

VANTAGE® Legend

User Manual



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Safety Information

READ ALL INSTRUCTIONS

For your own safety, the safety of others, and to prevent damage to the product and vehicles upon which it is used, it is important that all instructions and safety messages in this manual and the accompanying *Important Safety Instructions* manual be read and understood by all persons operating, or coming into contact with the product, before operating. We suggest you store a copy of each manual near the product in sight of the operator.

For your safety, read all instructions. Use your diagnostic tools only as described in the tool user's manual. Use only manufacturer recommended parts and accessories with your diagnostic tools.

This product is intended for use by properly trained and skilled professional automotive technicians. The safety messages presented throughout this manual and the accompanying *Important Safety Instructions* manual are reminders to the operator to exercise extreme care when using this product.

There are many variations in procedures, techniques, tools, and parts for servicing vehicles, as well as in the skill of the individual doing the work. Because of the vast number of test applications and variations in the products that can be tested with this instrument, we cannot possibly anticipate or provide advice or safety messages to cover every situation. It is the responsibility of the automotive technician to be knowledgeable of the system being tested. It is essential to use proper service methods and test procedures. It is important to perform tests in an appropriate and acceptable manner that does not endanger your safety, the safety of others in the work area, the equipment being used, or the vehicle being tested.

It is assumed that the operator has a thorough understanding of vehicle systems before using this product. Understanding of these system principles and operating theories is necessary for competent, safe and accurate use of this instrument.

Before using the equipment, always refer to and follow the safety messages and applicable test procedures provided by the manufacturer of the vehicle or equipment being tested. Use the product only as described in its user manual. Use only manufacturer recommended parts and accessories with your product.

Read, understand and follow all safety messages and instructions in this manual, the accompanying *Important Safety Instructions* manual, and on the test equipment.

Environmental Conditions:

- This product is intended for indoor use only
- This product is rated for Pollution Degree 2 (normal conditions)

Safety Signal Words

All safety messages contain a safety signal word that indicates the level of the hazard. An icon, when present, gives a graphical description of the hazard. Safety Signal words are:



Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury to the operator or to bystanders.



Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to the operator or to bystanders.



Indicates a potentially hazardous situation which, if not avoided, may result in moderate or minor injury to the operator or to bystanders.



Safety Message Conventions

Safety messages are provided to help prevent personal injury and equipment damage. Safety messages communicate the hazard, hazard avoidance and possible consequences using three different type styles:

- Normal type states the hazard.
- **Bold** type states how to avoid the hazard.
- *Italic type states the possible consequences of not avoiding the hazard.*

An icon, when present, gives a graphical description of the potential hazard.

Safety Message Example



 **WARNING**

Risk of electric shock.

- **Prior to recycling the battery pack, protect exposed terminals with heavy insulating tape to prevent shorting.**
- **Disconnect all test leads and turn diagnostic tools off before removing the battery pack.**
- **Do not attempt to disassemble the battery or remove any component projecting from or protecting the battery terminals.**
- **Do not expose the diagnostic tool or battery pack to rain, snow, or wet conditions.**
- **Do not short circuit the battery terminals.**

Electric shock can cause injury.

Important Safety Instructions

For a complete list of safety messages, refer to the accompanying *Important Safety Instructions manual*.

SAVE THESE INSTRUCTIONS



Using This Manual




Hyperlinks

Selectable hyperlinks are provided throughout this manual to quickly take you to related topics, procedures, and websites. Hyperlinks are identified by **Blue** colored text.

Text Hyperlink Example: <http://diagnostics.snapon.com>

Page Navigation Controls

The following navigation controls are provided on the top of each page of the user manual. They can be used in addition to the viewer controls in the toolbar.

Icon	Description
Quick Links Menu	Opens the Quick Links menu within the Table of Contents (TOC) section. From Quick Links you can link to most topics in this manual.
	
Jump Back	Click to move back one page.
	
Jump Forward	Click to move forward one page.
	

Content

This manual contains basic operating instructions and is structured in a manner to help you become familiar with your diagnostic tool features and perform basic operations.

The illustrations in this manual are intended as reference only and may not depict actual screen results, information, functions or standard equipment. Contact your sales representative for availability of other functions and optional equipment.

Conventions

The following conventions are used.

Terminology

The terms “Scanner” and “Scanner function” are used to describe the Scanner Function(s) of the diagnostic tool.

Examples:

- Select **Scanner** from the Home screen.
- From the Scanner main menu select **Continue**.
- The Scanner function provides many diagnostic tests.

The term “select” describes tapping/touching an icon on the touch screen, or highlighting an icon or menu choice and then selecting the confirmation menu choice such as **Continue, Accept, OK, Yes, or other similar** choice.

Abbreviated example for the following procedure: “Select **Brightness**”

1. Navigate to and highlight the **Brightness** selection.
2. Select **OK, or similar**, button.



Symbols

Different types of arrows are used. The “greater than” arrow (>) indicates an abbreviated set of selection (navigation) instructions.

Abbreviated example for the following procedure: “Select **Tools > Connect-to-PC**”

1. Select **Tools** from the home screen.
2. Highlight **Connect-to-PC** on the Tools menu.
3. Select **Connect-to-PC**.

The solid arrows (◀, ▶, ▼, ▲) are navigational instructions for the four directions of the directional buttons.

Example: Press the down ▼ arrow.

Bold Text

Bold emphasis is used in procedures to highlight selectable items such as control buttons, icons and menu options.

Example: Press the **OK** button

Notes and Important Messages

The following messages are used.

Notes

A NOTE provides helpful information such as additional explanations, tips, and comments.

Example:

NOTE

For additional information refer to...

Important

IMPORTANT indicates a situation which, if not avoided, may result in damage to the test equipment or vehicle.

Example:

IMPORTANT

Do not disconnect the data cable while the diagnostic tool is communicating with the ECM.

IMPORTANT

Read all applicable [Safety Information](#) before using this diagnostic tool!

Procedures

An arrow icon in the left-margin area indicates a procedure.

Example:



To change screen views:

1. Select the **Graph** icon.
The dropdown menu displays.
2. Select an option from the menu.
The screen layout changes to the format selected.



The VANTAGE® Legend is a multi-function two-channel lab scope, graphing multimeter, and the exclusive Snap-on Guided Component Test database combined into a single hand-held Diagnostic Tool.

This section introduces the basic features of the Diagnostic Tool, including the control buttons, meter connections, battery pack, and power sources. Technical Specifications are provided at the end of this section.

1.1 Main Topic Links

- [Control Buttons](#) page 1
- [Data and Power Connections](#) page 2
- [Battery Pack and Stand](#) page 2
- [Power Sources](#) page 3
- [Technical Specifications](#) page 3

1.2 Control Buttons

There are four “push type” control buttons and one “thumb pad rocker type” multi-directional button located on the right side of the Diagnostic Tool. All other Diagnostic Tool operations are controlled through the touch screen.



Figure 1-1 Front view

Item	Button	Description
1		<p>N/X or Cancel - Push type button</p> <ul style="list-style-type: none"> • To exit a menu or program. • To close an open list and return to the previous menu or screen. • To answer “No” when a yes/no choice is given.
2		<p>Y/✓ or Accept - Push type button</p> <ul style="list-style-type: none"> • To confirm a selection from a menu or program • To select an item that was highlighted using the direction arrows. • To advance to the next screen in a series. • To answer “Yes” when a yes or no choice is given.



Item	Button	Description
3		Directional - Thumb pad rocker type buttons Buttons move the cursor or highlight in their respective direction: <ul style="list-style-type: none"> • Up (▲) • Down (▼) • Left (◀) • Right (▶)
4		(Shortcut) - Push type button Programmable function button that can provide a shortcut for performing a variety of routine tasks. Refer to Configure Shortcut Button on page 58 for additional information.
5		Power (On/Off) - Push type button Turns the Diagnostic Tool on and off. Also, press and hold for 5 seconds for emergency shutdown

1.3 Data and Power Connections

Connectors and jacks for the scope multimeter, and the AC power supply are located on the top of the Diagnostic Tool.

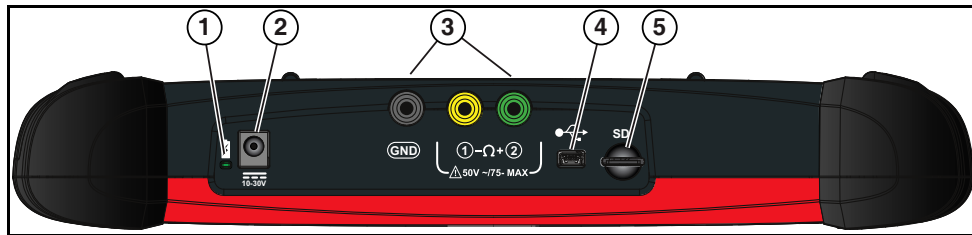


Figure 1-2 Top view

Item	Description
1	Battery Status Indicator LED <ul style="list-style-type: none"> • Green - battery is fully charged • Red - battery is charging • Amber - indicates there is a battery issue (correct before operating)
2	DC Power Supply Jack - AC power supply connection
3	Scope/Multimeter Jacks - Scope and multimeter lead connections

Item	Description
4	Mini USB Jack - USB cable connection used to connect the Diagnostic Tool to a personal computer
5	Micro secure digital (uSD) Card - contains operating system programming. IMPORTANT The uSD card must be installed for the Diagnostic Tool to operate. Do not remove the uSD card while the Diagnostic Tool is powered on.

1.4 Battery Pack and Stand

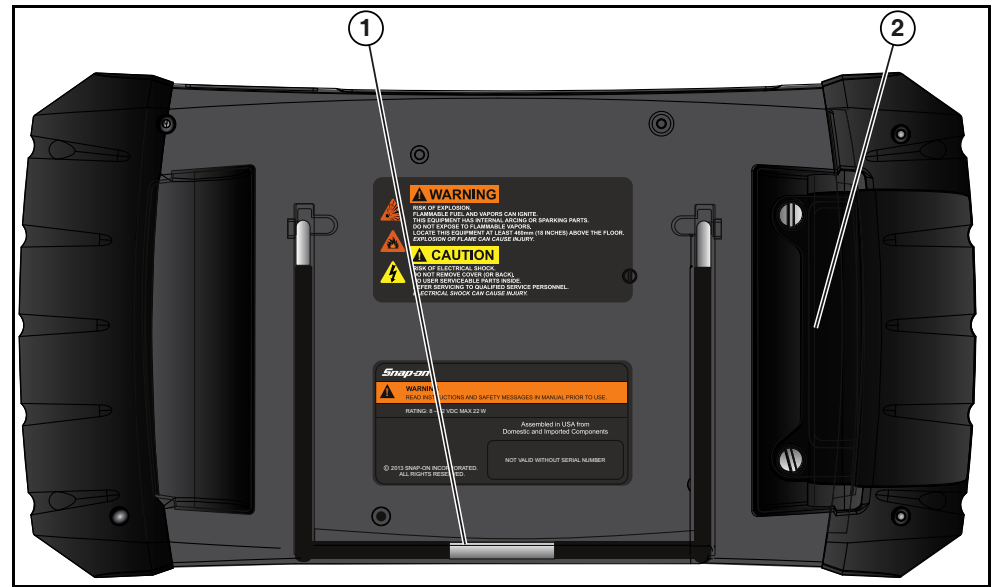


Figure 1-3 Back view

Item	Description
1	Built in-Stand (shown closed) - The built-in stand extends from the back of the Diagnostic Tool and clips into the Diagnostic Tool for storage.
2	Battery Cover - connection for AC power supply jack

1.5 Power Sources

Your Diagnostic Tool can receive power from any of the following sources:

- [Internal Battery Pack](#)
- [AC Power Supply](#)

1.5.1 Internal Battery Pack

The Diagnostic Tool can be powered from the internal rechargeable battery pack. A fully charged battery provides sufficient power for about 3 hours of continuous operation.

Battery charging occurs when the Diagnostic Tool is connected to the AC Power Supply and to a live AC power source.

The Battery Status Indicator LED (located next to the DC power supply jack) indicates battery status ([Figure 1-3](#)).

- **Green** - indicates battery is fully charged
- **Red** - indicates battery is charging
- **Amber** - indicates a battery issue. This is usually caused by excessive battery temperature (above 104°F/40°C), which disables charging. Allow the Diagnostic Tool to cool down before continuing operation.

1.5.2 AC Power Supply

The Diagnostic Tool can be powered from a standard AC outlet using the AC power supply. The connector on the end of the output cable of the AC power supply attaches to the DC power supply input jack on top of the Diagnostic Tool. Use only the AC power supply provided.

1.6 Technical Specifications

Item	Description / Specification
Touch Screen	Resistive Touch Panel
Display	8.0 inch diagonal, Color LCD
	800 x 480 resolution SWVGA
Meter	Category 1
Battery	Rechargeable lithium-ion battery pack
	Approximately 3 hour run time
	Approximately 5 hour charge time
Power Supply	Supply Rating; 15 VDC, 2A
DC Operating Voltage	10 to 30VDC
Width	12.9 in. (327.2 mm)
Height	6.5 in. (165 mm)
Depth	2.04 in. (51.8 mm)
Weight (including battery):	3.25 lb (1.47 kg)
Operating Temperature Range (ambient)	At 0 to 90% relative humidity (non-condensing) 32 to 113°F (0 to 45°C)
Storage Temperature (ambient)	At 0 to 70% relative humidity (non-condensing) -4 to 140°F (-20 to 60°C)
Environmental Conditions	This product is intended for indoor use only
	This product is rated for Pollution Degree 2 (normal conditions)



This section describes basic diagnostic tool operation, navigation, screen layout, icon functions, and screen messages. Before you operate the diagnostic tool, make sure the battery pack is fully charged or the diagnostic tool is powered by the AC power supply.

Main Topic Links

- [Turning On/Off and Emergency Shutdown](#) page 4
- [Basic Navigation](#) page 5
- [System Messages](#) page 7
- [Home Screen Layout](#) page 5
- [Home Screen Icons](#) page 6
- [Common Toolbar Control Icons](#) page 6

This section describes basic Diagnostic Tool operation, navigation, screen layout, icon functions, and screen messages. Before you operate the Diagnostic Tool, make sure the battery pack is fully charged or the Diagnostic Tool is powered by the AC power supply.

2.1 Turning On/Off and Emergency Shutdown

The following sections describe how to turn the Diagnostic Tool on and off and how to perform an emergency shutdown.

2.1.1 Turning On

The Diagnostic Tool will automatically turn on and open the Home screen ([Figure 2-1](#)) when power is supplied by the AC Power Supply. If the Diagnostic Tool does not automatically turn on, press and release the Power button on the front of the Diagnostic Tool to turn the Diagnostic Tool on.

2.1.2 Turning Off

IMPORTANT

*All vehicle communication must be terminated **BEFORE** turning off the Diagnostic Tool. A warning message displays if you attempt to turn the Diagnostic Tool off while communicating with the vehicle. Forcing a shut down while communicating may lead to ECM problems on some vehicles. Never disconnect the Data Cable when the Diagnostic Tool is communicating with the vehicle ECM.*



To turn off the Diagnostic Tool:

1. Close and exit all applications normally and navigate to the Home screen.
A “stopping communication” message may appear briefly before the Home screen displays.
2. Disconnect the Diagnostic Tool Data Cable from the vehicle.
3. Press and release the **Power** button.
A confirmation screen displays.
4. Press the **Y/✓** button or select **OK** from the menu to turn the Diagnostic tool off. To continue operating, press the **N/X** button or select **Cancel** from the menu.

2.1.3 Emergency Shutdown

IMPORTANT

Using the emergency shutdown procedure while communicating with the vehicle ECM may lead to ECM problems on some vehicles.

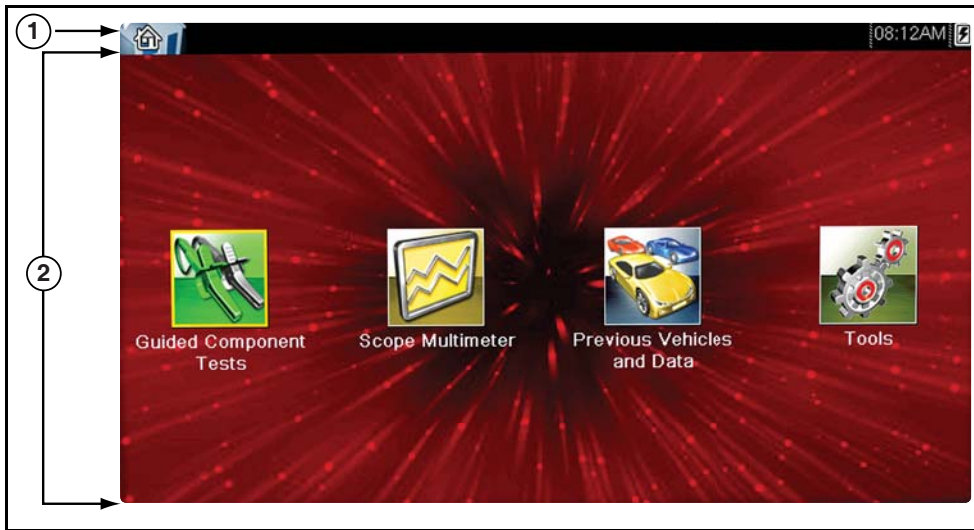
During normal operation turn the Diagnostic Tool off using the *Turning Off* procedure above. The emergency shutdown procedure should only be used if the Diagnostic Tool does not respond to navigation or control buttons or exhibits erratic operation. To force an emergency shutdown, press and hold the Power button for five seconds until the Diagnostic Tool turns off.



2.2 Basic Navigation

2.2.1 Home Screen Layout

The Home screen includes a title bar and main body. The Home screen contains icons, one for each of the primary Diagnostic Tool functions.



- 1— Title Bar
- 2— Main Body

Figure 2-1 Home screen

2.2.2 Title Bar

The title bar at the top of the screen provides basic information about current Diagnostic Tool operating conditions. Title bar options vary depending upon vehicle make and model, what function is active, what test is being performed, or what menu is selected. The title bar contains information only, there are no selectable items.

Elements of the Title bar let you know at a glance:

- What Diagnostic Tool function is currently active.
- The current time.
- The source and status of the power being supplied to the Diagnostic Tool.

An active function icon is always displayed along the left-hand edge of the Title bar. These icons resemble their Home screen icon counterparts in appearance and color. The name of the function displays to the right of the icon on some screens.

A real time clock displays to the left of the power supply icon. The clock is powered by a dedicated internal battery, so the correct time is maintained even when the main battery pack is discharged. Use the Tools function to set the clock and format how time is displayed. See [Clock Settings on page 62](#) for additional information.

The Title bar displays other information that varies depending upon what functions are being performed. Other information may include:

- The identification (ID) of the test vehicle
- The name of the active menu or function
- The name of the test being performed





Icon	Function
	Full Battery Charge Level - Indicates power is being supplied by the internal battery pack. Horizontal bars diminish as the battery discharges.
	Low Battery Charge Level - Indicates the internal battery pack is low and needs to be recharged immediately. A warning message will also display on the screen when the battery gets low.
	External Power Connected - Indicates power is being supplied by the AC Power Supply.



2.2.3 Home Screen Icons






Each available Diagnostic Tool function is represented by a icon on the home screen. The table below provides descriptions of the icon functions.

Select an icon from the Home screen to start a function. You can also use the control buttons to activate a function, a yellow border around the icon indicates it is highlighted, or in focus. Use the Directional buttons (◀, ▶, ▲, ▼) to highlight the desired function and then press the Y/✓ button to select it. A “please wait” message may display briefly, then automatically clear once the function is loaded and ready for use.

Function Name	Function Icon	Description
Guided Component Tests		Allows you to perform diagnostic tests for the identified vehicle. See Guided Component Tests on page 45.
Scope Multimeter		Allows you to perform lab scope, graphing multimeter and digital multimeter tests and measurements. See Scope / Multimeter on page 8.
Previous Vehicle & Data		Allows you to quickly reconfigure the Diagnostic Tool to a recently tested vehicle and to access saved data files. See Previous Vehicles and Data on page 55 for details.
Tools		Allows you to adjust Diagnostic Tool settings to your personal preferences and perform other special functions. See Tools on page 57 for details.

2.2.4 Common Toolbar Control Icons

Common control icon functions are described in the following table. Specific function control icons are described in their applicable sections. Displayed control icons vary depending on the active function or test. Select a control icon on a screen to activate a control function. You can also use the control buttons to activate a function, a yellow border around the icon indicates it is highlighted, or in focus. Use the Directional buttons (◀, ▶, ▲, ▼) to highlight the desired function and then press the Y/✓ button to select it.

Icon	Function	Icon	Function
	Back - Returns to the previously viewed screen. Icon is located on the left-hand edge of the toolbar.		Start (Capture) - Resumes active data collection.
	Home - Returns to the Home screen. Icon is located next to the Back icon on the left side of the toolbar.		Tools - Opens the tools menu.
	Save - Writes data from buffer memory to a file. The saved “movie” file can be accessed for future reference by selecting Previous Vehicles and Data > View Saved Data .		



2.2.5 Scroll Bar

A vertical scroll bar appears along the right-hand edge of the screen when additional data expands above or below what is currently on the screen (*Figure 2-2*).

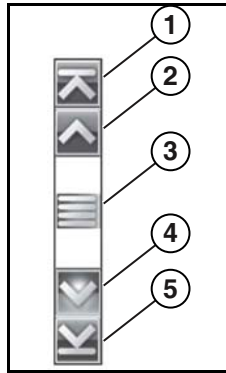


Figure 2-2 Scroll bar

- 1— **Beginning** - Moves to beginning of data displayed
- 2— **Step up** - Moves up one increment of the data displayed
- 3— **Slider (position indicator)** - Select and drag the **Slider** to scroll through data. The slider indicates the relative position of the current screen to the total available data.
- 4— **Step down** - Moves down one increment of the data displayed
- 5— **End** - Moves to end of data displayed

The Up (▲) and Down (▼) directional buttons can also be used to move through the data one line at a time. Press and hold a directional button to rapidly scroll through data.

2.3 System Messages

There are four types of system messages that may be displayed:

Message Type	Description
Loading and Connecting	Loading and connecting messages display when the Diagnostic Tool is performing an internal operation, such as loading a database, or initiating a test. The message automatically clears once the internal operation is complete.
Confirmation	Confirmation messages inform you when you are about to perform an action that cannot be reversed or when an action has been initiated that requires a confirmation to continue. When a response is not required, the message displays briefly, then disappears.
Warning	Warning messages inform you when completing the selected action may result in an irreversible change or in the loss of data. A confirmation is required to continue.
Error	Error messages inform you when a system or procedural error has occurred.



The Scope Multimeter function allows you to perform multiple types of circuit and component measurement tests. This section includes general operation procedures, instructions for saving and reviewing test data, optional settings, and general reference information.

3.1 Main Topic Links

- [Digital Multimeter \(DMM\)](#) page 8
- [Graphing Multimeter \(GMM\)](#) page 9
- [Lab Scope](#) page 10
- [Tests and Capabilities \(Quick Reference\)](#) page 11
- [Test Leads and Accessories](#) page 12
- [Operation and Controls](#) page 16
- [Capturing Data](#) page 33
- [Reviewing Data and Using Zoom \(Review Mode\)](#) page 34
- [Using Known Good Waveforms](#) page 39
- [General Reference](#) page 38

3.2 Digital Multimeter (DMM)

The digital multimeter gives you the ability to quickly make precise common electrical measurements (e.g. DC and AC voltage, resistance and amperage) on circuits and components to verify operation. The meter displays measurements in a digital numerical format, and is typically used for measuring signals that are not rapidly changing.

The DMM is ideal for performing basic tests on most standard automotive circuits, and displays the results in a large easy to see format.

To use the DMM, select the **Scope Multimeter** icon from the home screen then select **Digital Multimeter** from the menu. See [Tests and Capabilities \(Quick Reference\)](#) on page 11 for a list of available testing functions.

Specifications

Function	Range	Accuracy/Comments
Signal Measurement	Ch. 1— (yellow jack)	Input is referenced to common ground (GND— (black jack)
VDC (Full Scale)	75VDC	Do not measure greater than 75VDC
VAC (Full Scale)	50VAC	Do not measure greater than 50VAC (rms)
Signal Measurement Input Impedance	10 M Ω	-
Ohm Measurement Diode Test Continuity Test	Ch. 1— (yellow jack (-)) Ch. 2— (green jack (+))	-
Ohms	40 Ω —4 M Ω	Fixed scales or auto ranging
Glitch Capture	Approximately 50 μ S	-
Diode test	2V scale	-



3.3 Graphing Multimeter (GMM)

Unlike the DMM, the graphing multimeter provides two channels for testing and plots a visual graphing line of the signal instead of displaying digital values. The GMM displays a signal's measurements over time on a two-dimensional grid. This plotted graph is basically a graphical history (histogram) of the signal's measurements over time.

The GMM uses a higher sample rate (than a DMM) to calculate signal measurements. This characteristic along with the visual graph, make the GMM ideal for finding intermittent dropouts or glitches that may not be obvious when viewing a digital value. A key advantage of the GMM is being able to capture a signal over a long time interval and then review it's graphical history, to visually see if and when dropouts have occurred.

In addition, the GMM uses a combination of filter and peak detect modes to provide a good balance between detecting fast glitches and preventing unwanted noise from displaying.

Unlike the lab scope, the sweep scales used with typical GMM tests are of longer time intervals, and may range from seconds to minutes, compared to the lab scope sweep scales that use relatively short time intervals (e.g. milli and micro seconds). This allows you to monitor a signal over a longer period of time when looking for erratic glitches or dropouts.

To use the GMM, select the **Scope Multimeter** icon from the home screen then select **Graphing Multimeter** from the menu. See [Tests and Capabilities \(Quick Reference\)](#) on page 11 for a list of available testing functions.

Specifications

Function	Range	Accuracy/Comments
Signal Measurement	Ch. 1— (yellow jack) Ch. 2— (green jack)	Each channel input is referenced to common ground (GND— black jack)
Sample Rate	1.5 MSPS	Continuous sampling, MSPS = mega samples per second
Band Width	3 MHz	3 db point @ 3 MHz
Input Impedance	10 M Ω @ DC 4 k Ω @ 3 MHz	Channel 1 and 2
VDC (Full Scale)	75VDC	Do not measure greater than 75VDC
VAC (Full Scale)	50VAC	Do not measure greater than 50 VAC (rms)
Ohm Measurement Diode Test Continuity Test	Ch. 1— (yellow jack (-)) Ch. 2— (green jack (+))	-
Ohms	40 Ω —4 M Ω	Fixed scales
Low Amp Probe	20A scale (100mV/Amp) 40A scale (10mV/Amp) 60A scale (10mV/Amp)	Connect the positive (+) Amp Probe lead to the yellow jack on the diagnostic tool for values on Ch. 1, or to the green jack for values on Ch. 2. Connect the negative (-) lead to GND (black jack) ¹ .
1. Do not use the Low Amp Probe to measure current on conductors at a potential greater than 46VAC peak or 70VDC.		



3.4 Lab Scope

Similar to the GMM, the lab scope (oscilloscope) plots a visual image line of a signal's measurements over time on a two-dimensional grid. The visual line that is displayed is commonly called a trace, and the graphical form created by a signal is called a waveform.

Unlike the DMM, the lab scope allows you to visually see a signals waveform, which in turn allows you to see the strength and shape of the signal, as well as any noise that may be occurring on the circuit. The lab scope also samples signals at a high rate, which allows you to see a higher level of detail in short samples of the signal, especially in signals that change rapidly. In addition, the lab scope also provides more control over the acquisition of the signal and in how it is displayed, through the use of triggers and channel controls. All of these features allow you to analyze signals in great detail when performing diagnostics.

To use the lab scope, select the **Scope Multimeter** icon from the home screen then select **Lab Scope** from the menu. See [Tests and Capabilities \(Quick Reference\)](#) on page 11 for a list of available testing functions.

Specifications

Function	Range	Accuracy/Comments
Signal Measurement	Ch. 1— (yellow jack) Ch. 2— (green jack)	Each channel input is referenced to common ground (GND— black jack).
Sample Rate	For 50 μ S sweep 6 (MS/s) For 100 μ S sweep 3 (MS/s) For all other sweeps 1.5 (MS/s)	Continuous sampling, (MS/s) = mega samples per second
Band Width	3 MHz	3 db point @ 3 MHz
Input Impedance	10 M Ω @ DC 4 k Ω @ 3 MHz	Channel 1 and 2
VDC (Full Scale)	100mV–400V	Do not measure greater than 75VDC.
VAC (Full Scale)	100mV–400V	Do not measure greater than 50 VAC (rms).
Low Amp Probe	20A scale (100mV/Amp) 40A scale (10mV/Amp) 60A scale (10mV/Amp)	Connect the positive (+) Amp Probe lead to the yellow jack on the diagnostic tool for values on Ch.1, or to the green jack for values on Ch. 2. Connect the negative (–) lead to GND (black jack) ¹ .
1. Do not use the Low Amp Probe to measure current on conductors at a potential greater than 46VAC peak or 70VDC.		



3.5 Tests and Capabilities (Quick Reference)

The following chart identifies and describes available tests by function.

i NOTE

Not all the tests listed are described in this manual. This list is intended as reference only.

D M M	G M M	LS	Test	Function
		✓	Two Channel Lab Scope	Displays two Lab Scope channels automatically.
	✓		Dual Graphing Meter	Displays two Graphing Multimeter channels automatically.
		✓	Ignition Probe	Measures secondary Ignition voltage 2 to 50kV. Displays secondary ignition (kV) waveforms.
✓	✓	✓	Volts DC	Measures direct current voltage. DC voltage is measured through the two test leads connected to a DC circuit.
✓	✓		Volts DC - Average	Measures DC voltage using a filter to determine the average voltage over a period in time. DC voltage is measured through the two test leads connected to a DC circuit.
✓	✓		Volts AC RMS	Measures the effective AC voltage, not the peak voltage which results in measurements with higher accuracy. The AC RMS (root mean square) voltage value can be defined as the equivalent DC voltage of the AC voltage measured. RMS values are commonly used in AC electrical measurement, as they are more representative of DC measurements.
✓	✓		Ohms	Measures electrical resistance (opposition to current) 0 to 4 M Ohms. Scope supplied DC current is passed through the circuit to measure the resistance between the two connected test leads.

D M M	G M M	LS	Test	Function
✓			Diode/Continuity	Measures voltage drop across a diode and continuity through a diode. Scope supplied DC current is passed through the diode to measure the voltage drop between the two connected test leads. Typical setup for positive to negative current flow - positive lead (anode +/side) and negative (cathode -/side).
	✓		Frequency	Measures the number of times a signal repeats itself per second. Used to measure frequency of signals such as CKP, CMP and wheel speed sensors.
	✓		Pulse Width	Measures the on-time of various components (e.g. components that cycle on and off like the EGR, or canister purge).
	✓		Injector Pulse Width	Measures fuel injector on-time when checking for variances when engine load is changed and/or physical problems with the injector.
	✓		Duty Cycle	Measures the ratio of the pulse width to the complete cycle width, the on-time of components that cycle on and off like EGR, or canister purge from 0–100%.
✓	✓	✓	Low Amps (20)	Used to measure amperage of typical devices (e.g. ignition coils, injectors, fuel pumps) that may draw up to 20A peak (startup) when initially started. Also used to measure parasitic draw.
✓	✓	✓	Low Amps (40)	Used to measure amperage of typical motors and devices that may draw up to 40A peak (startup) when initially started.
✓	✓	✓	Low Amps (60)	Used to measure amperage of larger motors and devices that may draw up to 60A peak (startup) when initially started.
	✓		MC Dwell (60)	Measures carburetor Mixture Control Solenoids (0–60°). The duty cycle of the solenoid is expressed in the dwell angle of a 6 cylinder engine: 100% = 60 deg.
	✓		MC Dwell (90)	Measures fuel system Mixture Control Solenoids (0–90°). The duty cycle of the solenoid is expressed in the dwell angle of a 4 cylinder engine: 100% = 90 deg.



