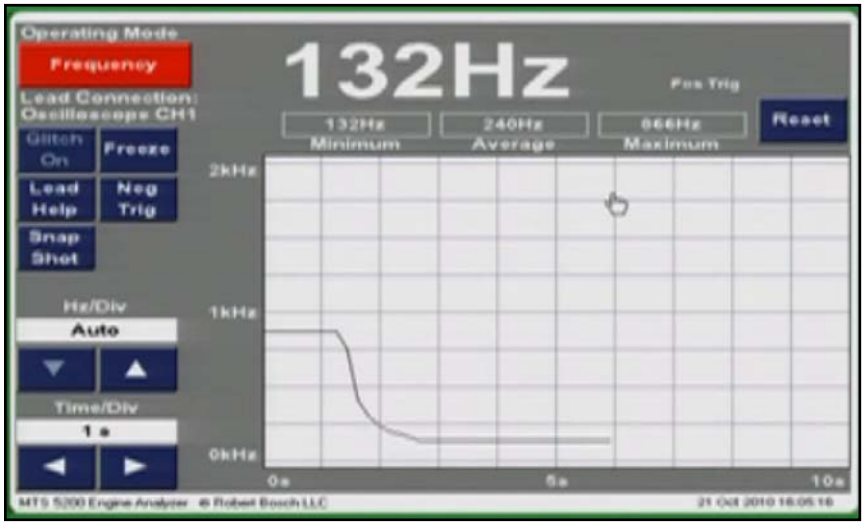
THE GRAPHING MULTIMETER

Frequency



We just looked at a voltage waveform for a TPS using the MTS 5200 connected to a demonstration board. Now let's look at a frequency waveform. A frequency waveform would be useful in diagnosing such things as a MAF sensor on Ford vehicles or even a CKP signal during a no start condition.

Pictured above you can see that waveform has a nice steady flat line. This flat line indicates that we are measuring a solid signal that has been processed using average amounts.



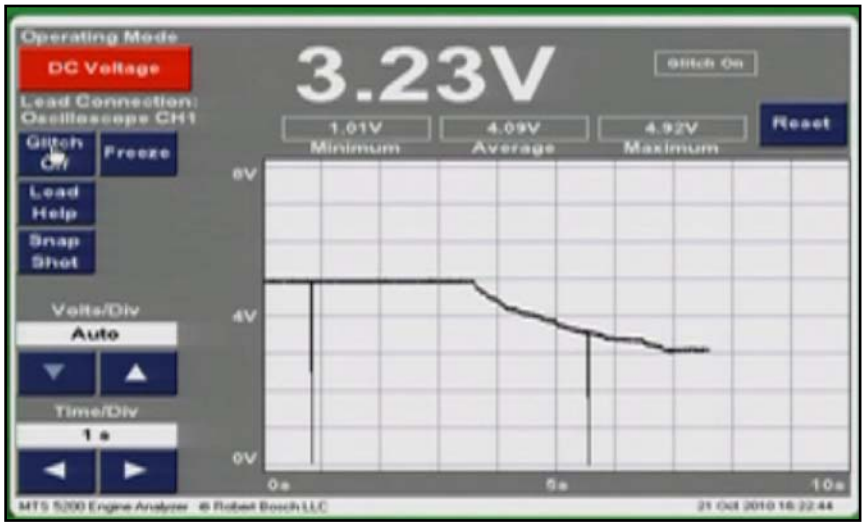
In the screen capture above you can see that as the instructor turns the knob on the demonstration board the frequency increases and then decreases. This action is simulating a MAF sensor signal as the accelerator pedal is depressed then released.

THE GRAPHING MULTIMETER

Frequency

For this type of signal it is important to keep an eye on the minimum and maximum values. This is because if you had a Ford vehicle that had a hesitation problem, you would look for the minimum signal to fall to 0.0Hz. If the signal falls to 0.0Hz, this indicates that there is a problem with the sensor.

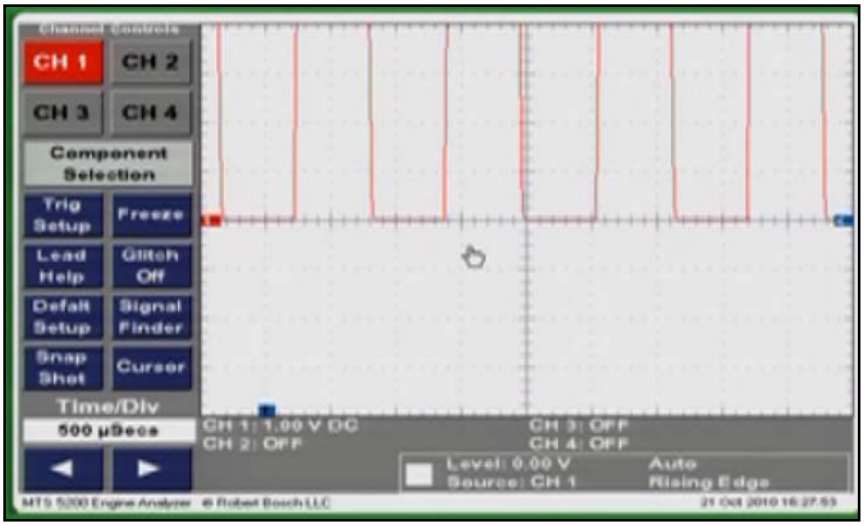
Coolant Sensor



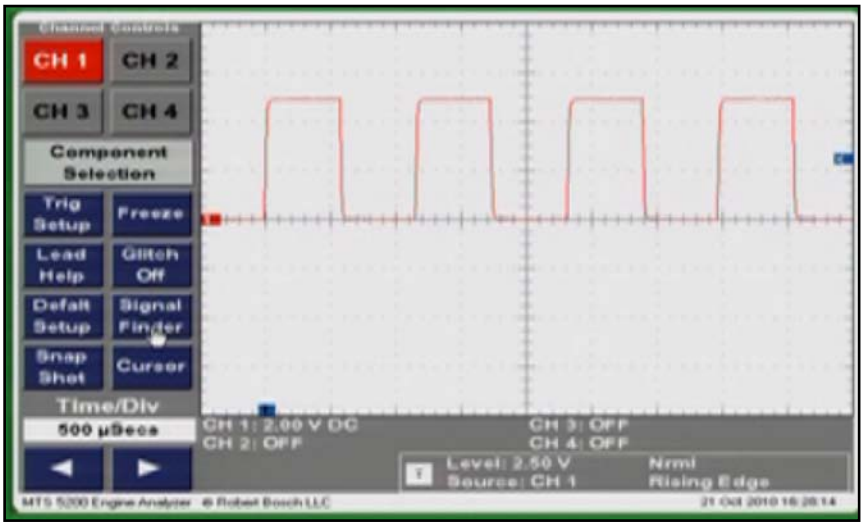
A coolant sensor is a thermistor that reads in voltage. Coolant sensors normally start at a high voltage with the engine cold and as the engine warms up the voltage drops.

In the screen capture above you can see that the voltage starts high then drops as the instructor turns the knob on the demonstration board simulating the engine warming up over time. Also note that there are two distinct downward spikes in the waveform indicating a fault.

THE LAB SCOPE (SQUARE WAVE WITH & WITHOUT GLITCH)

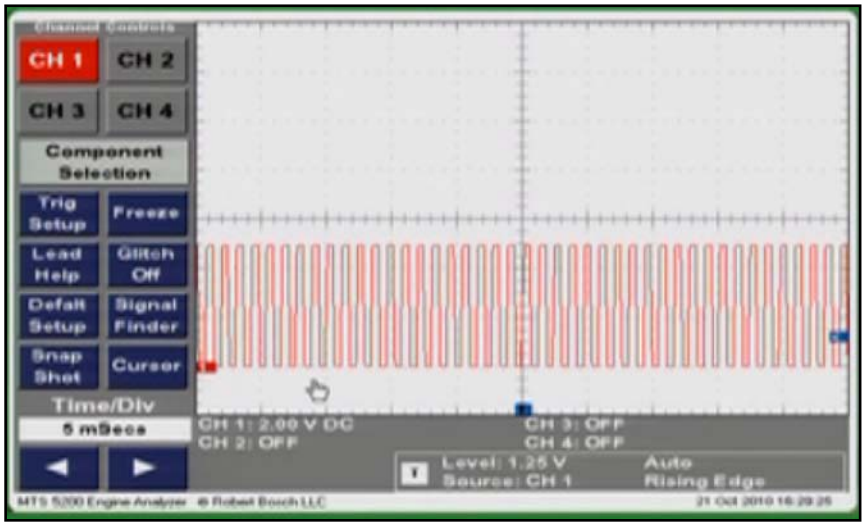


Using the lab scope on the connected to the variable frequency signal terminal of the demonstration board you can see that we have a waveform on the screen. Also note that the voltage goes off of the screen. This is a good place where you may want to use the Signal Finder function of the scope.



You can see in the screen capture above that by using the signal finder function the scope has analyzed the top and bottom of the signal and has adjusted the display to get a better picture of the waveform on the screen.

THE LAB SCOPE (SQUARE WAVE WITH & WITHOUT GLITCH)



Using the signal finder function is one way to set the scope up quickly, however it may not give you the display that you actually want. If we use the Component Selection function and actually choose the sensor that we are testing, we can set the scope up to view the patterns exactly how we want to.

Pictured above is a screen capture of a waveform where we have selected CKP (Hall Effect) sensor from the component selection menu. From this point you can adjust the display of the pattern by changing the volts per division or the voltage display itself.

The Time/Div control is always available for adjustment and is consistently located in the lower left corner of the display. This control determines what length of time is being viewed on the display. Adjustments can be made using the touch screen display buttons or the keypad buttons below the screen. Time/Div is adjustable from units of 20 seconds/div to 20 microseconds/div, and your change in Time/Div is seen immediately.

The Time/Division selection that you use is dependent on the type of waveform you are looking at and the characteristics of the waveform you wish to view. When viewing a waveform with a high frequency (such as a Mass Air Flow sensor), a fast Time/Div setting is used. When viewing a voltage trace or waveform with a slow frequency or voltage change (such as an 02 sensor), a slow Time/Div setting is used.

