1 Measurement

The Measurement application can provide all the features needed for performing electrical and electronic circuit tests as well as monitoring signal activities on today's vehicles.

After properly connecting with a test vehicle and communicating with MaxiSys Ultra, the VCMI (Vehicle Communication and Measurement Interface) is used as an integrated device that functions as an oscilloscope, a waveform generator, a multimeter and a digital OBDII breakout box.

1.1 Oscilloscope

An oscilloscope is a measuring instrument that shows how a signal varies with time in a graphical way. Various signal activities can be displayed and monitored on a two-dimensional grid. The graphical form created by a signal is called a waveform. The voltage-time characteristic of the signal or waveform is drawn as a visual line called the trace.

1.1.1 Safety Information

Follow these instructions below to reduce the risk of injury from electric shock and prevent equipment damage.

A. Maximum input ranges

Observe all terminal ratings and warnings marked on the product.

DANGER:

- To prevent electric shock, take all necessary safety precautions when working on equipment where voltages beyond the specified input range may exists. Contact with voltages outside of the specified measuring range presents a risk of electric shock.
- To prevent injury or death, the oscilloscope must not be directly connected to the battery. To measure battery voltages, use a differential isolating probe

specifically rated for battery use.

⚠ **WARNING:**

- Operation outside of the safe input range is likely to cause permanent damage to the oscilloscope and other connected equipment.

B. Grounding

⚠ **DANGER:**

- The scope's ground connection through the USB cable is for measurement purposes only. The oscilloscope does not have a protective safety ground.
- Do not connect the ground input (chassis) to any electrical power source. To prevent personal injury or death, use a voltmeter to check that there is no significant AC or DC voltage between the oscilloscope ground and the point to which you intend to connect the ground input.

⚠ **WARNING:**

- Applying a voltage to the ground input is likely to cause permanent damage to the oscilloscope, the attached computer, and other equipment.
- To prevent measurement errors caused by poor grounding, always use the high-quality USB cable supplied with the oscilloscope or Wi-Fi connection.

C. External connections

⚠ **DANGER:**

- To prevent injury or death, use only the power cord and adaptor supplied with the product.

D. Environment

⚠ **DANGER:**

- To prevent injury or death, do not use the product in wet or damp conditions, or around explosive gas or vapor.

⚠ **WARNING:**

- To prevent damage, always use and store your oscilloscope in appropriate environments.

E. Product Maintenance

The product contains no user-repairable parts. Repair, servicing and calibration require specialized test equipment and must be performed by Autel Tech Support or an approved service provider.

DANGER:

- To prevent injury or death, do not use the product if it appears to be damaged in any way. Stop using the product when any abnormal operations occur.

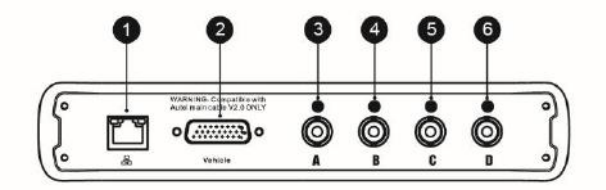
WARNING:

- Do not tamper with or disassemble the oscilloscope, connectors or accessories. Internal damage will affect performance.
- Do not block any of the instrument's air vents to avoid damage caused by overheating.
- When cleaning the oscilloscope, use wet soft cloth with mild detergent in water. Do not allow water to enter the oscilloscope casing.

1.1.2 General Introduction

1.1.2.1 Component Locations

The input channels are located at the bottom of the VCMI device and are compatible with many test leads and probes.

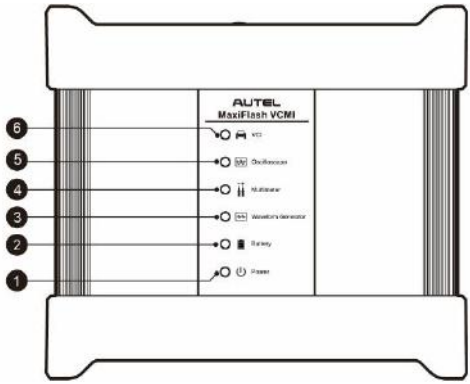


VCMI Bottom View

1. Ethernet Connector – Connects to RJ45 Network Cable
2. Vehicle Data Connector – Connects to the vehicle DLC using the provided Main Cable.
3. Input Channel A
4. Input Channel B

5. Input Channel C
6. Input Channel D

The oscilloscope LED is located on the front panel of the VCMI device. When the VCMI is properly connected and powered on, the oscilloscope LED flashes green when operating in the oscilloscope mode.



VCMI Front View

1. Power LED
2. Battery LED
3. Waveform Generator LED
4. Multimeter LED
5. Oscilloscope LED
6. Vehicle LED

1.1.2.2 Technical Specifications

Table 1-1 *Technical Specifications*

Item	Description
Channels	4
Bandwidth	20MHz

Item	Description
Maximum Sample Rate	● 1 or 2 channels: 80MS/s* ● 3 or 4 channels: 20MS/s* * MS/s = mega samples per second 1) Select arbitrary one channel, the maximum sample rate is 80MS/s. 2) Select two channels (AC, BC, AD, or BD), the maximum sample rate is also 80MS/s. 3) Select two channels (AB/CD) or more than three channels, the maximum sample rate is 20MS/s.
Input Ranges (Full Scale)	±50 mV to ±200V
Sensitivity	10 mV/div to 40V/div
Input Coupling	AC/DC
Input Impedance	1MΩ in parallel with 25pF
Vertical Resolution	12 bits
Buffer Memory	32M samples shared among active channels
Time Base Ranges	100ns/div to 1000s/div
Connection	● USB 2.0 ● Wi-Fi
Max. Wi-Fi Transmission Distance	Up to 98ft
DC Accuracy	±1% of full scale
Storage Humidity Range	5 to 95%RH, non-condensing

1.1.2.3 Accessories

Autel USB Cable V2 (the V2 icon can be seen on the cable) (SA001)

Connects the oscilloscope to the tablet to ensure reliable

signal transmission.

Secondary Ignition Pickup (SA273)

The BNC connector is connected to the oscilloscope to measure the secondary ignition voltage of conventional ignition systems and most HEI (High Energy Ignition) and DIS (Distributorless Ignition) systems.

Scope Test Lead

(Red: SA005, Green: SA006, Blue: SA007, Yellow: SA008)

The BNC connector is connected to the oscilloscope, and the 4mm banana plug is connected to various probes.

Breakout Lead (SA151)

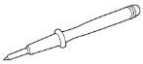
Enables easy access to existing automotive wiring harness connectors for obtaining signals of various sensors. Four sizes are available: 0.6 mm, 1.5 mm, 2.3 mm and 2.8 mm.

Flexible Back-pinning Probe (Red: SA053, Black: SA054)

Designed for back-probing under the insulation of multi-plug terminals to detect the signal of the test component. The flexible part can be bent and access to difficult areas. The probe tip is not replaceable.

Back-pinning Probe Set (SA051)

Designed for back-probing under the insulation of plugs to pick up the signal of the test component. The probe tip is replaceable.



Multimeter Probe (Red: SA055, Black: SA056)

Designed for connecting exposed wires or terminals.

Small Crocodile Clips (Red: SA057, Black: SA058)

Used to connect exposed wires or terminals. SA059 (red) and SA060 (black) for larger terminals.

Large Dolphin Clips (Red: SA059, Black: SA060)

Used to connect exposed wires or terminals, including battery terminals. SA057 (red) and SA058 (black) for smaller terminals.

Attenuators 20:1 (SA020)

Passive 20:1 attenuator, can output 1V when inputting a 20V signal.

Battery Clip (Optional) (Red: SA061, Black: SA062)

Dedicated to connecting car battery terminals.

65A AC/DC Current Clamp (Optional) (SA253)

Used to measure AC or DC currents up to 65A. Two scales are available: 1mV/10mA for 10mA to 20A, 1mV/100mA for 10mA to 65A.

650A AC/DC Current Clamp (Optional) (SA256)

Used to measure AC or DC currents up to 650A. Two scales are available: 1mV/100mA for 100mA to 200A, 1mV/1A for 100mA to 650A.

Coil On Plug (COP) Probe (Optional) (SA271)

Used with the oscilloscope to measure the secondary ignition voltage of COP.

HT Extension Lead (Optional) (SA275)

Fit the HT extension leads between the coil pack and the plugs of the independent ignition system (COP), and then place the (SA273) secondary ignition pickup on each lead to obtain the secondary ignition voltage.

1.1.3 Getting Started

Before opening the Oscilloscope application, the VCMI device must be connected to the tablet via the provided USB cable or Wi-Fi network.

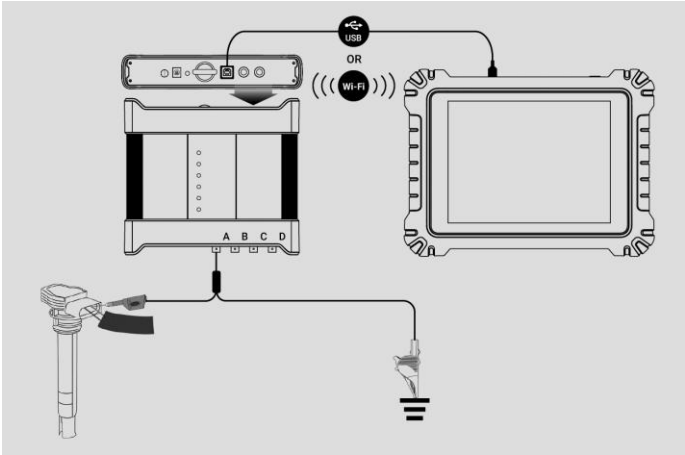


Figure 1-1 ***Sample Connection Diagram***

➢ **To open the oscilloscope application**

1. Insert the applicable test lead or probe terminal ends into the input channel(s) to complete the connection (refer to ***Figure 1-1***).
2. Tap the **Measurement** icon on the Home screen of the MaxiSys Ultra Tablet. The Measurement screen opens.
3. Tap the **Oscilloscope** icon to open the oscilloscope menu.
4. Select a desired testing option to continue.

NOTE

Please check the oscilloscope LED status indicator on the front panel of VCMI device. The oscilloscope LED flashes green when operating in the oscilloscope mode.

Message Prompt

A message showing “Are you sure to open the waveform of Demo mode?” displays after tapping the Oscilloscope icon and opening the oscilloscope menu. Please tap “**OK**” to enter the demo mode or tap “**Cancel**” to exit.

A message showing “Are you sure to open the waveform data?” also displays after the tablet and the VCMI connect successfully. Please tap “**OK**” to display the actual waveform or tap “**Cancel**” to exit.

1.1.4 Oscilloscope Update

The operating software of the oscilloscope is continually optimized. Tap the **Help** button in the upper half of the screen to update.

Before update the oscilloscope software, please make sure the tablet has a stable Internet connection.

1.1.4.1 APK Update

NOTE

The acronym APK (Android Package Kit) is used on the tablet and in this manual. This file contains all the assets of a particular app. To update the APK, is to install the latest version of the app on your tablet.

➢ **To update the APK**

1. Tap the **Help** button on the upper half of the screen. A dropdown menu displays.

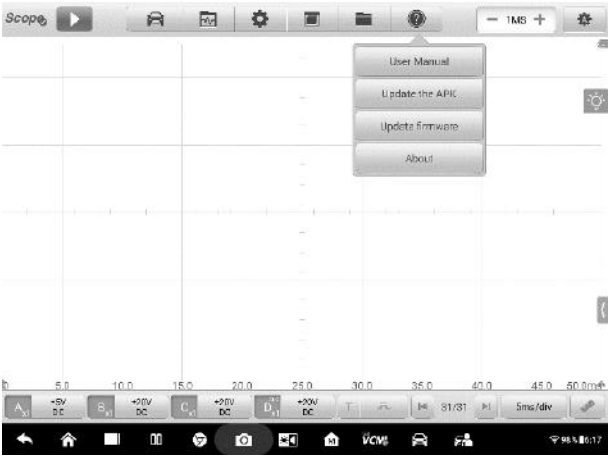


Figure 1-2 ***Sample Help Screen***

2. Tap the **Update the APK** in the dropdown menu. A confirmation message displays.

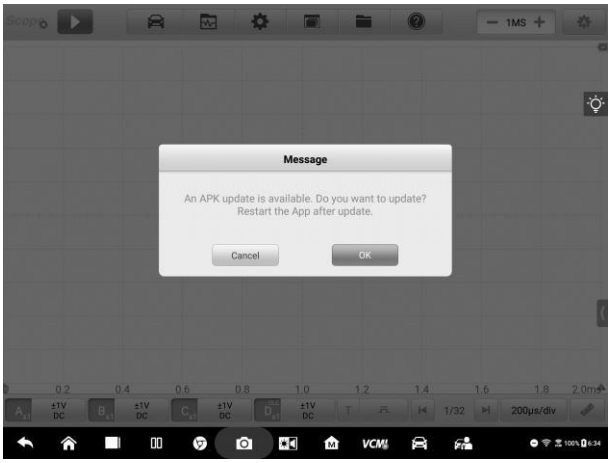


Figure 1-3 ***Sample Update Confirmation Screen***

3. Tap **OK** to update the software or tap **Cancel** to exit.

1.1.4.2 Firmware Update

➢ **To update the firmware**

1. Tap the **Help** button on the upper half of the screen. A dropdown menu displays. (***Figure 1-2***)
2. Tap **Update Firmware** in the dropdown list. The screen will switch to the **Update** section in the **VCMI Management** application.