D M M	G M M	LS	Test	Function
	✓	✓	100 PSI Vacuum	Used to measure vacuum up to 20 in.Hg, using the 0–100 psi transducer.
	✓	✓	100 PSI Pressure	Used to measure pressures for typical systems such as, fuel, oil, EVAP, hydraulic/transmission fluid etc. up to 100 psi, using the 0–100 psi transducer.
	✓	✓	500 PSI Pressure	Used to measure pressures for typical systems such as, hydraulic/transmission fluid pressure, cylinder compression, and AC high side up to 500 psi, using the 0–500 psi transducer.
	✓	✓	5000 PSI Pressure	Used to measure pressures for typical systems such as, ABS, power steering, and heavy-duty hydraulic system fluid up to 5000 psi, using the 0–5000 psi transducer.
	✓	✓	MT5030 Vacuum	Used to measure vacuum up to 29 in.Hg, using the MT5030 pressure transducer adapter.
	✓	✓	MT5030 Pressure	Used to measure fluid and gas pressures up to 500 psi, using the MT5030 pressure transducer adapter.
	✓	✓	EEDM506D Temperature	Used to measure temperatures from -50° to 1800° F (-45 to 982° C), using the EEDM506D pressure transducer adapter.

3.6 Test Leads and Accessories

Some of the leads, probes and adapters supplied with or that may be available, are explained in the following section.

NOTE

Not all test leads and/or accessories may be available in all markets. Contact your sales representative for information, or to find out more about these and other available accessories.

IMPORTANT

Avoid damaging test leads, do not pull on the wire when removing the leads from their jacks. Pull only on the lead terminal end.

3.6.1 Channel 1 Lead

The shielded yellow lead is used with channel 1, and is color matched with the channel 1 jack on the diagnostic tool.

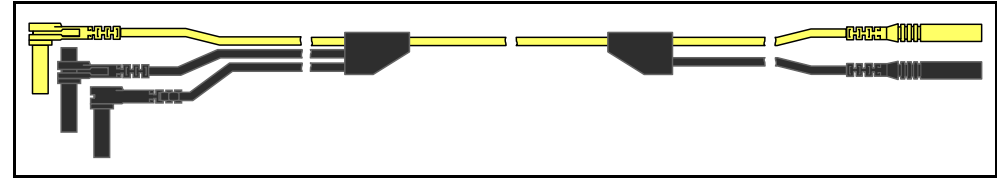


Figure 3-1 Yellow Channel 1 Lead

This lead also includes two black, right-angle common ground plugs. One plug is standard and the other is stackable. The standard ground plug should always be connected to the ground (GND) jack on the diagnostic tool.

The stackable ground plug is used for connecting additional ground leads, such as the Channel 2 or the Secondary Coil Adapter lead grounds. The stackable ground lead is internally connected to the standard ground lead, therefore it does not need to be connected to the diagnostic tool ground jack.

3.6.2 Channel 2 Lead

The shielded green lead is used with channel 2, and is color matched with the channel 2 jack on the diagnostic tool. This lead also includes a black, right-angle stackable ground plug.

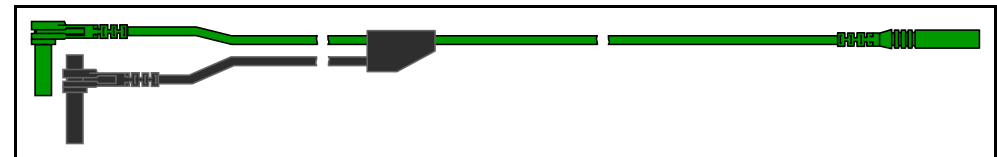


Figure 3-2 Green Channel 2 lead

3.6.3 Alligator Clips and Probes

Insulated alligator clips and probes (pointed type) can be attached to the end of the test leads. Each alligator clip is color matched with a test lead, and the probes are available in red and black.

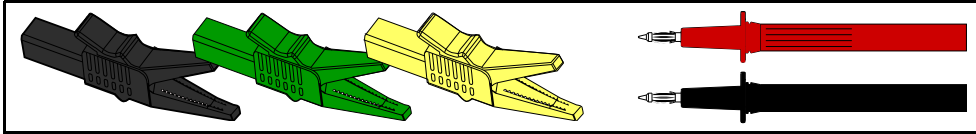


Figure 3-3 Alligator clips

3.6.4 Secondary Ignition Coil Adapter Lead and Clip-on Adapter (optional)

The secondary ignition adapter lead can be used with the secondary ignition clip-on wire adapter, coil-in-cap (CIC), or coil-on-plug (COP) secondary ignition adapters to display secondary ignition signals. The clip-on adapter clips over a secondary ignition wire to pickup a signal, and the CIC and COP adapters attach to the ignition coil. The coil adapter lead includes a black, right-angle stackable ground plug, and a RCA type connector that is used to connect the lead to a secondary ignition adapter. The spring clamp is used to connect to a ground.

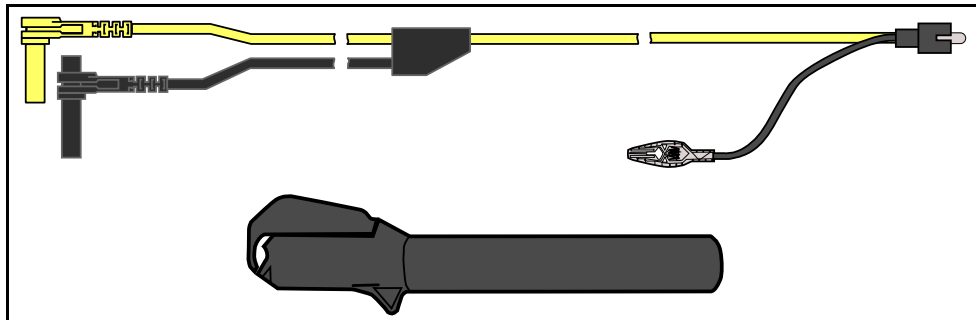


Figure 3-4 Secondary Ignition Coil Adapter Lead and Clip-on Wire Adapter

i NOTE

Contact your sales representative for additional information on OEM specific CIC and COP secondary ignition adapters.

3.6.5 Low Amp Current Probe (optional)

The Low Amp Current Probe is used measure AC or DC current up to 60A. This probe includes two scales (0 to 20A) and (0 to 60A) that can be used to provide accurate and reliable non-intrusive current measurement for components such as, ignition coils, fuel injectors, fuel pumps, relays, and electric motors.



Figure 3-5 Low Amp Current Probe

3.6.6 Temperature Probe Adapter (optional)

The temperature probe adapter can be used to measure temperatures ranging from -50°F to $1,800^{\circ}\text{F}$. Different probes are available for surface, fluid and air temperature measurements.



Figure 3-6



3.6.7 Pressure Transducers and Adapters (optional)

Different pressure transducers and adapters are available for measuring positive and negative gas and liquid pressures. Depending on the adapter, measurement capabilities range from 1 to 5000 psi and up to 29 inHg. Measurement and application capabilities vary per device.



Figure 3-7

3.6.8 Waveform Demonstration Tools (optional)

To help you sharpen your lab scope and graphing multimeter skills, optional waveform demonstration tools are available as a training aid. These demonstration tools generate common waveforms, and allow you to vary their display characteristics by turning glitches on/off, helping you to become more familiar with the lab scope controls. Common waveforms include, AC sine wave, variable frequency and pulse, secondary ignition, and more. There are two tools currently available, the standard model (Figure 3-8 left) and the vehicle simulator model (Figure 3-8 right) which produces waveforms (e.g. Crankshaft Position Sensor (CKP), Camshaft Position Sensor (CMP), Accelerator Pedal Sensor (APP), Wheel Speed Sensor (WSS) Signals, and more) representative of a 2012 BMW 328i Sedan.

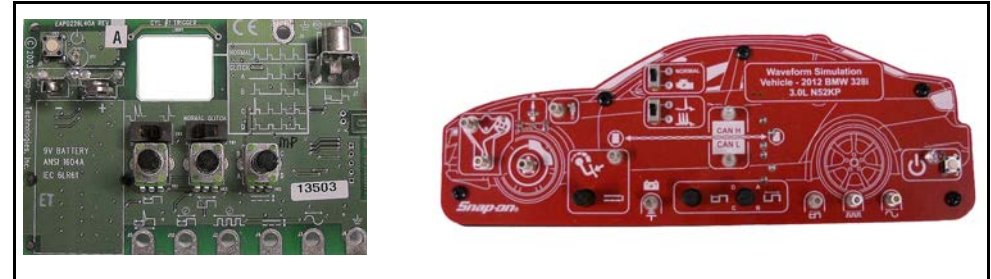


Figure 3-8

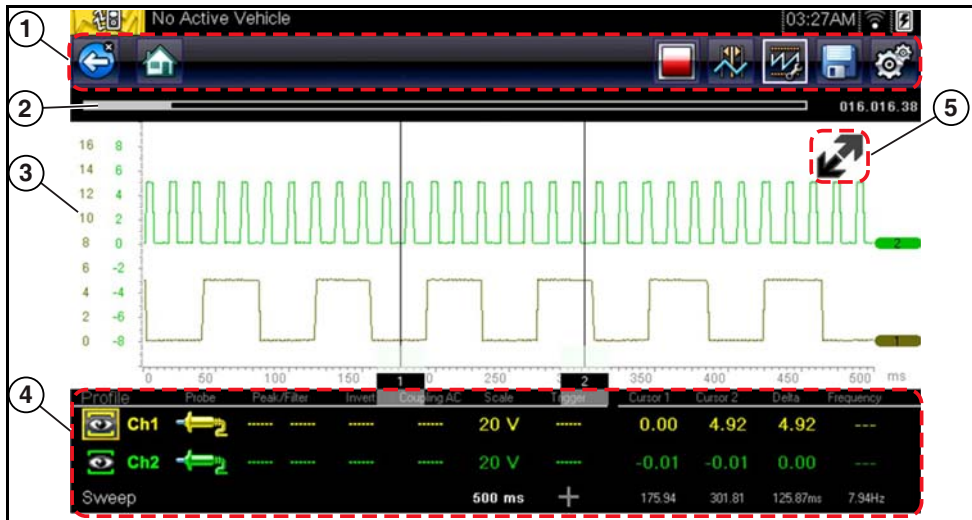
3.7 General Information

This section describes the general Scope Multimeter control icon functions, screen layout and optional settings. The screen layout and control icon functions are shared between the digital/graphing multimeters and lab scope.

NOTE

Scope and Multimeter tests are not vehicle specific, therefore vehicle identification is not required.

3.7.1 Scope Multimeter Screen Layout and Features






- 1— **Toolbar**—contains navigational and control icons
- 2— **Data Buffer Position Indicators**—graphical and numerical position indicators
- 3— **Main Body**—contains the meter/scope display
- 4— **Control Panel**—contains channel/trace controls
- 5— **Expand/Collapse icon**—toggles display between split and full screen views

Figure 3-9

Scope Multimeter Control Icons

The following control icons are common across most Scope Multimeter functions, however use may vary depending on the active function or test. A yellow frame surrounding an icon (highlighted), indicates it is selected. Other control icons (not shown) are described in [Common Toolbar Control Icons on page 6](#).

Icon	Function
	Pause - Pauses the data buffer
	Start (Capture) - Resumes active data collection.
	<p>Control Panel - (a) In full screen mode, when selected this icon becomes surrounded by a white frame and opens the control panel at the bottom of the screen while switching active selection focus to the Show/Hide or Probe icon in the Control Panel.</p> <p>(b) In split screen mode (control panel open), when selected this icon becomes surrounded by a white frame and switches active selection focus to the Show/Hide or Probe icon in the Control Panel.</p> <p>Note: Switching active selection focus to the Control Panel allows manual navigation (using the directional control buttons) of the Control Panel control icons</p>
	Zoom - Increases and decreases screen magnification. The zoom function is only available during data review (scope paused).
	Cursors - Toggles cursors on/off.
	<p>Step Forward - moves to the next point in the data. To quickly step forward, select this icon (yellow frame appears) then press and hold the Y/✓ button.</p> <p>(Note: To quickly step forward during data playback, press and hold the icon down until a red frame appears around the icon.)</p>
	Forward 1 Frame - allows forward movement by one frame. To quickly skip forward, select this icon (yellow frame appears around icon) then press and hold the Y/✓ button

Icon	Function
	Step Back - moves to the previous point in the data. To quickly step backward, select this icon (yellow frame appears) then press and hold the Y/✓ button. (Note: To quickly step backward during data playback, press and hold the icon down until a red frame appears around the icon.)
	Back 1 Frame - allows backward movement by one frame. To quickly skip backward, select this icon (yellow frame appears around icon) then press and hold the Y/✓ button.
	Expand / Collapse - Expands and collapses the Trace Detail area on the screen

Main Body

The main body may display the following:

- Menu - Select from a menu using the touch screen or the control buttons.
- Meter/Scope Display - Up to two signal traces can be displayed simultaneously. Each trace is displayed as voltage over time and the voltage level is recorded on the vertical, or “y”, axis and time is presented on the horizontal, or “x”, axis of the screen.

3.7.2 Measurement Out of Range (Alert)

When performing a test, if a group of arrows displays onscreen, this indicates that the measurement is out of range for the scale selected.

- Arrows pointing UP—measurement over maximum range
- Arrows pointing DOWN—measurement under minimum range

Voltage measurements also display arrows in place of live values when the voltage exceeds the input rating of the meter.



Figure 3-10



Risk of electrical shock.

- **Do not exceed voltage limits between inputs as indicated on the rating label.**
- **Use extreme caution when working with circuits that have greater than 40 volts AC or 24 volts DC.**

Electrical shock can cause personal injury, equipment damage, or circuit damage.

IMPORTANT

If arrows are displayed in the live voltage values, discontinue circuit testing.

Correct an out-of-range condition by selecting a scale setting appropriate for the signal being sampled. See [Scale \(Vertical scale adjustment\)](#) on page 19 for more information.

3.8 Operation and Controls

This section describes the general operation and controls used to configure the scope or meter to perform testing. All three functions share similar control panel settings, see [Control Panel and Settings](#) on page 17 for additional information.

NOTE

The information in the following sections is intended as a guide and general overview of the controls and functions used within the Scope Multimeter. Not all the settings or controls described throughout this section are applicable with all functions.



To open a scope multimeter function:

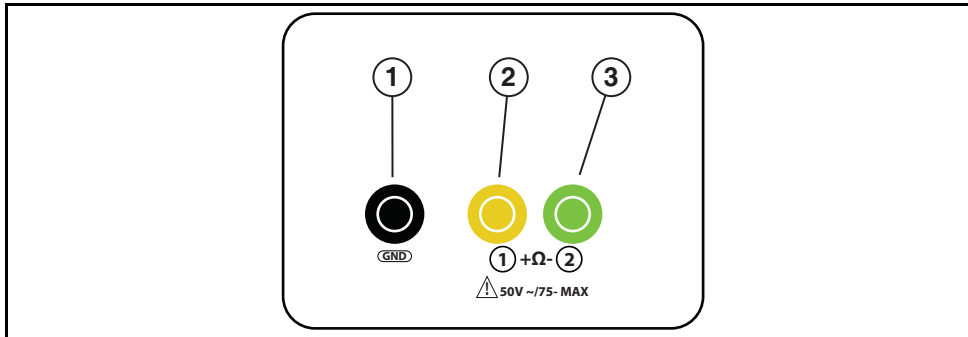
1. Select the **Scope Multimeter** icon from the home screen.
2. Select either **Lab Scope**, **Graphing Multimeter** or **Digital Multimeter** from the menu.

3.8.1 Test Lead / Probe Connection

Standard “safety type” test lead jacks are located on the top of the diagnostic tool, and are compatible with many test leads and probes. Insert the applicable test lead or probe terminal end into the jack to complete the connection.

IMPORTANT

To avoid damaging test leads, do not pull on the wire when removing the leads from their jacks. Pull only on the lead terminal end.



- 1— Ground Jack (Black)
- 2— Channel 1 Jack (Yellow)
- 3— Channel 2 Jack (Green)

Figure 3-11 Typical - Scope Multimeter Test Lead Jacks

3.8.2 Test Lead / Probe Calibration

Certain tests may display a confirmation prompt asking “Do you wish to calibrate this probe?” before continuing with the test. As general practice, it is important to ensure the test probe is calibrated before testing, to ensure accurate results.

Typical resistance, pressure, and vacuum tests will display the calibration message, reminding you to calibrate the probe. To perform the probe calibration, select **Yes** at the prompt and continue to follow the onscreen instructions to complete the calibration.

Example: For the ohms (resistance) calibration process, once completed, zero ohms should be displayed when the leads are connected together. When the leads are separated, the upward arrows on the display indicate infinite resistance or an open circuit.

NOTE

*During an ohms test or a pressure test, a manual probe recalibration can be initiated by selecting the probe icon from the Control Panel to open the probe menu. Then select either the **Ohms** or **Pressure (100, 500, 5000)** items from the probe menu. The menu selections will display a graphic of a balance scale with an “X” through it (on right side) to indicate that probe is not calibrated.*

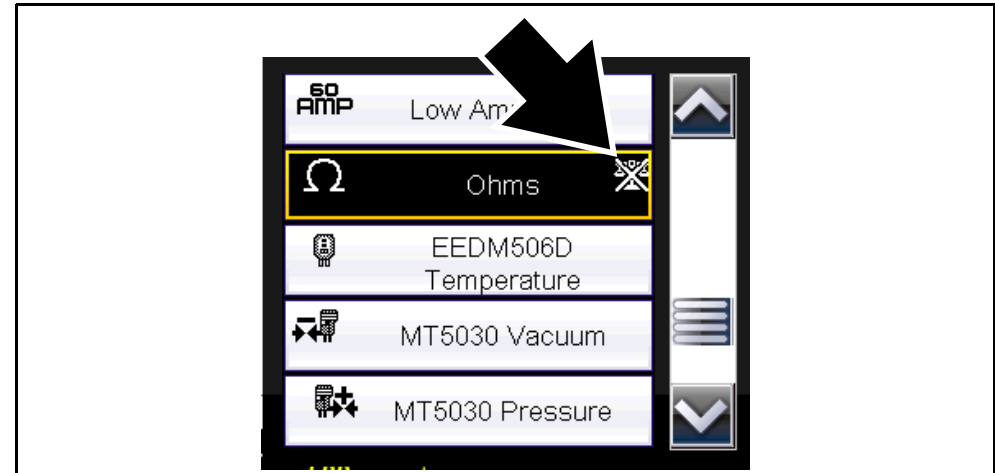


Figure 3-12 Probe menu - Ohms with “not calibrated” indicator displayed

3.8.3 Control Panel and Settings

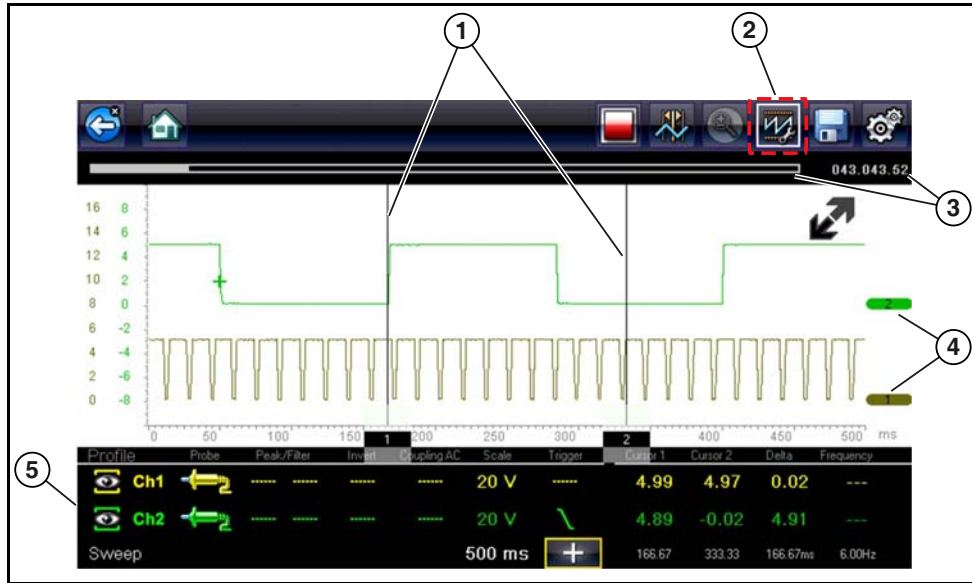
The control panel is common to all three Scope Multimeter functions, and contains the channel (or “trace”) settings and controls that are used to monitor and adjust the signal being measured. This section provides a general overview of all the channel settings and control features used across all three Scope Multimeter functions.

NOTE

This section is intended as a general overview of the channel settings. Not all the settings or controls described in this section are applicable with all functions, some may be “grayed out” or not active (applicable) depending on the function or test. Function availability is noted as applicable.

NOTE

The control panel can be toggled on/off by selecting the Expand/Collapse Icon to switch the screen between full and split test meter views.



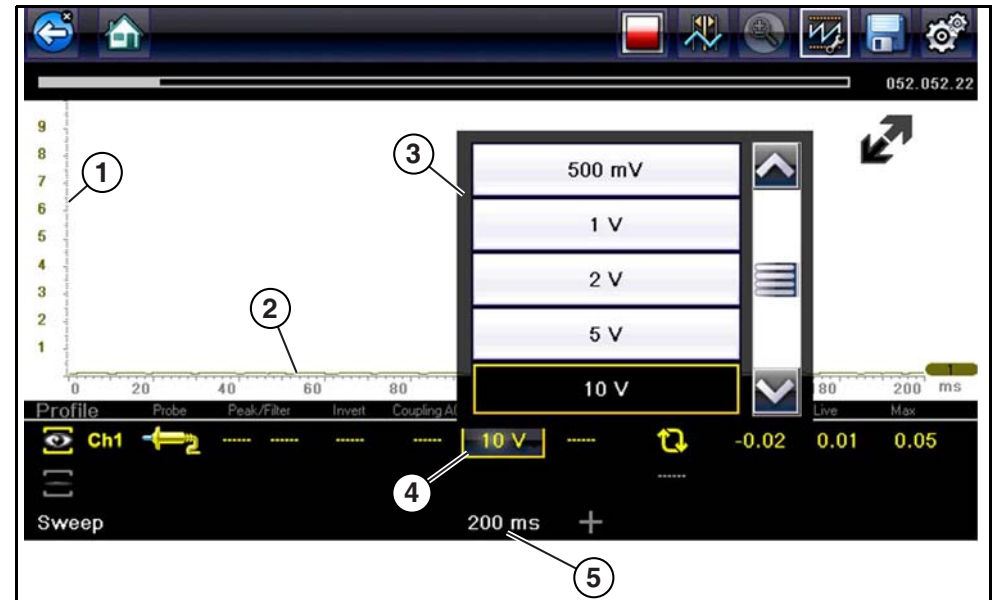
- 1— Cursors
- 2— Control Panel Icon
- 3— Data Buffer Position Indicators—graphical and numerical position indicators
- 4— Zero Base Line Indicators
- 5— Control Panel—contains channel/trace controls and settings

Figure 3-13

Scale, Sweep and Probe Settings

The most common and typically the first adjustments made when performing tests are the setup or adjustment of the scales and selection of a probe. All three of these adjustments are made from the control panel and are described in the following sections.

The following illustration is for reference, and identifies key terms and features used throughout the following sections:



- 1— Vertical Scale - [Y axis]
- 2— Horizontal (sweep or time) Scale - [X axis]
- 3— Vertical Scale Menu
- 4— Vertical Scale Icon
- 5— Sweep Scale Icon

Figure 3-14

Scale (Vertical scale adjustment)

The vertical scale (Y-axis) represents what is being measured (voltage, amperage, pressure etc.), and the unit of measurement it is being measured in. The vertical scale is “always” divided into 10 major divisions; how these divisions are defined, sets the scale of measurement.

NOTE

Vertical scales (either channel) can be set independently.

NOTE

Optional vertical scale preference settings are available. The Divisions option allow you to change (to your preference) how the vertical scale menu selections are represented, and the type of value that displays in the vertical scale icon. See [Divisions](#) on page 30.

To adjust the vertical scale unit of measurement, select the **Vertical Scale** icon to open the vertical scale menu. Select a value then press the **N/X** button, to exit the menu. The value displayed in the vertical scale icon indicates the active value.

Example: Selecting 10V, changes the vertical scale to a 10V volt scale. The scale is “always” divided by 10, therefore each division is incremented by 1V.

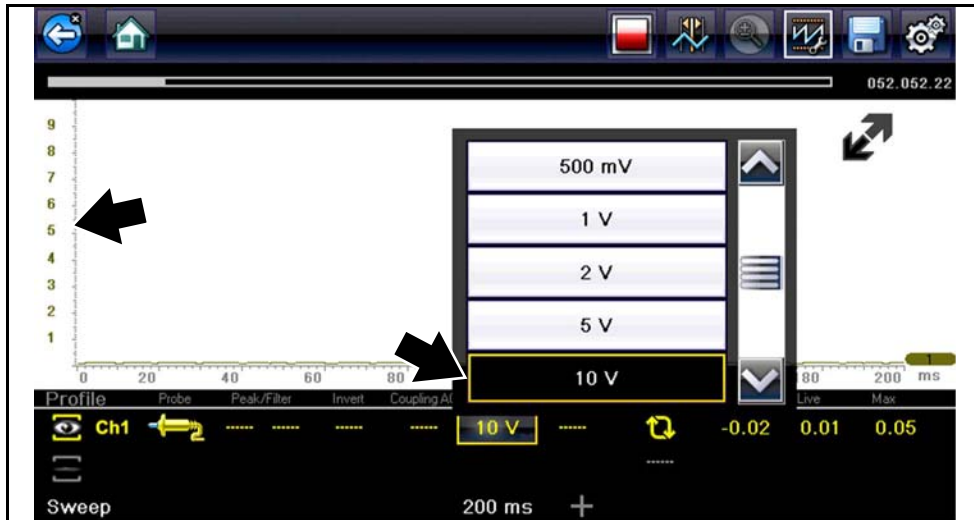


Figure 3-15

Example: Selecting 50 psi displays a 50 psi scale that is divided by 10, therefore each division is incremented by 5 psi.



Figure 3-16

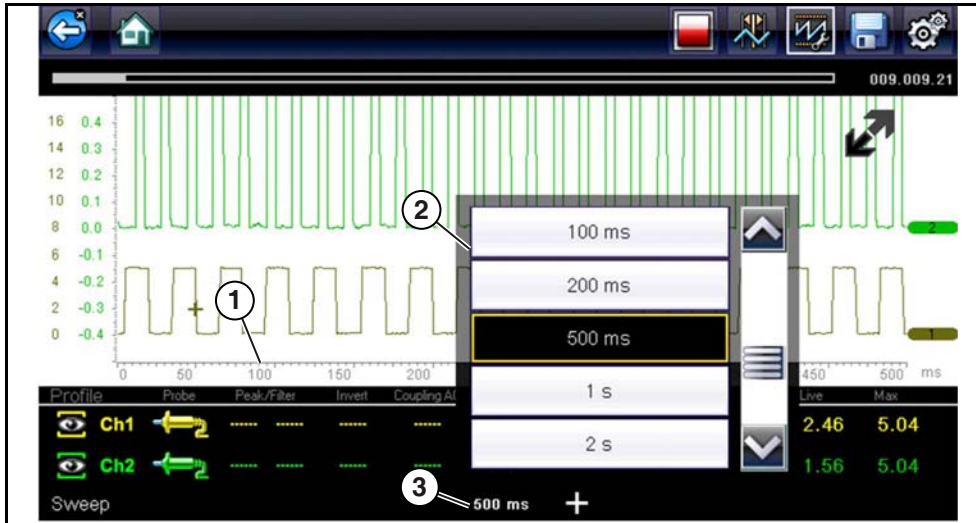
Sweep (Horizontal or Time scale adjustment)

The horizontal scale (X-axis) represents time, and the unit of measurement it is being measured in. The horizontal scale is “always” divided into 10 major divisions, how these divisions are defined, sets the scale of measurement. The value displayed in the sweep Scale icon indicates the active sweep setting.

NOTE

The sweep setting applies to all channels and cannot be set independently per channel.

To adjust the sweep scale unit of measurement value, select the Sweep Scale icon to open the sweep scale menu. Select a value then press the **N/X** button, to exit the menu.



- 1— Sweep Scale
- 2— Sweep Scale Menu
- 3— Sweep Scale Icon

Figure 3-17

Example: Selecting 500ms, changes the sweep scale to a 500ms scale. The scale is “always” divided by 10, therefore each division is incremented by 50ms.

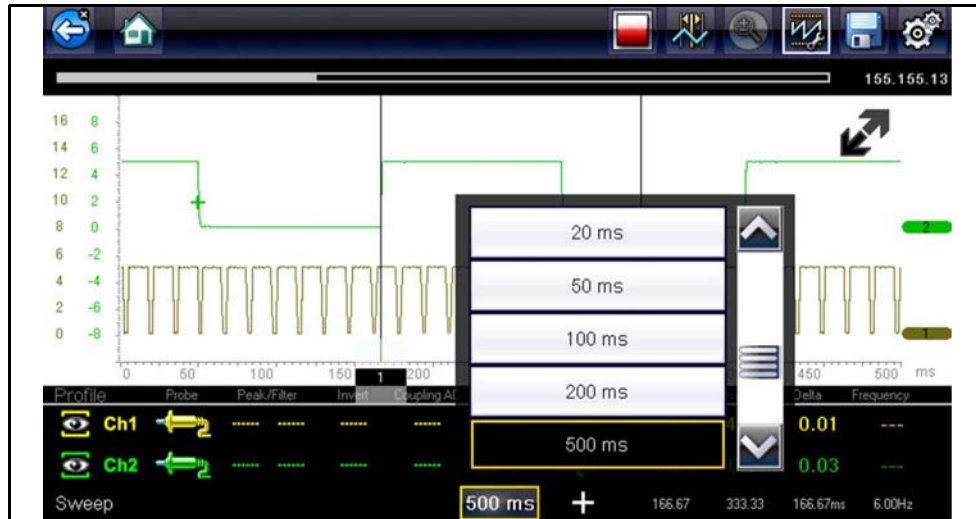


Figure 3-18

Probe (Probe type “test” selection)

Different types of Probes are available from the probe option menu, depending on which type of test you are performing. Changing the probe selection, also changes the vertical scale to the applicable type of measurement.

To select a Probe type, select the **Probe** icon to open the probe option menu, then select a probe. The probe icon will change to the selected probe. Select **Close** from the menu to close the menu.