In some cases viewing a waveform at too slow a Time/Div setting can result in frequency distortion (aliasing) or missing information. As you slow the Time/Div setting, you increase the time between samples, which allows data to be missed and not displayed. For example, if you display 3 or 4 cycles of an injector firing at a slow Time/Div setting, the slower sample rate might miss the injector's spike (inductive kick) or display it at a lower amplitude. If this occurs, Glitch Capture can be used to increase the sample rate and prevent missing data.

THE LAB SCOPE (SQUARE WAVE WITH & WITHOUT GLITCH)

Triggers

The MTS 5200 has a set of trigger controls that determine the exact instant the trace begins the sweep across the screen. If a trigger is set at a specific voltage level, and the signal being sampled achieves that trigger level voltage, then the MTS 5200 displays the signal. When triggering, a T appears in the small box at the left of the trigger settings box at the bottom of the touch screen display.

Normal Trigger

Normal trigger is a common trigger type and requires that you know the characteristics of the signal you are trying to display. The MTS 5200 displays a signal that meets the trigger level at the trigger position. If the signal does not meet the trigger level condition, the MTS 5200 does not display a signal.

If you lose the trigger condition while viewing a signal, the signal display area freezes and remains frozen until the signal reaches the trigger level. Normal trigger is the default trigger type on select vehicle components when using the Component Selection procedure to view a waveform such as fuel injector. Your last trigger type settings are saved in tester memory.

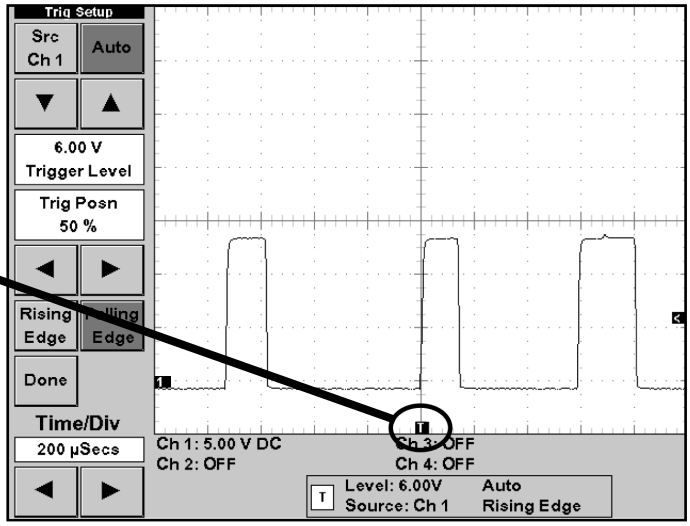
Trigger Edge works in conjunction with the Trigger Level. Any signal that meets the Trigger Level condition and your choice of trigger edge (Rising or Falling) is displayed at the Trigger Position.

The Rising Edge and Falling Edge buttons are available on the Trigger Setup menu as touch screen display buttons. If Rising Edge is selected, only a rising signal that reaches the trigger level and transitions to that voltage from a lower voltage meets the trigger conditions and is displayed. A Falling Edge trigger works just the opposite.

THE LAB SCOPE (SQUARE WAVE WITH & WITHOUT GLITCH)

Triggers

Trigger edge set to "Rising" position



A good way of understanding trigger points is this. Imagine that you are driving down the road and you have a camera in your hands and you want to take a series of pictures. You are the trigger. When you press the button on the camera to take a picture, you have captured an image or in the case of the lab scope, an event has been captured.

Every time the lab scope sees the voltage transition on the rising side, it sets a trigger capturing the event.

Auto (Automatic) Trigger

Auto trigger is the easiest type of trigger to use when viewing an automotive signal. The MTS 5200 displays a signal that meets the trigger level at the trigger position. If the signal does not meet the trigger level condition, the MTS 5200 automatically displays any signal that is received as if it were in Free Run mode.

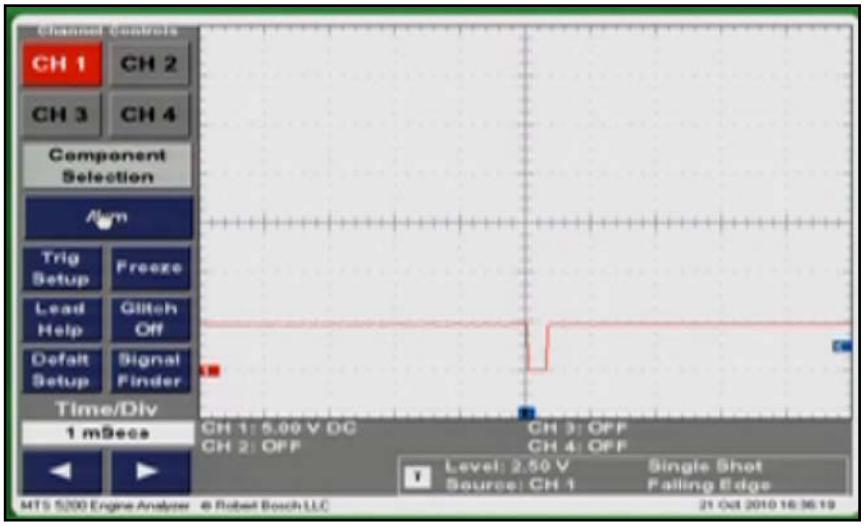
Once you see the signal, you can change the trigger level value to capture the waveform. Automatic trigger is the default trigger type on select vehicle components when using the Component Selection procedure to view a waveform such as Idle Air Control. Your last trigger type settings are saved in tester memory.

Free Run

Free Run trigger type is, in fact, a mode that eliminates the trigger function. In Free Run the MTS 5200 displays any signal that it receives. Free Run is generally used when viewing slower time base signals such as the Throttle Position Sensor signal. Free Run is the default trigger type on select vehicle components when using the Component Selection method to view a waveform such as TPS. Your last trigger type settings are saved in tester memory.

THE LAB SCOPE (SQUARE WAVE WITH & WITHOUT GLITCH)

Triggers



Single Shot Trigger

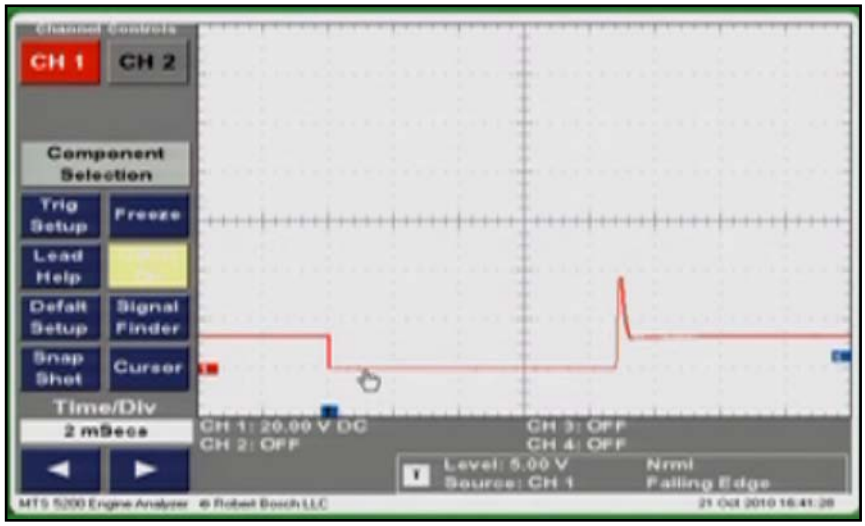
Single Shot trigger is used when you want to capture a certain characteristic of a known signal. If the signal under examination does not reach your trigger threshold setting, the MTS 5200 does not display any signal. Once you set up the trigger level and trigger position, arm the oscilloscope as follows:

Procedure: Arming the Oscilloscope

1. Select Single Shot from the Trigger Type menu in Trigger Setup mode.
2. Make your desired adjustments to Trigger Level, Trigger Position, Trigger Source, and Trigger Edge.
3. Touch Done to exit the Trigger Setup mode.
4. Press the Arm button, which appears below the Component Selection button.

Once the Arm button is pressed, the MTS 5200 waits to capture a single frame of the waveform that meets your trigger conditions. The MTS 5200 displays the signal characteristic that meets your requirements and freezes the signal display area. Your last trigger type settings are saved in tester memory.

THE LAB SCOPE (INJECTOR SIGNAL)

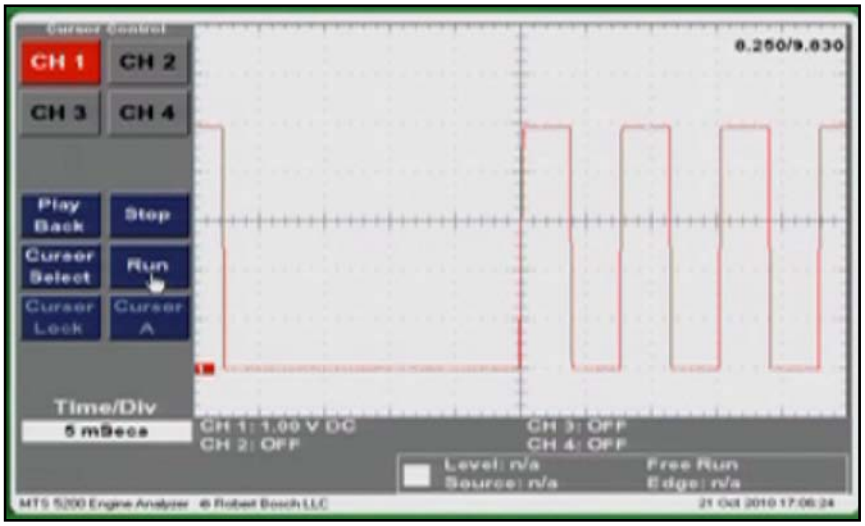


We have moved our test lead on the the demonstration board to the injector signal terminal. In the Signal Finder mode we have also selected Fuel Injectors from the Component Selection menu. From the fuel injector selection menu we have two options to choose from, Negative Control (Common) and Peak ‘n Hold. For our demonstration we have chosen the negative control (common) option.

You can see in the screen capture above that we have a good injector pattern. If you want to see more injector pulses all you have to do is to increase the times per division. Later in the hands on portion of this presentation we will show you how to compare live signals to each other to help find faults that you would not normally see.

NOTES

THE LAB SCOPE (MISSING TRIGGER)



An important thing we need to cover before moving on to the hands on portion are missing triggers (missing events). Depending upon how you set up your scope you may not be catching what you think that you should be catching.

An example would be that you do not have enough time set on the screen to capture the glitch. Make sure that you have your scope set up to display enough time to capture events that you may not otherwise see.