NOTE

Please **DISCONNECT** the MaxiScope from VCMI before updating. A message displays and tap "**OK**" to confirm that you have disconnected MaxiScope from VCMI.

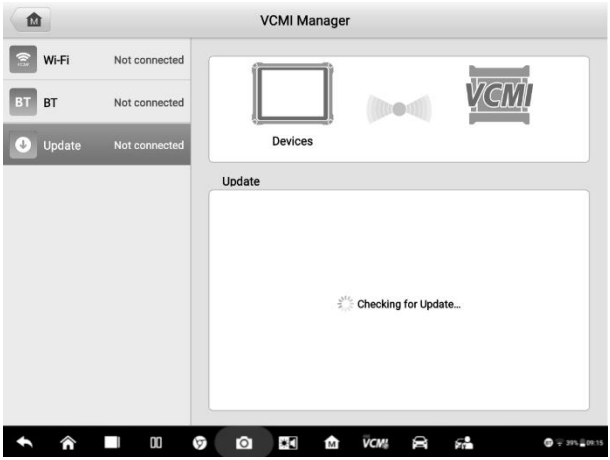


Figure 1-4 ***Sample Firmware Update Screen 1***

3. The current version and the latest version of the OS, firmware, and scope firmware will display. Tap **Update Now** to update. Please do not leave the update page during upgrade. It takes about 5-15 minutes for the whole process.

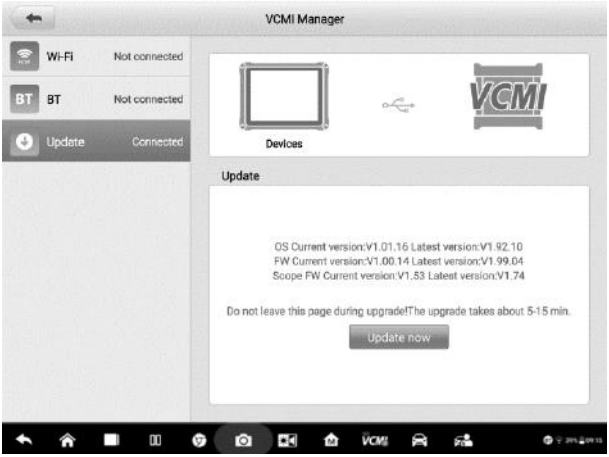


Figure 1-5 ***Sample Firmware Update Screen 2***

1.1.5 Screen Layout and Operations

The Oscilloscope application measures changing voltages of an electrical system over a period of time. This signal is depicted as a shape. The grid on the screen shows divisions of voltage and time to enable measurements to be made.

Tap the **Measurement** icon on the home screen then select **Oscilloscope** in the menu, the oscilloscope page displays. The screen typically includes the following sections.

NOTE

The Oscilloscope application can also be opened via the Android home screen. Tap the **Measurement** icon at the top of the Android home screen. Tap **Oscilloscope** icon.

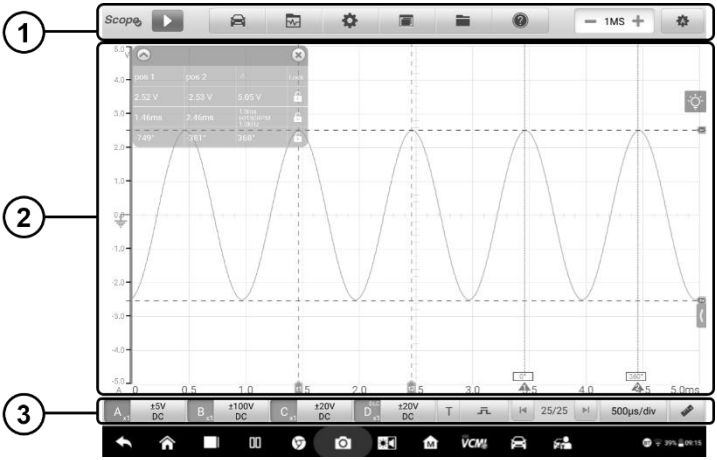


Figure 1-6 ***Sample Oscilloscope Menu Screen***

1. Upper Toolbar Buttons - see *Upper Toolbar Buttons* on page 13 for details.

2. Main View Section – see *Main View Section* on page 41 for details.

3. Lower Toolbar Buttons - see *Lower Toolbar Buttons* on page 49 for details.

1.1.5.1 Upper Toolbar Buttons

The upper toolbar buttons are used for configurations of various settings and operations. The following table provides brief descriptions of each button.

Table 1-2 ***Scope Navigation Toolbar Buttons***

Name	Button	Description
Scope Icon		Indicates the oscilloscope connection status. See *Scope Button* on page 14 for more information.
Start/Stop		Start or stop the oscilloscope device. See *Start/Stop Button* on page 14 for more information.
Presets		Access preset guide. Select preset to correctly configure oscilloscope to capture a waveform of the specified type. See *Presets Menu* on page 15 for more information.

Name	Button	Description
Waveform Library		Search, upload, share and follow the waveforms in the waveform library. See *Waveform Library* on page 18 for more information.
Settings		Configurations of mode setting, math channels, waveform generator, decoding setting, startup setting and demo setting. See *Settings Menu* on page 22 for more information.
Window Display		Set the layout and channel position. See *Window Display Menu* on page 34 for more information.
File		Print, open, save, delete the waveform data or upload the waveform to waveform library. Moreover, save, import the configuration and open the recent documents. See *File Menu* on page 38 for more information.
Help		View the user manual, update the APK (oscilloscope software) and firmware. See *Help Menu* on page 40 for more information.
Number of Samples	1MS	Set the maximum number of samples that will be captured on each channel. See *Number of Samples* on page 41 for more information.
Auto Scale		Set the appropriate amplitude range to display the signal correctly. See *Auto Scale* on page 41 for more information.

Scope Button

This **Scope button** displays the oscilloscope connection status. A **green check mark** means the tablet and oscilloscope are connected successfully; a **red X** means the tablet and the scope are not connected.

Start/Stop Button

Tap the **Start/Stop Button** icon to start or stop the oscilloscope device.

Name	Button	Description
Start		Tap to start the oscilloscope and initiate sampling.

Name	Button	Description
Stop		Tap to stop the oscilloscope and terminate sampling.

Presets Menu

Tap the vehicle icon button in the top navigation bar to enter the **Presets Menu**. This menu offers a wide variety of preset guided information for you to view.

The frequently used test components and options are listed in the presets menu:

- **Actuators -** Test the common car actuators such as injectors, fuel pumps, and canister purge solenoids.
- **Battery Charging -** Test the functions related to car charging, including current and voltage idle test.
- **Combination Test -** Combined test of the vehicle's sensors or actuators, such as the crankshaft position sensor and camshaft position sensor test; the primary ignition and crankshaft position test; the throttle position sensor and front oxygen sensor test.
- **Data Communication -** Test the vehicle communication buses including CAN-bus, LIN-bus, and K-Line.
- **Engine Starting -** Test the functions related to car starting, including starting current and voltage test.
- **Ignition Systems -** Test the ignition process of the vehicle, including the voltage and current test of the primary and secondary ignition.
- **Sensors -** Test the common car sensors such as oxygen sensors, camshaft sensors, and crankshaft sensors.

NOTE

Do not connect to High-voltage control signal such as the ignition control wire. It may cause the damage to the product. The measured voltage value during the actuator test may be different from the actual value.

➢ **To use the Presets menu**

1. Tap the **Presets** button in the top navigation bar. A submenu opens.
2. Tap the desired test component or option in the left column.

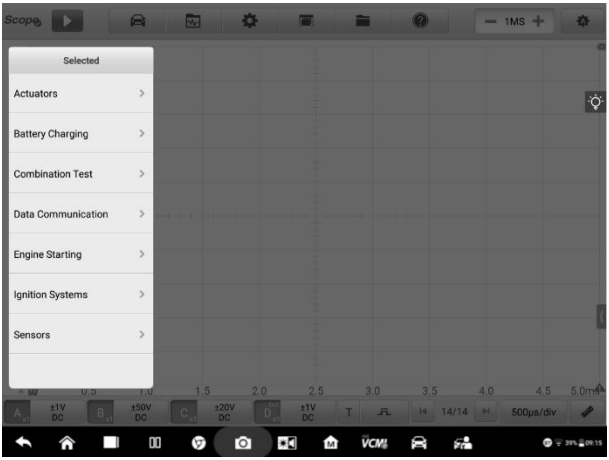


Figure 1-7 ***Sample Presets Menu Screen 1***

3. Tap the appropriate sub-options from the column that displays. Tap the icon to download the preset guided information.

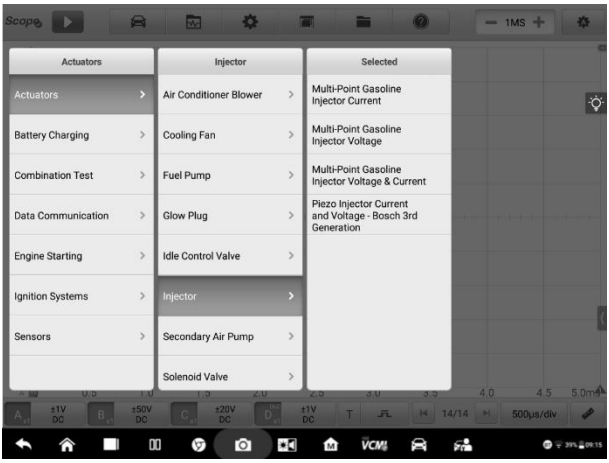


Figure 1-8 ***Sample Presets Menu Screen 2***

4. View the preset guided information. A reference signal waveform displays (an injector selection is used here as an example) on the Main Screen and the preset guided information on the right side of the screen.

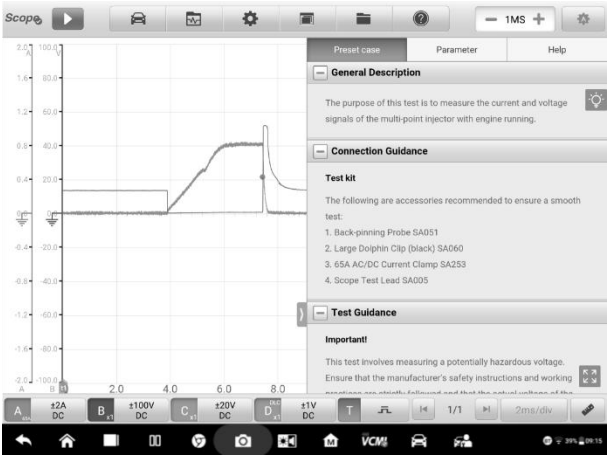


Figure 1-9 ***Sample Presets Display Screen***

5. Tap the arrow button to hide the preset guided information and display the waveform.

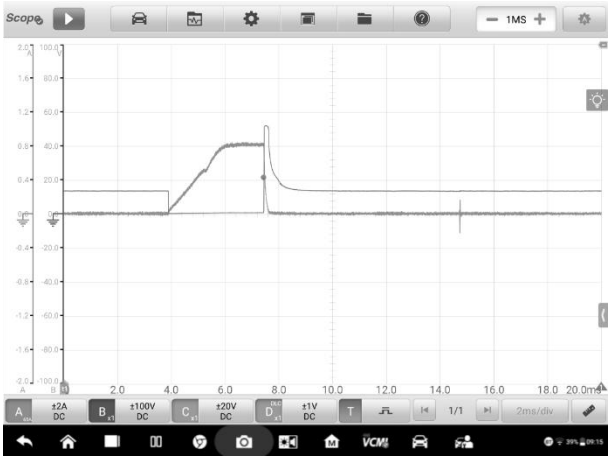


Figure 1-10 ***Sample Reference Signal Waveform Display***

NOTE

Parameter values such as the ranges of voltage and time divisions are automatically set for presets.

6. Tap the four-directional arrow icon in the lower right corner to display the

preset guided information such as the general description, connection guidance, connection diagram, test guidance, real vehicle connection, waveform analysis and related DTCs in full screen. Tap again to exit full screen.

NOTE

Images in the preset guided information can be displayed in a full screen for viewing in details.

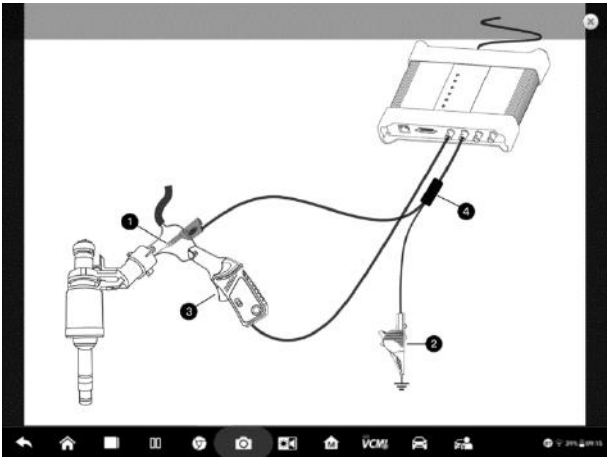


Figure 1-11 ***Sample Image Display (Full Screen)***

7. Tap the **Start/Stop** button. The oscilloscope will perform waveform acquisition according to the preset parameters.

Waveform Library

Tap the waveform icon in the top navigation bar to open the **Waveform Library Page**. The waveform library includes online waveform library and local waveform library.

Online Waveform Library

The waveforms in the online waveform library are picked and uploaded by Autel users during repair and test process using an oscilloscope. It allows you to search for the waveforms from the vehicle and component you want to test, or upload and share your own waveforms.