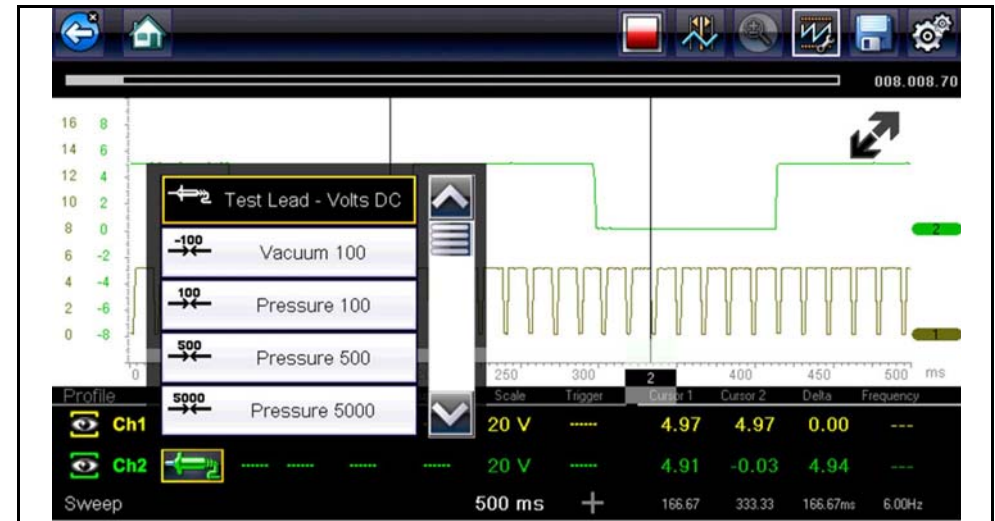


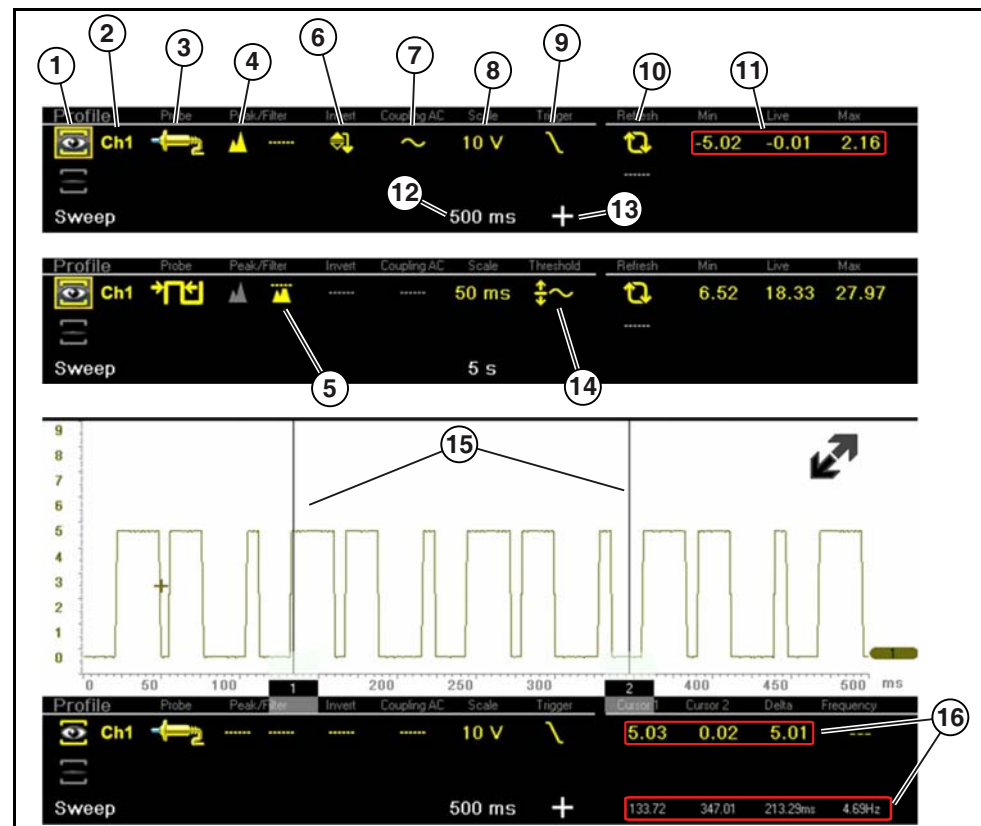
Figure 3-19 Probe option menu

For probe calibration information, see [Test Lead / Probe Calibration](#) on page 17.

Probe “test” Options	
Menu Option	Probe / Device Used
Test Lead - Volts DC	Standard Channel 1 and 2 test leads with alligator clips or test probes
Vacuum 100	(optional) 0-100 psi pressure transducer with pressure adapter
Pressure 100	
Pressure 500	(optional) 0-500 psi pressure transducer with pressure adapter
Pressure 5000	(optional) 0-5000 psi pressure transducer with pressure adapter
Low Amps 20	(optional) Low Amp Probe
Low Amps 40	
Low Amps 60	
Ignition	(optional) Secondary ignition adapter lead with desired secondary ignition coil adapter
EEDM506D Temperature	(optional) Part number - EEDM506D temperature adapter
MT5030 Vacuum	(optional) Part number - EEDM5030 0-500 pressure adapter
MT5030 Pressure	

Channel Settings

The majority of the channel (trace) settings and controls are located in the Control Panel. Each setting is represented by an icon, or a value. Icons are used to make adjustments, and the displayed values represent an individual characteristic. Depending on the test, applicable settings are displayed. The following image shows different views of the control panels to identify the different controls.



- 1— **Show/Hide (Channel display on/off)**—turns channel on/off
- 2— **Trace (Zero Baseline position adjustment)**—adjusts zero baseline position
- 3— **Probe (Probe type “test” selection)**—changes test probe function
- 4— **Peak Detect**—maximizes sampling rate
- 5— **Filter**—removes signal noise or interference
- 6— **Invert**—switches signal polarity
- 7— **Coupling AC**—blocks the DC portion of signal
- 8— **Scale (Vertical scale adjustment)**—adjusts vertical scale
- 9— **Trigger**—turns triggering on/off, and sets direction of trigger slope
- 10— **Refresh**—clears Min, Max and Live values and resets to zero
- 11— **Min, Live and Max Display Panel**—displays lowest, highest and current trace measurements set since the test was activated
- 12— **Sweep (Horizontal or Time scale adjustment)**—adjusts horizontal scale
- 13— **Trigger Position Icon**—opens trigger position control panel
- 14— **Threshold**—turns auto threshold on, to provide a more accurate measurement on select tests where noise is present (GMM only)
- 15— **Cursors**—used to measure time, amplitude and frequency
- 16— **Cursor Measurements Panel**—displays signal amplitude at cursor and cursor position in time

Figure 3-20



Show/Hide (Channel display on/off)

The Show/Hide icons allow you to turn the channels on and off.

To turn a channel on and off, select the applicable channel's **Show/Hide** icon.

Show/Hide Icons	
On (Channel displayed)	Off (Channel not displayed)

Trace (Zero Baseline position adjustment)

The Trace icon identifies the channel number and is used to open the zero baseline adjustment controls.

To adjust the vertical position of the zero baseline (0 value) of a trace (for either channel), select the **Trace** icon or to open the zero baseline adjustment controls. Select the up/down arrows to make adjustments or press the up/down directional buttons. Tap the main body screen section or press the **N/X** button, to exit.

The zero baseline can also be repositioned by touching and dragging the baseline marker up/down on the screen.

Trace Icon

Peak Detect

Peak Detect Off

When peak detect is off, the scope samples at a high rate but saves just enough sample points to the data buffer memory to plot a waveform across the screen. No preference is given to any point during the selection process.

NOTES

— Turning peak detect “off” is suitable for basic measurements, and viewing waveforms (e.g. oxygen (O2) or Cam sensor) when capturing fast events is not necessary.

— The longer the time sweep, the greater the chance a glitch could be missed because it occurred in between the sample points saved to the data buffer memory. To increase the chance of capturing a glitch with peak detect “off”, a shorter time sweep should be selected.

— Turning peak detect “off” avoids the need for an external filter to decrease the display of unwanted noise, which can make diagnosis more difficult.

Example: With a time sweep of 10 seconds on a screen 100 points wide, the effective sample rate would be 10 times a second. Decreasing the time sweep to 1 second, increases the effective sample rate to 100 times a second. At this time setting, a fast occurring event is more likely to be captured due to the increased rate. This is the standard mode of operation for many scopes.

Peak Detect On

When peak detect is “on”, all sample points are evaluated. The points stored to the data buffer memory are intelligently selected to capture fast events that might be missed at slower effective sample rates. Peak Detect captures fast events, spikes and glitches for signals going in both positive and negative directions.

NOTES

— Turn peak detect “on” when capturing fast events (e.g. ignition firing voltage, glitches, and intermittent events).

— Turning peak detect “on” may capture unwanted noise, therefore, using peak detect may not be suitable for some tests (e.g. oxygen (O2) sensor), as the waveform may be more difficult to evaluate due to the additional noise that may be displayed.

— Peak Detect decreases the possibility of waveform aliasing.



To turn peak detect on and off, select the **Peak Detect** icon.

Peak Detect Icons	
On (Sampling maximized)	Off (Sampling not maximized)

Filter

Using the filter feature can minimize or smooth out signal spikes and fast variations, depending on which function is its used with.

Filter - Lab Scope

Using the filter with the lab scope, smooths out fast spikes, which helps to provide a good balance between noise suppression and signal integrity.

Using the filter is useful when working with scales of 5 volts and below, as the lower the voltage scale, the more likely noise can occur.

Example: *Using the filter is helpful when testing components such as, an O2 sensor (1or 2 volt scale), or when performing a throttle position (TP) sensor sweep test (5 volt scale).*

In addition, the filter is also helpful for low amp probe tests, as a low voltage scale is used to measure the output of the probe (due to the conversion factors of the probe).

Example: *For a probe with a conversion factor of 100 mV/A connected to a 2 amp load, the scope uses a 200 mV scale to measure the output of the probe. The scope converts the measured output to 2 amps for display on the screen.*

Filter - GMM

Using the filter with the GMM, the filter minimizes noise by ignoring or smoothing out fast signal spikes.

- For a direct measurement test, such as volts, amps, or pressure, the filter minimizes the display of very fast spikes by averaging the sampled data when filter is active.
- For a calculated measurement test, such as frequency, pulse width, dwell, or duty cycle, extremely fast spikes (20 μ S and faster) from sources like the ignition system are ignored when filter is active.

To turn the filter on and off, select the **Filter** icon.

Filter Icons	
On (Interference is suppressed)	Off (Interference is not suppressed)

Invert

The Invert feature is used to switch signal polarity, so the trace appears upside down (inverted) on the screen. This is typically used when measuring amperage using the low amp probe, or high-voltage signals like, secondary ignition.

Example: *A signal that normally rises from 0 to +5 volts, if inverted would show falling from 0 to -5 volts.*

To turn inversion on/off, select the **Invert** icon.

Invert Icons	
On (Polarity is inverted)	Off (Polarity is not inverted)

Coupling AC

Coupling AC subtracts the average value of a signal so that small variations can be displayed in the waveform. This is accomplished by blocking the direct current (DC) portions of a signal in order to amplify (show) the alternating current (AC) portions of the signal, without driving the trace off of the screen.

Using coupling AC can be helpful when testing and diagnosing alternator ripple or fuel pump amperage, by allowing you to see any abnormal small variations or events.

To turn coupling AC on and off, select the **Coupling AC** icon.

Coupling AC Icons	
On (DC signal portion blocked)	Off (DC signal portion not blocked)

Trigger

NOTE

The Trigger feature is only available in the lab scope function.

A trigger can be used to stabilize a changing or erratic signal (a signal that may flicker or drift as it refreshes), so that it is easier to view or diagnose. This stabilization effect is accomplished by basically displaying the same part of the trace repeatedly from the same starting point, thus the flicker or drift is minimized which makes the trace appear more consistent or static.

A trigger is basically a “specific point” on the display, at which a trace will start to display (start the sweep) if it crosses that point.

The trigger feature allows you to set the conditions of that “specific point” also called a “trigger point”. When the trigger conditions are set, and a trace “meets” those conditions (crosses the trigger point), the trace will start.

Trigger conditions:

- **Vertical scale position (amplitude)**
- **Sweep position** - the horizontal scale position, or position in time
- **Slope direction** - the direction the trace must be moving (up/rising or positive) or (down/falling or negative) when crossing the trigger point.

NOTES

Triggers can be set on any channel, however only one trigger can be activated (used) at a time.

If a trigger is set outside the range of the scales, a yellow marker (e.g. arrow with plus symbol) will be displayed (Figure 3-22) indicating the trigger is out of range and a confirmation screen will display.

When a trigger is set on a channel, and more than one channel is active (displayed), trigger conditions must be met for that channel in order to display all the other channels.




To turn a trigger on/off:

A trigger is activated by selecting the trigger icon from the control panel, which then automatically initiates trigger slope setup.

3. Select the desired channel's **Trigger** icon.

Each tap of the icon sets the trigger to a different slope setting, or turns the trigger off.

4. Select the desired slope setting, to turn the trigger on.

Trigger Icon	Description
	Rising (up or positive) - Trigger is turned on to start the trace on the rising edge (as signal begins to rise)
	Falling (down or negative) - Trigger is turned on to start the trace on the falling edge (as signal begins to fall)
	Off - Trigger is turned off.

5. Proceed to “**To set trigger position**” next to complete the trigger set up.



To set trigger position:

Trigger position (also called trigger level) can be adjusted in two ways:

- Dragging the trigger marker (Figure 3-21) on the touch screen - rough adjustment
- Using the trigger position control panel (Figure 3-21) - fine adjustment

The trigger marker is indicated by a plus symbol (+) on the display (Figure 3-22). The trigger marker represents the trigger point and is displayed on the screen when the trigger is turned on.

To roughly position the trigger marker, select and drag it into position using the touch screen.

6. To more accurately position the trigger marker, select the **Trigger Position Control** icon (Figure 3-22).

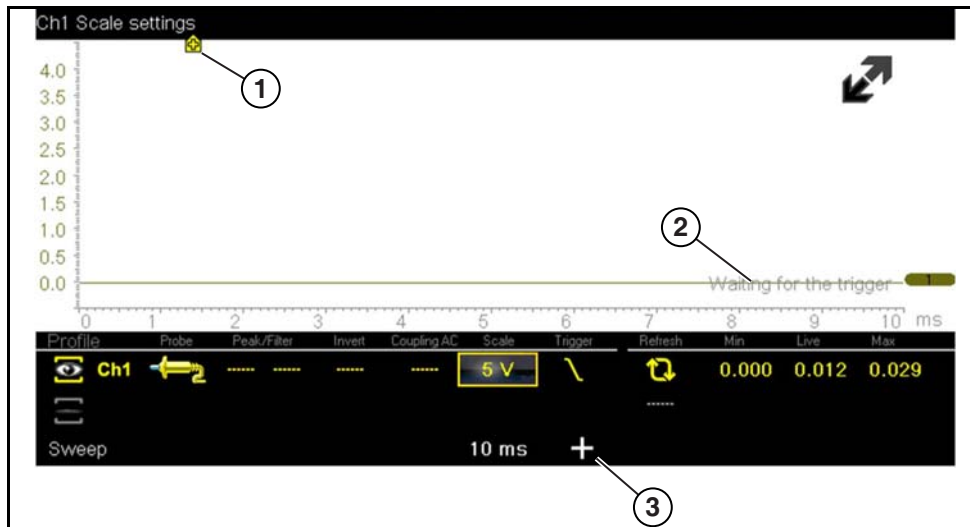
The trigger position control panel opens.

7. Use the directional controls provided, or the thumbpad directional controls to move the trigger marker into position (Figure 3-21). Sweep and vertical scale values are provided in the trigger position control panel, which gives you the precise position of the trigger marker.
8. Press the **N/X** button, to exit.



- 1— Trigger Marker
2— Trigger Position Control Panel

Figure 3-21 Trigger marker and position controls



- 1— Trigger Marker (out of range symbol)
2— Waiting for Trigger Message
3— Trigger Position Control Icon

Figure 3-22

Trigger Auto/Manual Mode (Optional Setting)

NOTE

The Auto and Manual Trigger modes allow you to set the criteria used to display signals on the screen. To change the trigger mode, the trigger must be set on one of the channels.

In both Auto and Manual Trigger mode the screen is updated when the signal crosses the trigger point in the selected direction (rising or falling), however:

- **Auto Trigger**—(default mode)
 - when Auto Trigger is on, even if the signal does not cross the trigger point, the screen automatically updates after a short period (allowing you to see the waveform). When this occurs, the message "Waiting for the trigger" (Figure 3-22) is displayed on the screen. The trigger point can then be set to optimize viewing.
- **Manual Trigger**
 - when Manual Trigger is on, if the signal does not cross the trigger point the screen will not update. This allows you to capture intermittent events, as the screen only updates when the signal meets your trigger selection.

NOTE

When using Manual Trigger, it may be easier to initially set the trigger point using Auto Trigger, as the screen will update regardless if the signal crosses the trigger point. Once the trigger point is set, then switch to Manual Trigger mode.

Selecting Trigger Auto/Manual Mode:

1. From the Control Panel (on the test meter screen), turn the trigger on for the desired channel.
2. Select the **Settings** icon from the toolbar.
3. Select **Settings > Configure Scope / Meter > Trigger Mode** from the menu selections.
4. Select either **Auto Trigger** or **Manual Trigger**.
5. Select **Back** or press the **N/X** button to navigate back to the test meter screen.

Threshold

NOTE

The Threshold function is only available in the Graphing Meter function for specific tests. This function may also be referred to as Auto Threshold Select (ATS).

The Threshold function can be used, to display and obtain a more accurate measurement when measuring signals (e.g. Frequency, Duty Cycle, MC Dwell and Pulse Width) that may be difficult to display or have noise or other undesirable variations in the signal. When selected, the Threshold function automatically sets a trigger and determines a threshold level in the middle of the signal range (calculated from the Min and Max measurements) to be used as a reference point to calculate the measurement. The falling edge (slope) of the signal is used in determining the threshold level.

To activate the Threshold function, select the **Threshold** icon, then select **Continue** from the confirmation screen (Figure 3-23). Once selected, the Threshold function remains active until the test is exited.

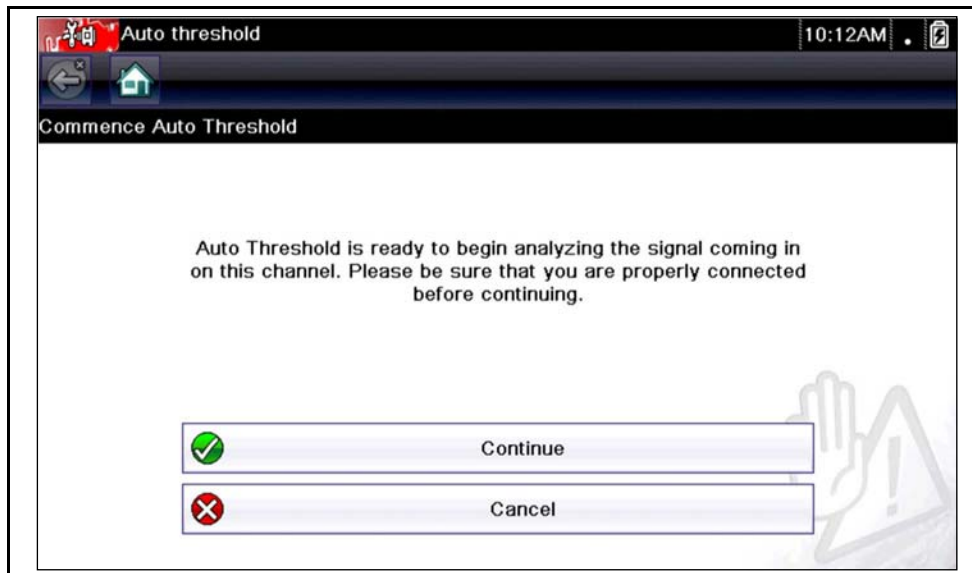


Figure 3-23 Auto Threshold Confirmation Screen

If after enabling the Threshold function, if the signal is still not displayed, reduce the vertical scale setting. Sometimes a low frequency signal may not display if the

vertical scale is set too high. If the signal still seems incorrect use the lab scope to verify the signal integrity and signal spacing. Slow or unequal spacing will display as a band or ragged signal, depending on the sweep setting.

Refresh

Selecting the **Refresh** icon (Figure 3-24) clears the active trace(s) displayed and restarts the signal tracking from zero. It also clears the minimum, maximum and live measurements displayed for both channels.

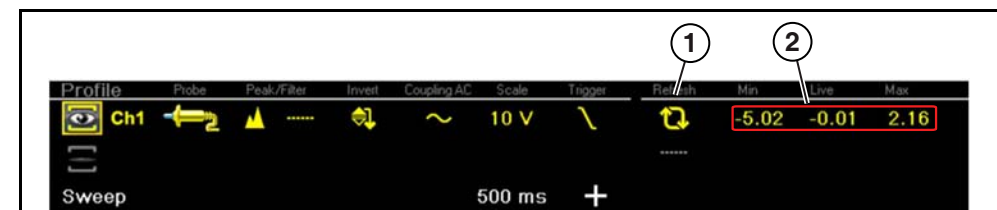
Use the Refresh feature to:

- Track the variation in a component or circuit under a certain condition. If the condition changes, Refresh lets you start tracking again to see the change.
- Verify that a connection problem you found by looking for a dropout or spike in min/max values has been fixed.

Min, Live and Max Display Panel

When Cursors are turned off, the Min, Live and Max display panel (Figure 3-24) is turned on displaying each channel's active signal minimum and maximum recorded measurements and live measurement.

- **Min** - lowest measurement recorded for the signal since the test was activated, or from the last time Refresh was selected
- **Max** - highest measurement recorded for the signal since the test was activated, or from the last time Refresh was selected
- **Live** - represents the "live" running average measurement of the signal being measured



1— Refresh Icon

2— Min, Live, Max Display Panel

Figure 3-24

Cursors

NOTE

The Cursors feature is only available in the lab scope and Graphing Meter functions.

Two vertical cursors are provided that allow you to make precise signal measurements, when determining signal characteristics such as, amplitude at specific points, and cycle time (duration) or frequency.

Using cursors can also be helpful when performing certain diagnostic tests, such as:

- O2 sensor rich/lean switch time
- fuel injector pulse width frequency
- secondary ignition spark duration
- crankshaft position sensor frequency

Measurements can quickly be taken between the two cursors, when measuring a single cycle or across multiple cycles by positioning the cursors at the start and end of the cycle or multiple cycles.

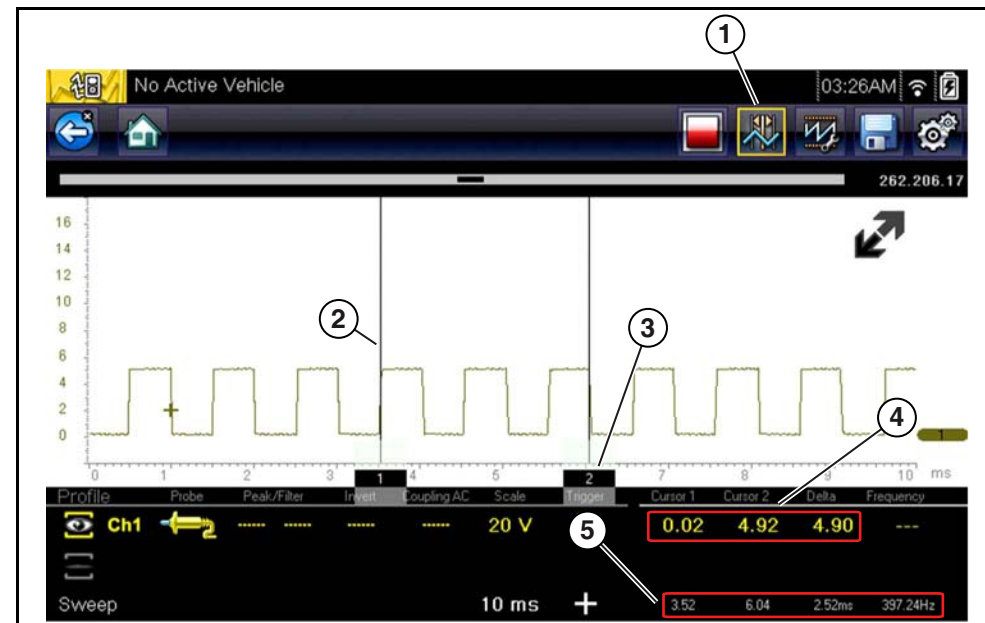
The cursor measurements panel is displayed when using the cursors, providing you digital values of the cursor measurements. See [Cursor Measurements Panel](#) on page 28 for additional information on the values displayed in the cursor measurements panel.

▶ To turn the cursors on/off:

To turn the Cursors on (display), select the **Cursor** icon from the toolbar.

Two cursors are displayed on the test screen, and the Refresh, Min, Live, Max display panel is switched off and replaced by the cursor measurements panel. See [Cursor Measurements Panel](#) on page 28 for additional information on the cursor measurements panel.

To turn the Cursors off, select the **Cursor** icon again from the toolbar.



1— Cursors Icon

2— Cursor (no. 1)

3— Cursor Marker (no. 2)

4— Cursor Measurement Panel - amplitude and delta display

5— Cursor Measurement Panel - time and delta display

Figure 3-25

▶ To position the cursors:

The cursors can be positioned anywhere within the range of the sweep scale ([Figure 3-25](#)).

1. Turn the Cursors on.
2. Using the touch screen, select either cursor marker (base) and drag it to the desired position.



Cursor Measurements Panel

When the cursors are turned on, the Refresh, Min, Live, Max display panel is switched off and replaced by the Cursor Measurements Panel.

The cursor measurements panel displays the following signal and cursor measurements:

- Signal amplitude at two points
- Signal amplitude difference (delta) between two points
- Cursor position in time at two points
- Difference (delta) in time between the cursors
- Frequency - frequency of the signal for the time period between cursor 1 and 2

The cursor measurements panel contains values for each channel in two displays.

The amplitude and delta display is provided in the channel specific color and includes:

- **Cursor 1** - signal amplitude at cursor 1 position
- **Cursor 2** - signal amplitude at cursor 2 position
- **Delta** - signal amplitude difference between cursor 1 and 2

The time and delta display is gray in color and includes:

- **Cursor 1** - cursor position in time at cursor 1
- **Cursor 2** - cursor position in time at cursor 2
- **Delta** - difference in time between cursor 1 and 2
- **Frequency** - the frequency value (Hz) of the signal for the time period between cursor 1 and 2

NOTES

Frequency is the number of times a signal repeats itself per second and is measured in hertz (Hz).

The frequency value displayed, is the inverse of the Delta value, and can also be calculated as 1 divided by Delta. The frequency value (Hz) shown is automatically calculated by the scope.

Example 1: Delta = 20.46ms, to get frequency divide 1 by .02046 (1/.02046 = 48.87Hz)

Example 2: Delta = 2.53ms, to get frequency divide 1 by .00253 (1/.00253 = 395.27Hz)

Use applicable decimal point placement during division as the Delta value changes.

3.8.4 Secondary Ignition Testing

The lab scope function can be used to display secondary ignition waveforms for conventional and select CIC and COP systems. To display secondary ignition waveforms, optional secondary ignition coil adapter(s) and a coil adapter lead assembly are required.

Contact your sales representative to purchase the optional adapter leads and/or Secondary Ignition Clip-on or COP/CIC Adapters.

- Adapter lead assembly needed:
 - Secondary Coil Adapter Lead Assembly - connects the diagnostic tool to a secondary ignition adapter (yellow and black scope connectors and black RCA type adapter connector). See [Secondary Ignition Coil Adapter Lead and Clip-on Adapter \(optional\)](#) on page 13.
- Secondary Ignition Adapters available:

Different secondary ignition coil adapters are available as optional equipment. These adapters attach to either the secondary lead (spark plug lead) or directly to the secondary ignition coil in order to pick up the secondary ignition signal.

 - Universal kV Ignition Clip-on adapter - clips over a spark plug or coil lead. See [Secondary Ignition Coil Adapter Lead and Clip-on Adapter \(optional\)](#) on page 13.
 - Universal stick and flag type adapters - are loosely positioned next to or on a secondary ignition coil.



- General purpose single flag pick-up.
- General purpose stick pick-up.
- Vehicle specific Clip-on adapters - are directly attached to (or next to) a secondary ignition coil (COP type) or to a distributor cap (CIC type). Secondary ignition coil-on-plug (COP) and coil-in-cap (CIC) adapters are available for universal and engine specific applications. All the adapters listed are available individually.
 - OEM specific COP adapters:
 - *Ford (COP-1)*
 - *Chrysler (COP-2)*
 - *VW/Audi (COP-3)*
 - *Acura/Honda/Isuzu (COP-4)*
 - *Volvo/BMW (COP-5)*
 - *Mercedes-Benz (COP-6)*
 - *Mercedes-Benz Dual Type (COP-7)*
 - *BMW (COP-8)*
 - *Lexus (COP-9)*
 - *Chrysler/Jeep/Lexus/Toyota (COP-11)*
 - OEM specific CIC adapters:
 - *GM HEI (CIC-1)*
 - *Toyota/Honda (CIC-2)*



Connecting the Secondary Coil Adapter Leads:

1. Connect the black (ground) lead into the diagnostic tool test lead ground jack.
2. Connect the yellow lead into the diagnostic tool test lead channel 1 jack.
3. Connect the adapter lead ground clamp to vehicle ground. If a jumper wire is used to extend the length of the adapter lead ground clamp lead, keep it as short as possible.
4. Connect the adapter lead RCA plug into the secondary ignition "clip-on" or COP/CIC coil adapter as needed.
5. Clamp the secondary clip-on adapter over a spark plug or coil lead, or attach the applicable COP/CIC coil adapter to the vehicle ignition coil.
6. Isolate the leads from other components, to avoid any unwanted noise that could be induced onto the signal.
7. From the lab scope function, select the Ignition Probe (probe setting).
8. If needed, turn the Invert function on.

Once a signal is displayed, further channel settings may be required to display the pattern characteristics you are looking for.

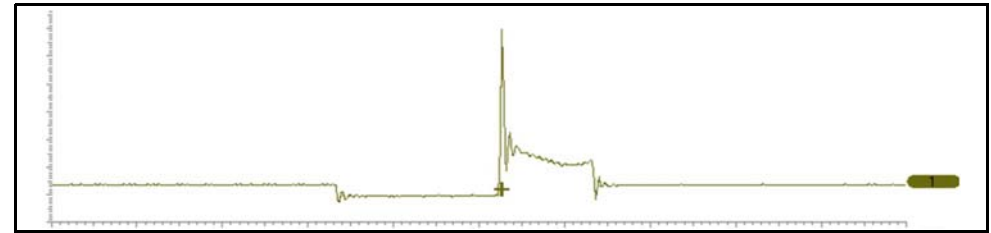


Figure 3-26 Typical Secondary Ignition Signal

3.9 Optional Settings

The following optional Scope/Meter settings are available, and can be set to your preference:

- [Trigger Auto/Manual Mode \(Optional Setting\)](#) on page 25
- [Display \(Grid on/off\)](#) on page 30
- [Divisions](#) on page 30

All optional settings are available from the Tools icon located on the Home screen. Select **Tools > Settings > Configure Scope/Meter** to access the options menu.