Later in the hands on portion of this presentation we will demonstrate on live vehicles how to use trigger points and cursors to capture these types of events.

NOTES

THE LAB SCOPE (RECORDING & SCREEN CAPTURE SAVING)

The file management system of the MTS 5200 allows you to view and manipulate saved images, snapshots, and text files by using the following functions:

- Viewing saved files
- Deleting one or multiple files
- Viewing detail information about a file
- Adding information about a file
- Formatting internal Flash
- Searching files for key words
- Upload screen captures (bitmaps) and FCI test log files to a PC

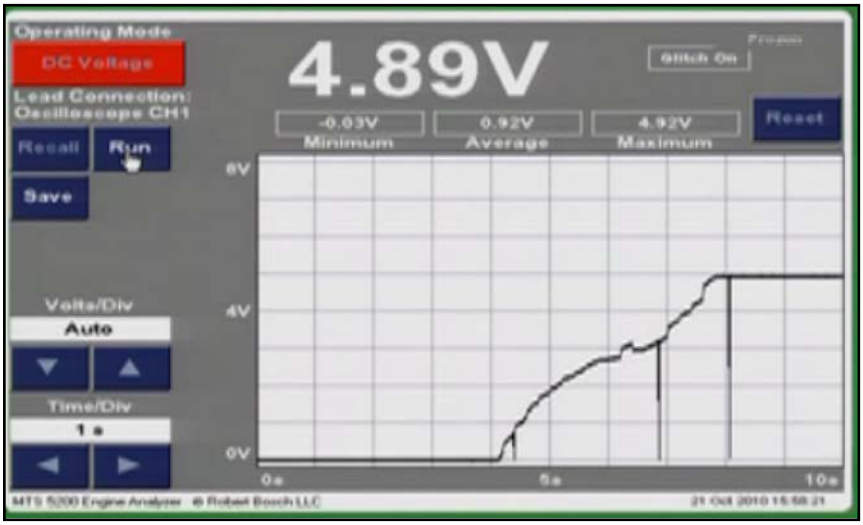
You access the file management system by touching Analyzer Utilities on the Main menu and selecting File Manager.

Pictured below is a screen capture (bitmap) that we took earlier of a TPS waveform dropping in and out.

SNAPSHOT/BITMAP/TEXT

These buttons toggle between Snapshot, which causes all the snapshot file names (.rpb) to be displayed, Bitmap, which causes all the bitmap file names (.bmp) to be displayed, and FCI, which causes all the FCI Test Log Files (.prt) to be displayed.

The default view is Bitmap, at which time the two buttons then read Snapshot and FCI. When one of these buttons is selected, the name changes to whatever mode was last viewed. Thus, the buttons will always be labeled with the two modes which are not currently being viewed.



1995 NISSAN IGNITION CASE STUDY

Now that we have covered the navigation and functions of the MTS 5200 it is time to take a look at the power it has when used in your diagnostic strategy. Up until now we have only demonstrated how to use the lab scope using one channel. Now we are going to show you how effective a lab scope can be using two channels.

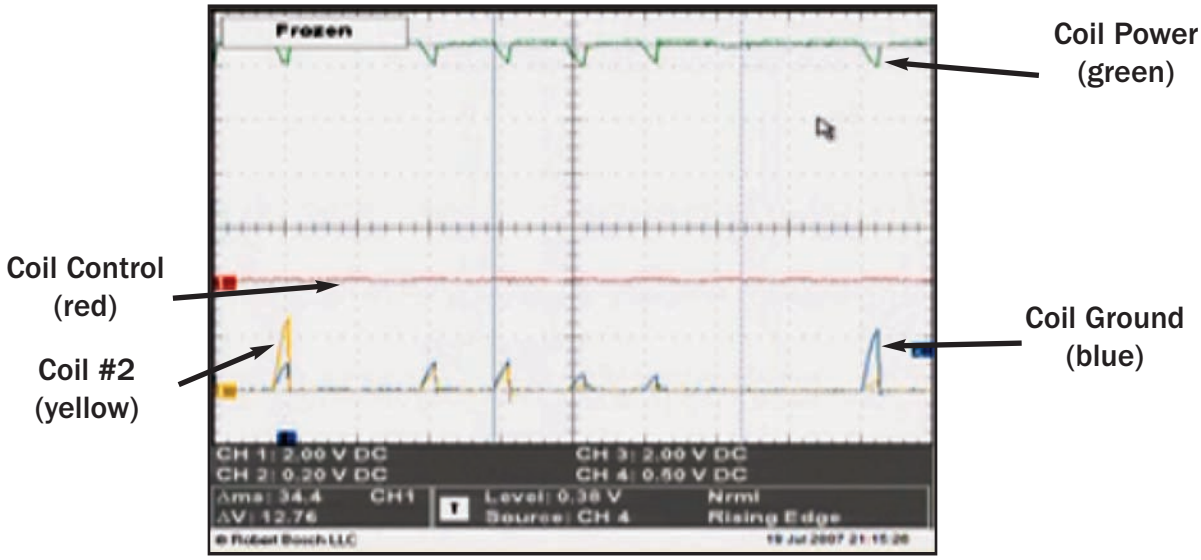
Our case study vehicle is going to be a 1995 Nissan Maxima with a 3.0L engine. This vehicle had just had the timing chain replaced and now the number 1 and number 3 coils have an intermittent misfire.

As you can see in the screen capture we are only using one (red) channel of the scope. For this vehicle the ignition coils have four wires. For this type of diagnostic we want to look at the ground trace of the coil to see the change in the energy being used to fire the ignition. As amperage gets used, it is shown on the ground line as a spike in the waveform. We can also see this on the power side of the coil but it would be displayed as a peak going down instead of up.

If you never see a spike in the negative trace pattern, as we do here, it is indicative of the PCM not telling the coil to fire. This means that the PCM did not like something in the system and did not tell the ignition coil to fire.

You may be wondering why one of the spikes in the waveform is higher than others. This is because the ground lead on the #2 ignition coil was the easiest to access.

1995 NISSAN IGNITION CASE STUDY



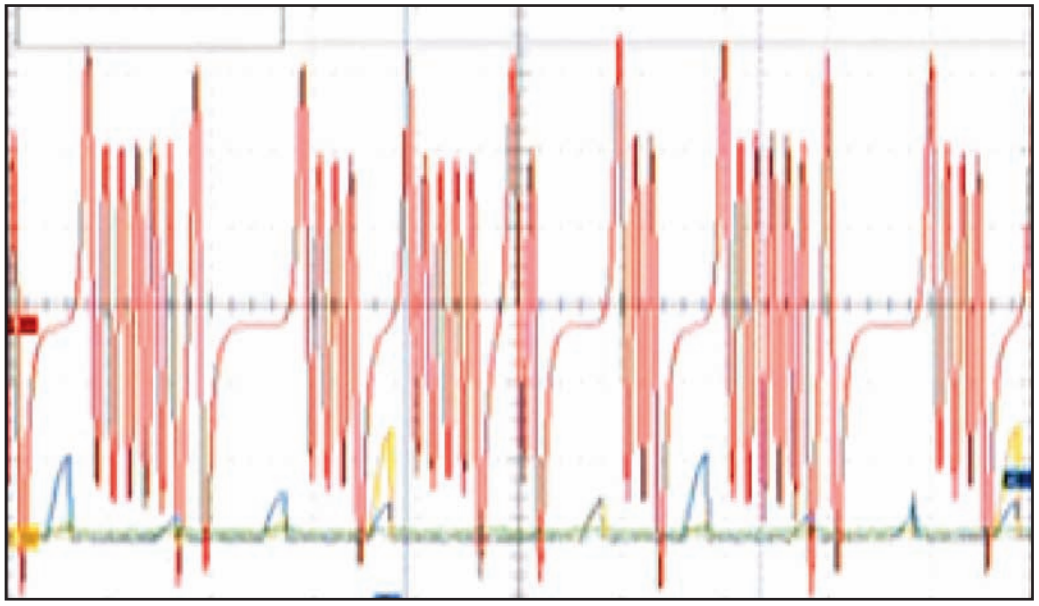
Now that we know that the PCM is not commanding the coil to fire we have to find out why. The instructor has connected all four of the channels of the scope to the ignition coil as shown in the screen capture above.

As you can see that as the vehicle is under acceleration there is a pulse missing on the blue and yellow traces. This is again indicating that the #3 ignition coil is not being commanded to fire.

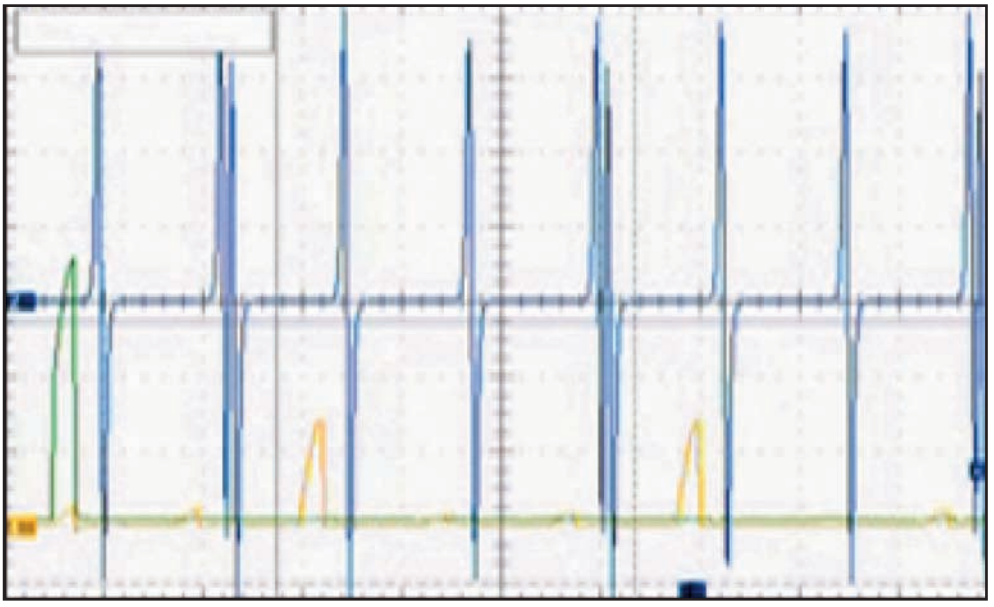
There are a few questions that we need to ask ourselves about this fault before we move on. Did the voltage go away? NO. Was there a problem with the ground side? NO. Did the control side of the coil have a problem? NO. Basically what we are seeing is that there was nothing wrong with the power, ground or the control of the coil and the PCM, based on other inputs, decided not to fire this coil.