The search result displays the information such as the waveform picture, waveform code, VIN code, vehicle code, etc. The waveform in the online library can also be loaded as reference waveform for better waveform analysis.

There are two methods to search for waveforms: Condition-based search and keyword-based search.

- **Condition-based Search**

On the condition-based search page, the waveform(s) can be accurately searched after selecting the corresponding conditions, such as the vehicle model, test category, status, etc. Once you have searched a waveform, you can open, share the waveform code to others, and follow as your favorite.

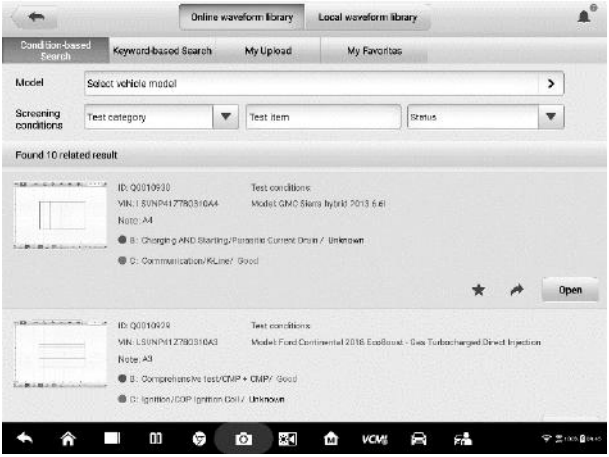


Figure 1-12 ***Sample Conditional-based Search Screen***

(1) **Model**: Tap the input field or the arrow icon on the right to select the vehicle model. The manufacture and model should be selected from the column that displays.

(2) Screening conditions

Three screening conditions are available: Test category, test item and status.

Tap the dropdown menu to select the test category such as the actuators, battery charging, engine starting, or no selection.

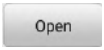
Tap the dropdown menu to select the condition status: no selection, good or

bad.

(3) Search result

The search result will automatically display in the lower section of the page after selecting the model and conditions, showing the image of waveform, waveform ID (waveform code), VIN or the screening conditions.

Tap the corresponding buttons on the lower right side to share, follow or open the waveform. Tap the **Load As Ref. Waveform** to load the waveform as a reference waveform for better waveform analysis.

Name	Button	Description
Share		Tap to display a waveform ID (waveform code) and you can share it through Twitter or Facebook to anyone you want.
Follow		Tap to follow the waveform as your favorite.
Open		Tap to open the waveform.

- **Keyword-based Search**

On the keyword-based search page, please input the waveform code, VIN, vehicle code, or screening conditions and then tap the “Search” button to roughly search the waveform(s) you want. You can also scan the waveform code or VIN by tapping the Scan icon in the input field to search the waveform.

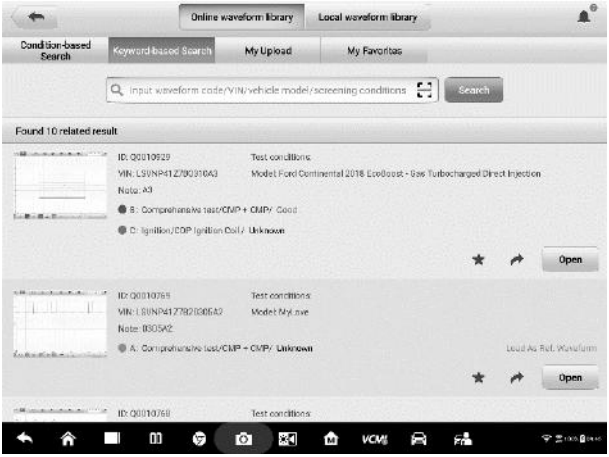


Figure 1-13 ***Sample Keyword-based Search Screen***

- **My Upload**

Your own waveforms can be saved and uploaded to the online server. The uploaded waveforms can be searched from “My Upload” tab.

Please input the waveform code, VIN, vehicle code, or screening conditions and then tap the “Search” button to search the waveform(s) you have uploaded. The waveform can be opened, shared, followed, reviewed and loaded as a reference waveform once you have found it.

- **My Favorites**

All the waveforms you have searched in the Condition-based Search, Keyword-based Search or My Upload tab can be followed as My Favorites by tapping the five-point start button. The waveform can also be opened, shared, followed and loaded as a reference waveform.

Local Waveform Library

The waveforms in the local waveform library are the ones saved in the tablet.

Input the waveform code, VIN, vehicle code, or screening conditions and then tap the “Search” button to search the waveform(s) saved in the local library. The found result displays the picture of waveform, waveform ID (the waveform code), screening conditions, vehicle model, etc. The waveforms can be opened, loaded as reference waveforms, shared waveform codes, uploaded or batch uploaded.

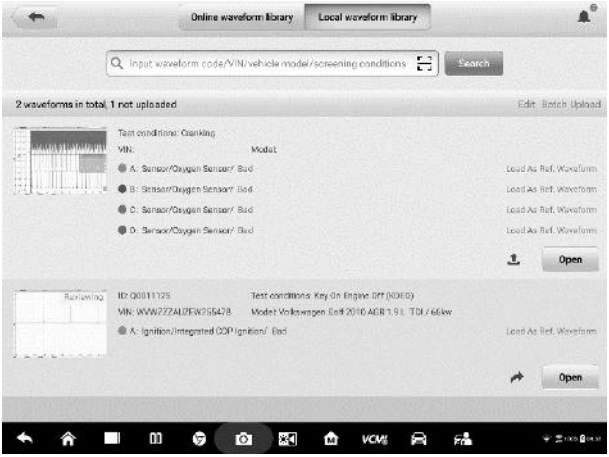


Figure 1-14 ***Sample Local Waveform Library Screen***

Settings Menu

Tap the gear icon button in the top navigation bar to open the **Setting Menu**. The **Mode, Math Channels**, **Waveform Generator, Decoding Settings, Startup Settings and Demo Settings** can be manually configured in the menu.

Mode Settings

Two modes and three display views are available: normal mode, demo mode, oscilloscope view, XY view and spectrum view.

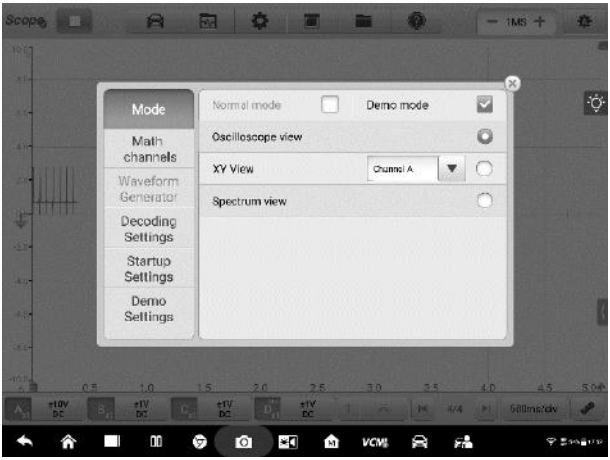


Figure 1-15 ***Sample Mode Setting Screen***

In **Normal Mode**, the actual waveform is displayed on the screen when a test component is connected to the oscilloscope. You can real-time monitor the signal waveform of sensors in the normal mode.

NOTE

The oscilloscope is required to be connected in the normal mode.

In **Demo Mode**, a demo waveform is displayed on the screen. The sine wave or square wave can also be displayed if you do not connect with the oscilloscope. The user can use this mode to familiarize him or herself with the functions of the oscilloscope.

The normal mode or demo mode can be selected with any one of these three views (oscilloscope view/XY view/spectrum view) at the same time to meet different signal display needs.

In the **Oscilloscope View**, the waveform shows how a signal varies with time in a graphical way.

In the **XY View**, the waveform shows the relationships between periodic signals, displaying a graph of one channel against another.

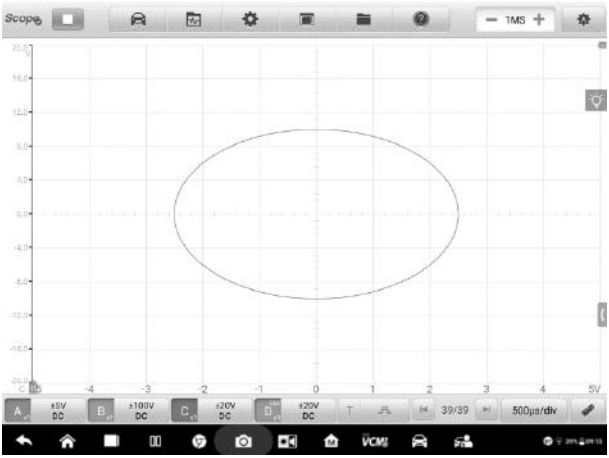


Figure 1-16 *Sample* XY View *Setting Screen*

In the **Spectrum View**, the waveform shows the signal level on a vertical axis against frequency on the horizontal axis in a graphical way. One or more spectra with a common frequency axis can be displayed in the spectrum view.

NOTE

The Wi-Fi connection does not support the XY View and Spectrum View. Please use the USB cable to connect the device, instead of the Wi-Fi connection.

The spectrum-related analysis options display after selecting the spectrum view in the Mode setting screen. Select the desired spectrum bins and window functions for better spectrum analysis.

The amplitude overrange of Y-axis can be adjusted by the amplitude level. When the sampling frequency is low, the current frequency can also be adjusted. The maximum frequency supports 20M.

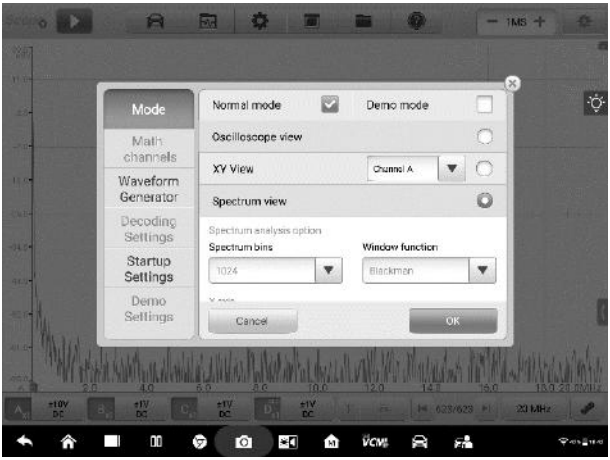


Figure 1-17 *Sample* Spectrum View *Setting Screen 1*

- **Spectrum Bins**: It allows you to set the number of frequency bins into which the spectrum is divided.
- **Window function**: It allows you to select one of the standard window functions to reduce the impact of running on a time-limited waveform.

Table 1-3 *Window Function Table*

Window	Main peak width (bins @ -3dB)	Highest side lobe (dB)	Side lobe roll-off (dB/octave)	Description
Rectangle	0.89	-13.2	6	No fading; maximal sharpness; used for short transients
Blackman	1.68	-58	18	Often used for audio work
Blackman-Harris	1.90	-92	6	Used for general purpose
Flattop	2.94	-44	6	Negligible pass-band ripple; mainly used for calibration
Gauss	1.33 to 1.79	-42 to -69	6	Gives minimal time and frequency errors

Window	Main peak width (bins @ -3dB)	Highest side lobe (dB)	Side lobe roll-off (dB/octave)	Description
Hann	1.20 to 1.86	-23 to -47	12 to 30	Used for audio and vibration work
Hamming	1.30	-41.9	6	Also called raised sine-squared; used for speech analysis
Triangle	1.28	-27	12	Also called Bartlett window

- **Display mode**: The Magnitude Mode displays the frequency spectrum of the last waveform.
- **Scale**: the scaling of the vertical axis.

  Logarithm: the vertical axis is scaled in decibels.
- **Logarithm unit:** the reference quantity used for the logarithm scale.

Logarithm Unit	Description
dBV	Reference level is 1V.
dBu	Reference level is 1mW with a load resistance of 600Ω.
dBm	Reference level is 1mW into the specified load impedance.
Any dB	Reference level is an arbitrary voltage.

- **X Scale**: the scale of the frequency axis.

  Linear: the axis is scaled in equal intervals from DC to the frequency.

➢ **To set the Spectrum View**

1. Tap the **Settings** button in the top navigation bar. A dialog box opens
2. Select the **Mode** option in the dialog box, and then tap to select **Spectrum View**.
3. Tap the input field or the dropdown arrow icon to select the desired options from the column. Tap “**OK**” to confirm.

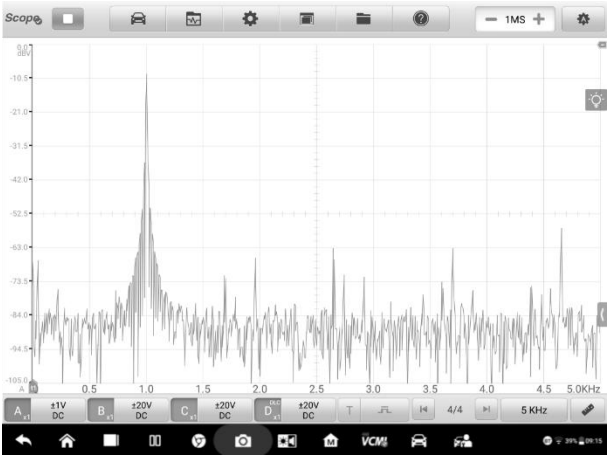


Figure 1-18 *Sample* Spectrum View *Setting Screen 2*

Math Channels

A math channel is a virtual channel generated by a mathematical function of the input channel. It can be displayed in an oscilloscope in the same way as an input signal, and like an input signal it has its own measure axis, scale and color.