3.9.1 Display (Grid on/off)

The Display option allows you to turn the screen grid on/off.

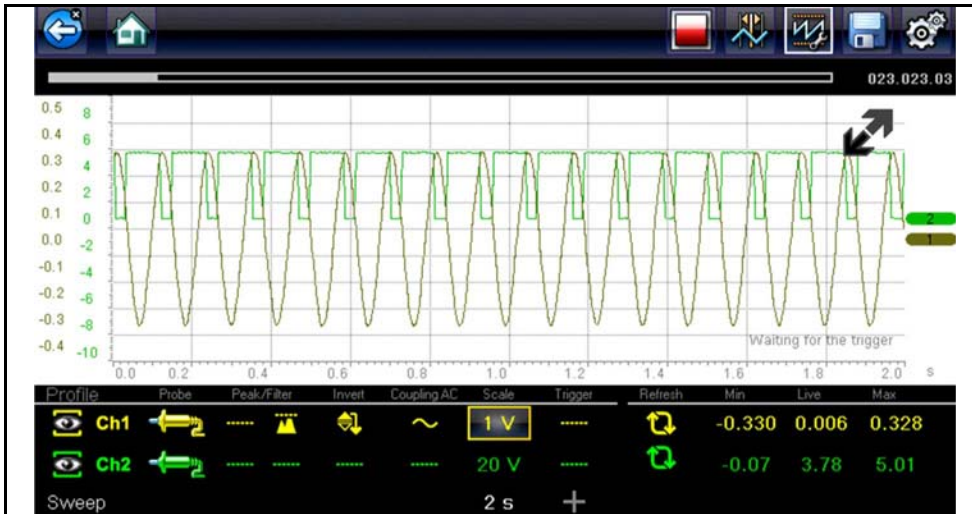


Figure 3-27 Grid on

- ▶ Changing the Display (grid on/off):**
1. Select the **Tools** icon from the Home screen.
 2. Select **Settings > Configure Scope/Meter > Display** from the menu options.
 3. Select the desired option:
 - **Show Grid**—turns grid lines on
 - **Hide Grid**—turns grid lines off
 4. Select the **Back** icon or press the **N/X** button to return to the Settings menu.

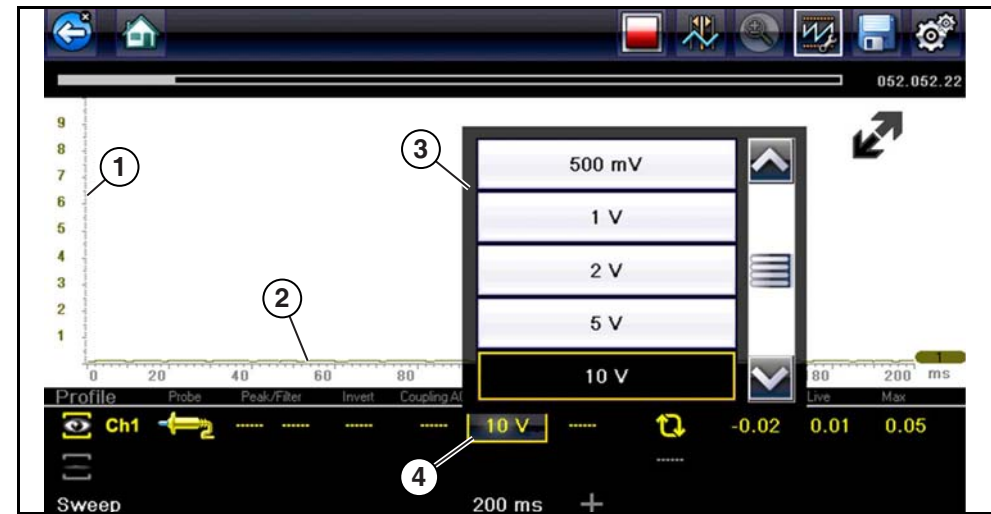
3.9.2 Divisions

The Divisions options allow you to change (to your preference) how the Vertical Scale Menu selections are represented, and the type of value that displays in the Vertical Scale icon.

This section describes the following settings:

- **Trace**
 - Trace Full Scale
 - Trace Per Division
- **Display**
 - Display Full Scale
 - Display Per Division

The following illustration is for reference, and identifies key terms and features used in this manual.



- 1— Vertical Scale
- 2— Sweep (horizontal or time) Scale
- 3— Vertical Scale Menu
- 4— Vertical Scale Icon

Figure 3-28

- To access the divisions option menu:**
1. Select **Tools** from the Home screen.
 2. Select **Settings** from the Tools and Setup menu.
 3. Select **Configure Scope/Meter** from the Settings menu.
 4. Select **Divisions** from the menu.
 5. Select either option:
 - **Trace Settings** - see [Trace Settings](#) on page 31
 - **Display Settings** - see [Display Settings](#) on page 32
 6. Select the **Back** icon or press the **N/X** button to return to the Settings menu.

Trace Settings

The Trace Settings option allows you to change how the vertical scale menu selections are represented.

NOTES

This setting ONLY changes the vertical scale, the sweep (horizontal) scale is NOT changed.

NOTES

When adjusting the vertical scale setting, it is important to remember that the vertical scale is divided into 10 major divisions, and all scale adjustments reflect this factor of 10. The division set of 10 cannot be changed, divisions cannot be added or removed.

Trace Full Scale - changes the dropdown vertical scale menu selections to full scale mode, which represents the selected unit of measurement over the entire (full) scale.

Example (Figure 3-29): Selecting 10V, changes the vertical scale to a 10V volt scale. The vertical scale is “always” divided by 10, therefore each division is incremented by 1V.

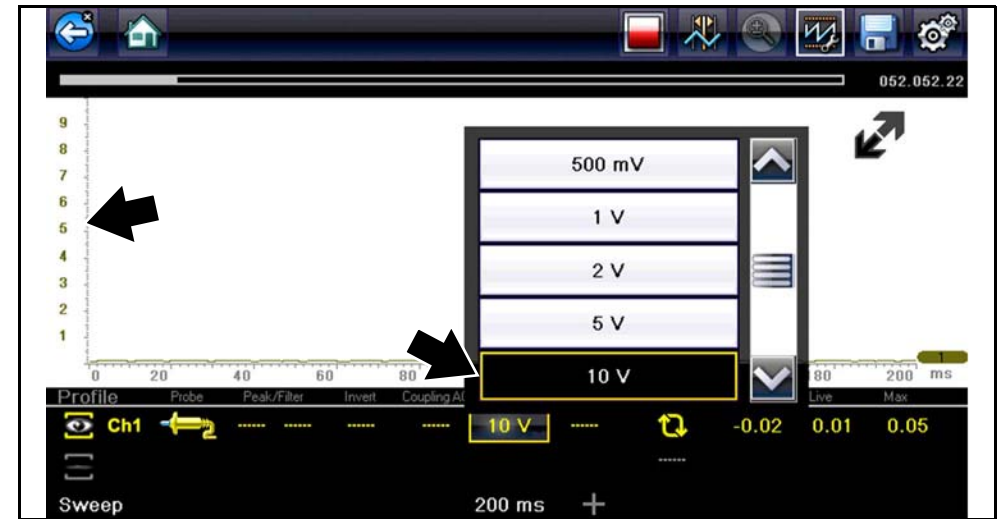


Figure 3-29

Trace Per Division - changes the dropdown vertical scale menu selections to ##/div mode, which in turn changes the vertical scale to represent ## by division.

- represents (variable) what is being measured (voltage, amperage, pressure etc.)

Example (Figure 3-30): Selecting 1.0V/div, displays a vertical scale divided by 10. The vertical scale is “always” divided by 10, therefore each division is incremented by 1.0V, thus a 10V scale.

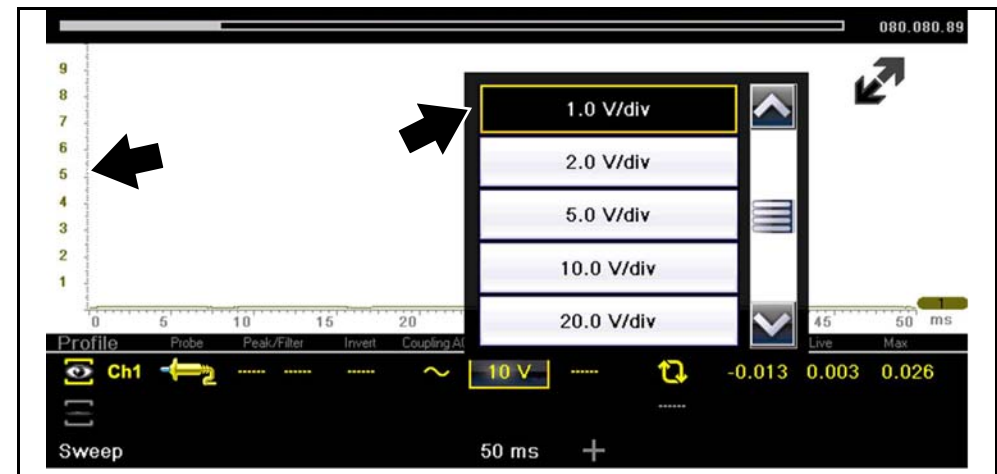


Figure 3-30

Display Settings

The Display setting allows you to change the displayed value in the Vertical Scale icon to your preference.

NOTE

This setting *ONLY* changes the value displayed in the Vertical Scale icon.

Display Full Scale - displays the value of the entire (full) scale

Example (Figure 3-31): If the vertical scale is set to 1V, the value displayed is 1V.

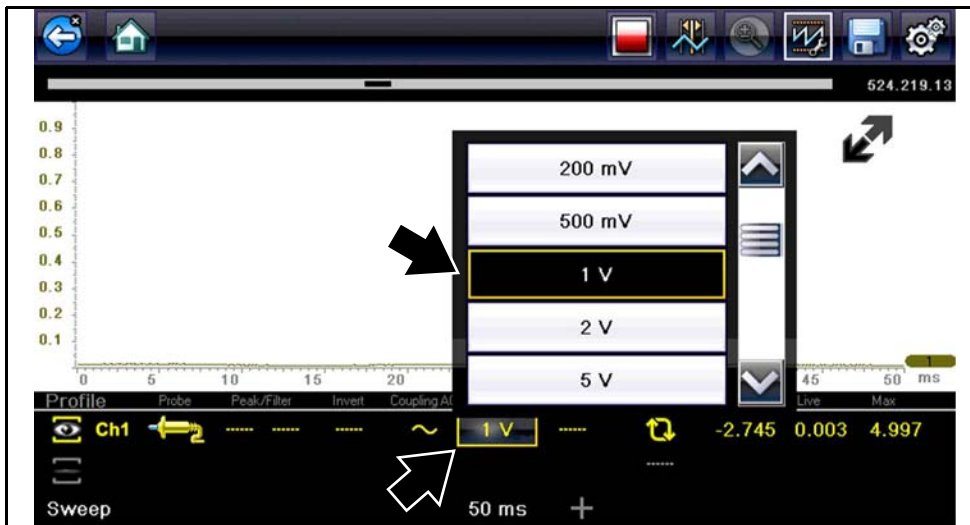


Figure 3-31

Display Per Division - displays the graduation value of the major scale divisions

Example (Figure 3-32): If the vertical scale is set to 1V, the value displayed is 0.1V.

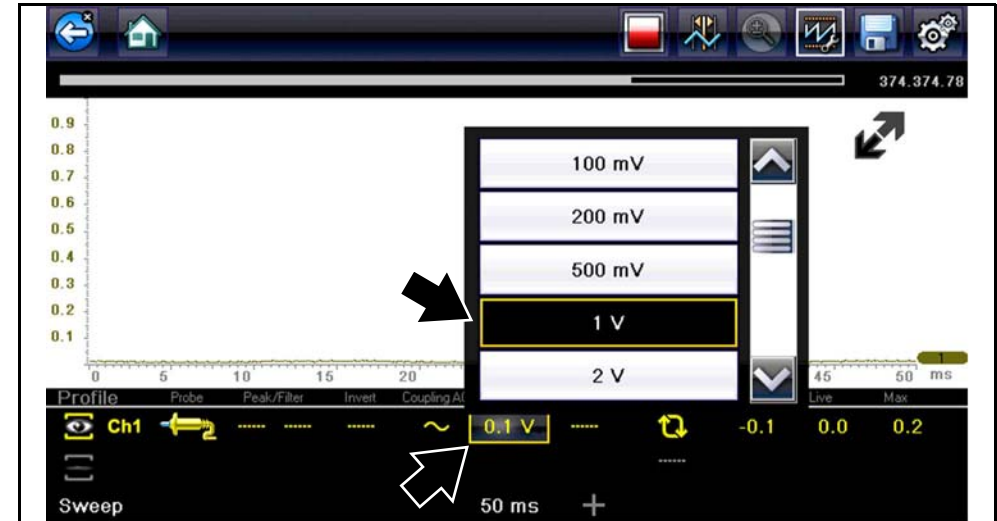


Figure 3-32

3.10 Capturing Data

The primary purpose and advantage of the Lab Scope and Graphing Multimeter, is their ability to capture, store and playback data (test signals). Having this ability can be invaluable when diagnosing intermittent issues, by providing you the ability to navigate through the data in detail to find events of interest, such as glitches and signal losses. The following sections describe the basics of the data buffer and the two basic modes of operation, Capture Mode and Review Mode.

3.10.1 About the Data Buffer

To gain a better understanding of the capabilities of the scope and the basics of capturing and reviewing data, understanding what the data buffer is and how it works is important.

The Lab Scope and Graphing Multimeter have the capability to capture, store and playback data (test signals) utilizing internal buffer storage memory. When a test function is selected (e.g. Lab Scope > DC Volts), the data is automatically stored in buffer memory, until the Pause icon is selected.

The amount of data you can capture is limited to a predetermined “total buffer memory” size. When the buffer memory reaches its full capacity, the data buffer will continue to store new data, however earlier stored data will be removed to allow room for the new data being stored. The most recent data is always available for review when the scope is paused, and can be reviewed using the toolbar controls

As a visual aid, a graphic Data Buffer Slider ([Figure 3-33 \(1\)](#)) is located at the top of screen and indicates the position of the current displayed frame of data in relation to the entire buffer memory capacity. **Note:** In Review Mode, the slider can be used to quickly move through paused data.

In addition, a Data Buffer Position Counter ([Figure 3-33 \(2\)](#)) displays the numerical position of the Data Buffer Slider within buffer memory.



1— Data Buffer Slider

2— Data Buffer Position Counter (XXX (Total memory “frames” available):
XXX (Whole frame number): XX (Fractional frame number)

Figure 3-33

3.10.2 Capturing Data (Capture Mode)

For control icon descriptions, see [Scope Multimeter Control Icons](#) on page 15.

Whenever you open Lab Scope or the Graphing Multimeter, the device is in Capture Mode. In Capture Mode, data is continuously being captured and stored in buffer memory at the same time it is being displayed onscreen.

i NOTE

Data is continuously stored in buffer memory with or without an active input test signal or trigger.

To help you understand how to work with captured data, an important concept to remember is that data is captured over a period of time. Therefore there is a direct relationship between the length of time the data is captured in, and the resultant level of detail you will have when reviewing it.

As every testing situation is different, the following is provided only as a guide when capturing data to provide the best flexibility when reviewing the data to find events.

In most situations if you start by using a sweep setting that is best suited for viewing the waveform “live”, or at a setting that provides the best detail to the naked eye, this will allow you to either see the event you are looking for “live”, or allow you to use the zoom feature (in Review Mode) to zoom out (2, 8, 32X etc.) and then search through the data buffer for events of interest.

It is important to remember that whatever sweep setting you use during data capture is what the 1X zoom level will be when you switch to Review Mode. Therefore, if you capture data using a sweep setting where the pattern displayed is tightly compacted (can’t visually see detail), then when you try to use zoom you will not be able to see any detail, as you will only be able to zoom out from the setting where you originally captured the data (displaying an even greater level of compacted data).

In other situations you may need to start at a faster sweep (shorter time) to capture more detail “live”, then zoom out (in Review Mode) to get a wider view and then zoom in at the points of interest where you need more detail. Using this strategy you will capture less total time, but be able to see more detail.

For some situations, if the sweep setting you are using is not fast enough to capture the event your looking for, turning Peak Detect on will increase the sample rate and may allow you to see the event.

Using peak detect can also help in avoiding aliasing if the sweep time is too great for the waveform being captured. Using peak detect is not appropriate for every instance, but when using longer sweep settings, it can help increase the capture time by allowing you to capture more than you could without it and still capture dropouts and points of interest. See [Peak Detect](#) on page 22 for more information.

For additional information on setup and capturing data (input signals) see [General Reference](#) on page 38.

NOTE

Glitches may cause drivability problems and may not turn on the MIL or set DTCs. As a general guide when looking for a suspected signal glitch, always try to verify the problem by duplicating the conditions while capturing data. Utilize the GMM to monitor the signal over longer time periods and review the histogram for possible faults.

3.10.3 Pausing Data

Data continuously stores in buffer memory until the **Pause** icon is selected.

Selecting the **Pause** icon, allows you to temporarily pause the data (input test signal) to review it in detail. See [Reviewing Data and Using Zoom \(Review Mode\)](#) on page 34 for more information.

To resume data capture, select the **Start** icon.

3.10.4 Reviewing Data and Using Zoom (Review Mode)

For control icon descriptions, see [Scope Multimeter Control Icons](#) on page 15.

Review Mode allows you to search through the captured data in detail to find events of interest, such as glitches and signal losses.

Press the **Pause** icon ([Figure 3-34](#)) to open Review Mode.

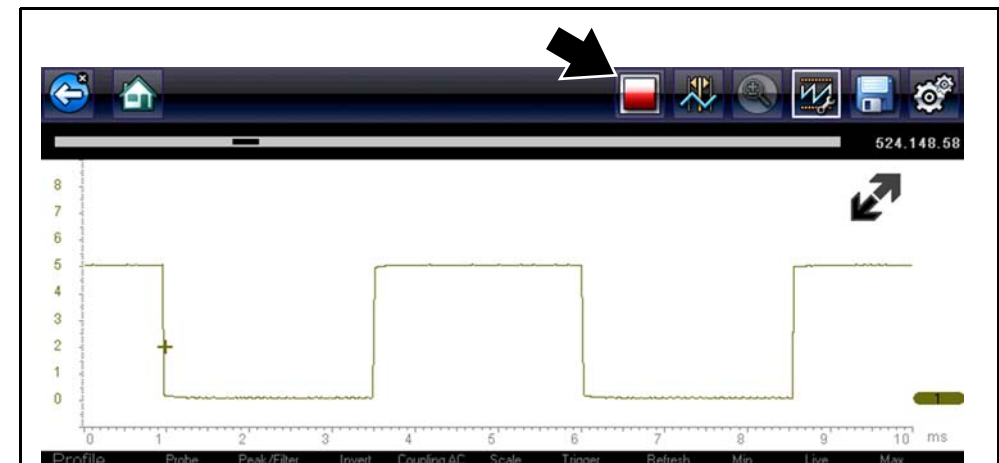
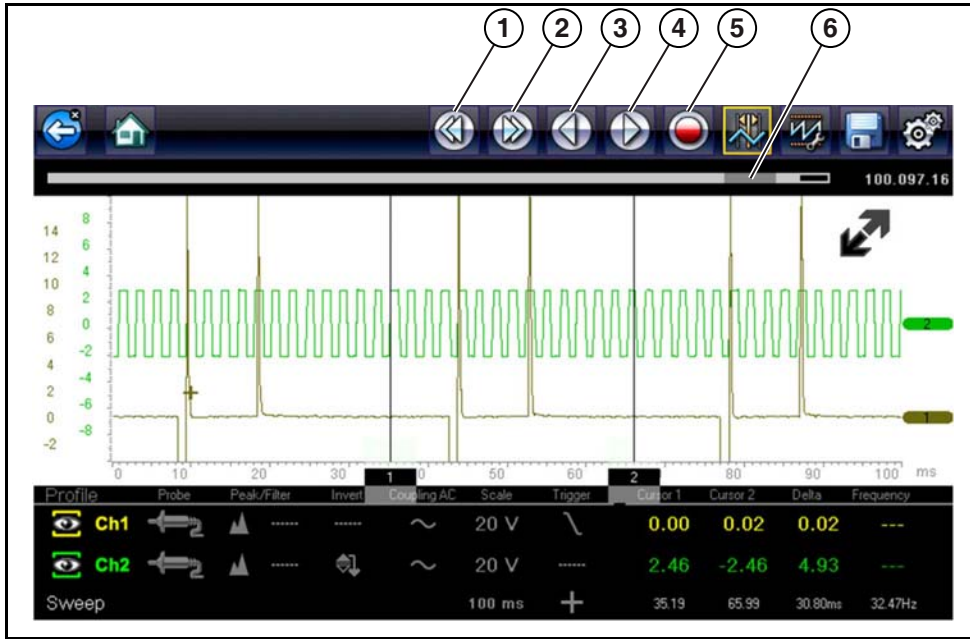


Figure 3-34

To search through the captured data, select the desired control icon to move forward or backward through the data. The following control icons ([Figure 3-35](#)) are active in Review Mode:

NOTE

You can also use the data buffer slider to quickly scroll through the captured data in buffer memory.



- 1— **Back 1 Frame** Moves to the previous frame in the data
- 2— **Forward 1 Frame** Moves to the next frame in the data
- 3— **Step Back** Moves to the previous point in the data
- 4— **Step Forward** Moves to the next point in the data
- 5— **Start (Capture)** Resumes data capture
- 6— **Data Buffer Slider**

Figure 3-35

NOTE

As there is a direct relationship between the length of time the data is captured in, and the resultant level of detail you will have when reviewing it, review the information in [Capturing Data](#) on page 33 for tips on capturing and reviewing data.

Using Zoom

For control icon descriptions, see [Scope Multimeter Control Icons](#) on page 15.

The zoom function is only available in Review Mode, and can be an invaluable tool when searching for events of interest within captured data. Zoom effectively gives you the ability to change the magnification level of the signal sweep during data review.

As zoom, allows you to change the magnification level of the signal sweep, this allows you to compress or expand multiple screens of data to quickly find glitches, or signal losses.

NOTE

Control icon function is normal when using zoom, with the following exception:

Forward 1 Frame / Back 1 Frame control icons - (press once) moves multiple frames relative to the set magnification level (e.g. 2X setting, moves 2 frames; 16X setting, moves 16 frames).



When the **Zoom** icon is selected ([Figure 3-36](#)) the display defaults to the "Max" magnification level and a dropdown scroll menu will display.

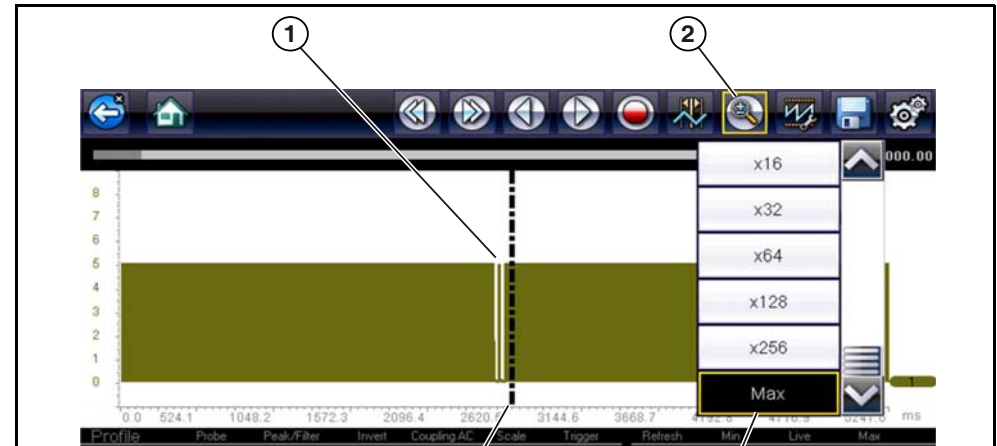


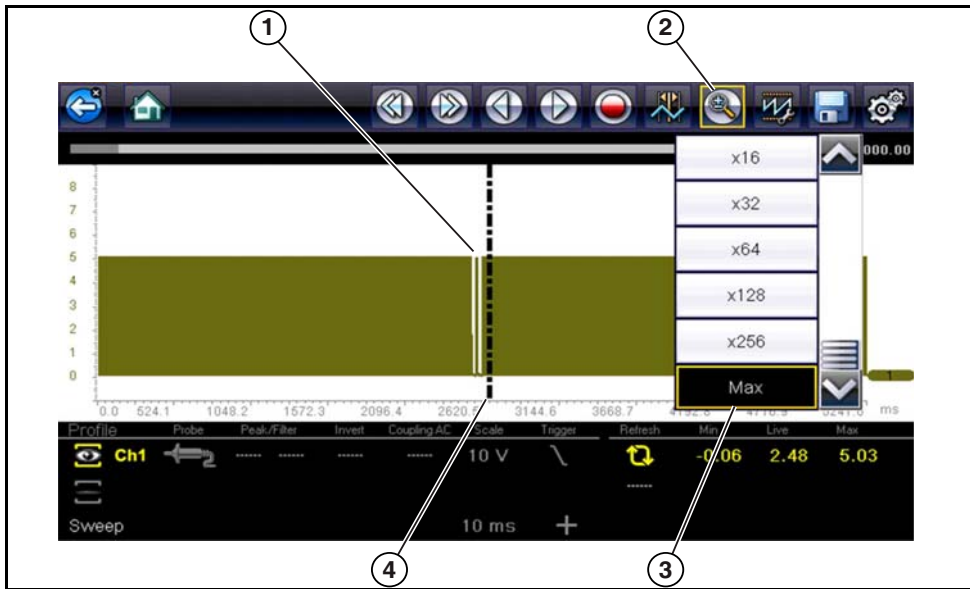
Figure 3-36

The dropdown menu allows you to select the display magnification level from a range of 1X to 512X (Max). The "Max" (maximum) option displays all data captured on one screen ([Figure 3-37](#)).

NOTE

It is important to remember that whatever sweep setting you used during data capture is what the 1X zoom level will show.

The active zoom options (1X to 512X (Max)) that are selectable are dependent on the amount of data stored in the buffer. Less data captured = less zoom options. More data captured = more zoom options.



1. Glitch
2. Zoom Icon
3. Zoom Magnification Level (Max shown)
4. Zoom Cursor

Figure 3-37 "Max" Magnification Level - displays all captured data

When zoom levels of 2X and higher are selected, a Zoom cursor (vertical dashed line) (Figure 3-37) displays onscreen. The cursor is used to quickly mark and navigate to points of interest or glitch in a captured waveform.

NOTE

To quickly identify a glitch in a pattern, it may be easier to initially view the waveform at a higher magnification level (e.g. 256X or "Max") to display the entire captured waveform, find the area of interest and then lower the zoom level to 8X or 2X to review that area in detail. See [Zoom Example](#) on page 37.

The Zoom cursor can be used to mark the approximate position of a glitch and can be manually dragged onscreen to the desired position. The new cursor position will be centered on the screen when a lower magnification level is selected.

Figure 3-38 shows an example at Max with the Zoom cursor positioned in the area of a signal drop glitch.

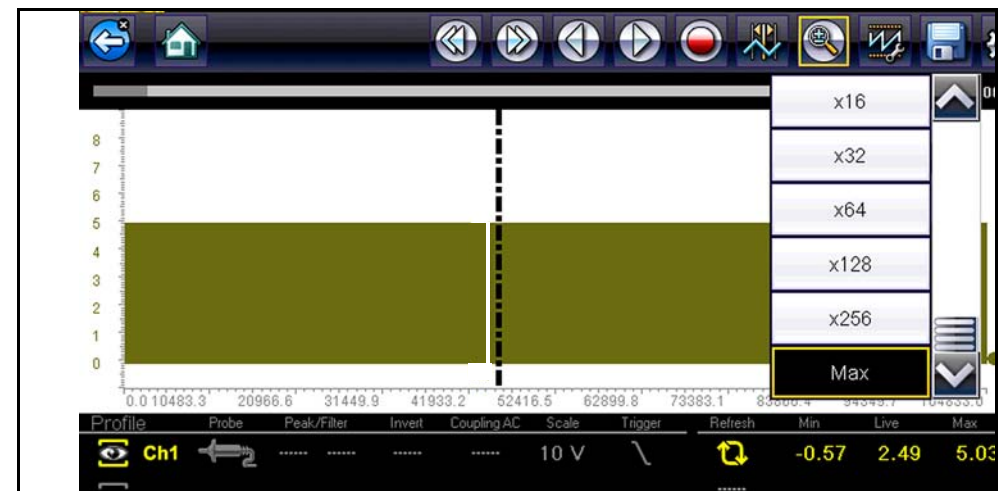


Figure 3-38



Figure 3-39 shows an example at 16X of the same waveform shown in Figure 3-38. In Figure 3-39 at 16X, the glitch is easily seen as compared to higher magnification levels.

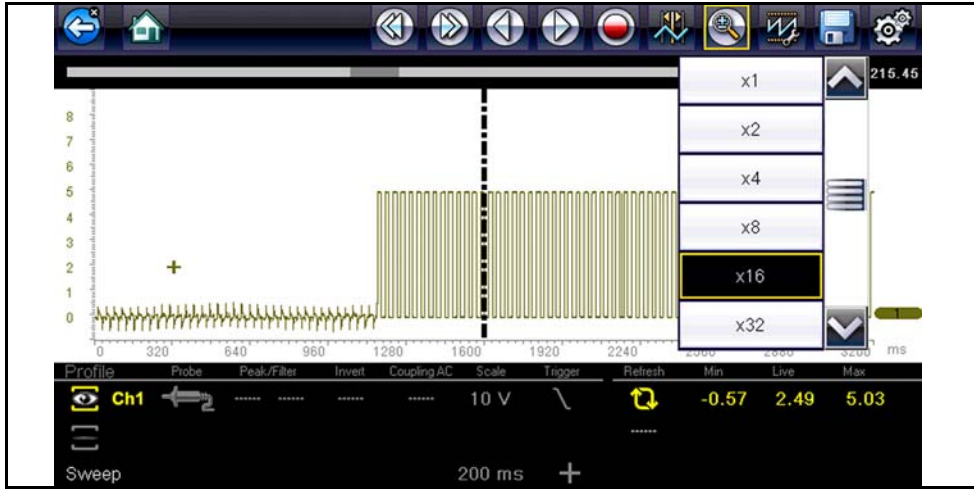


Figure 3-39

Zoom Example

While monitoring a MAF (Mass Air Flow Sensor) signal, the waveform displays normally. As the signal is being monitored, an erratic “condition” suddenly develops, then goes away, but may have not been observed on the screen. Pausing the data capture (when such an event occurs) allows you to analyze the waveform using a higher zoom level (wider view) to look for a glitch in the signal. The following **three** illustrations show a generic square waveform to illustrate this method.

1 - Monitoring / Capturing waveform as it displays normally (Figure 3-40). You may not see a glitch, while monitoring at this setting.