If you remember earlier, this vehicle had a timing chain replaced. At this point we have to ask ourselves if the chain was installed incorrectly. To determine this we need to look at the relationship between the camshaft position sensor (CMP) and the crankshaft position sensor (CKP).

1995 NISSAN IGNITION CASE STUDY

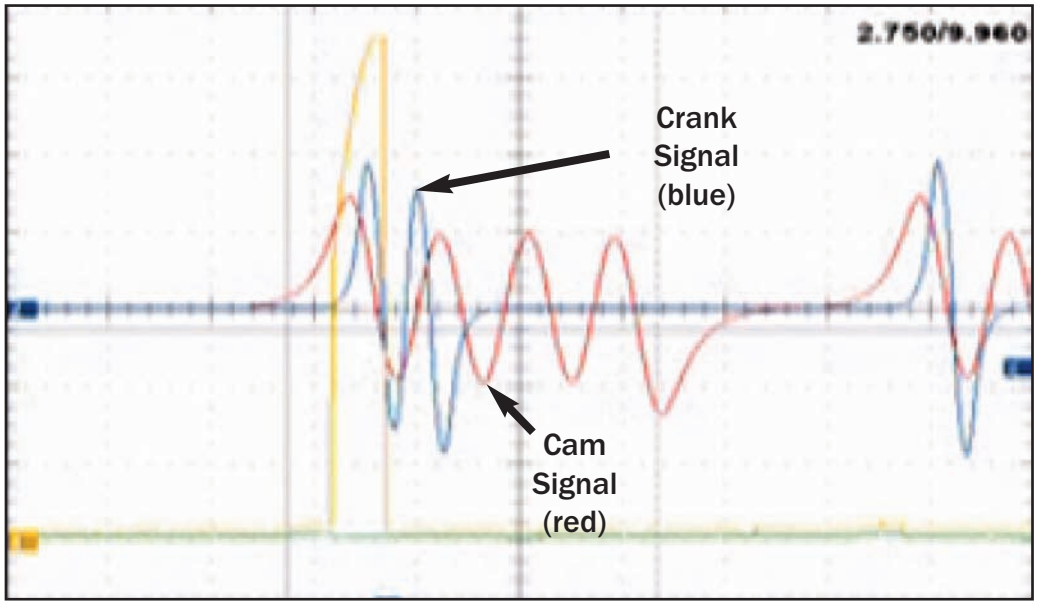


The first sensor that was the easiest to get to was the CMP sensor. As you can see in the waveform above, that at no time did the CMP sensor signal drop out, but the ignition pattern at the bottom is still dropping out intermittently. This indicates that the CMP sensor is doing what it is supposed to do and is in fact supplying a signal to the PCM and the problem is not a faulty CMP sensor.



Pictured above is a screen capture of the CKP sensor of the subject vehicle. Again, this pattern shows that the CKP sensor is doing what it is supposed to be doing and is in fact supplying a good signal to the PCM and the problem is not a faulty CKP sensor but the ignition pattern at the bottom is still dropping out intermittently.

1995 NISSAN IGNITION CASE STUDY

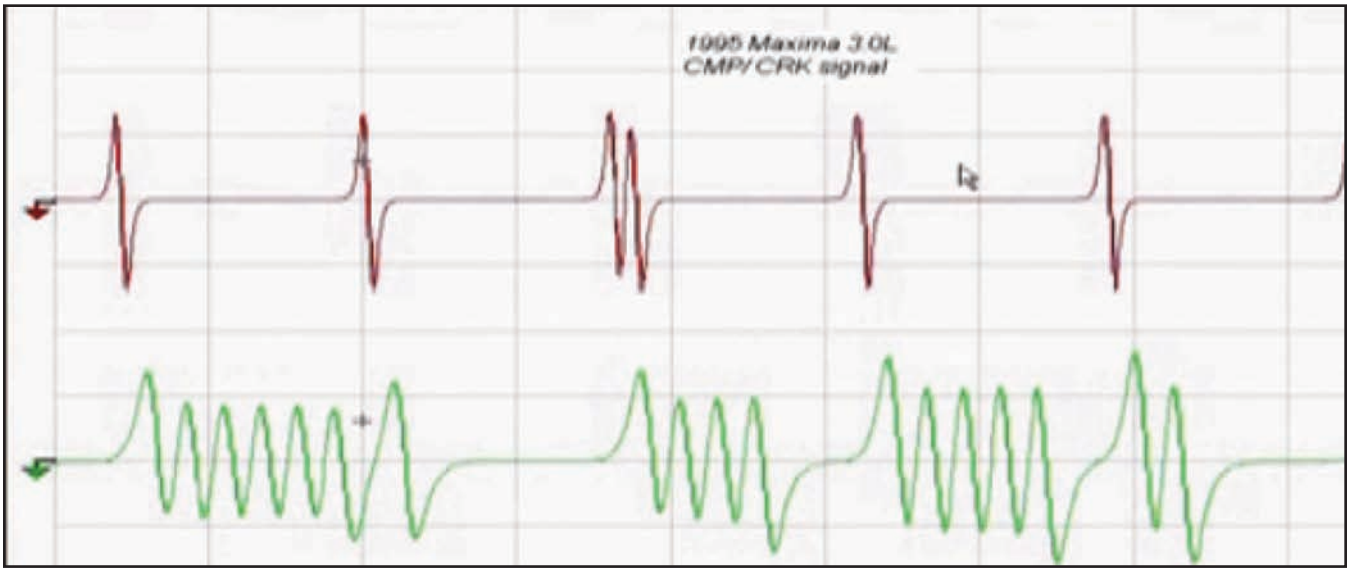


Since we have determined that the problem is NOT with the CKP sensor or the CMP sensor, we need to look closer at the relationship between the camshaft and the crankshaft.

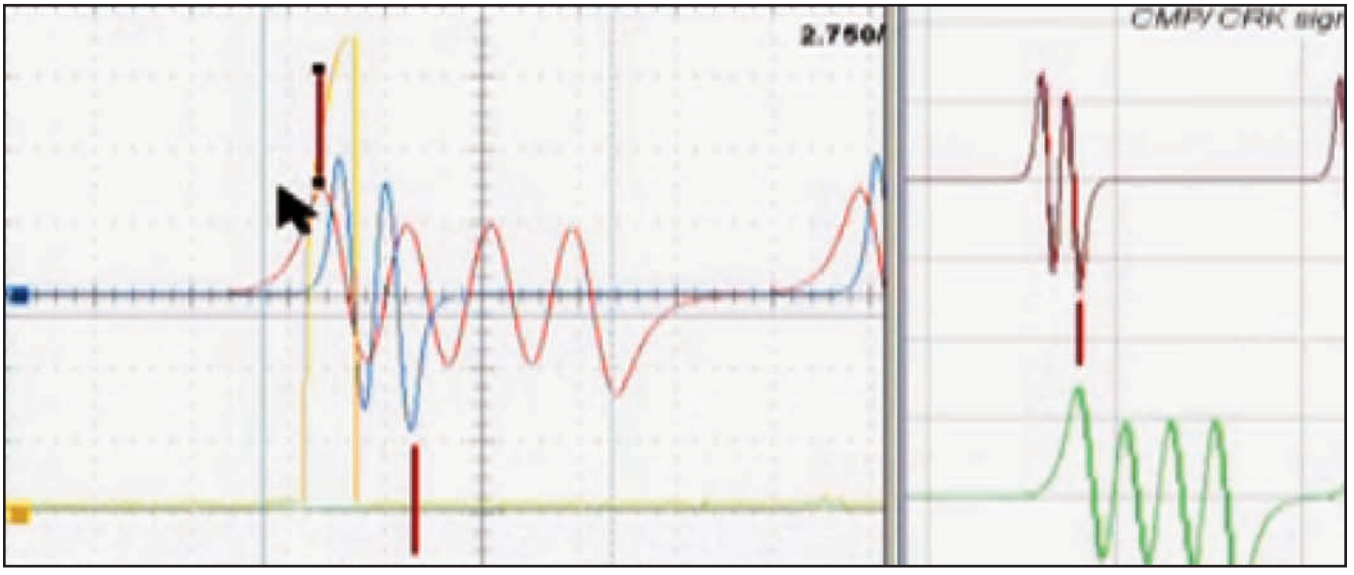
Pictured above is a waveform overlay that has the crankshaft signal in blue and the camshaft signal in red. The question we have to ask ourselves at this point is “What does a good signal look like?” To answer this question we need to know the “Known Good & Known Bad”. Either you have your own database of waveforms or you have to find a source of waveforms to answer this question.

One resource for these waveforms is the International Automotive Technicians Network (I.A.T.N.). This network can be found on the web at http://www.iatn.net/. If you are a member of IATN, you can look through a very extensive database of good and bad waveforms with notes and tips from technicians around the world for comparison to what you have on your scope.

1995 NISSAN IGNITION CASE STUDY



Pictured above is a screen capture of a CMP/CKP signal waveform taken from the IATN website. This waveform is showing us what a known good waveform for each looks like along with the relationship between the two.