The oscilloscope has a set of built-in math channels for the most important functions:

- **Turnover:** reverses the signal polarity to turn the waveform upside down on the screen
- **A+B:** channel A plus channel B
- **A-B**: channel A minus channel B
- **A*B:** multiply channel A by channel B
- **A/B**: channel A divided by channel B
- **Frequency**: the frequency of the signal
- **Pulse Width (+)**: the positive pulse width
- **Pulse Width (-)**: the negative pulse width
- **Duty Cycle (+)**: the positive duty cycle
- **Duty Cycle (-)**: the negative duty cycle

NOTE
When connecting via Wi-Fi, it only supports Turnover, A+B, A-B, A*B and A/B.

➢ **To set the math channel**

Using **Invert A** as an example.

1. Tap **Settings** button in the top navigation bar. A dialog box opens.
2. Select the **Math Channels** option in the dialog box.
3. To select the **Invert A**, tap the check box.

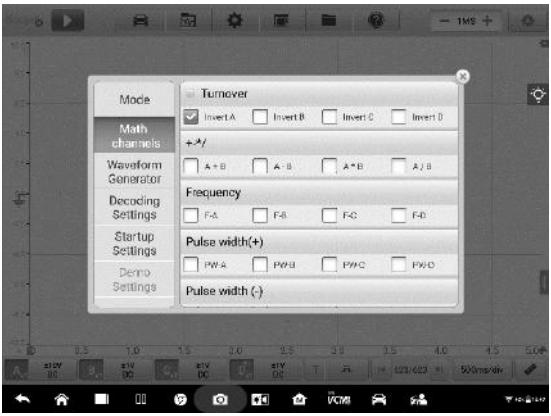


Figure 1-19 ***Sample Math Channel Setting Screen 1***

4. Close the dialog box, the waveforms are displayed on the screen.

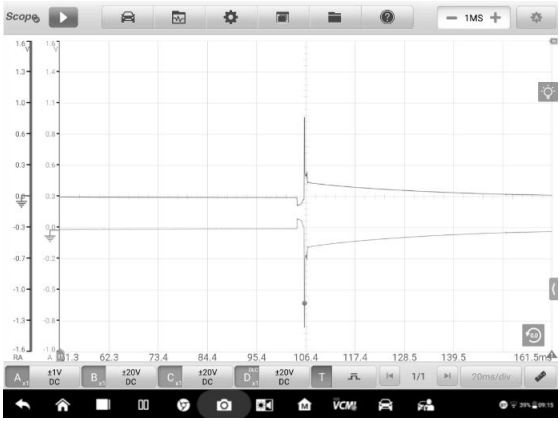


Figure 1-20 ***Sample Math Channel Setting Screen 2***

Waveform Generator Settings

The waveform generator operates simultaneously with the oscilloscope. Use the waveform generator to simulate the DC voltage, square wave, square wave (X+Y), triangle wave, and actuators drive.

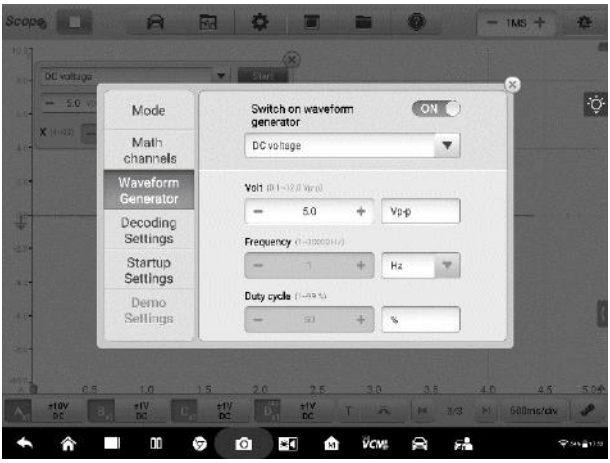


Figure 1-21 ***Sample Waveform Generator Setting Screen***

➢ **To set the waveform generator**

1. Tap the **Settings** button in the top navigation bar. A dialog box opens.
2. Select the **Waveform Generator** option in the dialog box.
3. Swipe the **OFF** to **ON** to enable the waveform generator. Select a desired option from the dropdown menu. Tap the **"+"** or **"-"** buttons to adjust the voltage, frequency and duty cycle values.

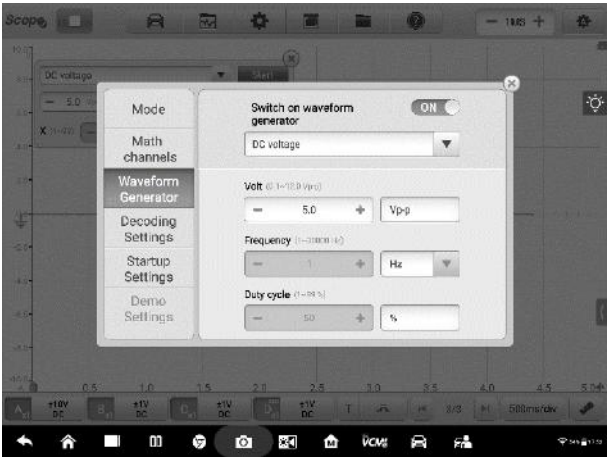


Figure 1-22 ***Sample Waveform generator Settings Screen***

4. Close the dialog box. The waveform generator settings are displayed on the screen.

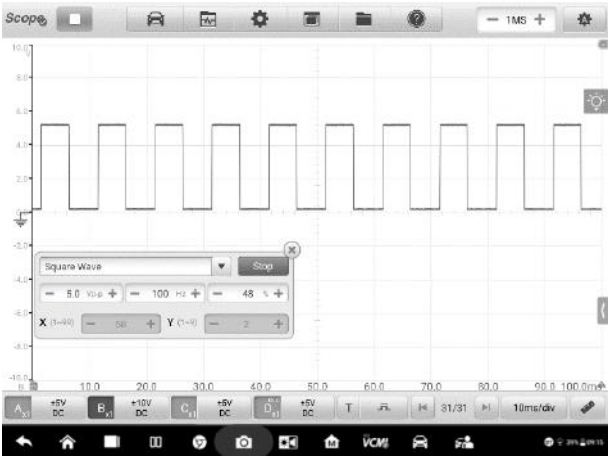


Figure 1-23 ***Sample Waveform generator Display Screen***

Decoding Settings

When the oscilloscope mode is selected, the decoding settings are available. Up to 8 different protocols are supported in the decoding settings.

Figure 1-24 ***Sample Decoding Settings Screen 1***

8 protocols are available: CAN High, CAN Low, LIN, FlexRay, RS232/UART, I2S, I2C, and USB (1.0/1.1). The detailed setting options vary by each protocol.

- ✧ **CAN High / CAN Low**: Controller Area Network (CAN) is a serial protocol used in automotive to allow microcontrollers to communicate with each other. It typically uses differential signaling (with signals named CAN High and CAN Low) to increase noise immunity.

- ✧ **LIN**: Local Interconnect Network (LIN) is a serial protocol used in automotive electronics to allow microcontrollers to communicate with low-speed peripherals.

- ✧ **FlexRa**y: It is an automotive network communications protocol for high-speed data.

- ✧ **RS232/UART:** Universal Asynchronous Receiver/Transmitter (UART) is the communication interface found in the serial or COM ports once commonly found on computers. Each channel of data is transmitted on a single wire pair using an electrical standard such as RS232.

- ✧ **I2S**: Inter-IC Sound (I2S) is a serial protocol used in digital audio devices for communications between circuits such as CD transports and audio DACs.
- ✧ **I2C**: Inter-Integrated Circuit (I2C) is a way to connect peripheral chips in consumer electronics products and is widely used in embedded systems.
- ✧ **USB (1.0/1.1)**: Universal Serial Bus (USB) is widely used in personal computers and tablets for communication.

Baud Rate: The baud rate will display a default value, which needs to be manually set according to the actual signal to get the correct decoding result.

Threshold: The voltage that defines the transition in either direction between high logic state and low logic state.

Name: The name of the protocol that you have selected above. The channel and the corresponding protocol name will display in the scope view after selection.

Display Setting: You can also choose a display mode for the decoded data: Hex or Binary.

➢ **To make the decoding settings**

Using **CAN High** as an example.

1. Tap the **Settings** button in the top navigation bar. A dialog box opens.
2. Select the **Mode** option in the dialog box and tap the **Oscilloscope Mode.**
3. Select the **Decoding Setting** in the dialog box.
4. Select the channel(s) that you want to set, and then select the "**CAN High**" protocol from the dropdown list.
5. For the baud rate and threshold, you can keep the displayed values or manually enter a value according to the actual signal.
6. Select the **Hex or Binary** display mode from the dropdown list.
7. Tap "**OK**" to confirm. The decoding settings are displayed on the screen.

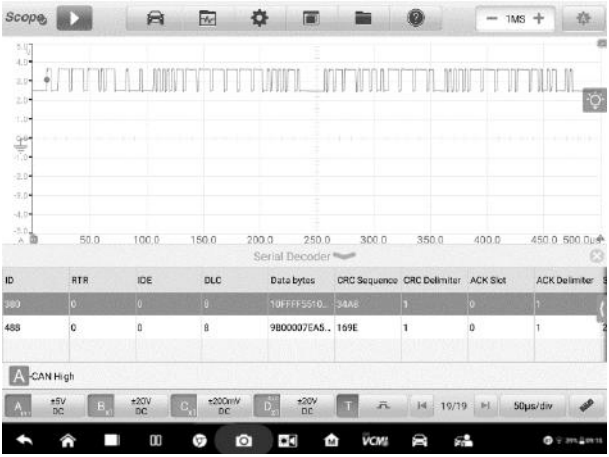


Figure 1-25 ***Sample Decoding Settings Screen 2***

Startup Settings

This function allows the user to choose the startup configuration when launching the oscilloscope application.

On the Startup Settings screen, there are three options: **Load the user default configuration at startup**, **Load the previous session configuration at startup**, and **Load the factory configuration at startup**. Select one option according to the specific need.

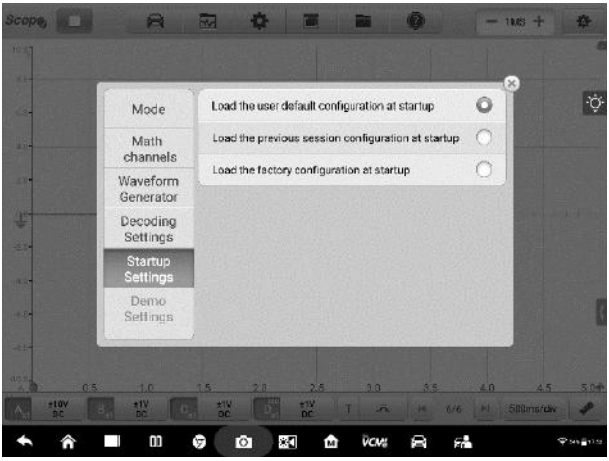


Figure 1-26 ***Sample Startup Settings Screen***

Demo Settings

This function allows the user select the demo waveform for each channel in Demo mode. Select one demo waveform from **Nozzle voltage**, **Nozzle current, Ignition signal**, **Sinusoidal signal**, **Square signal** and **signal of the crankshaft**. The rotating speed can be set by tapping the "-" or "+" icon to adjust the value. Tap "**OK**" to confirm the settings.

Figure 1-27 ***Sample Demo Settings Screen***

Window Display Menu

A display window with grid displays the data captured by the oscilloscope. By default, a single trace is displayed. Additional traces can be added via the window display menu.

Display Mode

The Window Display menu allows you to configure up to four traces.

Single Window – displays a single trace.

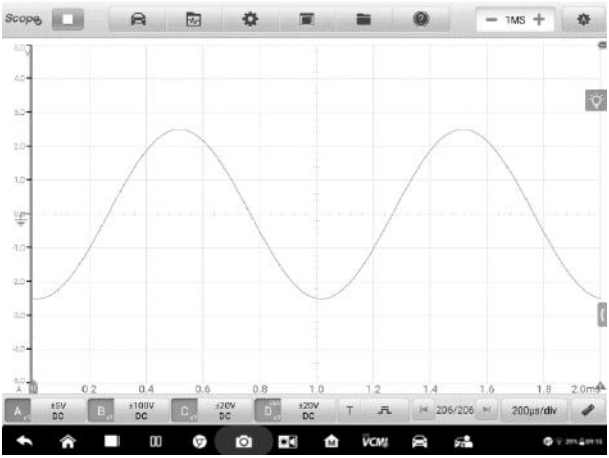


Figure 1-28 ***Sample Single Window Screen***

Double Window – displays two separate traces horizontally, one below the other.

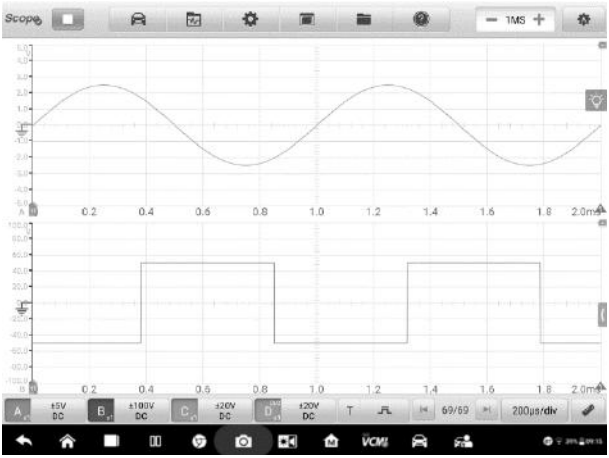


Figure 1-29 ***Sample Double Window Screen***

Triple Window – displays three separate traces horizontally, one below the other.