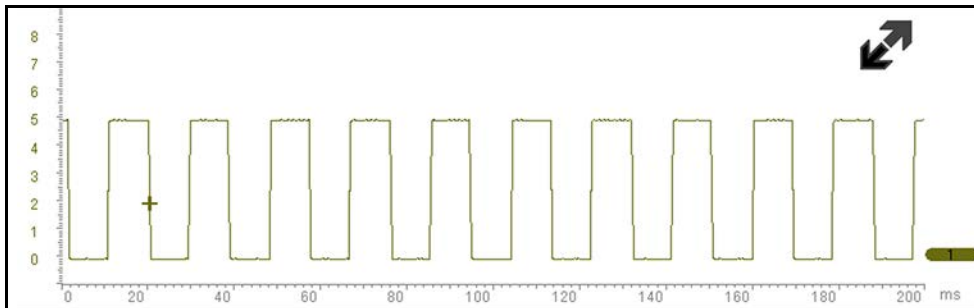


Figure 3-40

2 - Pause data capture and then zoom out (this example is at 256X) to see more data and to possibly find a glitch (Figure 3-41). In this example the cursor has been placed on the right side of a glitch. The waveform is too compressed to see any detail, however the glitch stands out as a thin light area in the waveform.

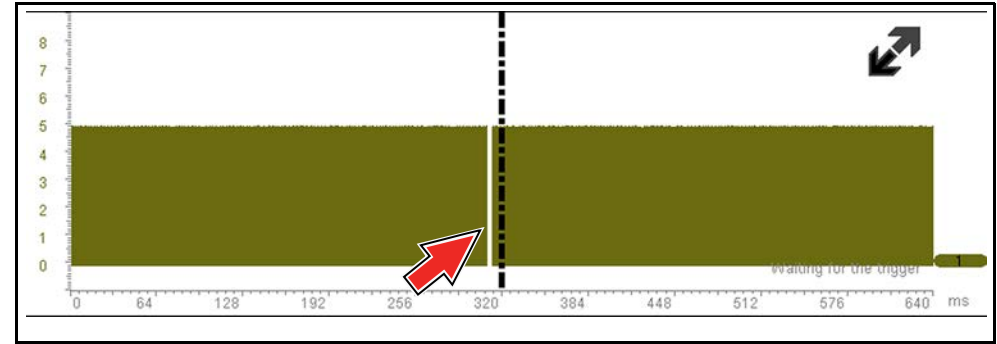


Figure 3-41

3 - Zoom back in (this example is at 8X) to view more detail (Figure 3-42) in the area where the cursor was placed by the glitch.

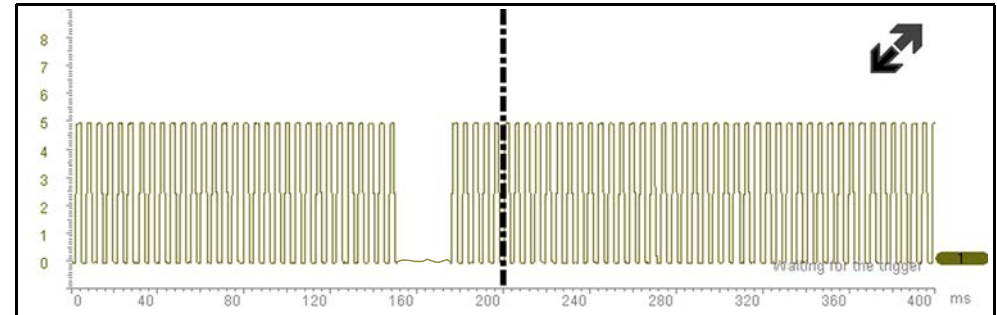


Figure 3-42

3.11 Saving Files

Selecting the **Save** icon writes the data stored in buffer memory to a file. Saving data files is useful when trying to isolate an intermittent problem or to verify a repair during a road test. The saved file can be played back (similar to a movie clip) by selecting **Previous Vehicles and Data > View Saved Data**. See [View Saved Data on page 56](#) for additional information.

NOTE

The **Save icon** performs the same function as “Save Movie” function choice for the programmable **Shortcut** button, see [Configure Shortcut Button on page 58](#) for details.

The saved file can also be downloaded to a personal computer (PC) using the Mini USB jack. Once connected to the PC, the files can be printed, transferred, and copied using ShopStream Connect. ShopStream Connect is a companion application that interfaces the diagnostic tool with a PC. ShopStream Connect is available at no cost, and can be downloaded online. See the ShopStream Connect website information at the front of this manual for additional information.

The toolbar control icons are described in [Scope Multimeter Control Icons on page 15](#) and [Common Toolbar Control Icons on page 6](#).

To save files:

Select the **Save** icon from the toolbar.

A save dialog box displays while files are being saved. The file is saved when the message box disappears.

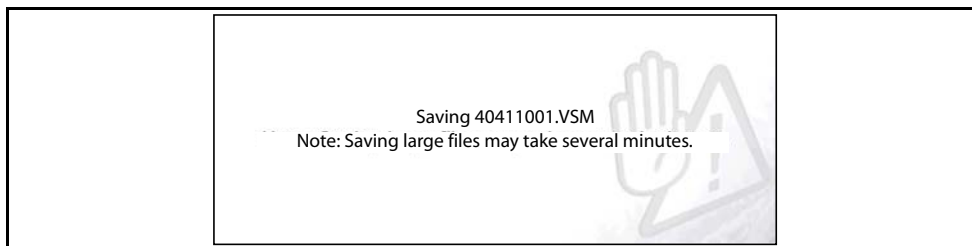


Figure 3-43 Save dialog box

3.12 Saving Screens

The **Shortcut** button can be programmed to save a snapshot (screen shot) of a visible screen as a bitmap file, see [Configure Shortcut Button on page 58](#) for details. The saved file can be viewed by selecting **Previous Vehicles and Data > View Saved Data**, see [View Saved Data on page 56](#) for additional information.

3.13 General Reference

3.13.1 Basic Setup Tips (unknown signal type)

When conducting automotive diagnostics, situations may arise when you need to capture and analyze a signal that you are not familiar with, or know what the intended waveform pattern should look like, or even how to set the scope to acquire the signal.

The following tips are intended to provide guidance, at the most basic level to assist you in your lab scope diagnostics.

Testing information and/or procedures for testing certain components may be available in the Guided Component Test function, see [Guided Component Tests on page 45](#) for additional information. If you have already narrowed down the system and/or component to test, ID the vehicle within the Guided Component Test function, and check the available tests first, as this may save you some time.

If the Guided Component Test function, does not have the test you are looking for, you need to determine are few thing about what you are testing to get the scope / meter set up to capture a signal or make a measurement.

NOTE

Testing information and known good waveform libraries may also be available from other sources (e.g. ShopKey[®] Pro or other online sources). Obtaining correct testing reference information can be a key advantage in making sound repair decisions.

Listed below are a few basic questions to help narrow down the testing direction to follow.

- Are you looking to make or test a simple voltage or current level or maybe check resistance or continuity? Then you may want to use the DMM.



- Are you looking to check a circuit/component for an erratic dropout or make a frequency test? You may want to use the GMM.
- Do you need to see signal details (level, shape, frequency etc.)? The lab scope may be the best choice.
- Are you testing a DC or AC signal?
- What is the operating range of the circuit?
- Do you know what type or shape the intended waveform should be?

After answering the questions above (at a minimum), you need to determine which Scope / Multimeter test function you are going to use (e.g. Lab Scope, DMM or GMM). See [Tests and Capabilities \(Quick Reference\)](#) on page 11.

Once your test function is selected, you can now connect the test leads and select the applicable probe and scales:

Probe (test) type, see [Probe \(Probe type “test” selection\)](#) on page 20

Vertical scale, see [Scale \(Vertical scale adjustment\)](#) on page 19

Sweep scale, see [Sweep \(Horizontal or Time scale adjustment\)](#) on page 19

Connect the test leads or probe, to the applicable test point(s). Always use the correct lead or probe designed for the test and ensure the signal and ground connections are clean and secure.

For the initial setup, you may wish to turn other channel settings off (e.g. Peak, Filter, Invert, AC Coupling, Threshold etc.), as these may affect the signal display. See [Channel Settings](#) on page 21.

As a default setting, trigger is normally off. The scope/meter uses internal circuitry to display a signal if present. However, in certain circumstances additional channel adjustments may be required, or the trigger mode may have to be turned on, for a signal that is present but is not displayed. You may also need to readjust the vertical scale if set to low, in order to bring the signal into the viewable display area.

At this point you should have a visible signal on the screen. An ideal signal should be displayed within the area of the display.

- If the signal goes beyond the top and bottom of the display, try and readjust the vertical scale to a higher setting, to bring the signal into the viewable display area.

Use the zero baseline controls or move the zero baseline marker onscreen to move the zero baseline of the signal vertically on the screen to the desired position. See [Trace \(Zero Baseline position adjustment\)](#) on page 22.

- If the signal cycles are compressed (close to each other), try and readjust the sweep scale (horizontal scale) to a lower setting to display less cycles.

Once you have a usable signal displayed, if needed use the trigger function to stabilize a changing or erratic signal (a signal that may flicker or drift), so that it is easier to view. Try and set the trigger at the mid-point of the signal, and then adjust as needed from there. See [Trigger](#) on page 24.

As all signals are different, and due to other variables, additional adjustments may be needed to get the signal displayed exactly how you need. Review the channel settings section in this manual for additional information on using the settings. See [Channel Settings](#) on page 21.

At this point you should have a signal displayed that will allow you to see the overall signal characteristics, and allow you to begin your diagnosis.

Comparing your captured waveforms to known good waveforms, can be a time saver and provide supporting evidence when trying to determine a fault. See [Using Known Good Waveforms](#) on page 39 for additional information.

3.13.2 Using Known Good Waveforms

In some cases captured waveforms may not provide enough information to determine if a suspected sensor or circuit is at fault. Comparing the test vehicle waveforms to known good waveforms, can help to provide supporting evidence when trying to determine a fault.

Known good waveform examples may be available from different sources including the Guided Component Tests function, or information services (e.g. ShopKey[®] Pro).

ShopKey Pro is an online (shopkeypro.com) automotive repair information source that includes OEM service information, community forums with actual repair tips from other technicians, and much more.

One of the many resources available within ShopKey Pro is the comprehensive collection of known good component waveform examples gathered through actual vehicle tests. Waveform and PID graph screenshot examples are provided by fellow member technicians and shared with all members in a searchable (vehicle/component specific) database.

As good practice, capturing waveforms before and after the repair will help you to build your own library of waveforms for future troubleshooting.

**To find waveform examples using ShopKey Pro:****NOTE**

The following ShopKeyPro.com navigation procedure are subject to change, as continuous site improvement are made. For the latest navigation procedures, see the help information provided on the website.

1. Sign in to ShopKeyPro.com.
If not already a member, sign up using the website or see you Snap-on sales representative.
2. Enter (identify) the vehicle details in the search field at the top of the screen (*Figure 3-44*).
3. Select the 1Search™ or Component Search tab (*Figure 3-44*).
4. Enter a search term (e.g. MAF sensor).
5. If SureTrack results are available, select the link under the Probable Components header.
6. From the SureTrack page, select the Waveforms and PIDs link (the link is active only if waveforms or PIDs are available) (*Figure 3-44*).

NOTE

Examples are not available for all vehicles or components, and are supplied from various diagnostic tools. All examples are provided as reference only.

For additional waveform reference information, visit the Snap-on Diagnostics forums to ask questions, and share information at:
<http://productforum.autorepairedata.com>

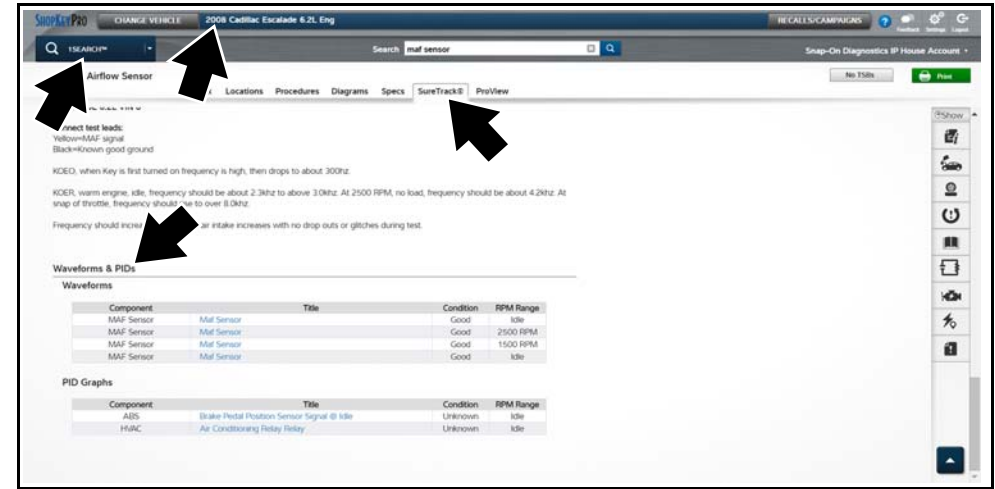


Figure 3-44 ShopKey Pro - SureTrack waveform examples

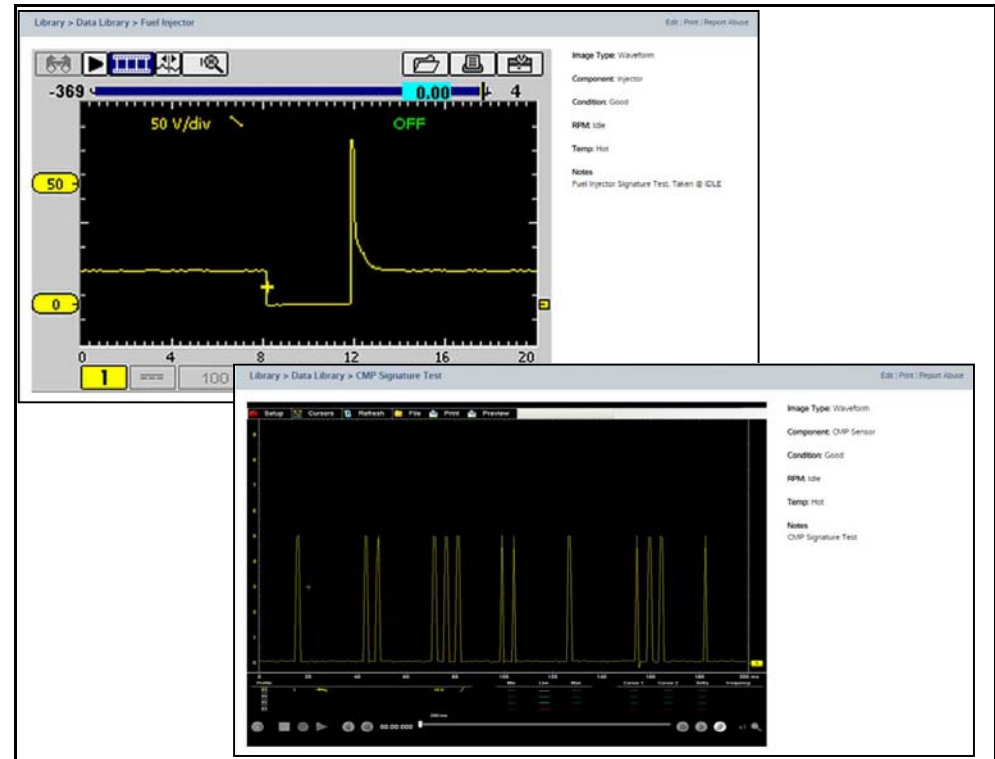


Figure 3-45 Waveform examples



3.13.3 Troubleshooting Signals

When capturing signals, you may occasionally encounter problems with the way the signal initially displays. Noise, hash, fuzz are some of the terms used to describe, unwanted signals displaying in or on the signal you are trying to capture, basically making the signal unclear. The following tips are intended to provide some basic guidance, to help resolve these types of issues if encountered.

- Make sure you have the correct test leads connected to the applicable test point(s) and test lead jacks on the diagnostic tool.
- Ensure the signal and ground connections are clean and secure, at the test points and diagnostic tool.
- Ensure the polarity of the test leads connections are correct.
- If using stackable connectors, try to isolate or only connect the leads being used to capture the signal.
- Make sure the ground lead is providing a direct ground from the circuit to the diagnostic tool test lead jack.
- Isolate the test leads from other components, leads, or systems that may induce unwanted noise into the signal being tested (e.g. electric motors, secondary ignition components, relays, alternators, etc.)
- Use the shortest test leads possible.
- Try different test leads, to verify the issue. Use the recommended snap-on leads or probes available for the diagnostic tool or equivalent. Shielded test leads are recommended.
- Check the test lead or probes for damage.
- Enable or disable channel controls also to help try and clean the signal:
 - **Peak Detect**—maximizes sampling rate, but may pickup unwanted noise
 - **Filter**—removes signal noise or interference
 - **Invert**—switches signal polarity
 - **Coupling AC**—blocks the DC portion of signal
 - **Threshold** —provides a more accurate measurement on select GMM tests where noise is present
 - **Scale (Vertical scale adjustment)**—adjusts vertical scale. Using a higher setting may provide a cleaner signal in some situations.

For signals that do not display or display off the screen, erratic, compressed etc.:

- Use a trigger to help stabilize the signal. Try and set the trigger at the mid-point of the signal, and then adjust as needed from there. See [Trigger](#) on page 24.

- If the signal wraps off the top and bottom of the display, try and readjust the vertical scale to a higher setting, to bring the signal into the viewable display area. See [Scale \(Vertical scale adjustment\)](#).
- If the signal cycles are compressed (close to each other), try and readjust the sweep scale (horizontal scale) to a lower setting to display less cycles. Try a higher setting if the cycles are spread too far across the screen and seem flat. See [Sweep \(Horizontal or Time scale adjustment\)](#) on page 19.
- Move the zero baseline marker to move the zero baseline of the signal vertically on the screen to the desired position. See [Trace \(Zero Baseline position adjustment\)](#) on page 22.
- Check calibration of test leads or probe(s) if applicable. See [Test Lead / Probe Calibration](#) on page 17.

3.13.4 Units of Measurement / Conversions

Base Units	
(Symbol) / Unit Prefix	Typical Expressions
(μ) micro	0.000001 or 10 ⁻⁶ or 1/1,000,000
(m) milli	0.001 or 10 ⁻³ or 1/1,000
(c) centi	0.01 or 10 ⁻² or 1/100
(k) kilo	10 ³ or 1,000
(M) mega	10 ⁶ or 1,000,000

Electrical Units	
(Symbol) / Description	Equivalents
(V) Voltage	$V = I \times R$
(I) Current	$I = V \div R$
(R) or (Ω) Resistance	$R = V \div I$
(Hz) Frequency	$f(\text{freq.}) = 1 \div T(\text{time})$ or 1 cycle per second
Voltage	
(μV) microvolt	1 μV = 0.000001 V
(mV) millivolt	1 mV = 0.001 V
(V) volt	1 V = 1000 mV
(kV) kilovolt	1kV = 1,000 Volts.
Ohms	
(mΩ) milliohm	1 mΩ = 0.001 ohms
(Ω) ohm	1 Ω = 1000 mΩ



Electrical Units	
(Symbol) / Description	Equivalents
(kΩ) kilohm	1 kΩ = 1000 Ω
(MΩ) megaohm	1 MΩ = 1,000,000 Ω
Amperes	
(μA) microamps	1 μA = 0.000001 amps
(mA) milliamps	1 mA = 0.001 amps
(A) amps	1A = 1000 mA
(ka) kiloamps	1 ka = 1000 amps
Frequency	
(MHz) megahertz	1 MHz = 1,000,000 Hertz
(kHz) kilohertz	1 kHz = 1000 Hertz

Pressure Units	
(Symbol) / Description	Equivalents
(psi) pounds per square inch	1 psi = 6894.757 Pa 1 psi = 0.06894757 bar 1 psi = 2.036021 inHg
(bar)	1 bar = 14.50377 psi 1 bar = 100000 Pa 1 bar = 29.52999 inHg
(Mbar) Millibar	1 Mbar = 0.001 bar
(Pa) pascal	1 Pa = 0.0001450377 psi 1 Pa = 0.00001 bar 1 Pa = 0.0002952999 inHg
(kPa) KiloPascas	1 kPa = 1000 Pa
(MPa) Megapascal	1 MPa = 1,000,000 Pa
(inHg) inches of mercury	1 inHg = 0.03386388 bar 1 inHg = 0.4911541 psi 1 inHg = 3386.388 Pa

Pressure Conversions	
psi x 0.0689 = bar	
psi x 6.8950 = kPa	
psi x 0.0703 = kg/cm ²	
bar x 14.5030 = psi	
bar x 100.0000 = kPa	

Pressure Conversions	
bar x 29.5300 = inHg (60°F)	
kPa x 0.1450 = psi	
kPa x 0.0100 = bar	
kPa x 0.0102 = kg/cm ²	
kPa x 0.295299 = inHg	
kg/cm ² x 98.0700 = psi	
kg/cm ² x 0.9807 = bar	
kg/cm ² x 14.2200 = kPa	
inHg (60°) x 0.0333 = bar	
inHg (60°) x 3.3770 = kPa	
inHg (60°) x 0.0344 = kg/cm ²	
inHg x 25.4 = mmHg	
mmHg x 0.003994 = inHg	

Temperature Units	
(Symbol) / Description	Conversions
(°C) degree Celsius	°C = 0.556 x (°F - 32)
(°F) degree Fahrenheit	°F = (1.8 x °C) + 32

Time Units	
(Symbol) / Description	Equivalents
(μs) microsecond	1 μs = 0.000001 of a second
(ms) millisecond	1 ms = 0.001 of a second
(s) second	1 s = 1000 ms

Duty % to Dwell Conversions			
Duty Cycle	Dwell		
	4 cyl	6 cyl	8 cyl
%			
10	9.0	6.0	4.5
20	18.0	12.0	9.0
30	27.0	18.0	13.5
40	36.0	24.0	18.0
50	45.0	30.0	22.5
60	54.0	36.0	27.0



Duty % to Dwell Conversions			
Duty Cycle	Dwell		
%	4 cyl	6 cyl	8 cyl
70	63.0	42.0	31.5
80	72.0	48.0	36.0
90	81.0	54.0	40.5
100	90.0	60.0	45.0

3.13.5 Glossary of Common Terms

Term / Abbreviation	Description
AC	Alternating Current - electrical current that switches polarity at regular intervals.
Aliasing	An effect that causes an incorrect signal to be displayed and/or causes a trigger to malfunction, due to the input signal exceeding the sample rate of the scope.
Amperage	The strength of an electric current, expressed in amperes
Amplitude	Vertical magnitude (level or position) of a signal, or the varying quantity from its zero value.
Buffer	An electronic reservoir for temporary storage of data
Cursor	Onscreen markers used to measure time, amplitude and frequency
Coupling AC	Function used to subtract the average value of a signal so that small variations can be displayed in the waveform.
DC	Direct Current - electrical current that flows in one direction only
Delta	Difference in time between two events.
Dropout	An intermittent or unwanted, vertical fall in a signal to zero that may cause an undesired result.
Duty cycle	Measurement of the length of a signals on time. Specified as a percentage (ratio), of the total cycle time.
Dwell	Used to measure a signals on time in degrees of dwell. Commonly used to measure mixture control solenoids on carbureted feedback engines and specified in duty cycle %.

Term / Abbreviation	Description
Dwell 60	Measurement of the length of a signals on time displayed on a 0 to 60 degree scale. 0° = 0%; 30° = 50%; 60° = 100%.
Dwell 90	Measurement of the length of a signals on time displayed on a 0 to 90 degree scale. 0° = 0%; 45° = 50%; 90° = 100%.
Filter	Function used to filter or smooth out spikes and fast variations in signals.
Frequency	The number of times a signal repeats in one second. Measured in Hertz (cycles per second).
Glitch	An intermittent or unwanted, error in a signal that may cause a false or undesired result.
Grid	The graph displayed on the scope screen that is made up of the x and y axis scales that aid in the measuring of signal characteristics.
Horizontal Scale	See Sweep Scale
Invert	Function used to switch signal polarity,
Lambda (λ)	Used to represent a numerical value denoting the actual measured air/fuel ratio with respect to the ideal air/fuel ratio at stoichiometry. Lambda equals one (1) when the actual air/fuel ratio is equal to the theoretical (stoichiometric) air/fuel ratio of 14.7 (14.66) to 1. Lambda less than 1 means excess fuel; greater than 1 means excess air.
Megasamples per second (MS/s)	Sample rate unit equal to one million samples per second
Noise or Hash	Unwanted voltage, current or signal interference that is imposed on a signal.
Parasitic Voltage	Trace voltage in a circuit after the main power source is disconnected.
Peak	The maximum amplitude value present in a varying or alternating voltage. This value may be either positive or negative.
Peak Detect	Peak detect captures and evaluates all signal sample points, in order to display fast occurring events or glitches.
Pressure Transducer	Electronic device that converts pressures (negative/ positive) to electrical signals.



Term / Abbreviation	Description
Pulse	A signal with abrupt (fast) signal direction changes in a positive or negative direction, with consistent level and duration.
Pulse Period	One complete on and off cycle or time period.
Pulse Train	Collection of signal pulses traveling together.
Pulse Width (duration)	Measurement of a signals on time in a circuit that pulses on and off. Specified in units of time.
Pulse Width Modulation (PWM)	A signal that continuously cycles on and off while the on-time varies within each cycle.
RMS	The RMS (root mean square) value of alternating currents and voltages is the effective current or voltage applied, rather than the peak current or voltage measurable. The AC RMS voltage value can be defined as the equivalent DC voltage of the AC voltage measured. RMS values are commonly used in AC electrical measurement, as they are more representative of DC measurements.
Sample Rate	Number of times (frequency) the scope/meter takes a sample of the signal. Specified in mega samples per second (MS/s).
Sampling	Process of obtaining a sequence of instantaneous values for a signal at regular or intermittent intervals. When a quantity of samples are collected the operational status of the device is determined.
Screen Update Rate	How often the captured data is (updated) displayed on the screen.
Signal	Detectable voltage, current, or magnetic field, by which specific information is transmitted in an electronic circuit or system.
Square Wave	A square or rectangular waveform (digital) which alternately switches high to low (on/off) for specific lengths of time, that has very fast rise and fall times.
Sweep Scale	The horizontal scale on the grid. Also referred to as time scale or x axis.
Threshold	The threshold function automatically sets a trigger and determines a threshold level in the middle of the signal range (calculated from the Min and Max measurements) to be used as a reference point to calculate the measurement.
Trace	The actual visible line displayed on the scope screen.

Term / Abbreviation	Description
Trigger	A conditional function that initiates if and when a trace is drawn on the screen.
Trigger Slope	The slope that a trigger source signal must reach before the trigger circuit initiates a sweep
VAC	Volts Alternating Current
VDC	Volts Direct Current
Vertical Scale	The vertical scale on the grid or (y-axis) represents what is being measured (voltage, amperage, pressure etc.), and the unit of measurement it is being measured in.
Volt	Unit of electric potential difference.
Voltage	Electromotive force or potential difference, expressed in volts.
Voltage (inductive) Kick	A voltage, many times higher than the applied voltage, produced by the collapsing magnetic field in a coil when the current through it is abruptly terminated.
Waveform	The graphic representation (form) of a signal over time, which the trace displays on the screen.
Zero Base Line	Reference setting or 0% level of a graph scale.



The Guided Component Tests function provides you with an extensive collection of vehicle specific component tests and reference information. It is like having access to a complete library of automotive repair manuals for testing multiple vehicle components.

The preconfigured meter tests and reference information provided are vehicle specific and designed to help save you diagnostic time, verify faulty components, and verify the repair.

Detailed instructions and reference information are provided to guide you through the testing process, from locating the component, to selecting the appropriate test, showing test lead connections, and illustrating electrical connector and pin configurations. In addition, test results (including waveform examples), procedures, tips, and specifications may also be provided.

i NOTE

Availability of tests and information may vary.

As an added resource, Training and Classes provides even more support by including (non-vehicle specific) tests and resources that allow you to quickly perform common tests, review basic reference information and more.

4.1 Main Topic Links

- [Training and Classes](#) page 45
- [Power User Tests](#) page 46
- [Screen Layout and Icons](#) page 48
- [Operation](#) page 49
- [Saving and Reviewing Data Files](#) page 54

4.2 Training and Classes

Training and Classes is a companion feature to the Guided Component Tests function. This resource includes a wide collection of common (non-vehicle specific) reference information and tests, such as measuring fuel pump current ramp, and monitoring CKP and CMP signals simultaneously. Also included are, basic component operation and theory information, testing procedures, tips, definitions, illustrations, diagnostic tool feature descriptions and accessory information.



To access Training and Classes:

1. Select **Guided Component Tests** from the Home screen.
2. Select **Training and Classes** from the Vehicle Make menu ([Figure 4-1](#)) to access the menu options.

Each menu option is described in the following sections:

- [Power User Tests](#)
- [How To Guide](#)
- [Features and Benefits](#)

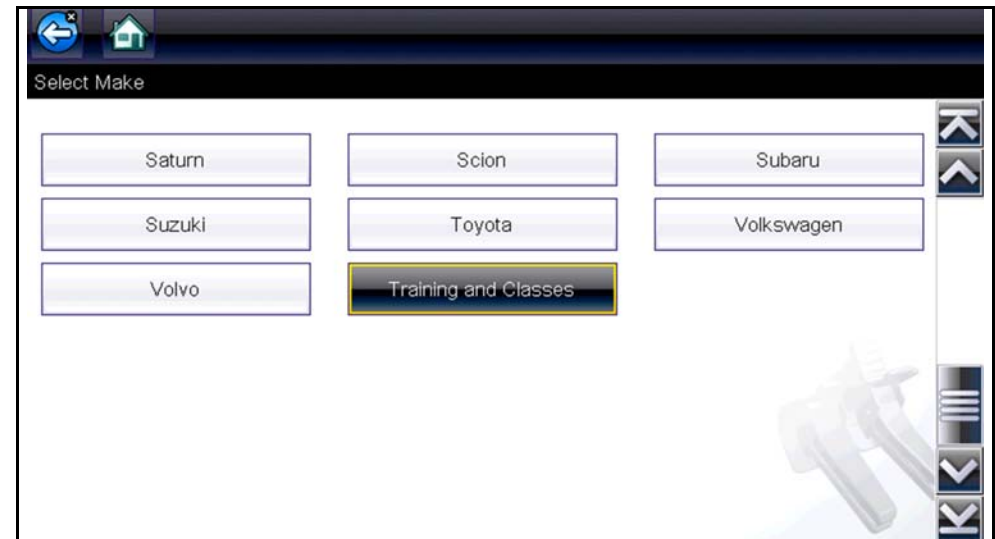


Figure 4-1



4.2.1 Power User Tests

Power User Tests provide you quick access to preconfigured meter tests for a number of common automotive system tests. Most tests provide onscreen help and testing information along with a description of the test and the expected results, including known good waveforms.