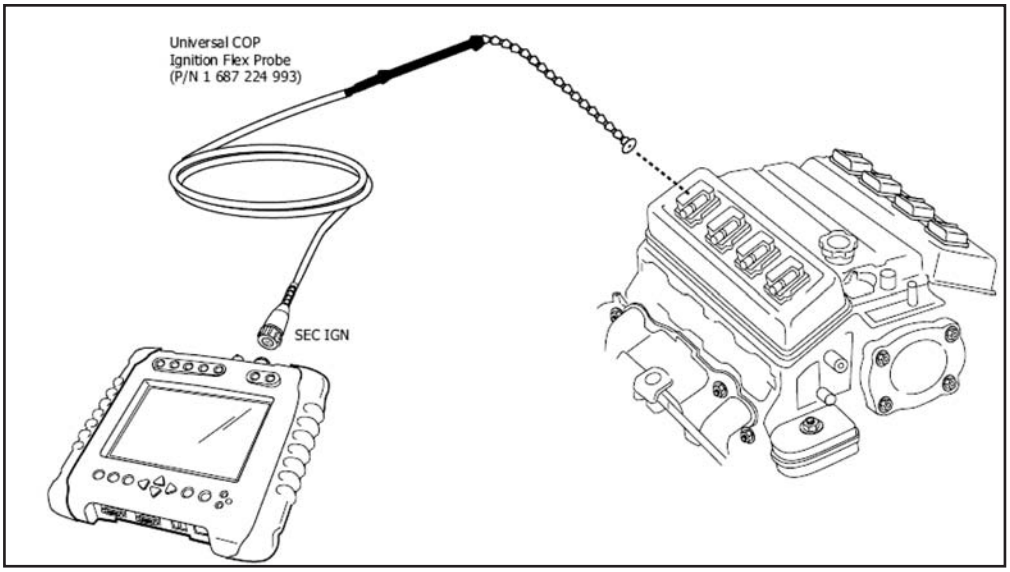
If we take the known good wave form and compare it to the waveform taken from our subject vehicle, you can see that the timing of the CMP sensor and the CKP sensor do not match. This tells us that that the timing chain had been installed incorrectly.

The next day the technician disassembled the engine and did in fact find that the timing chain was installed incorrectly by at least one tooth. After correcting the problem and reassembling the engine, the test was run again and all of the ignition coils fired as they were supposed to and the patterns matched perfectly verifying the repair.

LIVE VEHICLE TESTING (SECONDARY IGNITION COP WAND)

In this portion of the presentation we are going to take a look at some of the basic signals and circuits underneath the hood of a live vehicle. We will use the MTS 5200 and demonstrate how you connect it to the most common signals that you will be testing.

Our demonstration vehicle is a 2004 Ford Crown Victoria. One of the most common problems with this vehicle is coil on plug (COP) system and one of the first things that you will be using your lab scope for are ignition problems.



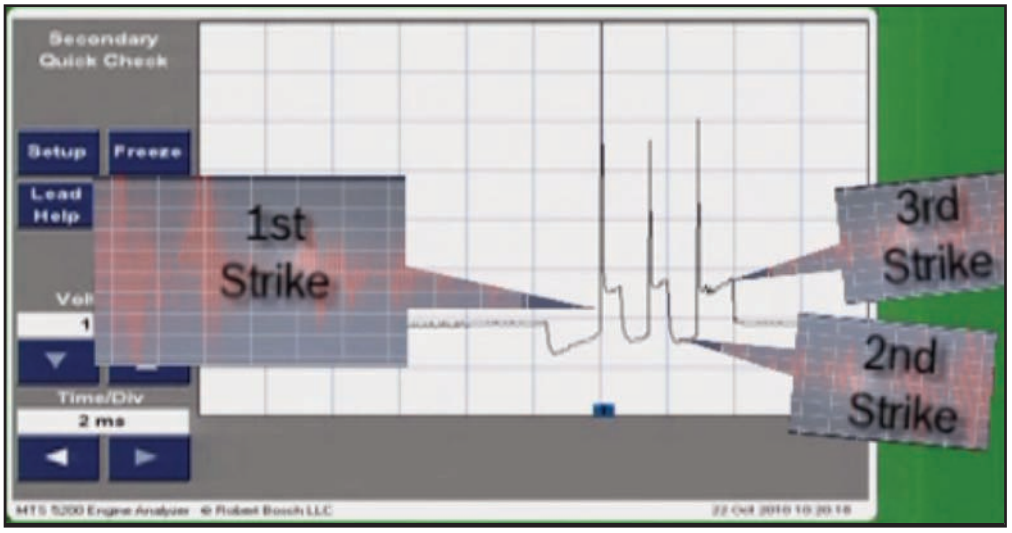
To test the secondary ignition system of this vehicle we need to use the Coil On Plug (COP) wand. The COP wand contains a probe which is designed to be used with most domestic and import COP vehicle ignition systems with accessible coils. The probe provides easy access for secondary ignition pattern comparisons on COP ignition systems using the MTS 5200.

Connect the COP wand as follows:

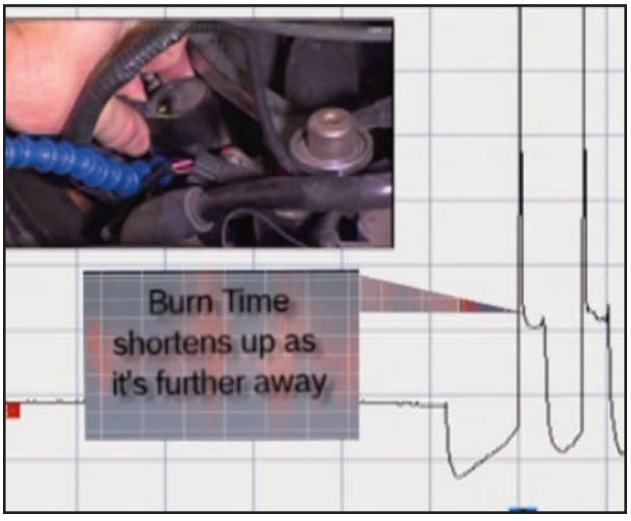
1: Turn on the MTS 5200 and select Secondary Quick Check from the testers main menu.
2: Connect the circular black connector from the wand to the SEC IGN input of the analyzer.
3: With the vehicle running, place the tip of the flex probe as close to the suspect ignition coil as you can to obtain a good signal.
4: When a signal appears on the lab scope screen, adjust the Volts/Div setting for optimum signal viewing.
5: Repeat steps 1 - 3 to view each cylinder for comparison.

During this procedure, always remember to hold the probe the same distance and position to the coil for each cylinder being analyzed.

LIVE VEHICLE TESTING (SECONDARY IGNITION COP WAND)



You can see in the screen capture above that this vehicle has a multi-strike ignition system as indicated by the three firing patterns in the waveform. The first thing we need to look at is the primary (1st strike) ignition pattern of each ignition coil. As we move from coil to coil we can determine that all of the coils are firing correctly giving us a known good pattern for our database.

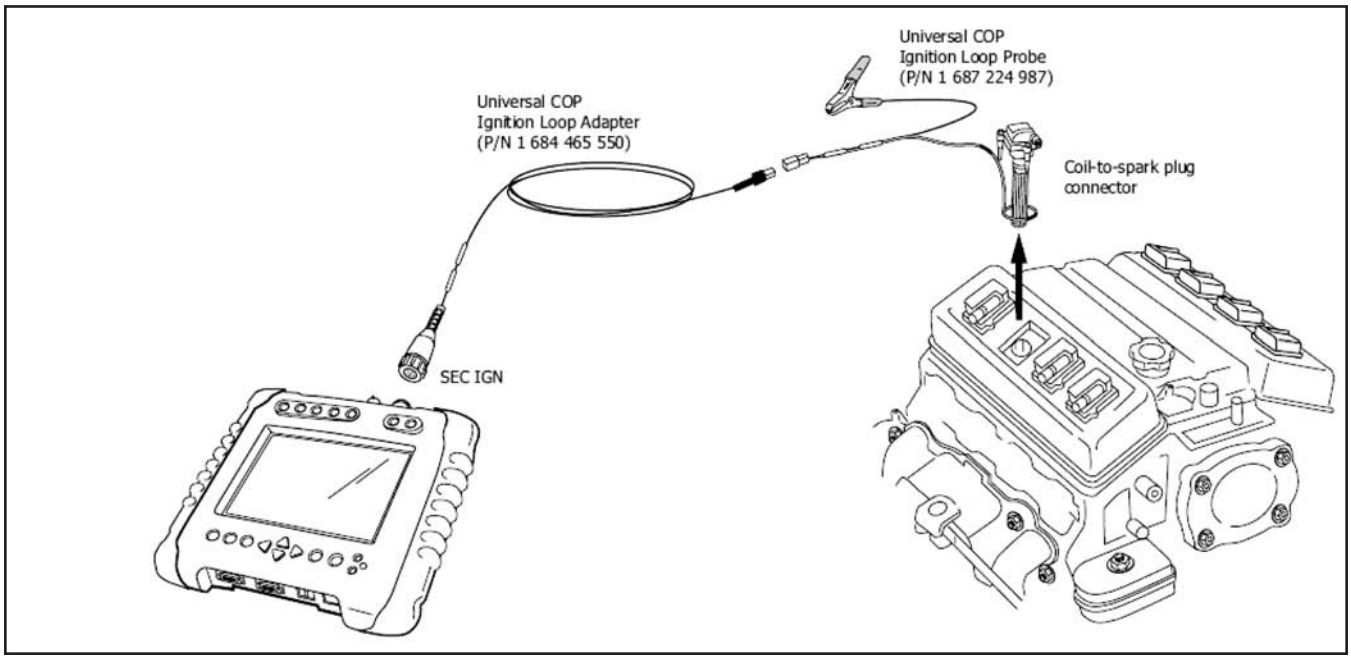


To simulate a fault the instructor has removed the bolts that secure the ignition coil to the engine and begins to move the coil away from the engine.

As this is done, you can see that the burn time begins to shorten up as it is moved further away.

LIVE VEHICLE TESTING (SECONDARY IGNITION COP LOOP)

Many times on vehicles that have COP ignition systems it is difficult to spot a misfire at idle. Normally misfires on COP ignition vehicles occur when the vehicle is running down the road. To detect misfires while driving the vehicle we want to use a COP loop.