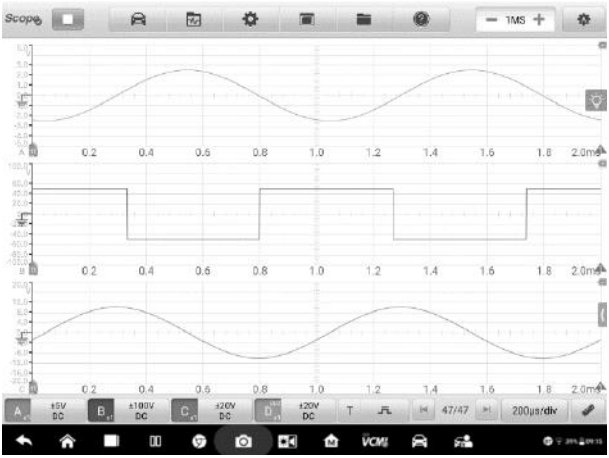


Figure 1-30 ***Sample Triple Window Screen***

Quadruple Window – displays four separate traces, two horizontally, two vertically.

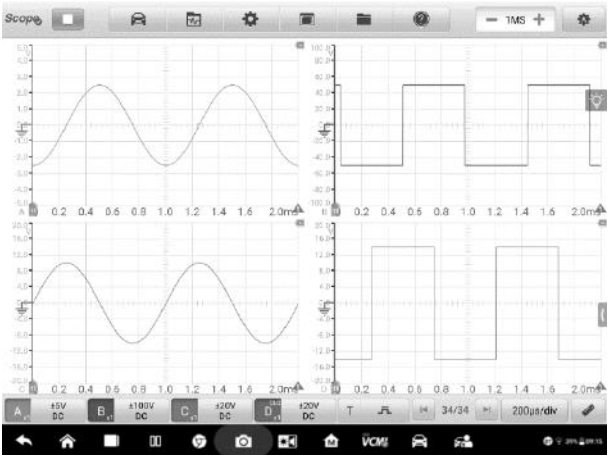


Figure 1-31 ***Sample Quadruple Windows Screen***

➢ **To set the display mode**

1. Tap the **Window Display** button in the top navigation bar. A dialog box opens.
2. Select the **Display Mode** in the dialog box.
3. Tap the appropriate number icon to display the corresponding number of

traces onscreen.

Figure 1-32 ***Sample Display Mode Selection Screen***

4. Close the dialog box. The window is displayed as selected.

Channel Settings

The channel settings allow you to arrange the display position of the activated channels. Select which channels are visible in the display window. The display status is set to **ON**, the input channels are enabled, otherwise, the input channels (set to OFF status) are not available for viewing.

➢ **To set the channel setting**

1. Tap the **Window Display** button in the top navigation bar. A dialog box opens.
2. Select the **Channel Settings** in the dialog box.
3. Swipe the display status icon to **ON**. Select the position for each channel from the dropdown menu.

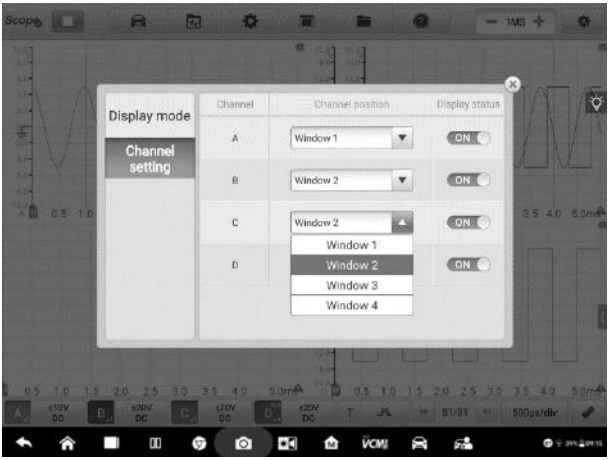


Figure 1-33 ***Sample Channel Setting Screen***

4. Close the dialog box and the activated channel is displayed in the selected window.

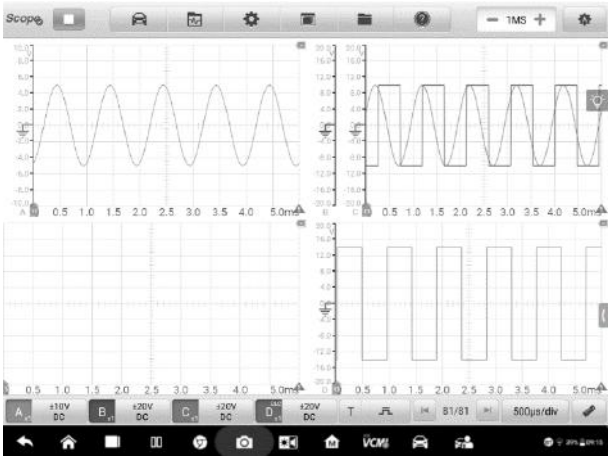


Figure 1-34 ***Sample Channel Display Screen***

File Menu

The **File** button allows you to print, open, save, and delete the waveform data. The **File Menu** supports the following functions.

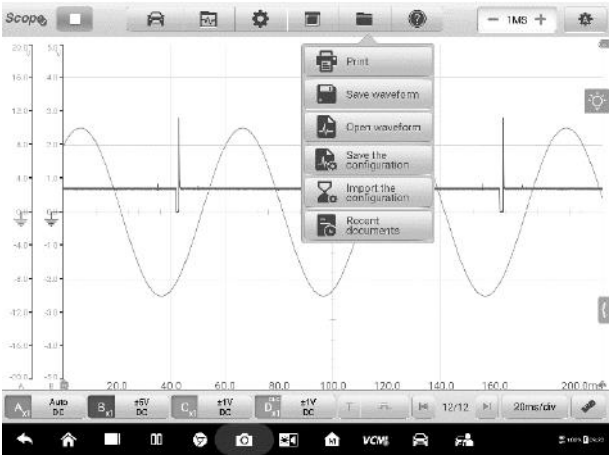


Figure 1-35 ***Sample File Menu Screen***

- **Print –** Tap to create and print a temporary PNG picture of the current waveforms.

NOTE

1. Make sure the tablet is properly setup to print and is connected to the printer.
2. Make sure the network is available.

- **Waveform Operation**

This section allows you to save and open the waveforms.

Save waveform – Tap to capture and save the current waveforms or the latest 5 frame waveforms. On the Save Waveform screen, tap inside of each input field and enter corresponding information. Tap Save or Save as default.

NOTE

The Save option requires that you enter a file name; Save as default will name the file itself.

Tap the Save as Text option to save the current waveform data to a text file. Use the ES File Explorer app on the Android home screen to review file: **Home > ES File Explorer > Local > Internal Storage > Scan > Data > Scope > txt.**

Open waveform – Tap to retrieve the saved waveforms. Select and/or delete the saved waveforms by tapping the **Edit** button in the upper right corner of the screen.

- **Configuration Operation**

The configurations can be saved and imported, or set to default.

Save the configuration – Tap to save the configuration values of waveforms on the current screen including the amplitude, the time base, the number of samples, etc.

Import the configuration – Tap to import the saved configuration values of waveforms. Tap the System Default Configuration option to cancel the current setting values and refresh the screen to retrieve the default setting values.

- **Recent documents** – Tap to open the recent documents in order to view the waveforms currently opened in the waveform library.

Help Menu

The Help Menu displays the user manual, update the APK and firmware, and view version numbers of the installed APK and firmware.

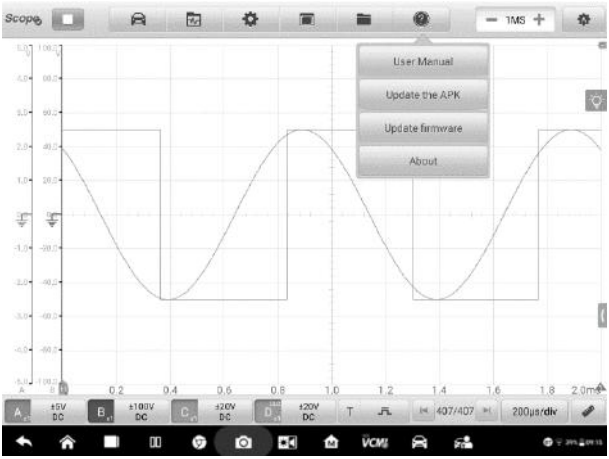


Figure 1-36 ***Sample Help Menu Screen***

User Manual – displays instruction for the prosper use of the oscilloscope.

Update the APK – connects to the Autel server and to check for latest application software.

Update Firmware – connects to the Autel server and to check for latest firmware version.

About – displays the model number of the oscilloscope and the installed versions of the software and firmware.

Number of Samples

This button allows you to set the maximum number of samples that will be captured by each channel. The sampling rate of current time base can be adjusted by changing the number of samples. Review the sampling interval, sampling rate, and sample size in the ***Parameter and Help*** sheet.

Tap the minus or plus icon to adjust the number of samples.

Auto Scale

Use the **Auto Scale** button to enable the device to analyze a signal of an enabled channel and determine the appropriate amplitude range to optimize the display of signal. In auto scale setting, the time base is only valid for periodic signals.

1.1.5.2 Main View Section

Up to four traces, along with digital readouts of current signal values, signal status and triggering conditions, can be displayed simultaneously on the main view section screen.

Each trace has two control features, **X-axis** and **Y-axis**, which enable you to adjust the oscilloscope settings to suit the particular test measurement. If multiple traces are displayed at the same time, the **Y-axis** for each trace is adjusted separately while the **X-axis** is the same for all traces.

- **Y-axis** – the voltage level is recorded on the vertical. It displays on the left side of the screen.
- **X-axis** – time is presented on the horizontal line. It is shown along the bottom of the screen.

Measurement Overrange Indicator

When the signal voltage exceeds the measurement input range, a **red overrange indicator** with the message "**overrange**" is displayed in the top left corner of the screen displays. Exceeding the common-mode input range may result in inaccurate measurements and can lead to severe signal distortion.

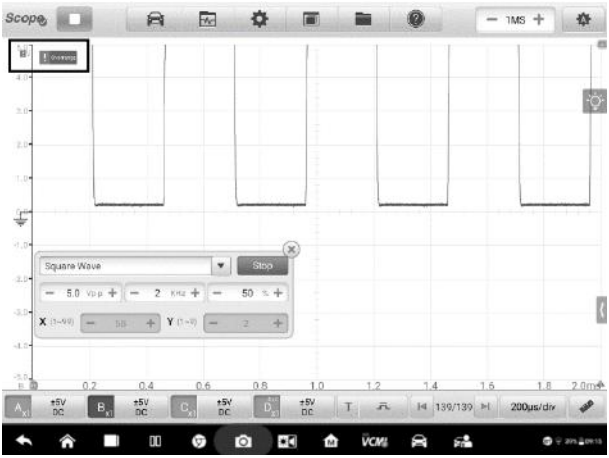


Figure 1-37 ***Sample Overrange Indicator Screen***

Select an appropriate scale setting for the signal being sampled to avoid an overrange condition.

IMPORTANT

To prevent electric shock, do not exceed voltage limits between inputs.

Channel Selection

In the main view section, a channel has two conditions: selected and unselected. A channel must be selected in order for the waveform to be movement, to use the zoom-in or to add voltage rulers.

Tap the zero baseline marker or the Y-axis (the line thickens when selected). After the channel is selected, the waveform can be zoomed. Tap the counterclockwise arrow button at the right corner to recover after zoomed.

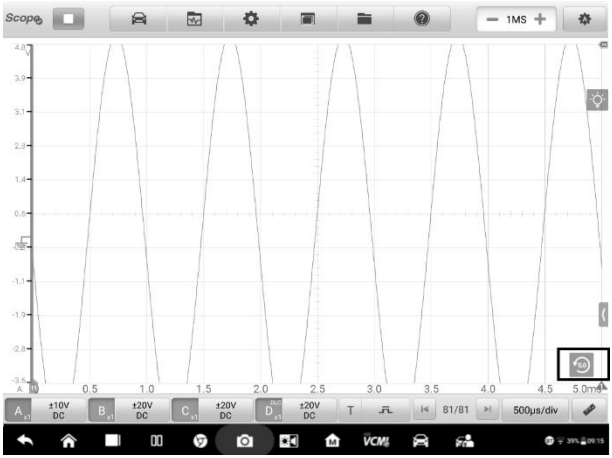


Figure 1-38 ***Sample Channel Selection 1 (Selected)***

Tap the zero baseline marker or the Y-axis again to exit the channel selection.

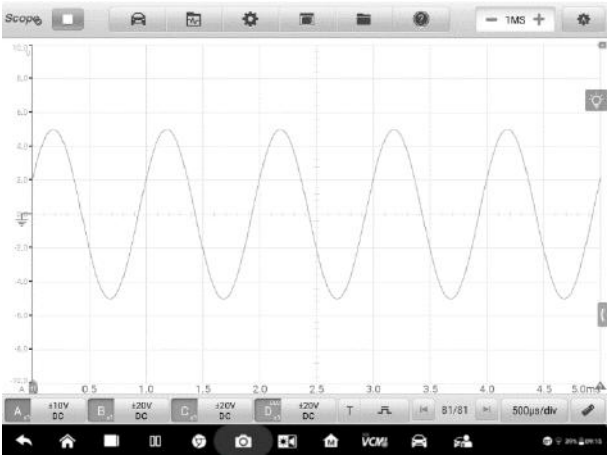


Figure 1-39 ***Sample Channel Selection 1 (Unselected)***

Waveform Zooming

The zooming function allows you to change the size and position of a signal during or after capturing a waveform to examine it in greater details. It does not change the stored data, but the way it displays.