Here is a sample listing of the types and specific tests that may be available within Power User Tests:

- **Current Probe Tests** - provides common tests configured to use the Snap-on Low Amp Current probes or generic Low Amp Current probes. Snap-on Low Amp Current Probe operation information is also provided within the *Snap-on Low Amp Probe Reference Manual* option.
 - Fuel Injector Current Ramp (multiple types)
 - Fuel Pump Current Ramp
 - Fuel Pump RPM Calculation
 - Ignition Coil Current Ramp (multiple types)
 - Parasitic Draw
 - Snap-on Low Amp Probe Reference Manual
- **Dual Channel Tests** - provides common tests configured to measure or compare two signals
 - CAN-BUS High/Low
 - CKP and CMP Relationship
 - EGR Solenoid and Position Sensor
 - EVAP Solenoid and Diagnostic Switch
 - FlexRay Bus
 - Injector and Oxygen Sensor
 - Knock Sensor and EST
 - MC Dwell and Oxygen Sensor
 - Pre and Post Cat Oxygen Sensors
 - Throttle Positions 1 & 2
 - WSS (Hall Effect Type)
- **Transducer Tests** - provides common single and dual channel tests configured to measure various types of pressures, voltage and current. Transducers are available as optional equipment.
 - A/T Line Pressure and Shift Solenoid
 - A/T Line Pressure Test
 - EGR Temperature Sensor and EGR Vacuum
 - Exhaust Back Pressure Test
 - Fuel Pressure and Fuel Pump Current
 - Fuel Pressure and Fuel Pump Voltage

- Fuel Pressure Test

How To Guide

The **How To** option provides multiple topics and references ranging from instructional and basic theory to troubleshooting and testing instructions. Menu options may include:

- **10-minute Electronic Classes**—provides basic electrical theory and testing information. Topics may include:
 - Ohm's Law
 - Variable Resistors
 - Amperage
 - Diode Continuity
 - Electrical Circuits
 - Guided Voltage Drop Test
 - Other Electrical Measurements
 - Resistance
 - Scientific Notation
 - Voltage
- **15-minute Ignition Class**—provides basic introductory ignition system information. Topics may include:
 - Introduction
 - Coil on Plug (COP)
 - Conventional
 - Waste Spark
- **Illustrated Terms & Definitions**—provides common term definitions, illustrations and tips associated with automotive component testing.
- **No-Start Basics**—provides basic step-by-step procedures for the diagnosis of a no-start condition on carbureted and fuel injected vehicles.
- **O2 Sensor & Feedback System Analysis**—provides basic definition and theory information for the following O2 sensor topics:
 - Air Fuel Ratio Sensors
 - Correct PCM Response (includes configured meter test)
 - Heated Oxygen Sensor
 - Non-Heated Oxygen Sensor
 - Open and Closed Loop
 - Oxygen Sensor Types
 - Understanding Oxygen Sensors (includes configured meter test)



- **Snap-on Automotive Theory**— provides basic theory information on multiple topics including:
 - Air Conditioning
 - Diagnosing Battery Draws
 - Diesel Particulate Filters
 - Electronic Parking Assistance
 - HID Headlights
 - Hybrid Vehicles
 - LIN-BUS
 - Supplemental Restraint Systems
 - Tire Pressure Monitoring (TPMS)
- **Test Tips**—provides basic testing information, tips and procedures for specific tests and meter operations. Topics may include:
 - Alternator Ripple Test
 - EVP Sensor Test
 - Frequency, Pulse Width and Duty Cycle Test
 - Graphing AC Voltage
 - Injector Pulse Width Test
 - Parasitic Draw Test
 - Reading Pulsed DTC's
 - TPS Sweep Test
 - Using Cursors
 - Using Pressure Transducers
 - Using Triggers
 - Wiggle Test
 - Zirconia Oxygen Sensor Rise Time
- **Theory and Operation**—provides basic theory information for the following topics:
 - Oxygen Sensors
 - Relays
- **20-minute Current Ramp Classes**—provides an introduction to current ramp testing using the Snap-on Low Amp Current Probes. Snap-on Low Amp Current Probe operation information is also provided within the *Snap-on Low Amp Probe Reference Manual* option. Topics may include:
 - Fuel Injector Current Ramp (multiple types)
 - Fuel Pump Current Ramp
 - Fuel Pump RPM Calculation
 - Ignition Coil Current Ramp (multiple types)
 - Parasitic Draw
 - Snap-on Low Amp Probe Reference Manual

- Using Fuse Box for Current Test Hard to Reach Wiring

Features and Benefits

Selecting **Features and Benefits** provides basic feature description and operational information about the diagnostic tool. Additional information is provided for ShopStream Connect, optional waveform demonstration boards and optional accessories. Selections include:

- **5-Minute Walk Thru With Demo Board**—provides instructions on the operation of the optional waveform demonstration board(s) to sharpen your Lab Scope and Meter skills. Topics may include:
 - New Demo Board (PN) #EESX306A—provides functionality information and basic step-by-step demonstration information of multiple generated waveforms
 - Old Demo Board (PN) #SSP816—provides functionality information and basic step-by-step demonstration information for multiple generated waveforms

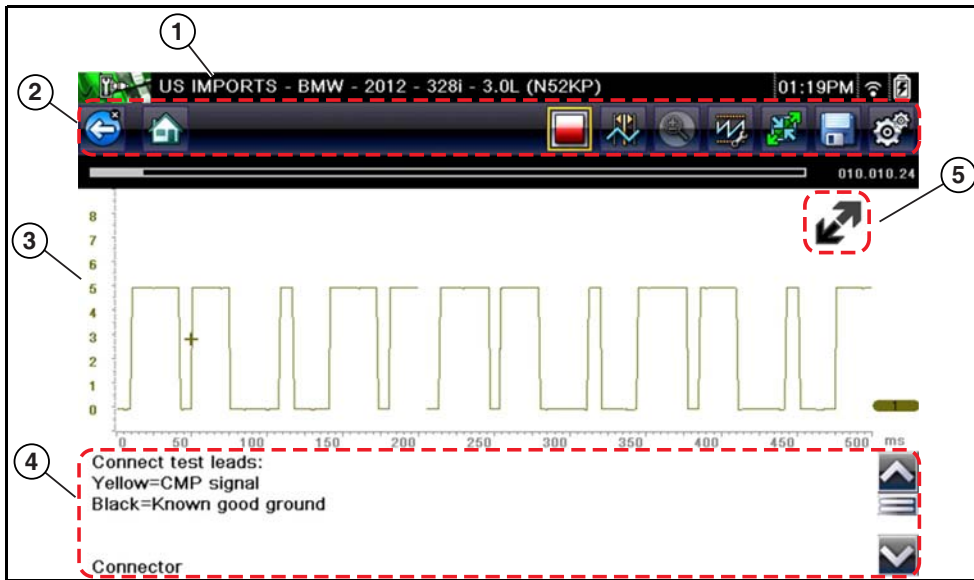
The optional demonstration board(s) generate various waveforms similar to signals commonly found on modern vehicle control systems. The demonstration board(s) not only help you learn how to use the Guided Component Tests software, it allows you to hone your skills and diagnostic techniques without connecting to an actual vehicle. Contact your sales representative for details.
- **Accessories**—provides descriptions for the optional accessories available for the diagnostic tool. Accessory topics may include:
 - Low Amp Probe
 - Pressure/Vacuum Transducers
 - ShopStream Connect
 - Test Leads and Clips
- **Product Description**—provides an overview of diagnostic tool capabilities and operations.



4.3 Screen Layout and Icons

This section describes the Guided Component Tests control icon functions and screen layout.

4.3.1 Screen Layout



- 1— **Vehicle Identification**
- 2— **Toolbar**—contains control icons
- 3— **Main Body**—displays menus, information, meter scales and signal traces
- 4— **Information Panel**—displays test information
- 5— **Expand/Collapse icon**—toggles Main body view between full and split views

Figure 4-2 Test screen

Main Body

The main body of a Guided Component Test screen may display any of the following:

- **Selectable Menu** - Select menu options using the touch screen or control buttons.
- **Component Information** - Provides information to assist you with testing.
- **Test Meter** - The test meter can display up to two signals, simultaneously. Signal and display adjustments are made through the Control Panel. Signals are displayed using a grid with scales, both vertical (y axis), and horizontal (x axis).

Meter touch screen functionality is limited, however you can adjust the zero baseline position (0 value) of the signal on the horizontal scale by touching and dragging the zero baseline marker.

4.3.2 Guided Component Tests Control Icons

Guided Component Tests toolbar control icons may vary depending on the active function or test. A yellow frame surrounding an icon (highlighted), indicates it is selected. Other control icons (not shown) are described in [Common Toolbar Control Icons](#) on page 6.

Table 4-1 (sheet 1 of 2)





Icon	Function
	Pause - Pauses the data buffer.
	<p>Control Panel - (a). In full screen mode (when selected) this icon displays a white frame around it, and opens the control panel at the bottom of the screen; while switching the active selection focus to the Show/Hide or Probe icon in the Control Panel.</p> <p>(b). In split screen mode (control panel open), when selected this icon displays a white frame around it, and switches the active selection focus to the Show/Hide or Probe icon in the Control Panel.</p> <p>Note: Switching active selection focus to the Control Panel allows manual navigation (using the directional control buttons) of the Control Panel control icons.</p>

Table 4-1 (sheet 2 of 2)

Icon	Function
	Cursors - Toggles cursors on/off.
	Expand/Collapse Icon - Toggles the Main body display between full and split screen.

4.4 Operation

As the information and tests provided within the Guided Component Test function is vehicle specific, the vehicle must first be identified in order to retrieve the correct data.

4.4.1 Vehicle Identification

The Guided Component Test information presented is specific to the vehicle being tested. Therefore, the vehicle must be identified so that the correct data can be retrieved.

The vehicle identification sequence is menu driven, follow the screen prompts to enter the information. Exact procedures may vary by the make, model, and year of the vehicle.



To identify a vehicle for testing:

1. Select the **Guided Component Tests** icon on the Home screen.
2. Select a vehicle type from the menu.

A list of manufacturers displays ([Figure 4-3](#)).

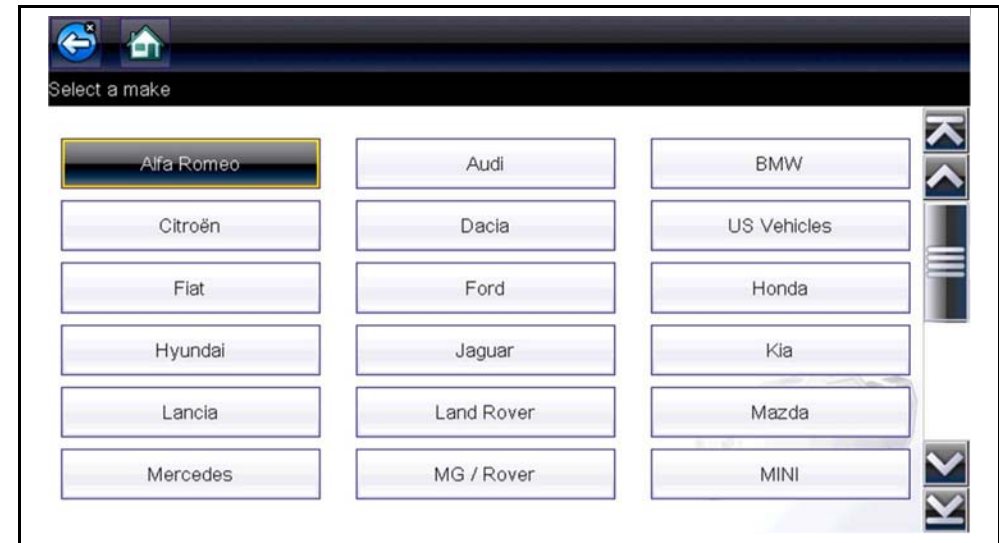


Figure 4-3 Manufacturer list

3. Select the vehicle manufacturer from the list.
A model year menu displays.
4. Select the vehicle year from the menu.
A list of vehicle models displays. Several selections may be required to complete the vehicle identification, follow the screen prompts to enter the required information.



A confirmation screen displays once all the required information has been entered (*Figure 4-4*).

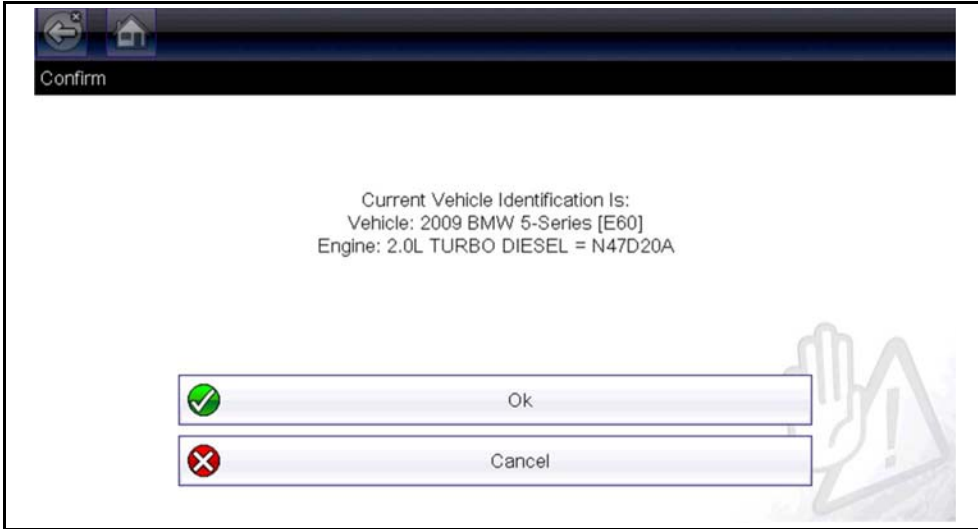


Figure 4-4 Vehicle confirmation screen

5. From the Confirm Vehicle screen select:
 - a. **OK** to continue.
 - b. **Cancel** to return to the previous screen.

A list of systems available for testing displays (*Figure 4-5*).

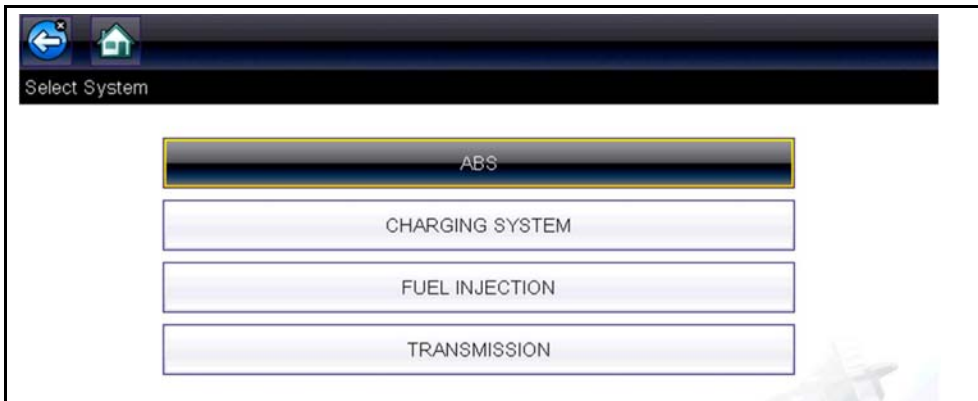


Figure 4-5 Available systems menu

6. Select a system and a list of tests available for the identified vehicle displays
7. Select a test from the list to continue.

The identification sequence is now complete, refer to the Operations section that follows for details on how to navigate through the Guided Component Tests information and perform tests.

To select a system and component to test:

1. Select a system from the list (*Figure 4-6*).

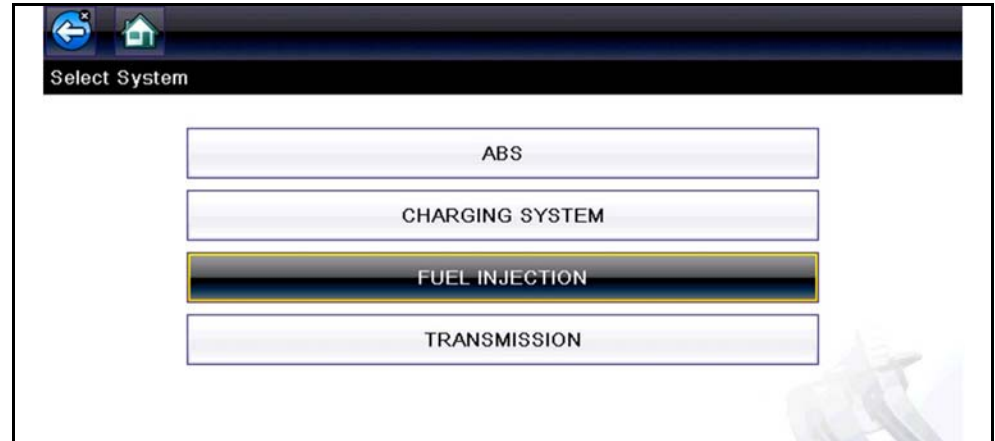


Figure 4-6 Systems Menu

A list of Components (and/or sub systems) is displayed (*Figure 4-7*).

2. Select a Component to continue.



Figure 4-7 Component Menu

Depending on the vehicle and component selected, different options and sub-menus may be displayed. Information and tests may vary:

- **Component Information**— see *Component Information* on page 51.
- **Tests**— see *Tests* on page 52.
- **Reference Information**—provides identification of components, connector pin location and functions, and abbreviation reference.

4.4.2 Component Information

Component Information provides (if available) specific operational information on the selected component, and may also include electrical connector and pin location and function details

 **To view component information:**

1. Select a component.
2. Select **Component Information** from the Component Test menu (*Figure 4-8*).

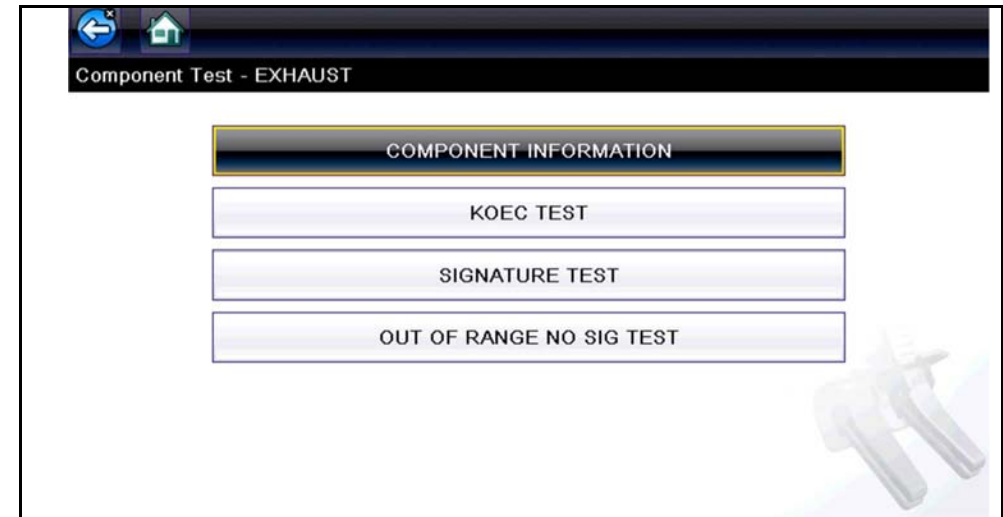


Figure 4-8 Component Tests Menu

NOTE

An additional selection may be required for some components (e.g. selecting front or rear for an oxygen sensor (O2S)).

Component Information is displayed (*Figure 4-9* and *Figure 4-10*).

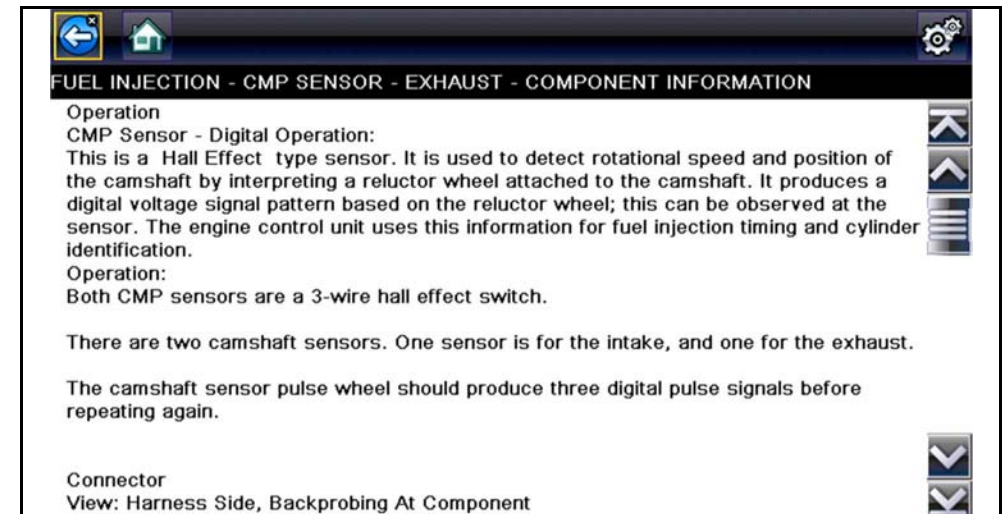


Figure 4-9 Component Information Screen

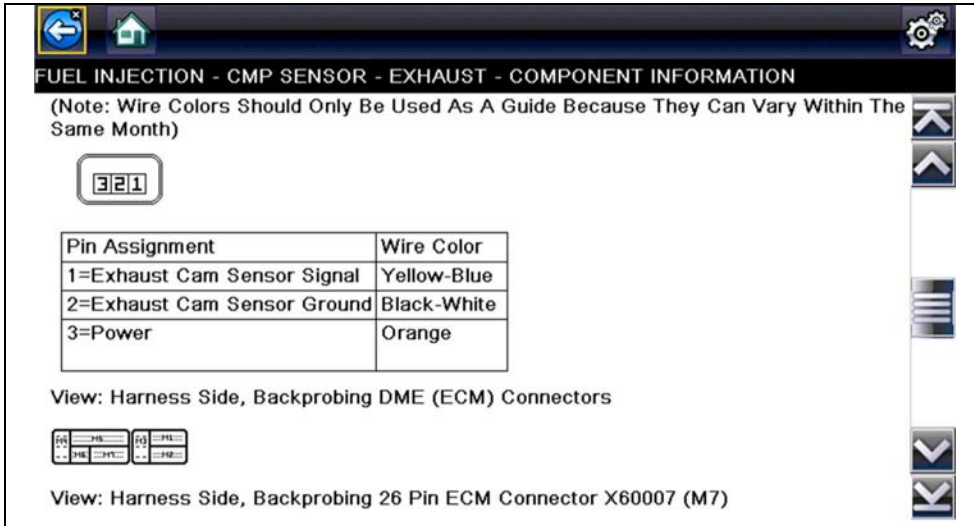


Figure 4-10 Component Information Screen - Continued

Screens are divided into sections to quickly guide you to the correct information (available sections and information will vary):

- **Operation**—provides a general description of component operation.
- **Tech note**—provides component related tips (e.g. common failures or faults), additional information may include OEM service updates and recall information.
- **Connector**—displays illustrated electrical connectors and socket/pin identification.
- **Location**—provides component locations, testing tips, and alternate testing locations if available.

Use the scroll bar to view additional information.

3. Select **Back** on the Toolbar, or press the **N/X** button, to return to the component menu.

4.4.3 Tests

Tests provides (if available) specific instructions to help you perform tests on components. Selecting a component test opens a preconfigured meter to start the test, and may also provide connection instructions, specifications and testing tips.

To select a test:

1. Select a component.
2. Select a **Test** from the Component Test menu (Figure 4-11).

The component test menu lists all of the tests available for the selected component. Choices vary by the type of component, as well as the make, model, and year of the vehicle.

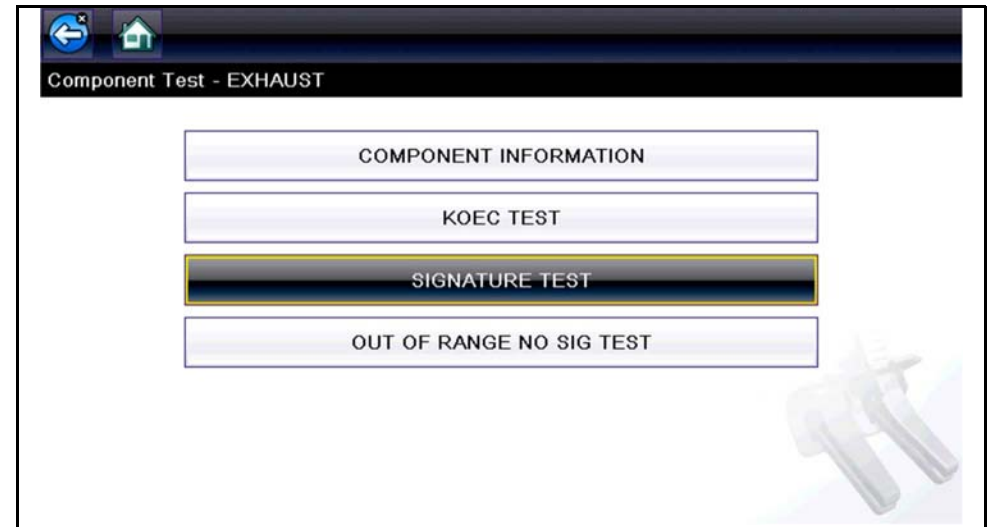


Figure 4-11 Component Test Menu

NOTES

An additional selection may be required for some Component Tests (e.g. selecting front or rear for an oxygen sensor).



The test screen displays (Figure 4-12).

A Guided Component Test screen initially opens with the information panel below the main body. Use the scrollbar to display hidden information.

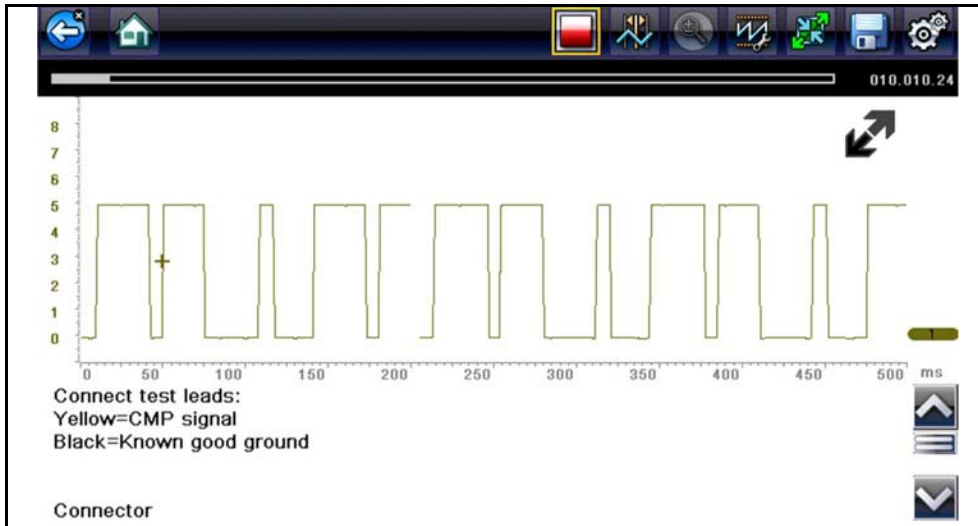


Figure 4-12 Test screen

3. Tap on the Information Panel once to display the information panel in full screen view. Tap on it again to return to split view. The **Expand/Collapse** icon can also be used to toggle through split and full screen views (Figure 4-13).

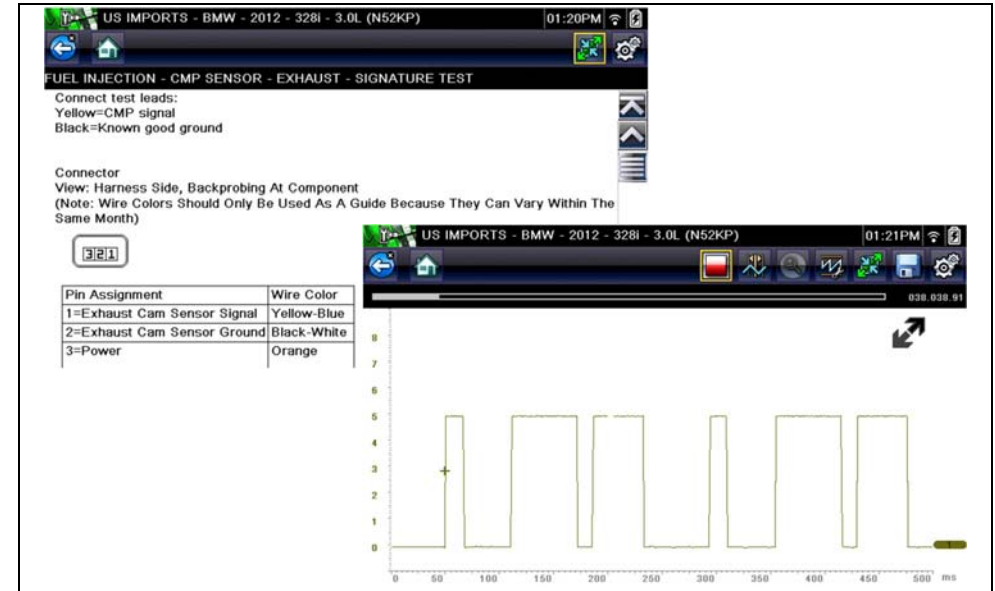


Figure 4-13 View Options

Some tests (e.g. signature integrity tests) may include waveform examples within the information panel. These waveform examples allow you to compare your test results for quick diagnosis (Figure 4-14).

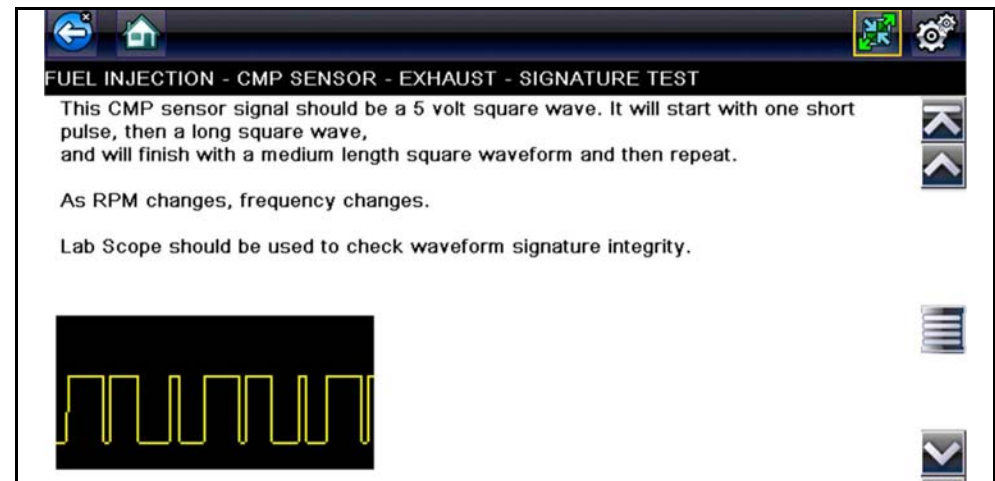


Figure 4-14 Waveform Example

4. Select **Back** on the toolbar to return to the menu.

Channel Settings

The test meter is preconfigured, for most of the component tests. However, if the need to change channel settings is needed, adjustments can be made by selecting the **Control Panel** icon from the toolbar to display the Control Panel (*Figure 4-15*). For additional information on channel settings, see *Control Panel and Settings* on page 17.