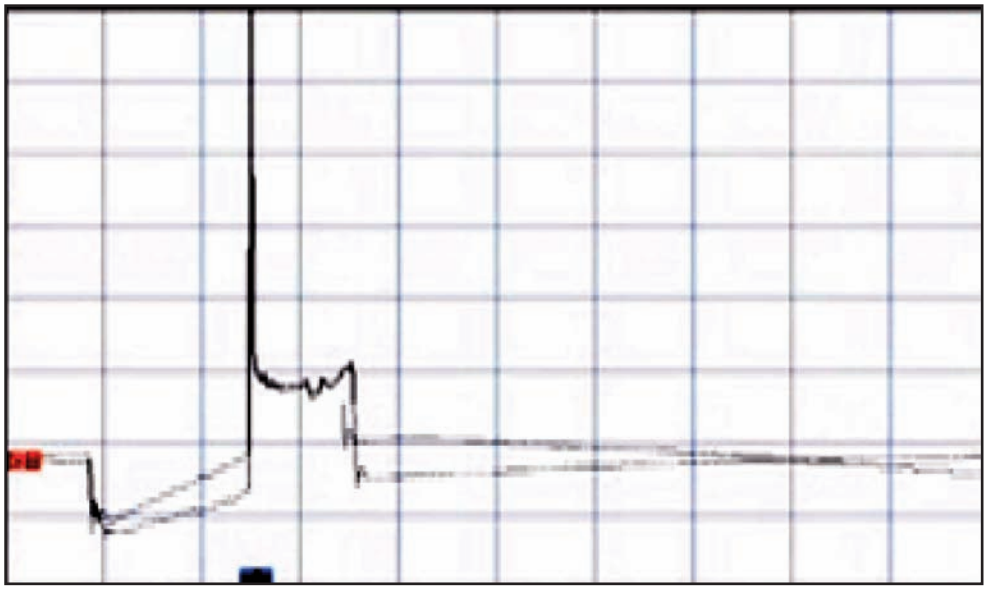


The COP loop is a cable that works much like the COP wand except the end has an adjustable loop that can be slipped around an ignition wire or an ignition coil and secured without having to be held by your hand.

In order to get the loop around an ignition coil, you need to unplug the coil harness connector from the coil, slip the loop around the coil, then reconnect the coil harness connector to the coil.

After connecting the loop to the coil you need to find a suitable ground connection for the ground clamp such as the negative battery terminal. Make sure that when you run your wires into the vehicle that they are not in contact with any moving parts or a part that gets extremely hot. This could cause damage to the cables.

LIVE VEHICLE TESTING (SECONDARY IGNITION COP LOOP)



You can see in the screen capture above that the scope has been set up with the trigger point on the leading edge of the waveform. Also note that the Time/Div has been increased giving more resolution to the pattern for easier viewing.

One of the first things we notice is that the pattern is no longer in multi strike and has gone to a single ignition strike. If there was a misfire in this engine, this is where you would see it. This pattern indicates that the ignition coil is firing good and there is no fault.

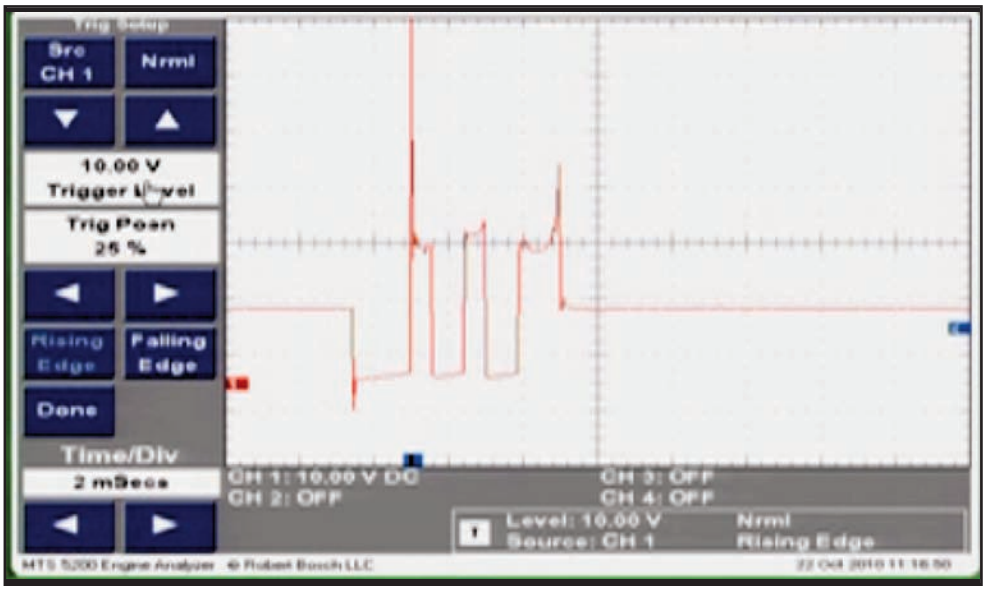
This is where you need to start capturing the waveforms and saving them to the PC. Doing this over time will give you a great reference database that you can call upon if you have a similar vehicle in your bay that may or may not have a misfire. You can use a good known pattern from your database and compare it to the vehicle in your bay and determine if the vehicle has a problem or not.

NOTES

SECONDARY IGNITION TESTING WITH THE LAB SCOPE

So far we have covered two ways to diagnose secondary ignition problems. We have used the COP wand and the COP loop but there is also another method you can try, and that is using the 4 channel lab scope to diagnose the ignition patterns.

For this demonstration we are going to look at two ignition coils simultaneously on the lab scope. To do this we are going to connect the black lead from the lab scope to the negative battery terminal for a ground. Using back probe adapters, we connect the red lead from the lab scope to the power side of one coil, and the blue lead from the lab scope to the power side of another coil.



The screen capture above shows what the ignition pattern for the first channel (red) looks like when the triggers and the Time/Div have been set correctly. If we set the second channel (blue) to the same settings, we can overlay the patterns together and compare them accordingly.

NOTES

SECONDARY IGNITION TESTING REVIEW

We have covered several different methods of testing the secondary ignition. As not to confuse you lets recap the things that really count.

1. If you are performing any type of ignition repair or diagnostics, start with the COP wand. This is the quickest way you can get an ignition pattern on the screen of your lab scope.

2. If the vehicle you are working on has a misfire during driving situations or uses an ignition coil that does not produce a magnetic field, use the COP loop. Keep in mind that to use this method you need to know what cylinder is misfiring. This is a completely different subject that is covered on other AVI training programs. Visit www.auto-video.com or call 1-800-718-7246 for more information about Misfire Diagnostics.

3. The most effective way to test ignition coils is to look at two ignition coils simultaneously on the lab scope using multiple channels and comparing the waveforms to each other.

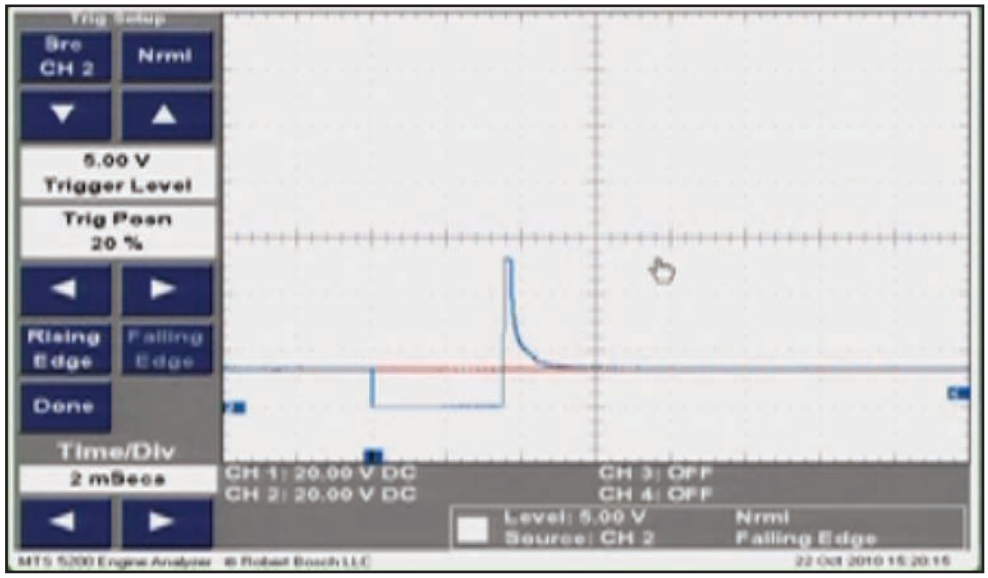
LIVE VEHICLE TESTING (FUEL INJECTORS)

In this section of the presentation we are going to focus on testing fuel injectors using the lab scope. Much like the two lead method we used to diagnose the ignition coils earlier, we are going to use two leads, red and blue, to compare two sperate fuel injectors.

Once again we are going to look at the colors of the injector harness wires to determine which wires we want to back probe to. For our vehicle the red harness wire is common among all of the injectors telling us that it is the power wire feeding the injector voltage. Once our leads are connected to the vehicle we can start the engine and begin to review the patterns on the screen.

NOTES

LIVE VEHICLE TESTING (FUEL INJECTORS)



The screen capture above illustrates what a known good injector pattern looks like on our subject vehicle. As with the previous ignition patterns, you can switch between channel 1 and channel 2 to compare signals.

Also, and we cannot stress this enough, start capturing and saving these waveforms to your database. This will allow you to compare vehicles in your bay to similar vehicles that you have captured either good or bad waveforms.

LIVE VEHICLE TESTING (FUEL PUMP)

Moving on let's take a look at diagnosing fuel pumps. For example purposes let's say you had a vehicle in your shop that had 120,000 miles on it and you just performed a major service on it costing the customer over $1,500.00. Two weeks later the vehicle is back in your shop with a no start condition.

More than likely the customer is going to think that the problem they are having now was caused by you and the costly service they just had done in your shop. Sad but true, this happens too often in our industry.

Testing the fuel pump with the lab scope is a great way to ensure preventive maintenance is performed correctly. Most fuel pumps can be tested in 10 minutes or less.

To test the fuel pump we not only need the lab scope but a 0 - 60 amp current probe as well.

LIVE VEHICLE TESTING (FUEL PUMP)

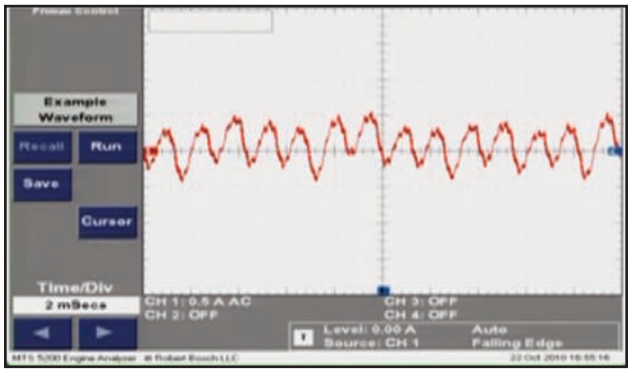
You will get very good at using this current probe as you get better at using your lab scope. You need to get in the habit of testing every fuel pump on every high mileage vehicle that comes through your shop. This will enable you to catch a problem fuel pump BEFORE it creates a customer concern.