The X-axis and Y-axis can be zoomed using your fingertips. The waveform can be zoomed during or after capturing the signal.

Measurement Rulers

The coordinate Rulers allow the voltage and time duration of a waveform to be measured precisely. They are useful when determining signal characteristics such as amplitude at specific points, the cycle time (duration) and frequency.

There are three types of measurement rulers: the vertical **Time Ruler**, the horizontal **Voltage/Current Ruler**, and the vertical **Angle Ruler**.

Tap the **Ruler Activator** in the lower left corner of the grid and drag it across the screen to the desired position. A **Time Ruler** is generated.

Tap the **Angle Activator** in the lower right corner of the grid and drag it across the screen to the desired position. An **Angle Ruler** is generated.

The two angle rulers are positioned to mark the start and end of a cycle. By default, the start and end angle values are 0° and 720°, which can be configured in the Phase Setting box.

The **Voltage/Current Ruler** can be generated in the similar way by tapping the **Ruler Activator** in the upper right corner and dragging it downwards.

When Measurement Rulers are generated, a **Ruler Table** showing time and voltage values for the corresponding channels will be displayed. The **Delta** icon refers to the absolute difference between the values of the rulers, which can be locked by tapping the **Lock** icon. Tap the **X** button in the upper right corner of the ruler table to delete all rulers.

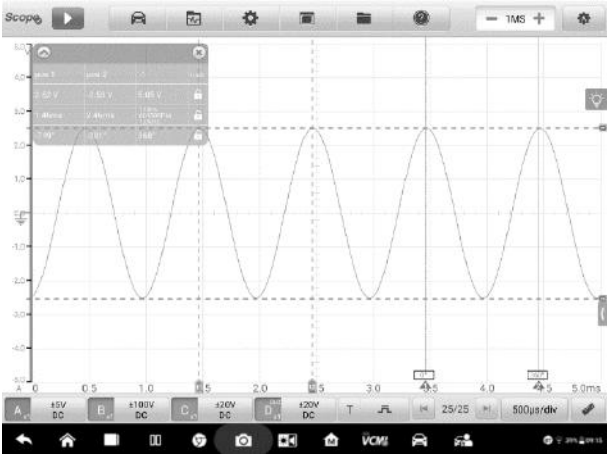


Figure 1-40 ***Sample Rulers Display Screen***

➢ **To configure angle settings**

1. Drag **Angle Activator** to generate the angle rulers.
2. Tap the start or end angle value to open the Phase Setting box.
3. Input the desired phase value and the ruler value in the field.

Figure 1-41 ***Sample Phase Setting Screen***

4. Tap **Confirm** in the upper right corner to save the settings, or tap **Cancel** to exit without saving.

Zero Baseline

The zero baseline is marked the 0 value in the Y-axis, showing the ground level of each channel waveform.

After the channel is selected, the Zero Baseline can be adjusted by dragging the zero baseline marker up/down along the Y-axis, or dragging the waveform up/down, or moving the screen up/down in the grid.

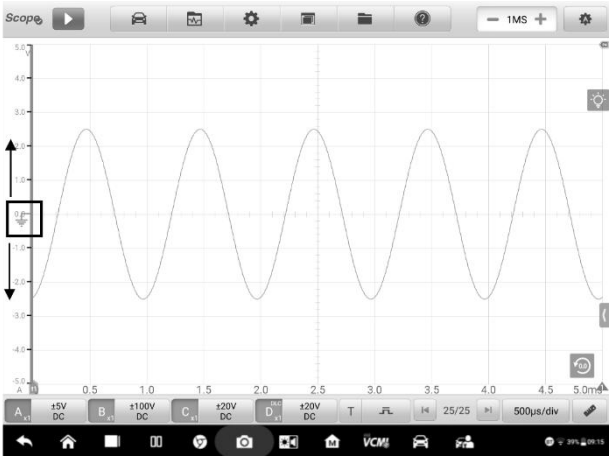


Figure 1-42 ***Sample Dragging Zero Baseline Marker Screen***

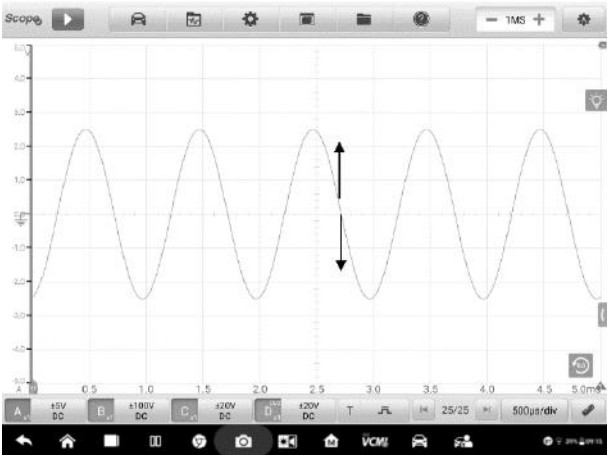


Figure 1-43 ***Sample Dragging Waveform or Moving Screen***

NOTE

To reposition waveform or to move the screen, tap the zero baseline marker to select. The line will display thicker when selected.

Parameter and Help

Tap the arrow button in the lower right corner of the screen to open the Parameter and Help windows.

The **Parameter** function allows you to view the values of parameters including sampling interval, sampling rate, sample size, channel, range and coupling mode.

The **Help** function displays the user manual of the oscilloscope. The Help page also displays when selecting the Help and User Manual buttons on the upper toolbar. The help information can be full-page shown by tapping the four-directional arrow icon in the lower right corner.

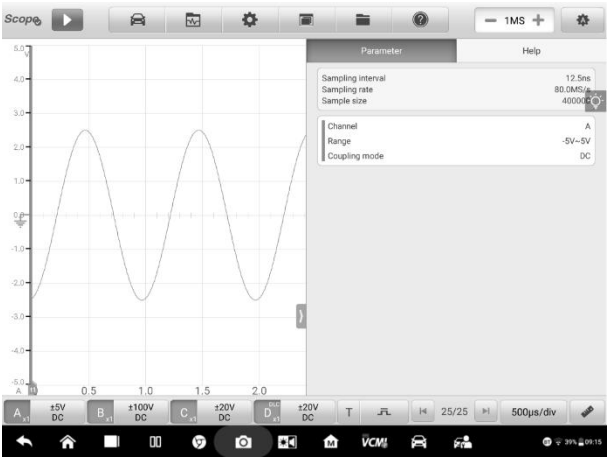


Figure 1-44 ***Sample Parameter Screen***

➢ **To open or close the parameter and help window**

1. Tap the arrow button on the right-hand side of the screen.

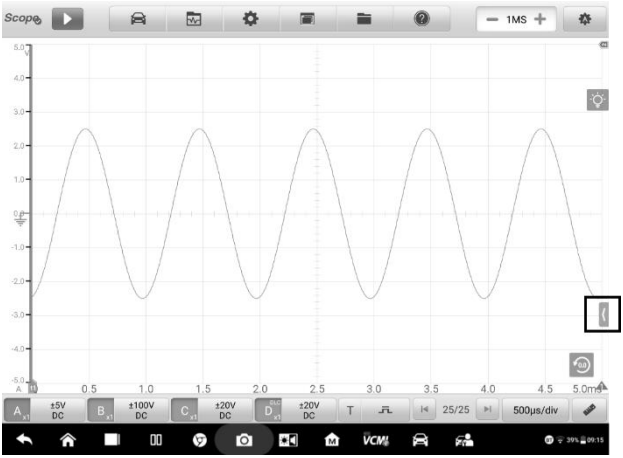


Figure 1-45 ***Arrow Button Position Screen***

2. The parameter and help window displays.
3. To close, tap the arrow button again or tap any space outside of the window.

Note

The preset guided information is also displayed on the right side of the screen when the specific options and test components have been selected from the Presets menu.

Real-time Help

The real-time help button is a bulb-shaped button that can be dragged and moved on the screen.

Tap this real-time help button to directly switch to display all the relevant introduction and test procedure information after you tap any function on the oscilloscope screen, for better understanding the selected function.

➢ **To view the real-time help information**

Take the Presets function as an example.

1. Tap the **Presets** button on the upper toolbar to open the preset menu.
2. Tap the bulb-shaped real-time help button. All the information about the presets menu is displayed on right side of the screen.

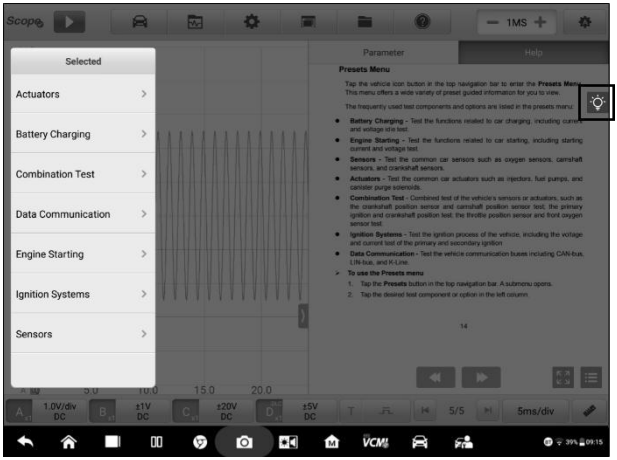


Figure 1-46 ***Sample Real-time Help Screen 1***

3. View the information by dragging it up and down using your fingertips.

The real-time help information can be displayed in a full screen by tapping the four-directional arrow icon in the lower right corner. Tap it again to recover the half-screen display.

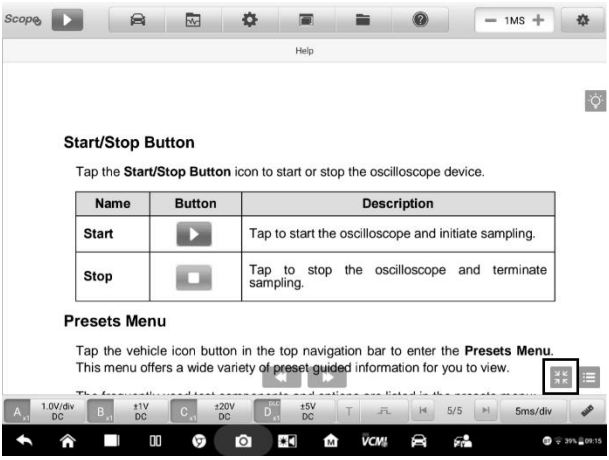


Figure 1-47 ***Sample Real-time Help Screen 2 (Full Screen)***

1.1.5.3 Lower Toolbar Buttons

The buttons in the lower toolbar include the channel control buttons, trigger setting buttons, buffer button, time base button and measurement button. The following table provides brief description of each button.

Table 1-4 *Lower Toolbar Buttons*

Name	Button	Description
Channel Control	A x1 ±5V DC	Tap to configure the settings of each channel. Active channel icons display in color; inactive icons display in gray. See *Channel Control* on page 50 for more information.
Trigger		Tap to open the trigger setting menu. See *Trigger* on page 61 for more information.
Buffer	32/32	Tap the Back or Next button to scroll to the previous or the next frame in the waveform. See *Buffer* on page 71 for more information.
Time Base	200μs/div	Tap to select an appropriate time per division. See *Time Base* on page 72 for more information.
Measurement		Tap to select an appropriate measurement. See *Measurement* on page 74 for more information.

Channel Control

There are four input channels: **input channel A, input channel B, input channel C, and input channel D**. The four channel buttons display on the lower left side of the screen. Set the input channel(s) through the corresponding channel control button(s).

Each **Channel Control** button includes the input channel number, the amplitude value and probe value. The probe value displays in the lower right corner of the left column of the channel control button. The amplitude value displays in the right column of the channel control button.

➢ **To activate and close the channel**

1. Tap the left column of the channel control button to activate the channel. The button color changes from gray to the corresponding color of the channel. Or,

2. Tap the right column of the channel control button to open the settings dialog box.

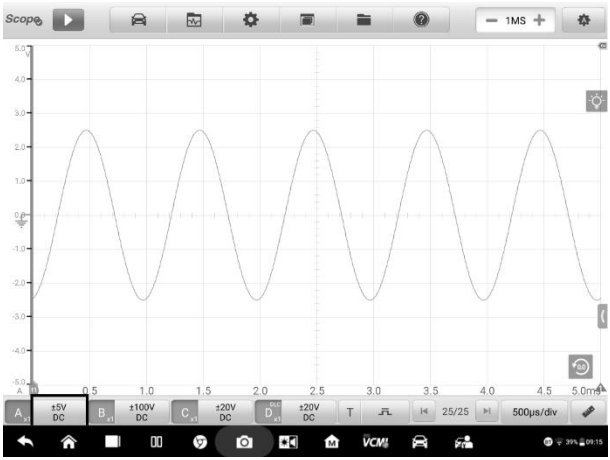


Figure 1-48 ***Sample Activate Channel Screen***

3. Tap the left column of channel control button again to close the channel. The closed channel button displays gray.

Channel Color

Identify each channel waveform by color.

Table 1-5 ***Channel Color Table***

Input Channel	Color
A	Red
B	Green
C	Blue
D	Yellow

The amplitude, probe, low-pass filtering and DLC channel settings can be configured in the Channel control dialog box.