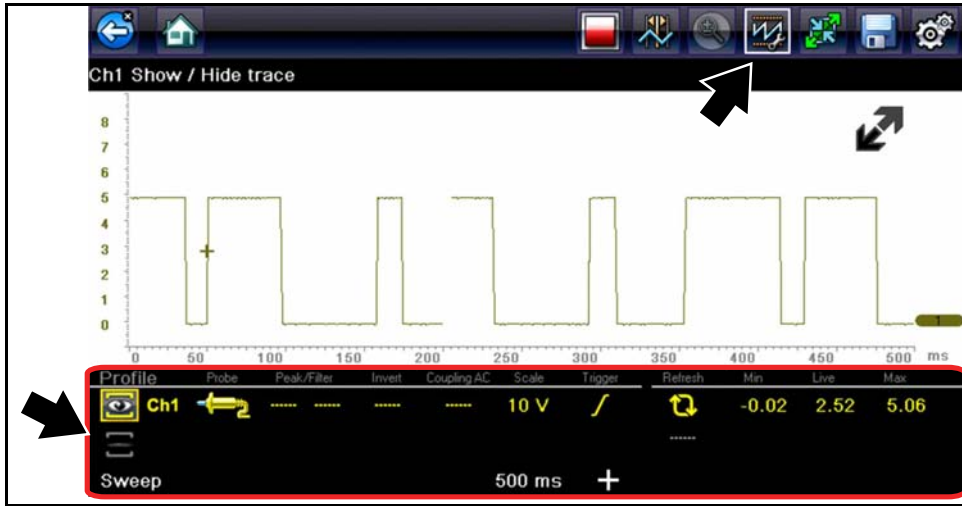


Figure 4-15 Control Panel - Channel Controls

4.4.4 Saving and Reviewing Data Files

Save and Stop control icon operation and data review procedures are the same as used for the Scope/Multimeter function, see *Saving and Reviewing Scope / Multimeter Data Files* on page 32.



This section describes the basic operation of the Previous Vehicles and Data function.



The **Previous Vehicles and Data** icon is located on the Home screen. This function allows you to select recently tested vehicles and access saved data files.

Main Topic Links

- [Vehicle History](#) page 55
- [View Saved Data](#) page 56
- [Delete Saved Data](#) page 56

5.1 Previous Vehicles and Data Menu

5.1.1 Vehicle History

The Diagnostic Tool stores the identification of the last twenty-five vehicles tested, so there is no need to go through the complete vehicle identification sequence when performing a retest after repairs have been made. The oldest vehicle record is deleted when a new vehicle is identified once there are twenty-five vehicles on file.



Figure 5-1 Vehicle history list



To select from the vehicle History:

1. Select **Previous Vehicles and Data** from the Home screen.
2. Select **Vehicle History** from the menu.

A list of up to 25 previously tested vehicles displays. Each vehicle is given a unique file name. Scroll to view the entire list.

3. With the item to be opened highlighted, either select the vehicle ID or press the **Y/✓** button.

The appropriate software loads and a vehicle ID confirmation screen displays.

4. Select **OK** or press the **Y/✓** button to continue.
The System Menu for the selected vehicle displays.

5.1.2 View Saved Data

Selecting the **View Saved Data** menu option opens a list of all the saved data (movie) files and screen images that are stored in memory. Saved files are listed in chronological order by the date and time that they were created with the most recent files are at the top of the list.



Figure 5-2 Saved data list

Saved files can either be opened directly on the Diagnostic Tool, or downloaded to a personal computer and opened using ShopStream Connect. See [Stopping and Reviewing Data Files](#) on page 34 and [Connect-to-PC](#) on page 58 for additional information.

NOTE

A maximum of 50 files are displayed. To view all (if more than 50) files stored, use ShopStream Connect. See [Connect-to-PC](#) on page 58 for additional information.

To review a saved data file or image:

1. Select **Previous Vehicles and Data** from the Home screen.
2. Select **View Saved Data** from the menu.
3. Select a file to review from the list.

5.1.3 Delete Saved Data

This menu option is used to permanently erase saved files from memory.



To delete a saved file:

1. Select **Previous Vehicles and Data** from the Home screen.
2. Select **Delete Saved Data** from the menu.
A list of saved files displays.

NOTE

The *Select All/Deselect All* and *Delete* icons become available on the toolbar so that you can either delete individual files or clear the entire memory buffer all at once.

3. Select a file from the list and a confirmation message displays.
4. Select an option from the confirmation message:
 - **OK**—deletes the selected file and returns to the saved files list, which no longer includes the deleted file.
 - **Cancel**—returns to the saved files list without deleting the selected file.
5. Select **Back** on the toolbar to return to the Previous Vehicles and Data menu, select **Home** to return to the Home screen.



This section describes the basic operation of the Tools function.



The **Tools** icon is located on the Home screen. This function allows you to configure diagnostic tool settings to your preferences.

Main Topic Links

- [Connect-to-PC](#) page 58
- [Configure Shortcut Button](#) page 58
- [System Information](#) page 59
- [Settings](#) page 59
 - [High Contrast Toolbar](#) page 60
 - [Brightness](#) page 60
 - [Color Theme](#) page 60
 - [Font Type](#) page 61
 - [Backlight Time](#) page 61
 - [Touch Screen Calibration](#) page 61
 - [Time Zone](#) page 62
 - [Clock Settings](#) page 62
 - [Daylight Savings Time](#) page 62
 - [Time Format](#) page 62
 - [Date Format](#) page 62

6.1 Tools Menu

The following options are available from the Tools menu:

- [Connect-to-PC](#)—use to transfer and share files with a personal computer (PC)
- [Configure Shortcut Button](#) on page 58—use to change the function of the shortcut button
- [System Information](#) on page 59—use to view configuration information for the Diagnostic Tool
- [Settings](#) on page 59—use to configure certain characteristics of the Diagnostic Tool

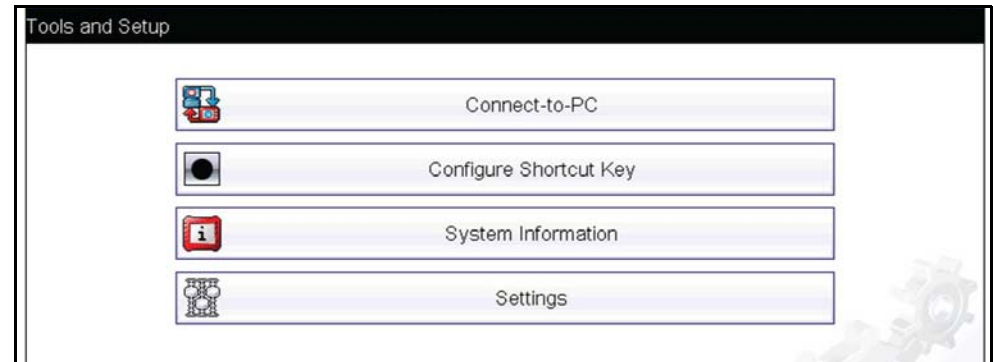


Figure 6-1 Tools menu

6.1.1 Connect-to-PC

Connect-to-PC allows you to transfer saved data files on your Diagnostic Tool to your personal computer using a USB cable.

The optional ShopStream Connect™ PC software allows you to view, print and save data files on your PC. In addition, you can download software updates from the PC to the Diagnostic Tool. These features provide an ideal way to manage saved data files. The ShopStream Connect application is available free online, see [ShopStream Connect™](#) on page 64.



To connect the diagnostic tool to a PC:

1. Connect the supplied USB cable to the diagnostic tool and then to the PC. A USB cable, supplied with your diagnostic tool, is used to connect the diagnostic tool to the PC. When the diagnostic tool is connected to the PC a communications icon appears on the right edge of the title bar.
2. Select **Tools** from the Home screen.
3. Select **Connect-to-PC** from the Tools and Setup menu.
A screen message will display to confirm the tool is in Connect-to-PC-mode.

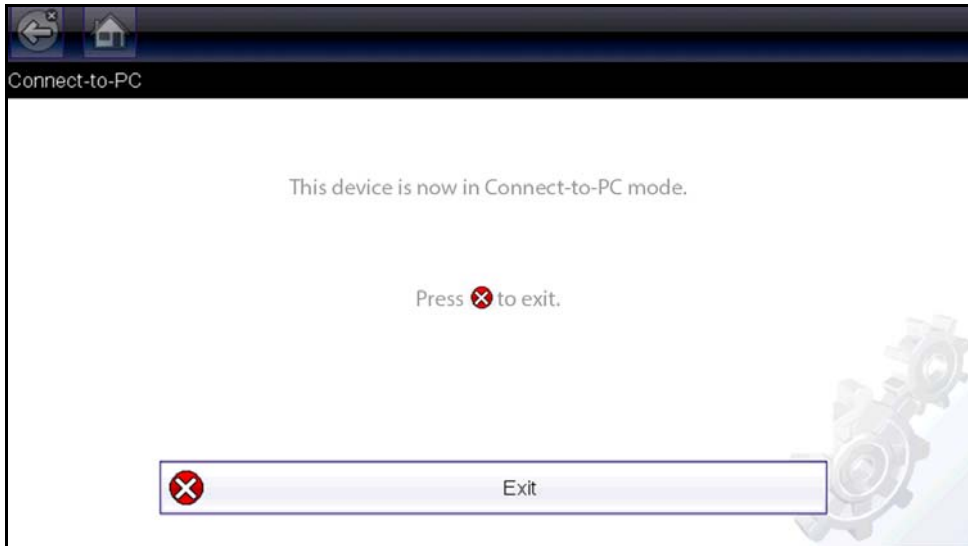


Figure 6-2

6.1.2 Configure Shortcut Button

This feature allows you to change the function of the **Shortcut** button. Options are:

- **Brightness**—opens the brightness setting screen.
- **Save Screen**—saves a bitmap image of the visible screen.
- **Save Movie**—writes data from buffer memory to a file for future playback.
- **Show Shortcut Menu**—opens the menu so you can quickly select from any of the functions.
- **Toggle Record/Pause**—programs the Shortcut button to work as the Pause and Start icons.



To assign a function to the Shortcut button:

1. Select **Tools** from the Home screen.
The Tools menu opens.
2. Select **Configure Shortcut button** from the menu.
3. Select a function from the menu.
4. Select the **Back** on the toolbar or press the **N/X** button to return to the options menu.

6.1.3 System Information

System Information allows you to view patent information and system information such as the software version and serial number of your Diagnostic Tool.

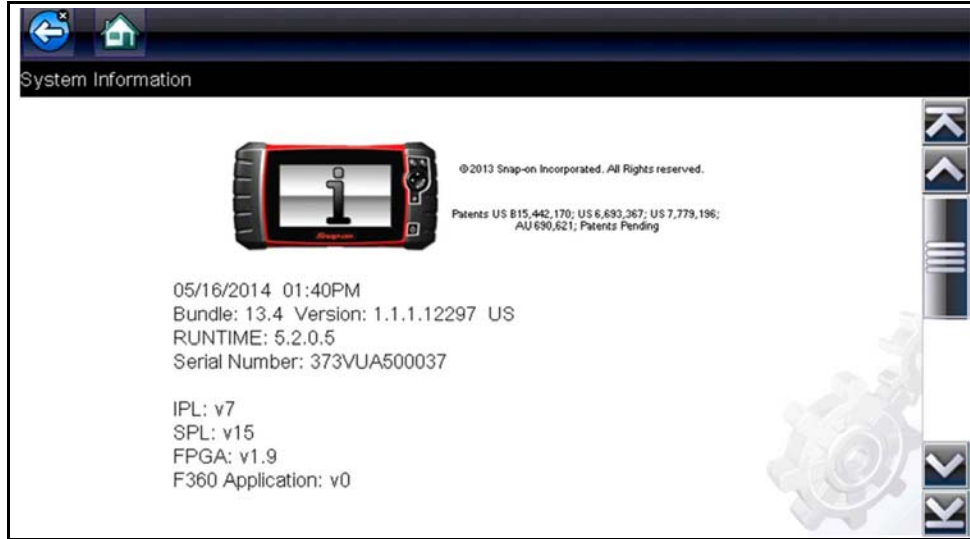


Figure 6-3 System information

- To display the System information screen:**
1. Select **Tools** from the Home screen to open the menu.
 2. Select **System Information** from the menu.
The System Information screen displays.
 3. Scroll as needed to view all of the data.
 4. Select **Back** on the toolbar or press the **N/X** button to return to the options menu.

6.1.4 Settings

This Tools selection allows you to adjust certain basic Diagnostic Tool functions to your personal preferences. Selecting opens an additional menu that offers the following:

- System Settings - see [System Settings](#) on page 59
- Configure Units - see [Configure Units](#) on page 63

System Settings

Selecting System Settings opens a menu with two options; Display and Date & Time. Either selection opens an additional menu.

Display options include:

- [Brightness](#) on page 60—adjusts the intensity of the screen back lighting.
- [Color Theme](#) on page 60—changes the background color of the screen display.
- [High Contrast Toolbar](#) on page 60—enhances toolbar graphics for poor lighting conditions.
- [Font Type](#) on page 61—switches between standard and bold text for better visibility.
- [Backlight Time](#) on page 61—adjusts how long the screen stays on with an idle Diagnostic Tool.
- [Touch Screen Calibration](#) on page 61—calibrates the touch screen display.

Date & Time options include:

- [Time Zone](#) on page 62—sets the internal clock to the local time standard.
- [Clock Settings](#) on page 62—sets the time on the internal clock.
- [Daylight Savings Time](#) on page 62—configures the clock for Daylight Savings Time.
- [Time Format](#) on page 62—switches the time displays between a 12 or 24 hour clock.
- [Date Format](#) on page 62—configures how the month, date, and year displays.

Brightness

Selecting this option opens the brightness setting screen for adjusting the back lighting of the display (*Figure 6-4*).

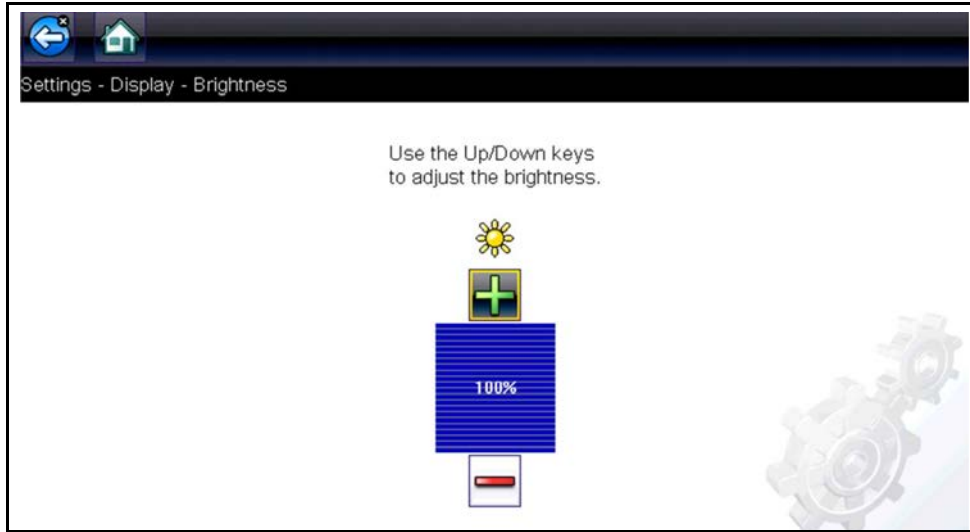


Figure 6-4 Brightness setting

Each push of the **Plus** and **Minus** icons, or the up (▲) and down (▼) arrows, incrementally changes the back lighting up or down respectively.

Select **Back** from the toolbar or press the **N/X** button to exit.

Color Theme

This option allows you to select between a white and black background for the screen. The black background can be beneficial when working under poor lighting conditions.

Selecting opens a menu with two choices: **Day Theme** (white background) and **Night Theme** (black background). Make a selection and a “please wait” message momentarily displays followed by the Home screen. The new toolbar setting is now active.

High Contrast Toolbar

This option allows you to switch to a high contrast toolbar. This toolbar features black and white icons with crisp graphics that are easier to see in poor lighting conditions or bright sunlight.



Figure 6-5 High-contrast toolbar

Selecting opens a menu with two choices; Color Toolbar and High Contrast Toolbar. Select and a “please wait” message displays followed by the Home screen. The new setting is now active.

Font Type

This option allows you to select between standard and bold faced type for the display screen. Bold type makes screen writing more legible under poor lighting or bright sunlight conditions.

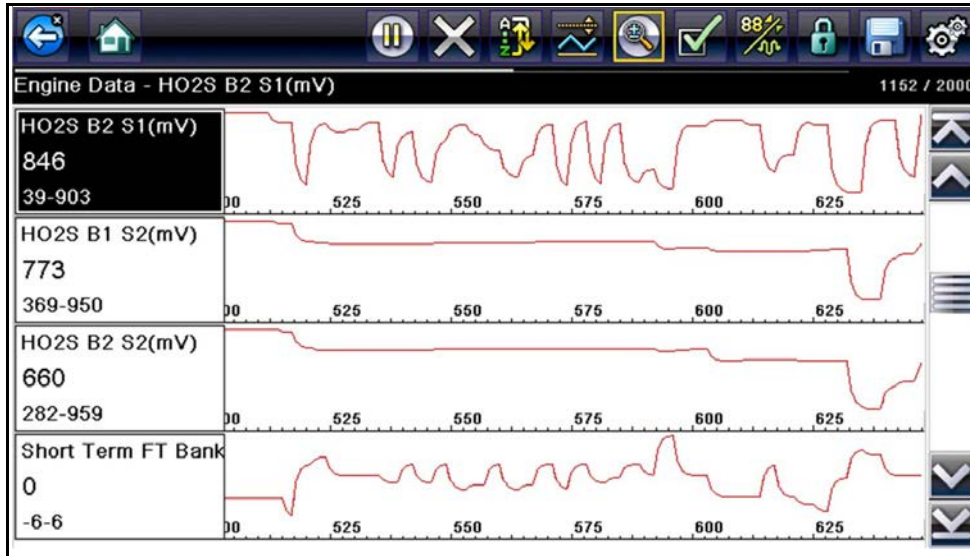


Figure 6-6 Bold Font

Selecting opens a menu with two choices: Normal Font and Bold Font. Select a menu item or scroll and then press the **Y/✓** button to make a selection. The change is instantaneous. Select the Back or Home icon on the toolbar to return to either the Settings menu or the Home screen.

Backlight Time

This option allows you to configure how long the screen backlight remains on when the Diagnostic Tool is inactive. The following choices are available:

- Always On
- 15 Seconds
- 30 Seconds
- 45 Seconds
- 60 Seconds

Select the menu item desired, or scroll and then press the **Y/✓** button to make a selection. Select **Back** or **Home** on the toolbar to return to either the Settings menu or the Home screen.

Touch Screen Calibration

Calibrating the touch screen maintains the accuracy of the touch-sensitive display.

IMPORTANT

To avoid serious damage to the Diagnostic Tool, always complete the touch screen calibration sequence once it has begun. Never turn off the Diagnostic Tool while a screen calibration is in process.

▶ To calibrate the touch screen:

1. Select **Tools** from the Home screen to open the menu.
2. Select **Settings** from the menu.
3. Select **Touch Calibration** from the menu.

The calibration screen opens ([Figure 6-7](#)).



Figure 6-7 Touch screen calibration



4. Select each box on the screen as it displays.

The display returns to the Settings menu once the screen calibration procedure is complete.

Time Zone

This option opens a menu of time zone settings. Scroll to highlight, then select the local time zone. The display returns to the Settings menu once a time zone is selected.

Clock Settings

This option opens a window for resetting the time on the real-time clock.



To set the clock:

1. Select **Tools** from the Home screen to open the menu.
2. Select **Settings** from the menu.
3. Select **Clock Settings** from the menu.

A warning message briefly displays followed by the Clock Settings screen ([Figure 6-8](#)).

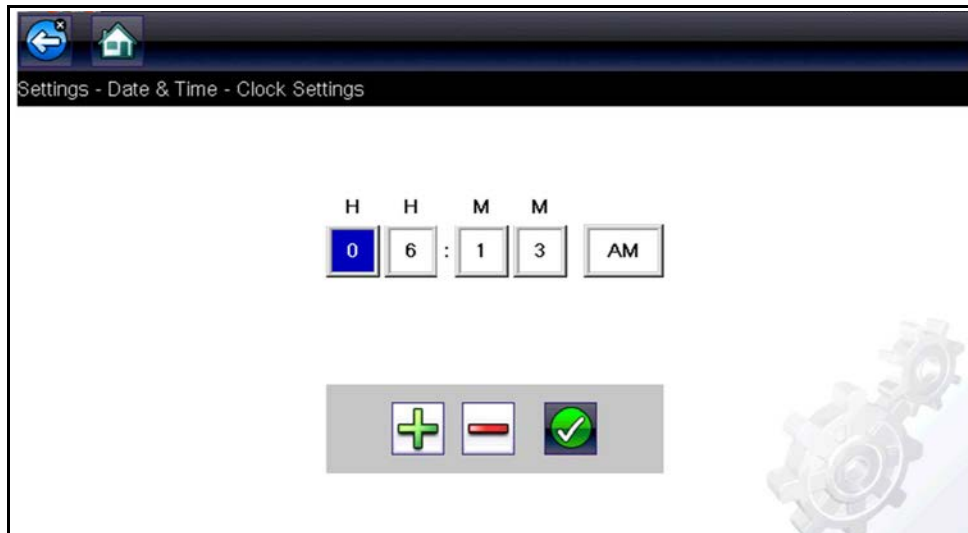


Figure 6-8 Clock settings

4. Select the **up (+)** icon on the screen or press the **up (▲)** button to incrementally increase the number in the highlighted field. Select the **down (-)** icon on the screen or press the **down (▼)** button to incrementally decrease the number.
5. Select the **check (✓)** icon on the screen or press the **Y/✓** button to move the highlight to the next field.
6. Repeat Step 4 and Step 5 until the correct time is displayed.
7. Select the **Back** icon on the toolbar or press the **N/X** button to close the Clock Settings window and return to the Settings menu.

Daylight Savings Time

This option opens a menu to configure the internal clock for Daylight Savings Time. Choose from:

- **ON**—sets the clock for Daylight Savings time.
- **OFF**—sets the clock for standard time.

Make either selection, then select the **Back** icon or press the **N/X** button to return to the menu.

Time Format

This option determines whether time is displayed on a 12 or 24 hour clock. Selecting opens a menu with two choices:

- **24 Hour Format**
- **12 Hour Format**

Make either selection, then select the **Back** icon or press the **N/X** button to return to the menu.

Date Format

This option allows you to select how date information is displayed. Select from:

- **(MM_DD_YYYY)**—Month, Day, Year
- **(DD_MM_YYYY)**—Day, Month, Year
- **(YYYY_MM_DD)**—Year, Month, Day

Make a selection, then select the **Back** icon or press the **N/X** button to return to the menu.



Configure Scope/Meter

These menu options allow you to configure certain characteristics of the display screen to your preference when using the Scope Multimeter module.


- See [Trigger Auto/Manual Mode \(Optional Setting\)](#) on page 25, on page 102 for Trigger Mode settings.
- For Display and Divisions settings, see [Display Settings](#) on page 32

Configure Units

Selecting opens a dialog box that allows you to choose between US customary or metric units of measure for temperature, vehicle speed, air pressure, and other pressures.



Figure 6-9 Configure units menu

-  **To change the units setup:**
1. Select **Tools** from the Home screen to open the menu.
 2. Select **Configure Units** to open the menu.
 3. Select an item from the Configure Units menu.
 4. Select a setting from the listed choices.
 5. Select **Back** on the toolbar or press the **N/X** button to return to the options menu.



Introduction

This section provides a brief introduction to the features and operation of ShopStream Connect (SSC).

SSC is a companion PC application (provided at no charge) that extends the capabilities of your diagnostic tool, by connecting to your PC.

SSC allows you to:

- Print data files, screenshots and code scan reports
- Download software upgrades and updates to your PC, and then install them on to your diagnostic tool.
- Transfer data files bi-directionally between your diagnostic tool and your PC.
- View, save and manage your data files on your PC.
- Add or edit notes and comments to your data files.

The ShopStream Connect (SSC) software is available online at:

<http://diagnostics.snapon.com/ssc>

Complete ShopStream Connect operation instructions can be found in the ShopStream Connect User Manual, located online at:

<http://diagnostics.snapon.com/usermanuals>

Main Topic Links

- [Using SSC \(Connecting to your PC\)](#) page 64
- [SSC Main Screen](#) page 65
- [Scanner DataViewer](#) page 66
- [Image Viewer](#) page 66
- [Printing the \(Code Scan\) Vehicle System Report](#) page 67
- [Customizing the \(Code Scan\) Vehicle System Report](#) page 68
- [Software Upgrades and Updates](#) page 70

7.1 Using SSC (Connecting to your PC)



To connect and use SSC with your diagnostic tool:

1. Download and install SSC on your PC from:
<http://diagnostics.snapon.com/ssc>
2. Turn your diagnostic tool on.
3. Connect the supplied USB cable from the USB jack on your diagnostic tool to your PC:
4. From the diagnostic tool Home screen, select **Tools > Connect-to-PC**.

The “**Device is now in Connect-to-PC mode**” screen message is displayed (*Figure 7-1*) and the ShopStream Connect software will open automatically on your PC (*Figure 7-2*).

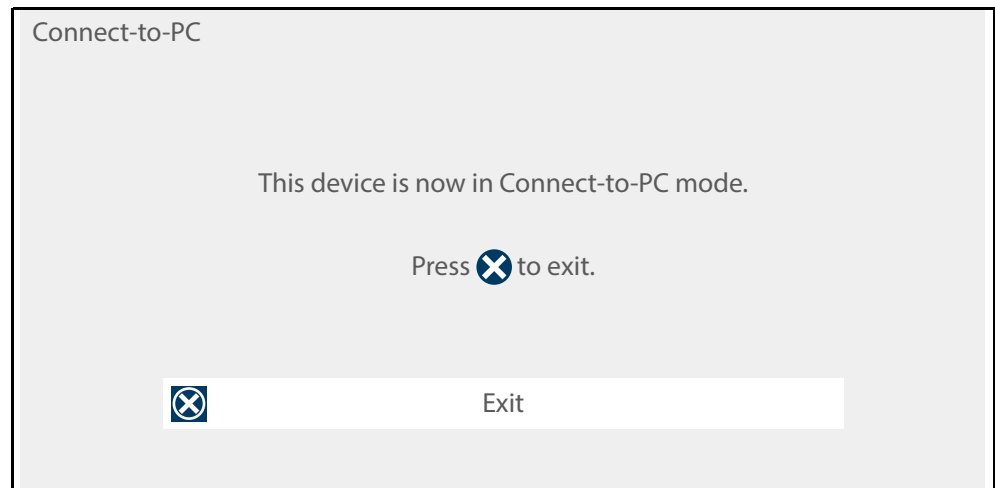


Figure 7-1

If the ShopStream Connect software does not open, open it from the Windows Start menu or use the ShopStream Connect shortcut icon on the Windows desktop (automatically created during installation).

7.2 SSC Main Screen

The ShopStream Connect software will open automatically when you connect the diagnostic tool to your PC USB connection, *Using SSC (Connecting to your PC) on page 64*.

The following shows the main screen layout for ShopStream Connect software.

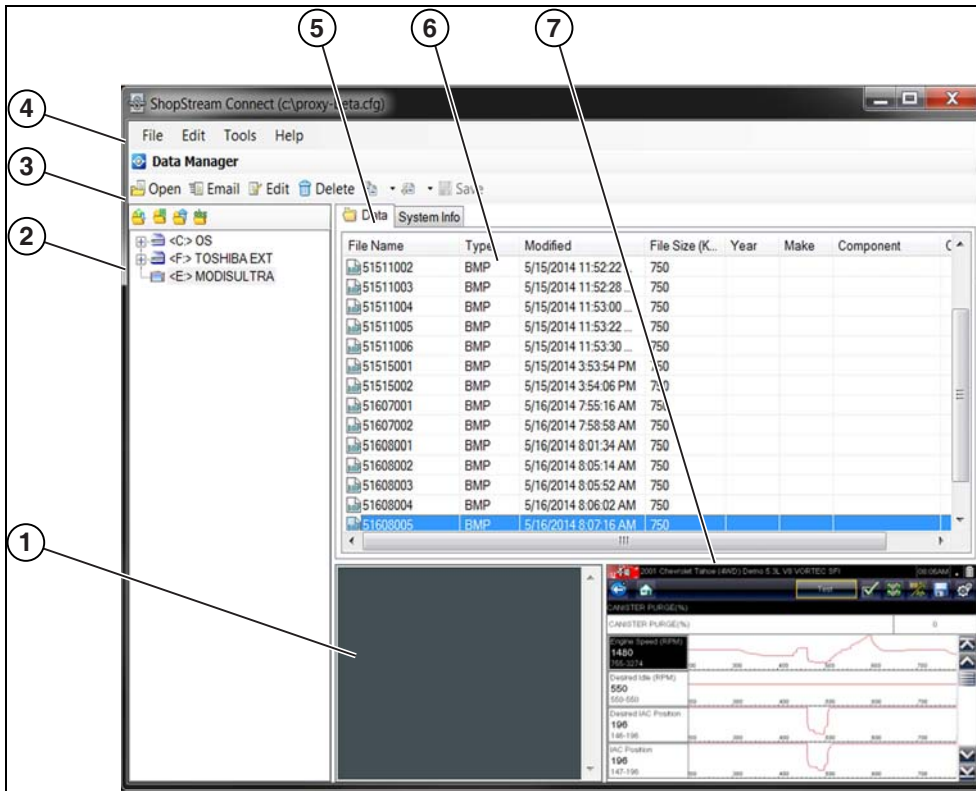


Figure 7-2

1— Notes Window—allows you add notes to select data files. Select Save from the menu bar to save your notes. *NOTE: Not all file types allow notes, the Notes window will be grayed out when a file type that does not support notes is highlighted. Some image files may display notes for reference purposes (the notes are grayed out and not editable).*

2— File directory structure—displays the file directory structure of your PC in standard Windows format, and shows any connected diagnostic tools at the bottom of the data list.

3— Data Manager Toolbar—provides control icons that perform a variety of operations on data files.

4— Main Menu bar—contains **File**, **Edit**, **Tools**, and **Help** menus.

5— Tabs—provides access to data files and presets stored on the diagnostic tool or on the PC, and also allows viewing of software revision details of the diagnostic tool.

6— Main display—shows stored data files details. *NOTE: The files listed are sortable (ascending/descending) by clicking on the column tab at the top (e.g. File Name, Type, etc.) Sort preferences are saved when the ShopStream Connect program is closed.*

7— Preview—displays a sample of the file if the selected file is a image file.

7.3 Scanner DataViewer

SSC allows you to view data files recorded with your diagnostic tool, on your PC. When a Scanner data file is selected, it opens and displays in the Scanner DataViewer (*Figure 7-3*). Scanner DataViewer allows you play the data file and custom configure the data in a number of ways.



- 1— Menu bar
- 2— Display toolbar
- 3— Graph display
- 4— Properties icon
- 5— Vertical Scroll bar
- 6— Zoom controls
- 7— Slider bar
- 8— Navigation toolbar
- 9— Parameter text list
- 10—Highlighted PIDs - indicates graphs currently displayed
- 11—Parameter configuration tabs

Figure 7-3

7.4 Image Viewer

SSC allows you to view and print .bmp, .jpg and .sps image files (screenshots) saved on your diagnostic tool, with your PC.

NOTE

File extension types vary depending on the diagnostic tool. Not all the file extensions described here may be available on your diagnostic tool.