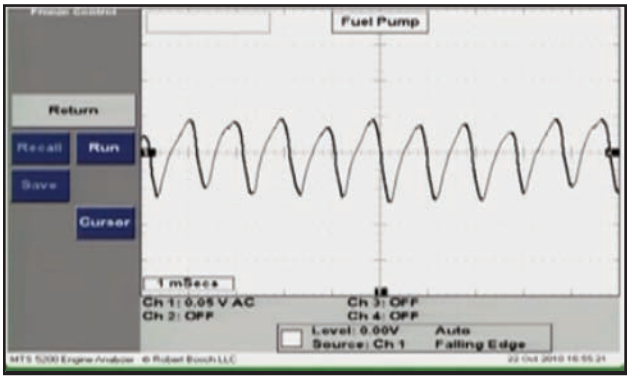
To test the the fuel pump on our subject vehicle we first need to connect the current probe to the lab scope. Then we need to identify which fuse in the fuse box controls the fuel pump and remove it. Once we remove the fuse we need to install a suitable jumper wire, such as the Fuse Buddy pictured left, into the space where the fuel pump fuse was located.

Once you have the lab scope screen set up to view the pattern the way you want to see it, turn on the current probe and clamp it around the jumper wire.

LIVE VEHICLE TESTING (FUEL PUMP)

Using a suitable scan tool we can duty cycle the fuel pump without the vehicle running, and analyze the waveform on the lab scope. If your scan tool is not capable of this, you may have to find another way to command the fuel pump on. This can be done by such ways as locating the fuel pump relay, removing it and jumpering the appropriate connection locations.





Pictured above are two fuel pump waveforms. The waveform on the left is of our subject vehicle and the waveform on the right is a sample waveform we selected from the lab scope. If you ever have a doubt in your mind what a good waveform looks like, always go to the lab scope and select “Example Waveform” to view what a good waveform should look like.

For our subject vehicle, we can see that we have good peaks and valleys in the pattern indicating a good fuel pump.

NOTES

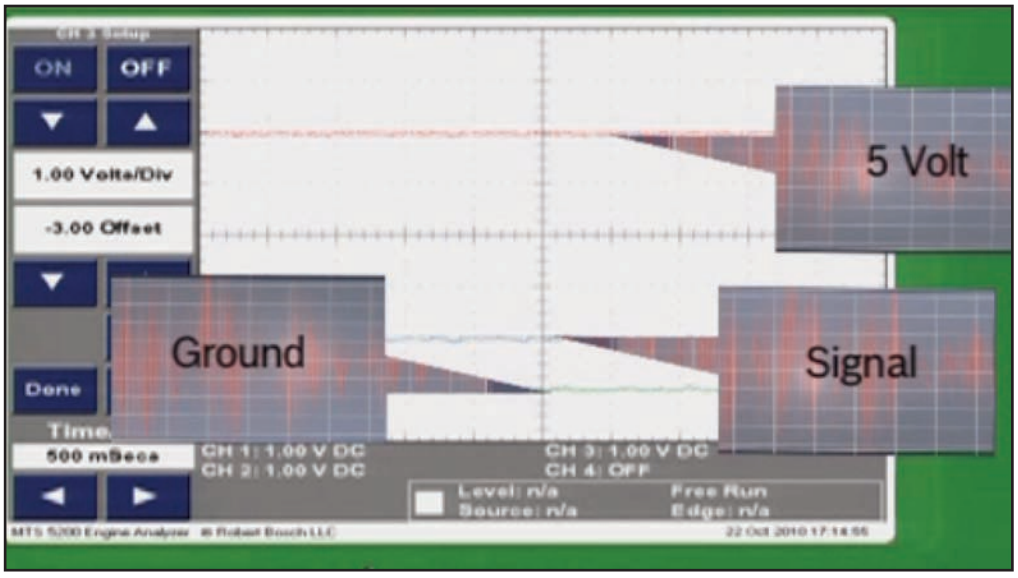
LIVE VEHICLE TESTING (TPS - GMM)

For this portion of the presentation we are going to take a closer look at the throttle position sensor (TPS). The TPS is a very common sensor and when it fails you will usually have a hesitation or problems that are very similar to hesitations.

The first thing we need to cover is the issues surrounding connecting to the sensor. There is no one database or manual out there that has every sensor with the connections mapped out for us. This is not as big of a problem as you might think.

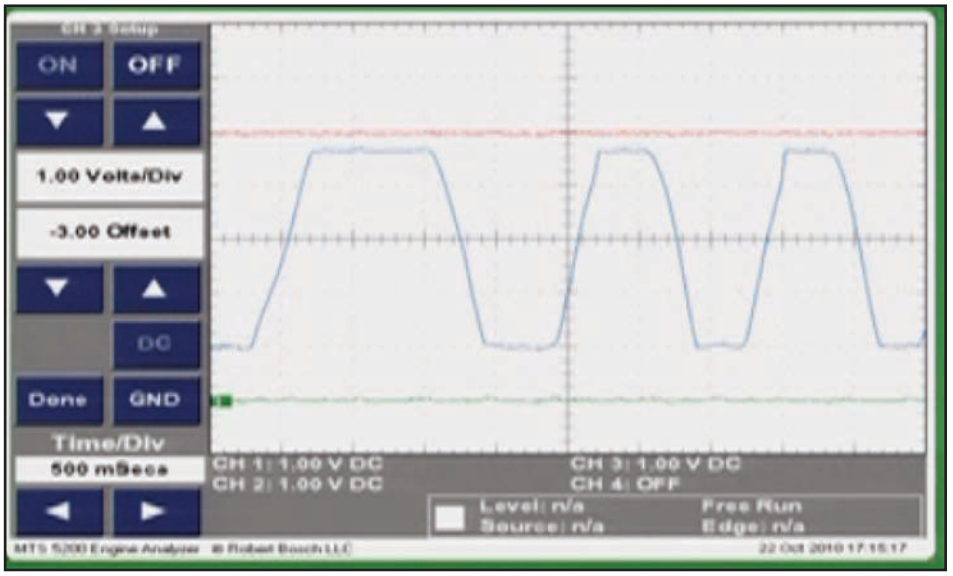
If we know how a sensor works, it makes it much easier to diagnose what the problem might be. Most TPS are 3 wires. They have a 5 volt reference wire, a ground wire that would show 0.0 volts and a 0.5 volt signal wire. The point we are trying to make here is this, by the time you look up the wiring diagram for the vehicle you are working on, you could have already tested the sensor with the lab scope and determined if the sensor was faulty or not. The fact remains that you still would have needed to test the wires anyway.

If you understand the sensor and the circuit, all you need to do is probe the wire with the lab scope and analyze the signal.



Pictured above is a screen capture of all three channels of the lab scope after we have back probed the TPS harness connector. You can see that the top trace (red) is our 5 volt reference, the middle trace (blue) is our signal and the bottom trace (green) is our ground.

LIVE VEHICLE TESTING (TPS - GMM)



In the screen capture above you can see that as we exercise the throttle from WOT to closed, the signal trace on the screen follows the movement indicating that the TPS is working correctly.

There is one thing to keep in mind here. Normally a TPS will fail between the 30% - 40% threshold. This is because that most cars are driven at the 30% - 40% load range under cruising conditions. A good thing to do is to open up the throttle and exercise it between this 30% - 40% threshold and see if there are any glitches in the waveform.

Another thing to keep in mind is that we are testing this sensor with the engine off and in a cold soak condition. There is no heat underneath the hood. More often than not, the failure will happen when the hood is closed and the engine is at normal operating temperature. What you need to do is to test these sensors under normal operating conditions.

As always, make sure you capture and save images and add them to your database as you perform your diagnostics.

LIVE VEHICLE TESTING (RECAP)

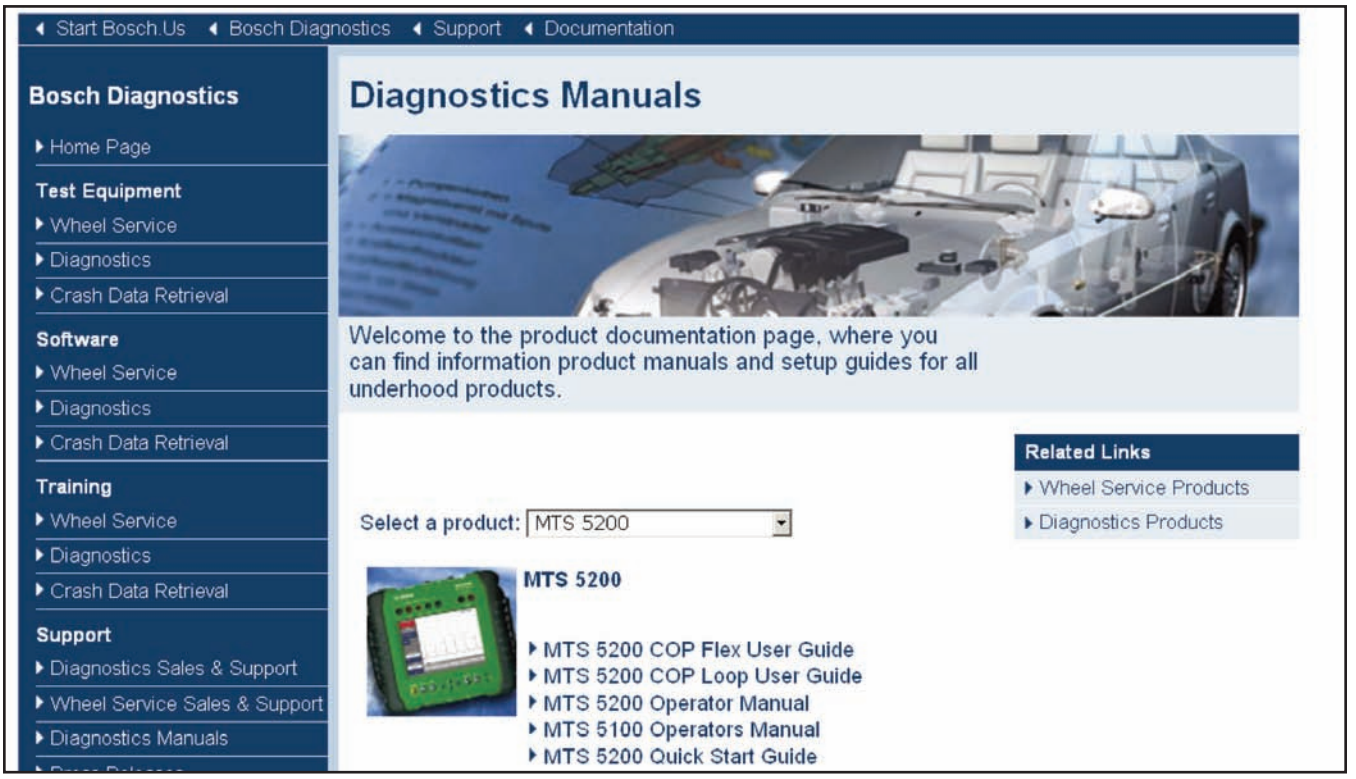
What we have shown you in these demonstrations is how easy it is to connect the lab scope to different components on the vehicle using some very simple leads. The bottom line is that you need to be able to diagnose these vehicles quickly and efficiently and repair them. The sooner you get used to using your lab scope and building a database of known good and known bad waveforms, the more money you are going to make.