Amplitude Settings

The amplitude settings allow you to set up the oscilloscope to capture signals with the specified range. If the input signal exceeds the selected range, an over-range

indicator will be displayed. Select **Auto** to enable the device to adjust the vertical scale automatically.

It only changes the vertical scale, while the horizontal scale is not changed. AC and DC voltage can be toggled to set up the input circuitry.

Note

The vertical scale is ALWAYS divided into 10 major divisions, and all scale settings reflect in these 10 divisions. The division set of 10 cannot be changed.

There are two modes available to set the amplitude value.

Mode 1: For example, selecting DC 5V sets the channel amplitude to **±5 DC** (displayed on the right side of the channel control button), the vertical scale range is from -5V to +5V. The vertical scale is divided into 10 segments, each segment increases by 1V.

Figure 1-49 ***Channel Setting Dialog Box Screen***

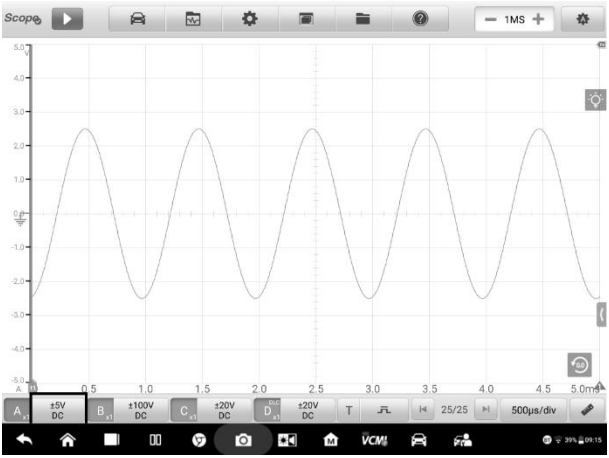


Figure 1-50 ***Sample Amplitude Setting Screen (DC 5V)***

Mode 2: Select the ## **/div** button to adjust value incremented by each division. For example, selecting DC 1.0V/div, sets the channel amplitude to **1.0V/div DC** (seen at the right side of the channel control button). Each segment increases by 1V. As the vertical scale is divided into 10 segments, the entire vertical scale range is from -5V to +5V.

Figure 1-51 ***Sample Amplitude Setting Screen (DC 1.0V/div)***

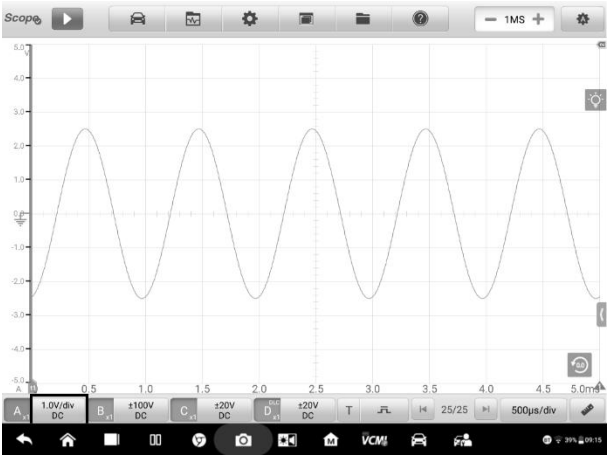


Figure 1-52 ***Sample Amplitude Setting Screen (DC 1.0V/div)***

Probe Settings

A probe is an accessory that connects to your oscilloscope and to detect signals to be measured. It can pick up different forms of signal, but generally delivers a voltage signal.

This oscilloscope has built-in definitions of standard probes. By default, the probe is set to be x1, which means 1V signal at the input to the probe will display as 1V.

The inner probes (built-in probes) include:

- **X1**: no attenuation
- **10：1 Attenuator**: select when using a 10-fold attenuation probe
- **20：1 Attenuator**: select when using a 20-fold attenuation probe (SA020)
- **X1000**: select when using a 1,000-fold attenuation probe
- **65A Current Clamp (1mV/10mA mode, Max: 20A)**: 1mV/10mA mode on 65A current clamp, the max. current is 20A
- **65A Current Clamp (1mV/100mA mode, Max: 65A)**: 1mV/100mA mode on 65A current clamp, the max. current is 65A
- **650A Current Clamp (1mV/100mA mode, Max: 200A)**: 1mV/100mA mode on 650A current clamp, the max. current is 200A
- **650A Current Clamp (1mV/1A mode, Max: 650A)**: 1mV/1A mode on 650A current clamp, the max. current is 650A

- **Coil-On-Plug Ignition Probe [COP]**: select when using the COP ignition probe (SA271)
- **Secondary Ignition Probe [ignition]**: select when using the secondary ignition probe (SA273)
- **Secondary Ignition Probe (inverted) [R_ignition]**: select when using the secondary ignition probe (SA273) and inverting the secondary ignition signal

You can select the inner standard probes in the probe settings. After selecting a correct probe, the settings can be seen in the lower right corner of the left column of the channel control button, indicating the probe is in use.

Tap the question mark icon to view the image of the corresponding current clamp in full screen.

Figure 1-53 ***Sample Inner Probe Setting Screen***

Probe Edit

Add custom probes not included in the built-in standard probe menu.

NOTE

Please refer to the probe's instruction manual or consult the corresponding manufacturer for the linear equation (y=mx+c).

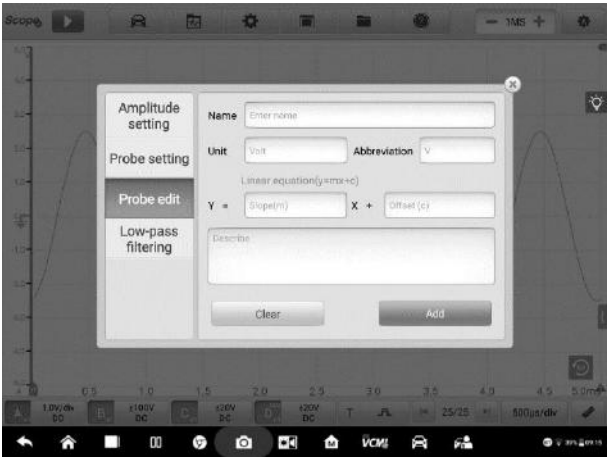


Figure 1-54 ***Sample Probe Edit Screen 1***

➢ **To add custom probes**

Add a 20：1 Attenuator as an example:

1. Tap the right column of the channel control button at the bottom of the screen to open the setting dialog box.
2. Select the **Probe Edit** option in the left column of the dialog box.
3. Tap each field to open the virtual keyboard and input the required information.

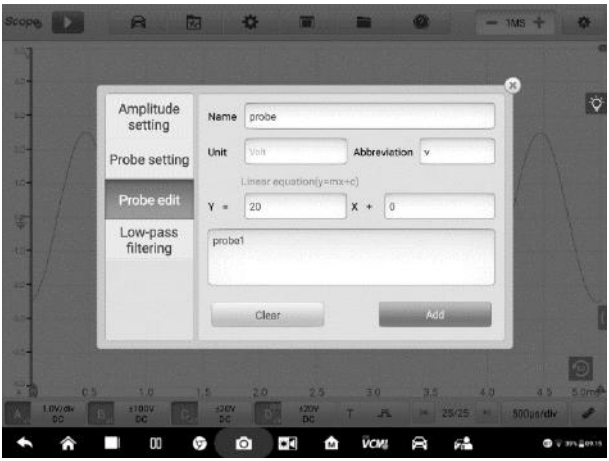


Figure 1-55 ***Sample Probe Edit Screen 2***

4. Tap **Add** to save the settings, or tap **Clear** to exit without saving.
5. The added probe will be listed in the Probe Settings window.

Figure 1-56 ***Sample Probe Edit Screen 3***

LPF (Low-pass Filtering)

The low-pass filtering (LPF) is an independent digital low-pass filter for each input channel used to remove noise from the signal.

It is helpful to find and reject low frequencies from the selected input channel for more accurate measurements. Take the two screenshots below as an example to show the comparison with or without setting the low-pass filtering. The following two screenshots show the difference between waveforms with the low-pass filtering and waveforms without the low-pass filtering.

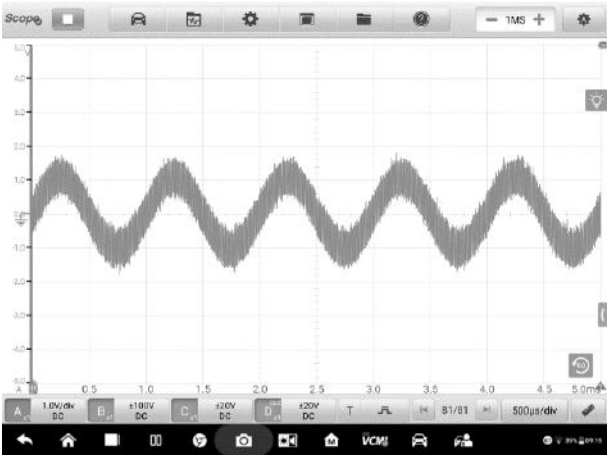


Figure 1-57 ***Before Setting Low-pass Filtering Screen***

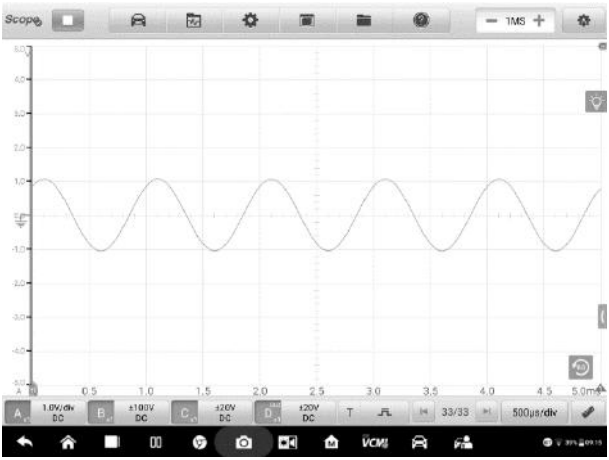


Figure 1-58 ***After Setting Low-pass Filtering Screen***

➢ **To configure the low-pass filtering settings**

1. Tap the right column of the channel control button to open the setting dialog box.
2. Select the **Low-pass Filtering** option from the left column of the dialog box.
3. Tap the checkbox of the appropriate channel and adjust frequency by tapping the minus or plus. The unit can be switched to **Hz, KHz or MHz** from the dropdown list.

Figure 1-59 ***Sample Low-pass Filtering Screen***

4. Tap **Yes** to save the settings or close the dialog box directly to exit without saving.

DLC Channel

The DLC (Data Link Connector) channel enables data to be collected from the vehicle's OBDII pins for analysis of vehicle communications. The DLC channel icon displays on the **input channel D** button.

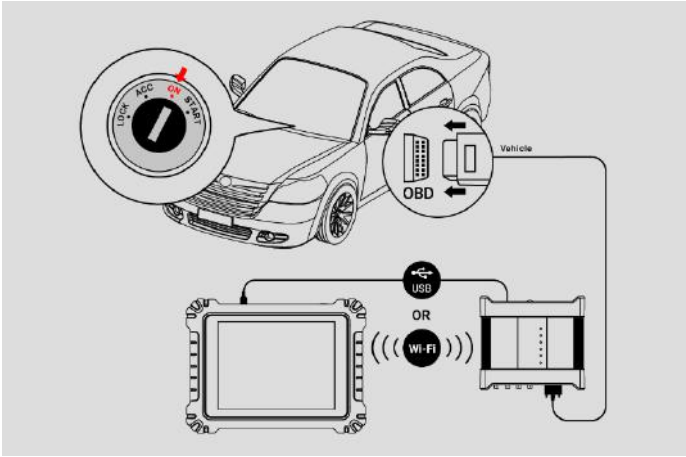


Figure 1-60 ***Sample DLC Connection Diagram***

➢ **To open and set the DLC channel**

1. Tap the right column of the channel D button at the bottom of the screen to open the setting dialog box.
2. Select the **DLC Channel** in the left column of the dialog box.
3. Swipe the **Enable DLC channel** to **ON**. Select the appropriate pins.

NOTE

If the Enable DLC channel button **CAN NOT** be swiped to **ON**, please remember to connect the VCMI power adapter and keep it charging.

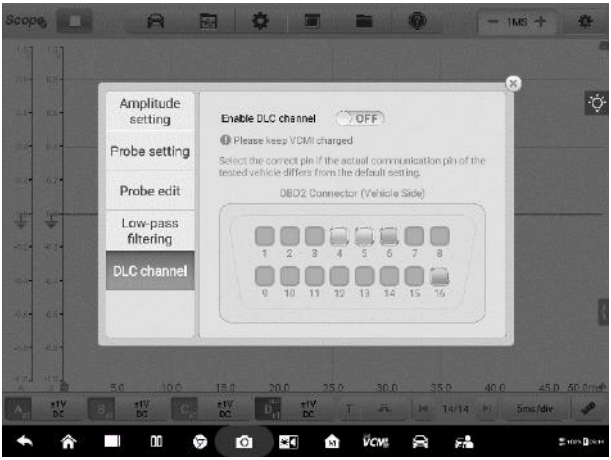


Figure 1-61 ***Sample DLC Channel Setting Screen 1***

4. Close the dialog box, the selected result is displayed on the screen. Tap the amplitude setting button at the bottom of the screen to adjust the value for the DLC channel.