- 1— Exit - closes the Image Viewer
- 2— Print - prints the image
- 3— Print Preview - allows the image to be previewed before printing
- 4— Captured Screen Image

Figure 7-4

7.5 Printing the (Code Scan) Vehicle System Report

To print the Vehicle System Report, the saved code scan .XML file must be opened using ShopStream Connect.

To print the Vehicle System Report using ShopStream Connect:

1. Double-click the code scan .XML file from the file list to open the Vehicle System Report ([Figure 7-5](#)) in the Code Scan Viewer ([Figure 7-6](#)).

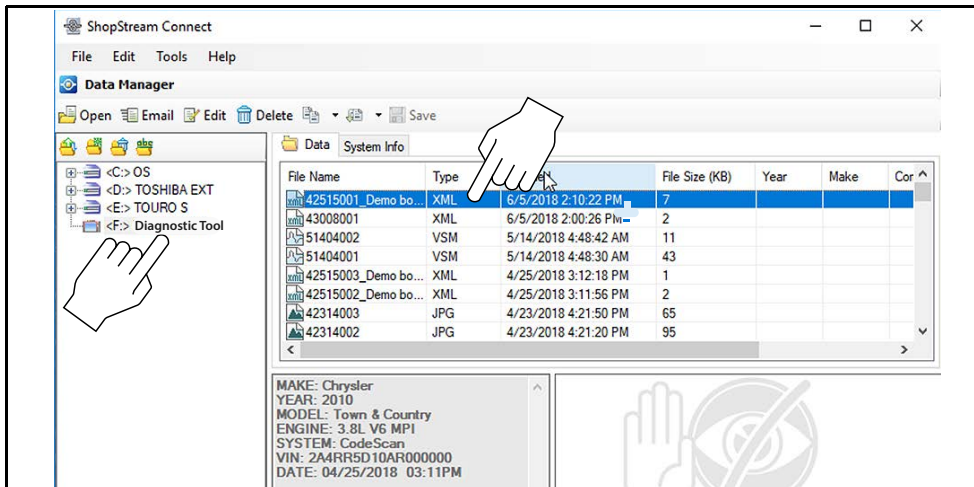


Figure 7-5

2. Select **Print** or **Print Preview** from the Code Scan Viewer menu to print or preview the Vehicle System Report ([Figure 7-6](#)).

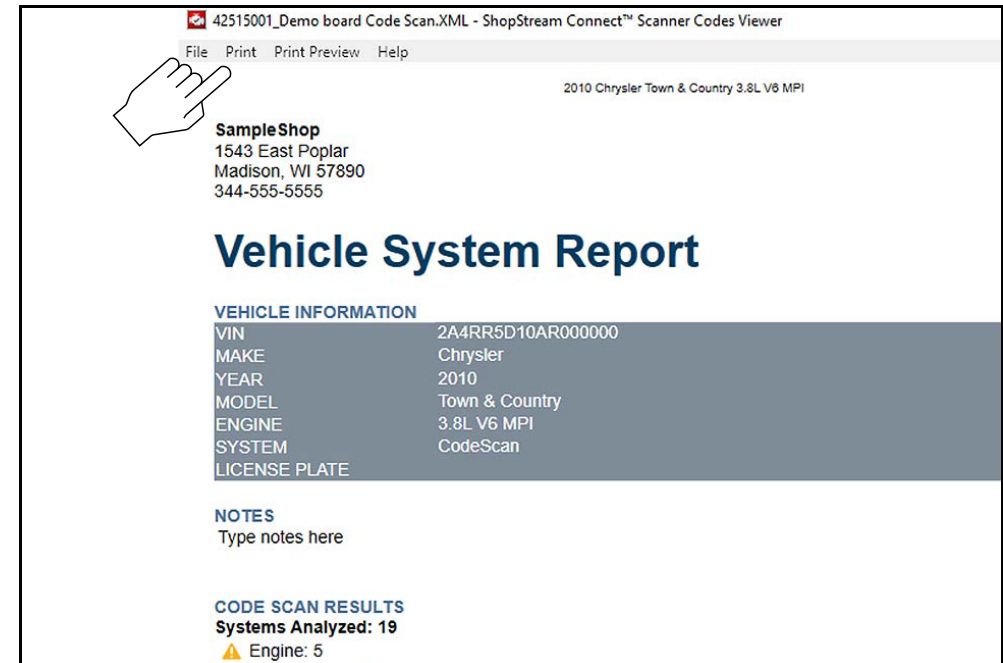


Figure 7-6

Selecting **Print** opens the Windows print dialog window ([Figure 7-7](#)). Select your printer from the list, then select **Print** to print the report.

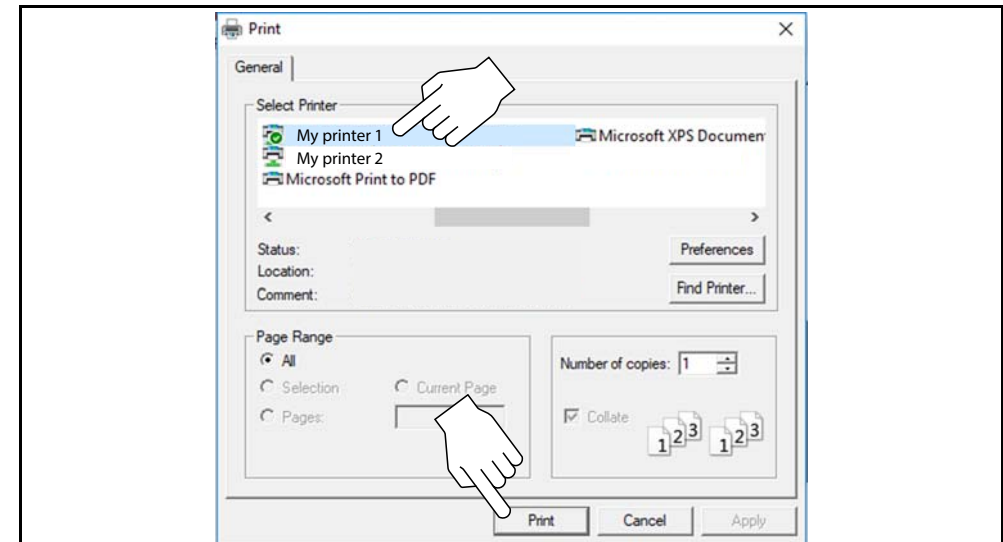


Figure 7-7



7.6 Customizing the (Code Scan) Vehicle System Report

Select fields of the Vehicle System Report can be edited, and you can also add notes or a Pre/Post Scan header to the report using ShopStream Connect.

To add Pre Scan or Post Scan to the report header:

1. Double-click the code scan .XML file from the file list to open the Vehicle System Report ([Figure 7-8](#)) in the Code Scan Viewer.
2. Hover the cursor over the area shown in [Figure 7-8](#), and select the desired option to add to the report header.

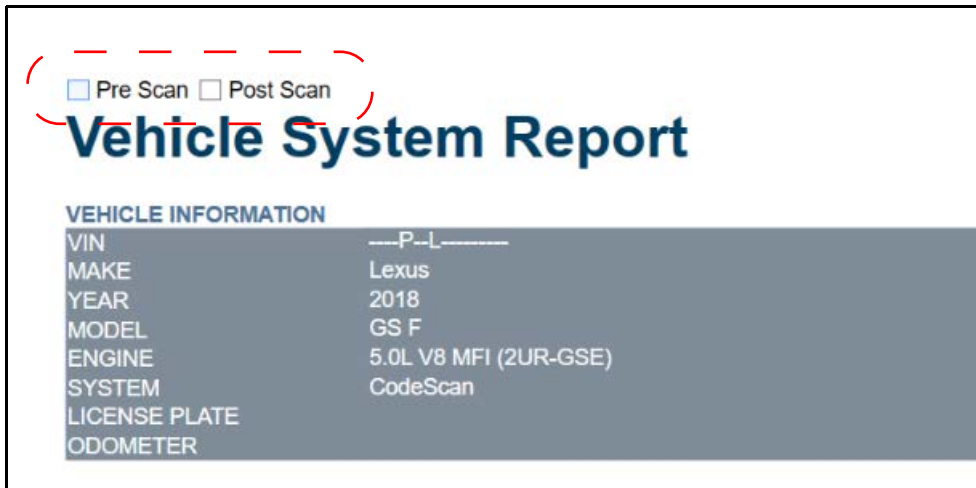


Figure 7-8

To edit the Shop Information (header) of the Vehicle System Report:

1. From ShopStream Connect, select **Tools > Options > Edit Shop Info** ([Figure 7-9](#)).

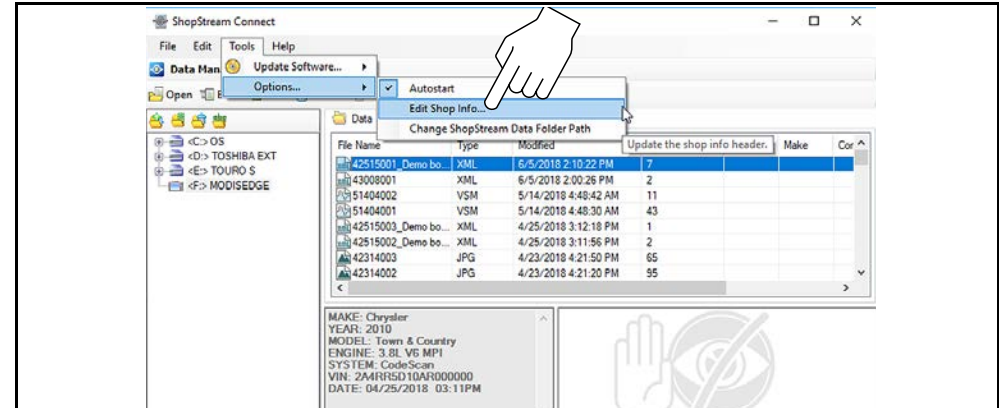


Figure 7-9

2. The **Shop Info** dialog box opens ([Figure 7-10](#)) allowing you to enter the name address, and phone number for your shop. This information is included as a header on the report.

Figure 7-10 shows the 'Edit Shop Info' dialog box. The fields are as follows:

Field	Value
Shop Name	SampleShop
Address 1	1543 East Poplar
Address 2	
City	Madison
State/Province, County	WI
Zipcode	57890
Phone 1	344-555-5555
Phone 2	

The 'Messages' section includes:

- Line 1: [Empty field]
- Line 2: [Empty field]
- Line 3: [Empty field]

Checkboxes:

- Use Shop Info in Printout Header
- Use timestamp in Vehicle System Report

Buttons: Save, Cancel

Print Header Preview:

```
6/6/2018 2:57 PM
SampleShop
1543 East Poplar
Madison WI 57890
344-555-5555
```

Figure 7-10

A preview panel at the bottom of the box shows how the information will appear on a print out (Figure 7-10).

3. Check the “**Use Shop Info in Printout Header**” box to show the Shop Info in the printout (Figure 7-10).
4. Check the “**Use timestamp in Vehicle System Report**” box to show the time the vehicle was scanned in the printout (Figure 7-10).
5. When you are finished editing, select **Save** (Figure 7-10) to save the information and close the dialog box.

To edit the VIN and License Plate fields, and/or add notes to the Vehicle System Report:

1. From ShopStream Connect, open the code scan .XML file to be edited (Figure 7-11).
2. Click in the editable fields as shown in (Figure 7-11) to change the values or add notes.
3. Check the “**Add the notes to the printed copy**” box to show the notes in the printout (Figure 7-11).

Figure 7-11 shows the 'Scanner Codes Viewer' application. The report details are as follows:

42515001_Demo board Code Scan.XML - ShopStream Connect™ Scanner Codes Viewer

File Print Print Preview Help

2010 Chrysler Town & Country 3.8L V6 MPI

SampleShop
1543 East Poplar
Madison, WI 57890
344-555-5555

Vehicle System Report

VEHICLE INFORMATION

VIN	
MAKE	Chrysler
YEAR	2010
MODEL	Town & Country
ENGINE	3.8L V6 MPI
SYSTEM	CodeScan
LICENSE PLATE	

NOTES

Add the notes to the printed copy

CODE SCAN RESULTS

System analyzed: 19

- ▲ Airbag: 5
- ▲ Airbag: 2
- ▲ Airbag: 2
- ▲ Central Gateway (FCM): 0
- ▲ Door Module - Front Left (DMFL): 2
- ▲ Door Module - Front Right (DMFR): 2
- ▲ Door Module - Rear Left (DMRL): 2
- ▲ Door Module - Rear Right (DMRR): 2
- ▲ Heat Ventilation A/C (HVAC): 1
- ▲ Instrument Cluster Module (CCN): 0
- ▲ Power Liftgate Module (PLGM): 1
- ▲ Power Sliding Door Module - Left (PSDML): 3
- ▲ Power Sliding Door Module - Right (PSDMR): 2

Figure 7-11



7.7 Software Upgrades and Updates

Upgrade/Update Descriptions:

- **Software Upgrade** - a software upgrade is a new software version (contact your sales representative for purchase information).
- **Software Update** - a software update is a service release for installed software. These are available free of charge, and are provided as necessary to update installed software. When your diagnostic tool is connected to a PC using SSC, the SSC software will automatically check for updates, and if an update is available, it will provide installation instructions. Follow the screen prompts to accept, download and install the software.

NOTE

To receive updates or upgrades, SSC software must be installed on your PC and have connection to the Internet.



Example - Updating diagnostic tool software:

1. Select **Tools > Update Software >** (diagnostic tool type - e.g. ETHOS Edge, MODIS Edge, SOLUS Edge, etc.) from the Menu bar ([Figure 7-12](#)).

The software checks the Snap-on web server for available updates.

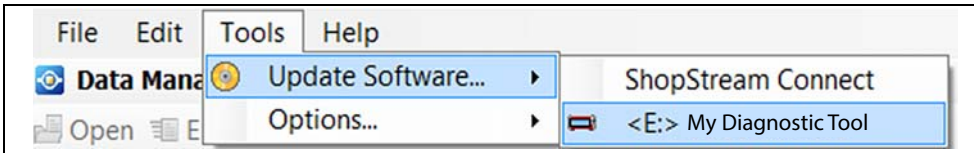


Figure 7-12

2. If service release updates are available, select **Next** to continue, then select **Download** and follow the on-screen instructions to complete the installation ([Figure 7-13](#)).

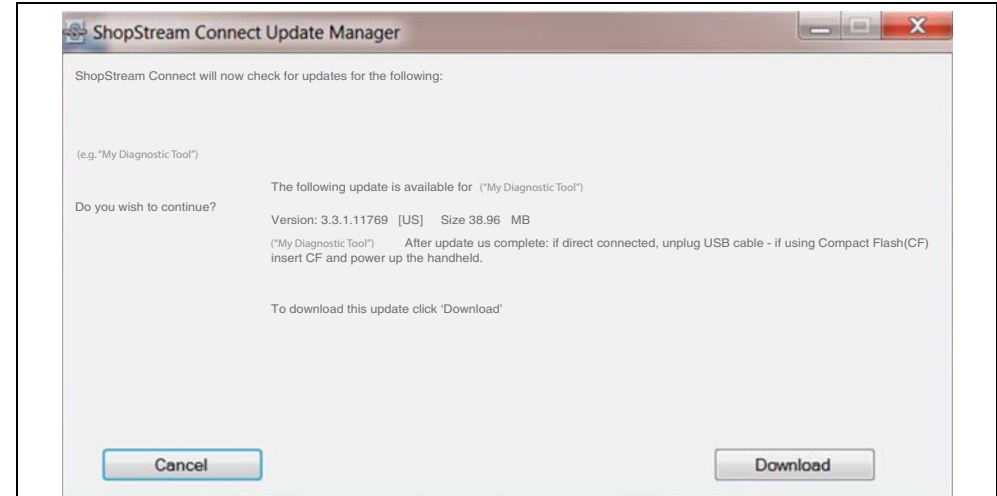


Figure 7-13

NOTE

For additional information on ShopStream Connect software updates and upgrades, download the ShopStream Connect User Manual from our website: <http://diagnostics.snapon.com/usermanuals>

7.7.1 End User License Agreement

Before software installation at initial purchase, and before all subsequent software updates/upgrades installations End User License Agreement (EULA) acceptance is required.

IMPORTANT

Use of Software is governed by the terms and conditions of the End User License Agreement. The diagnostic tool should not be initially operated until the End User License Agreement is read. Use of the device acknowledges your acceptance of the End User License Agreement. The Snap-on Incorporated Software End User License Agreement is available at: <https://eula.snapon.com/diagnostics>

To Accept: at the screen prompt ([Figure 7-14](#)) click the checkbox on the left side of the window, and then select **Agree and Continue**. The software will be installed automatically.



Figure 7-14 below represents a typical EULA acceptance agreement screen.

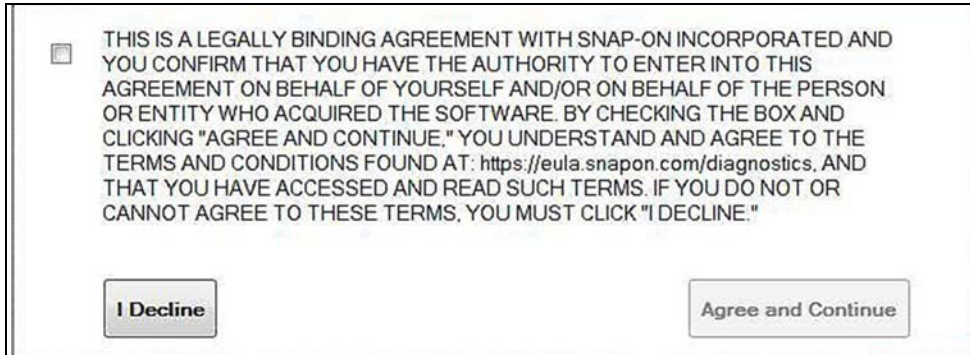


Figure 7-14 Typical EULA acceptance screen

To Decline: at the screen prompt (Figure 7-14) select **I Decline**. A confirmation message is displayed providing options to Go Back or Exit the software installation (Figure 7-15).

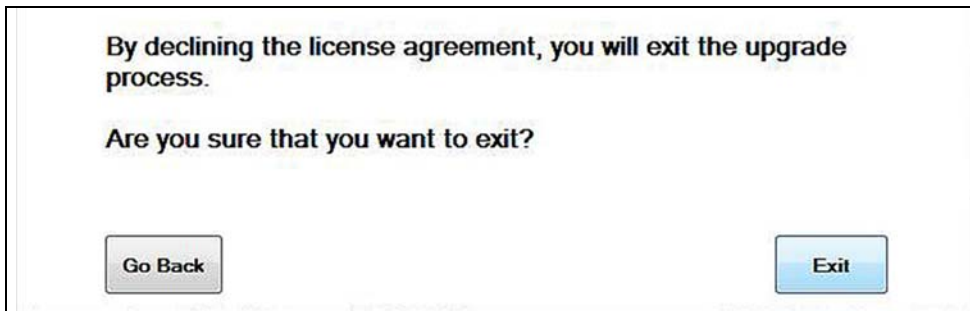


Figure 7-15 Typical EULA acceptance screen



This section describes basic cleaning and battery replacement procedures for your diagnostic tool.

Main Topic Links

- [Cleaning and Inspecting the Diagnostic Tool](#) page 72
- [Battery Pack Service](#) page 72
- [Cleaning the Touch Screen](#) page 72
- [Safety](#) page 72
- [Ordering a New Battery Pack](#) page 73
- [Replacing the Battery Pack](#) page 73
- [Disposing of the Battery Pack](#) page 74

8.1 Cleaning and Inspecting the Diagnostic Tool

Periodically perform the following tasks to keep your diagnostic tool in proper working order:

- Check the housing, cables and connectors for dirt and damage before and after each use.
- At the end of each work day, wipe the diagnostic tool housing, cables and connectors clean with a damp cloth.

IMPORTANT

Do not use any abrasive cleansers or automotive chemicals on the diagnostic tool.

8.1.1 Cleaning the Touch Screen

The touch screen can be cleaned with a soft cloth and a mild window cleaner.

IMPORTANT

Do not use any abrasive cleansers or automotive chemicals on the touch screen.

8.2 Battery Pack Service

8.2.1 Safety

Follow all safety guidelines when handling the battery pack.



! WARNING

Risk of electric shock.

- **Prior to recycling the battery pack, protect exposed terminals with heavy insulating tape to prevent shorting.**
- **Disconnect all test leads and turn diagnostic tools off before removing the battery pack.**
- **Do not attempt to disassemble the battery or remove any component projecting from or protecting the battery terminals.**
- **Do not expose the diagnostic tool or battery pack to rain, snow, or wet conditions.**
- **Do not short circuit the battery terminals.**

Electric shock can cause injury.



WARNING

Risk of explosion.

- **The Lithium battery is factory replaceable only, incorrect replacement or tampering with the battery pack may cause an explosion.**

Explosion can cause death or serious injury.

IMPORTANT

The battery pack contains no user serviceable components. Tampering with the battery pack terminals or housing will void the product warranty.

Keep the following in mind when using and handling the battery pack:

- Do not short circuit battery pack terminals.
- Do not immerse the diagnostic tool or battery pack in water, or allow water to enter the diagnostic tool or battery pack.
- Do not crush, disassemble, or tamper with the battery pack.
- Do not heat the battery pack to over 100°C (212°F), or dispose of it in a fire.
- Do not expose the battery pack to excessive physical shock or vibration.
- Keep the battery pack out of reach of children.
- Do not use a battery pack that appears to have suffered abuse or damage.
- Charge the battery pack in the appropriate charger only.
- Do not use a battery charger that has been modified or damaged.
- Use the battery pack for the specified product only.
- Store the battery pack in a cool, dry, well ventilated area.

NOTE

The battery pack should be used within a short period of time (about 30 days) after charging to prevent loss of capacity due to self-discharging.

If long-term storage of the battery pack is necessary, it should be stored in a cool, dry, well ventilated place with a 30 to 75 percent state of charge to prevent loss of characteristics.

To prolong the life of your battery, turn off the diagnostic tool when not in use. The diagnostic tool has a built in charger that recharges the battery on demand whenever it is connected to a power source.

8.2.2 Ordering a New Battery Pack

If the battery pack needs to be replaced, contact your sales representative to order a new battery pack.

IMPORTANT

Only use the recommended Snap-on replacement battery pack.

8.2.3 Replacing the Battery Pack

If the battery pack no longer holds a charge, contact your sales representative to order a new one.

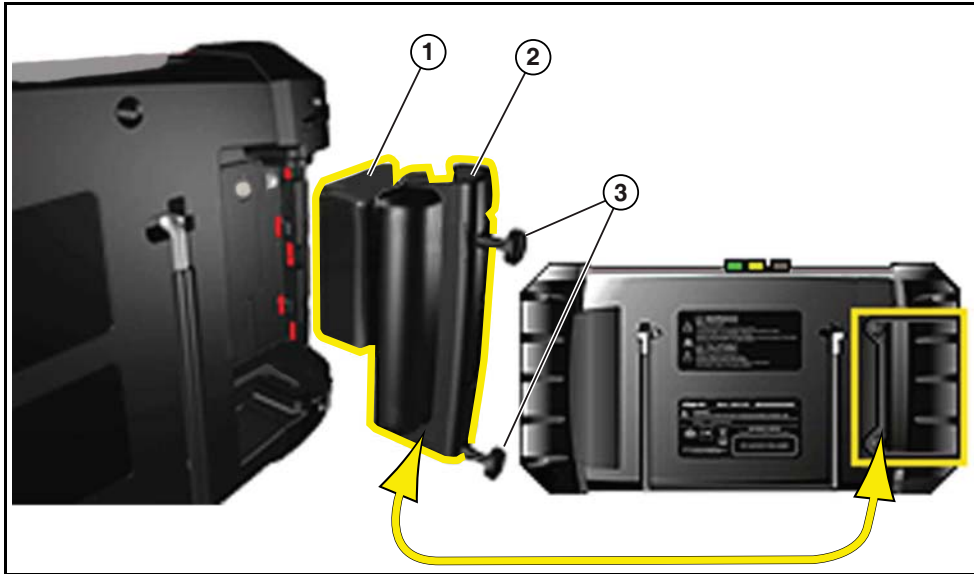
IMPORTANT

Replace the battery pack with original Snap-on replacement parts only.



To replace the battery pack:

1. Loosen the two captive screws that retain the battery compartment cover on the back-side of the Diagnostic Tool (*Figure 8-1*).
2. Pull up on the inner edge of the battery compartment cover to release it, pivot the cover into an upright position, then lift the battery cover off of the housing.
3. Slide the battery down to disengage the electrical contacts.
4. Remove the battery from the tool housing.
5. Align the tabs on the sides of the battery compartment with the slots on the new battery, then place the battery into the housing.
6. Slide the battery up to engage the electrical contacts and snap it into place.
7. Fit the battery cover onto on the housing, then pivot the cover down so that it snaps into place.
8. Snug up the captive screws to hold the cover in place. ***Do not overtighten the screws!***



- 1— Battery
- 2— Battery Cover
- 3— Battery Cover Screws

Figure 8-1 Battery pack replacement

8.2.4 Disposing of the Battery Pack

Always dispose of the battery pack according to local regulations, which vary for different countries and regions. The battery pack, while non-hazardous waste, does contain recyclable materials. If shipping is required, ship the battery pack to a recycling facility in accordance with local, national, and international regulations.

IMPORTANT

Always dispose of materials according to local regulations.

For additional information within the **United States of America** contact:

- Rechargeable Battery Recycling Corporation (RBRC) at www.call2recycle.org
Phone - 800 822-8837

For additional information within **Canada** contact:

- Rechargeable Battery Recycling Corporation (RBRC) at www.call2recycle.ca
Phone - 888 224 9764

Products bearing the WEEE logo ([Figure 8-2](#)) are subject to European Union regulations.



Figure 8-2 WEEE logo

Contact your sales representative for details.



Customer Support / Training

Support Contact Information

Phone / E-mail - Technical Assistance

1-800-424-7226 / diagnostics_support@snapon.com

or use our online contact form

- <https://www1.snapon.com/diagnostics/us/Contact>

Website Links:

Snap-on Diagnostics and Information

- <http://diagnostics.snapon.com>

Manuals / Technical Documentation - This manual is periodically revised to ensure the latest information is included. Download the latest version of this manual and other related technical documentation at:

- <http://diagnostics.snapon.com/usermanuals>

For technical assistance in all other markets, contact your selling agent.

Product Training Videos

Diagnostic tool specific training videos are available on our website. Follow along and learn the basics of diagnostic tool operation with our free training videos.

Videos are product specific and are available at:

<http://diagnostics.snapon.com> - Click on the "Training & Support" tab, select the applicable diagnostic tool, then select "See Training".

i NOTE

Sample titles are listed below. Not all titles may be available for all diagnostic tools, and are subject to change.

Snap-on® Training Solutions® - Training Videos (examples)	
Introduction and Navigation	Global OBD-II
Scanner Codes	Digital Multimeter
Scanner Data in PID View	Graphing Multimeter & Lab Scope
Scanner Data in Graphing View	Guided Component Tests
Fast-Track® Troubleshooter	Vehicle Specs & Resets
Functional Tests	SureTrack® & Wi-Fi



Diagnostic Quick Tips - Video Series

Snap-on Diagnostic Quick Tips videos are available at no charge on our website and on our YouTube channel. These videos are developed from real repair case studies to help professional technicians use diagnostic tools to solve specific vehicle problems (e.g. performing a Ford Relative Injector Flow Test).

Additional videos are also available showing specific diagnostic tool features (e.g. ShopStream Connect - Software Updates).



Figure 9-1

Videos are available at:

<http://diagnostics.snapon.com> - Click on the “Training & Support” tab, select the applicable diagnostic tool, then select “See Quick Tips”

<https://www.youtube.com/user/snaponscanner/videos> - Use the search function to find a title, or enter “Diagnostic Quick Tips” in the search field to see a list of all applicable titles.

NOTES

URL links (above) and titles listed (below) are subject to change and may not be available in all markets.

A sample list of titles are listed below, other titles may be available.

Some videos may not applicable for use with all diagnostic tools.

Snap-on® Training Solutions® - Diagnostic Quick Tips Videos (examples)

Air/Fuel Ratio Sensor Test	Fuel Injector Voltage and Current Tests (Scope)
Alternator Ripple Test (Scope)	Fuel Pump Current Ramp Test (Scope)
BMW® Rain Sensor Calibration	Harley-Davidson® ABS Brake Bleed
CAN Bus Diagnostics (Scope)	Harley-Davidson® Functional Tests
Chevrolet® Volt Coolant Pump Bleed	Harley-Davidson® Key Fob Programming
Chrysler HVAC Test	Hyundai Blind Spot Detection System Calibration
Chrysler VVT System Cleaning	Hyundai Occupant Detection System Reset
Chrysler Wheel & Tire Calibrations	Ignition Coil Current and Voltage Comparison
COP Ignition Test	Ignition Coil Current Ramp Test
Dual Screen Diagnostics: Scanner vs. Scope	Ignition Coil Primary Voltage Test
Electronic Throttle Control System Diagnostics	Ignition System Diagnostics Using the SIA2000 (Scope)
FIAT® 500 Proxi Alignment	MINI Battery Relearn
FIAT® 500 Throttle Body Relearn	Multi Channel Cam / Crank Correlation
Flex Ray Bus Diagnostics	OBD-II Mode 10 Permanent Codes
Ford Battery Monitor System	Oil Specs & Service Light Resets
Ford Coil Current RFI Test (Scope)	PID Trigger Functions (Scanner)
Ford Flash Reprogramming	Piezo Injectors Signature Test
Ford Misfire Monitor Neutral Profile Correction (Scanner)	Relative Compression Test (Scope)
Ford PATS Key Programming	ShopStream Connect - Data Manipulation
Ford Relative Compression Test	ShopStream Connect - Software Updates



Snap-on® Training Solutions® - Diagnostic Quick Tips Videos (examples)	
Ford Relative Injector Flow Test	Speed Up Your Diagnostics (Scanner)
Ford TPMS Reprogramming	The Power of Troubleshooter Tips (Scanner)
Ford® 6.7L Transmission Solenoid Characterization	Top Level Menus: Built In Scope Training
Ford® Diesel Injector Coding	Toyota EVAP Test
VW / Audi Flexible Service Reset (Scanner)	Toyota Multiple Freeze Frame (Scanner)
	Toyota Transmission Compensation Coding



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Patent Information

For a listing of Snap-on products that are protected by patents in the United States and elsewhere, visit: <https://patents.snapon.com>

Manual Application

This manual includes information and images applicable to diagnostic software version 19.4. Some information within this manual may not be applicable to other diagnostic software versions.

Disclaimer of Warranties and Limitation of Liabilities

All pictures and illustrations shown are for reference purposes only. All information, specifications and illustrations in this manual are based on the latest information available at the time of printing and are subject to change without notice. While the authors have taken due care in the preparation of this manual, nothing contained herein:

- Modifies or alters in any way the standard terms and conditions of the purchase, lease, or rental agreement under the terms of which the equipment to which this manual relates was acquired.
- Increases in any way the liability to the customer or to third parties.

Snap-on[®] reserves the right to make changes at any time without notice.

IMPORTANT

Before operating or maintaining this unit, please read this manual carefully paying extra attention to the safety warnings and precautions.

Manuals / Technical Documentation - The information in this manual is periodically revised to ensure the latest information is included. Download the latest version of this manual and other related technical documentation from the Snap-on Diagnostics website.