MTS 5200 FAQ'S

Where To Find The Manual

Again we want to congratulate you for taking the initiative in buying this DVD and taking the time to watch it. Also, don't forget to download the users manual and read it thoroughly. you can find the users manual at:

http://www.boschdiagnostics.com/support/documentation/Pages/DiagnosticsDocumentation.aspx?type=UnderHood



Each of the manuals listed on the screen can be download, saved and printed out whenever you have a question or you need to reference them.

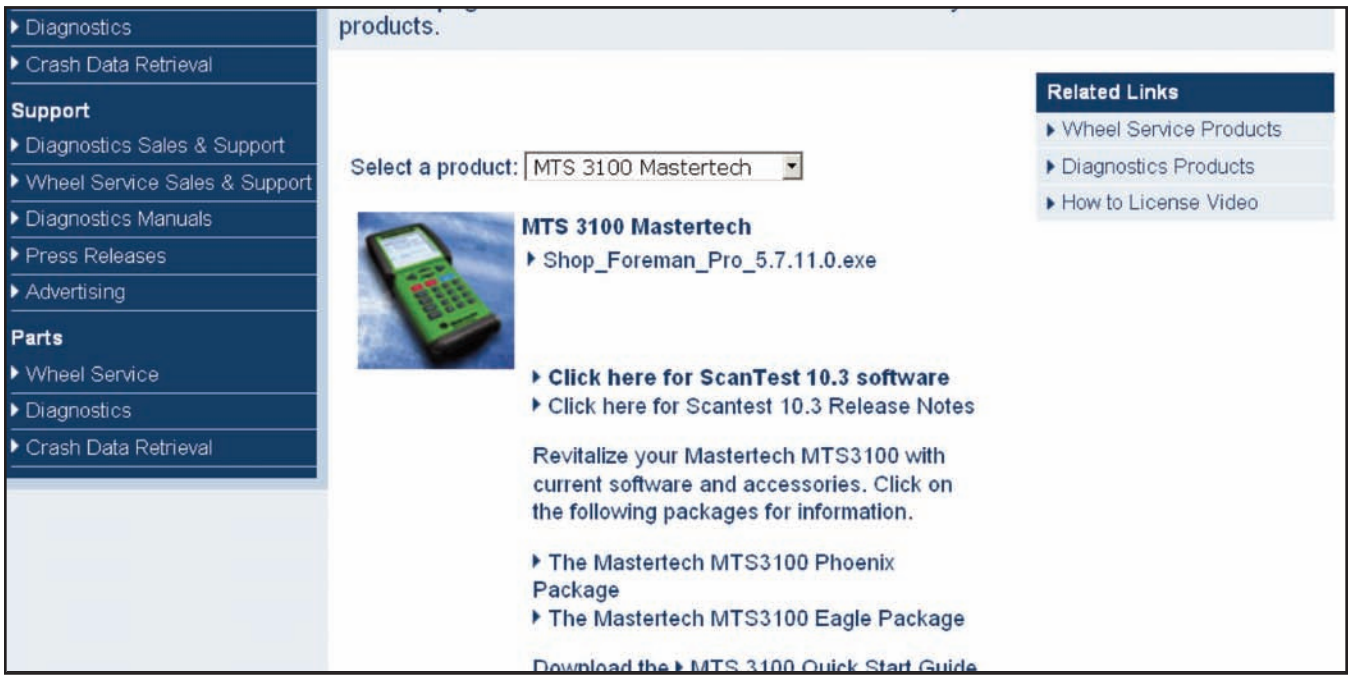
MTS 5200 FAQ'S

Where To Find Shop Foreman Pro

Shop Foreman Pro can be downloaded free of charge at:

http://www.boschdiagnostics.com/software/diagnosticssoftware/pages/software.aspx?type=underhood

From there make sure that you choose "MTS 3100 Mastertech" from the drop down menu.



Click on the "Shop_Foreman_Pro_5.7.11.0.exe" link and follow the prompts on the screen to install it to your PC.

Battery Life

The battery in the MTS 5200 was never designed to last for hours. The purpose of the battery was just in case you had lost connection to any main power source. At best you will get 30 minutes of battery power allowing you to get reconnected and not losing any data.

Be sure to exercise the battery as we discussed at the beginning of the presentation. This will help to extend the life of the battery but you still won't get hours of life.

MTS 5200 FAQ'S

Loading The Software On The MTS 5200

Something that may occur during the use of your lab scope is that the screen may not appear as it should. It may appear that some of the displays and menus have become jumbled up and not readable. This can occur when the battery goes dead and the scope closes down abruptly during use.

To fix this you need to reload the software. This is easily done from the discs that were supplied to you when you purchased your lab scope. If you do not have the discs, feel free to get in touch with the customer service department at BOSCH and they will be happy to make arrangements to get a disc to you.

Once you have loaded the disc into the drive, open the drive folder and double click on the "Menuapp_5200.exe" file and follow the prompts on the screen. This process will take 30 - 45 minutes to complete and will restore the unit to its original factory settings.

SFP Software Access - Website

Now that you have downloaded and installed Shop Foreman Pro to your PC, you need to connect the PC to the MTS 5200. Other than the PC and the MTS 5200 you are going to need what is called a "crossover cable". A crossover cable is a CAT 5 cable that is different from what is commonly known as a "straight" cable. Be advised, a straight cable will not work for this. You must use a CAT 5 Crossover cable.

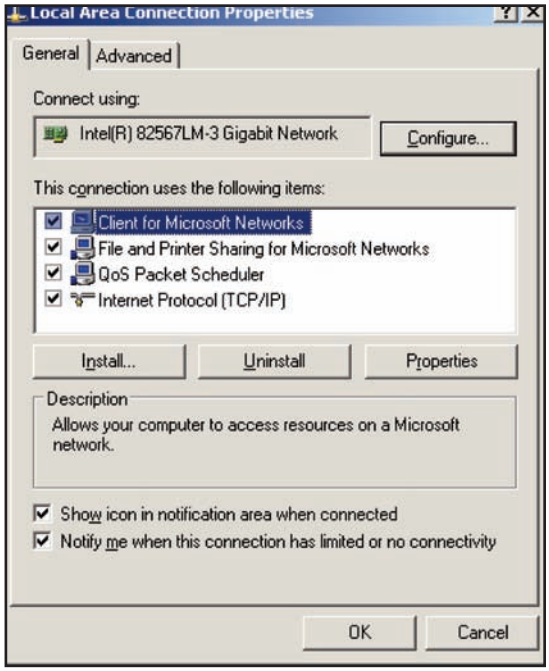
First you need to connect the crossover cable to the Local Area Network (LAN) port on the MTS 5200 located on the bottom of the tool and to the right as shown in the screen capture to the left.

MTS 5200 FAQ'S

SFP Software Access - Website

The other end of the crossover cable needs to be connected to the LAN port connection on the PC that you will be using. Once both connections have been made, power both the MTS 5200 and the PC.

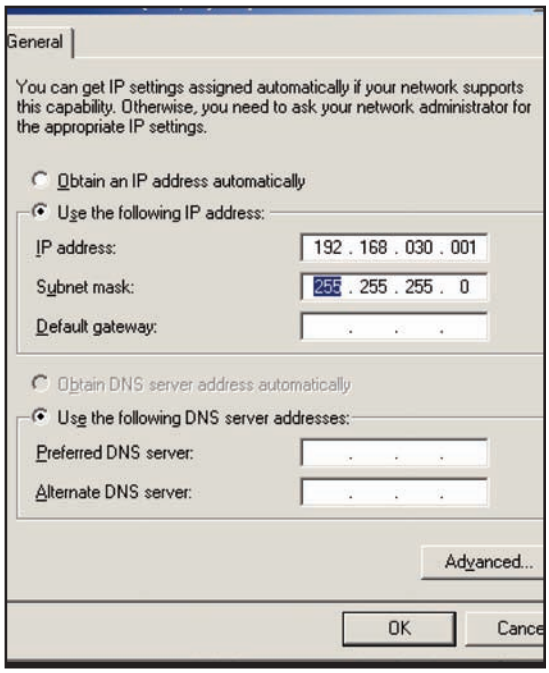
Next you want to determine which network connection you will be using and open up the properties panel of that connection.



Next you need to click on "Internet Protocol (TCP/IP), then click on properties. Once this window opens, you need to enter the IP address manually, Click on "Use the following IP address and enter 192 168 030 001. This will automatically fill in the Submask to 255 255 255 0. Click OK and close the windows.

At this point the lab scope and the PC should be able to communicate with each other.

The last step is to open the Shop Foreman Pro software and and open up "Engine Analyzer" in the Setup functions. At this point you need to enter the IP address of the MTS 5200 which should be 192 168 030 002. Notice that this IP address is one higher than the IP address you entered for the PC. This is because the units need to be one digit apart to be able to communicate with one another. You should now be able to communicate between the PC and the MTS 5200.



One note of caution, you may need to reset the IP address to connect to the internet if you are using a cable connection instead of a wireless connection. If you need further assistance, consult the users manual.

IN CONCLUSION

Practicing the techniques and tricks that we have showed you during this demonstration will help you to learn the ins and outs of the daily use of the MTS 5200. We have given you some common areas and issues that you will be using on a frequent basis to aid in your diagnostics.

Take the time to use the scope on good known vehicles and as always, capture known good and known bad waveforms and save them to your database for future reference.

The more you use your lab scope, the better you will become with it resulting in better customer satisfaction and more money in your pocket.

NOTES