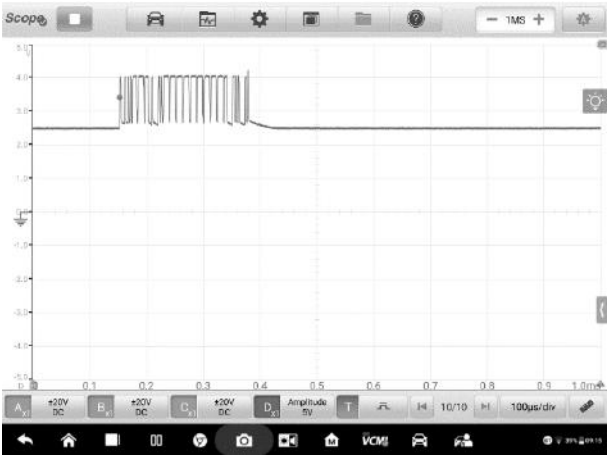


Figure 1-62 ***Sample DLC Channel Setting Screen 2***

5. Swipe the **Enable DLC channel** to OFF to close the DLC channel and switch to the oscilloscope function.

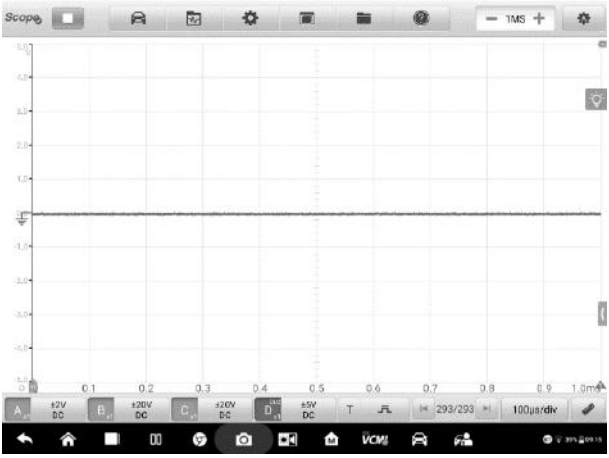


Figure 1-63 ***Sample DLC Channel Setting Screen 3***

Trigger

The trigger feature is used to stabilize repetitive waveforms to obtain a clear signal characterization.

A trigger is activated when a signal crosses set thresholds. Trigger points can also be set manually as the user views a waveform.

When the oscilloscope is capturing the signal, tap the left column of the **Trigger** button to activate the trigger function. A **trigger point** displays as a blue point.

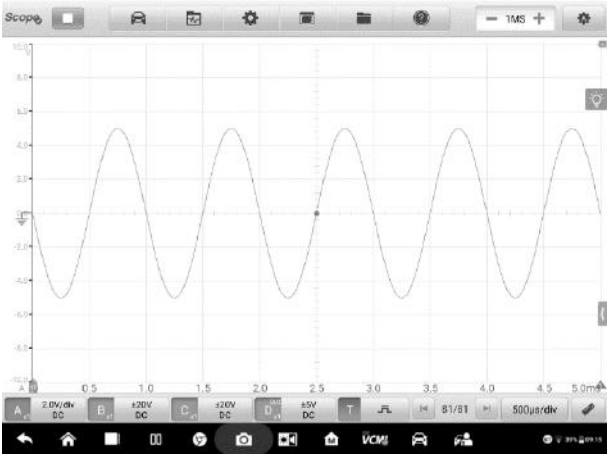


Figure 1-64 ***Sample Trigger Point Screen***

When the oscilloscope is capturing the signal, tap the right column of the **Trigger** button to open the trigger settings dialog box.

Figure 1-65 ***Sample Trigger Settings Screen***

Edge Triggering

The edge trigger is one of the most common trigger modes and is activated when voltage rises above or falls below a preset threshold. This trigger type allows you to configure the trigger mode, threshold, trigger channel and pulse direction settings. Tap **Done** to save the settings or tap **Cancel** to exit without saving.

NOTE

The oscilloscope switches to the continuous mode if the time base is set to more than or equal to 200ms/div. The Edge Triggering is supported in the continuous mode.

- **Trigger Mode**

Four trigger modes are available: **None, Auto, Repeat and Single**.

Figure 1-66 ***Sample Trigger Mode Screen***

The table below offers brief descriptions for each trigger mode.

Table 1-6 ***Trigger Mode Table***

Trigger Mode	Description
None	In this trigger mode, the oscilloscope can continuously capture data, without waiting for a trigger event.
Auto	In this trigger mode, the oscilloscope will wait for a trigger before capturing data. It can automatically update after a short period, even if the signal does not across the trigger point.

Trigger Mode	Description
Repeat	In this trigger mode, the oscilloscope waits until a trigger event occurs. If there is no trigger event, nothing will be displayed on the screen.
Single	In this trigger mode, the oscilloscope stops capturing data once a trigger event occurs.

- **Channel**

Select the applicable trigger channel from the dropdown menu. The selected channel is the one that the oscilloscope monitors for the trigger condition.

Figure 1-67 ***Sample Trigger Channel Screen***

- **Pulse Direction**

Two pulse direction settings are available: **Rise** and **Fall**.

Figure 1-68 ***Sample Pulse Direction Screen***

✧ **Rise Edge Trigger** - Indicates trigger is turned on to start the trace on the rising edge of the waveform.

✧ **Fall Edge Trigger** – Indicates trigger is turned on to start the trace on the falling edge of the waveform

- **Threshold**

The **Threshold** allows you to set the voltage threshold for the trigger.

✧ To precisely position the trigger point, input the value in the Threshold field in the trigger settings dialog box.

✧ To roughly position the trigger point, drag the trigger point to a desired position.

➢ **To configure the trigger settings**

1. Tap the right column of the **Trigger** button to open the trigger settings dialog box.
2. Select the trigger mode, trigger channel and pulse direction in the dropdown list.
3. Input the value in the Threshold field in the trigger settings dialog box.
4. Tap **OK** to save settings or tap **Cancel** to exit without saving.

Advanced Edge

This trigger type includes all the functions of the edge trigger type, plus two additional options: **the Rising or Falling option** and **the hysteresis option**.

Rising or Falling option in the dropdown menu of the pulse direction: Dual edges of a waveform can be triggered. This mode is especially useful for monitoring pulses of both polarities at once.

Hysteresis option: It is used to reduce false triggering on noisy signals. When hysteresis is enabled, a second trigger threshold voltage is used in addition to the main trigger threshold. The trigger fires only when the signal crosses the two thresholds in the correct order. The first threshold arms the trigger, and the second causes it to fire.

Figure 1-69 ***Sample Advanced Edge Settings Screen***

Window

This trigger type helps to monitor when the signal enters or exits a specified voltage window.

Three options are available for the pulse direction: **Entering, Exiting, Entering or Exiting**. The **Threshold 1** and **Threshold 2** are the upper and lower voltage limits of the window.

Figure 1-70 ***Sample Window Settings Screen***

Pulse Width

This trigger type allows you to monitor pulses of a specified width.

Figure 1-71 ***Sample Pulse Width Settings Screen***

➢ **To set the pulse width**

1. Tap the **Trigger** button at the bottom of the screen to open the Trigger Settings dialog box.

2. Select the **Pulse Width** in the left column of the dialog box.
3. Select the desired trigger mode and channel mode.
4. Set the pulse direction to either Positive pulse or Negative pulse according to the polarity of the pulse.
5. Select one of the four Conditions:
   - **More than:** triggers on pulses wider than the specified time.
   - **Less than:** triggers on pulses narrower than the specified time.
   - **In the time range**: triggers on pulses wider than Time 1 but narrower than Time 2.
   - **Out of the time range:** triggers on pulses narrower than Time 1 but wider than Time 2.
6. Set the trigger **Threshold** and **Hysteresis**.
7. Set the **Time 1** or **Time 2** in minutes (if available) to define the pulse width.
8. Tap **OK** to save settings or tap **Cancel** to exit without saving.

Interval

This trigger type allows you to search for two consecutive edges of the same polarity separated by a specified time interval.

For the setting operation, please refer to the operation steps of Pulse Width, but the pulse direction with Rise or Fall selection instead of Positive or Negative.

Figure 1-72 ***Sample Interval Settings Screen***

Window Pulse Width

This trigger type combines with the window trigger and the pulse width trigger. It detects when a signal enters or exits an input range and stays for a specified period of time. Two **Region** options can be selected: **In range** and **Out of range**.

Figure 1-73 ***Sample Window Pulse Width Settings Screen***

Horizontal Distortion

This trigger type helps to monitor an edge that occurs after a specified time with on edges. It is useful for triggering at the end of a pulse train.

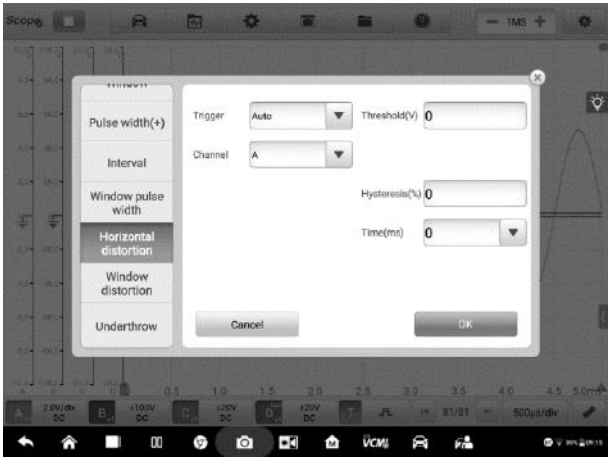


Figure 1-74 ***Sample Horizontal Distortion Settings Screen***

Window Distortion

This trigger type monitors when a signal enters a specified voltage range and stays within that range for a specified period of time.

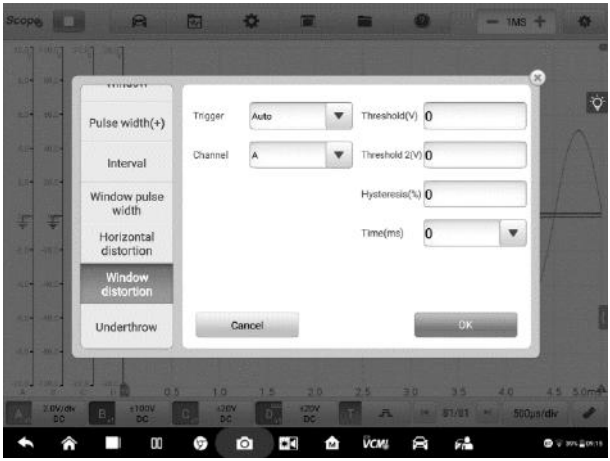


Figure 1-75 ***Sample Window Distortion Settings Screen***

Underthrow

This trigger type monitors a pulse that exceeds one threshold and then drops below the same threshold without exceeding the second threshold. This type of trigger is typically used to find pulses that do not reach a valid logic level.

Figure 1-76 ***Sample Underthrow Settings Screen***

Buffer

The waveform buffer shows which signal waveform is displayed on the current screen and how many signal waveforms are captured and stored in the buffer memory.

The oscilloscope can capture and store waveforms. Select a waveform from the waveform buffer by tapping the **Previous** or **Next** button.

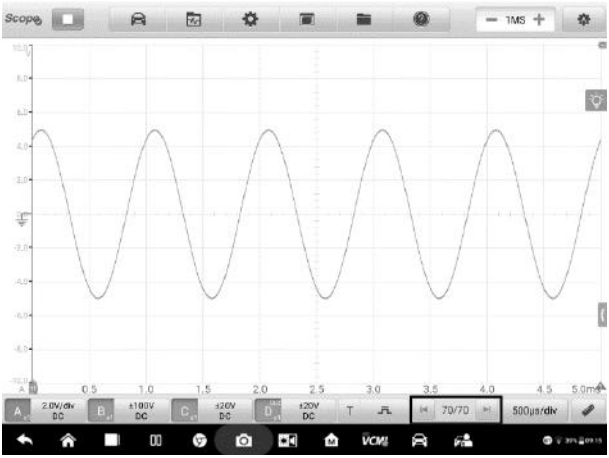


Figure 1-77 ***Sample Buffer Screen***

Name	Button	Description
Previous		Tap to display the previous waveform in the buffer.
Buffer Index	32/32	Displays the number of the waveform currently displayed onscreen out of the total number of buffered waveforms.
Next		Tap to display the next waveform in the buffer.

Time Base

The time base controls the time interval across the oscilloscope display. Tap the Time Base button at the bottom to open the setting dialog box.

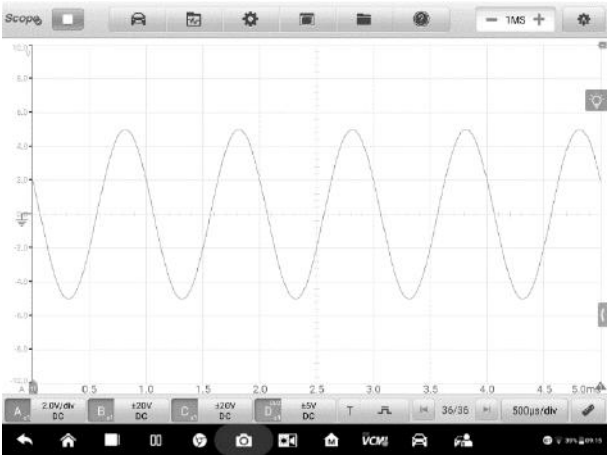


Figure 1-78 ***Sample Time Base Screen 1 (Normal Mode)***

Continuous Mode: if the time base is set to more than or equal to 200ms/div, the oscilloscope switches to the continuous mode. In this mode, the oscilloscope updates the trace continuously as each capture progresses, rather than waiting for a complete capture before updating the trace.

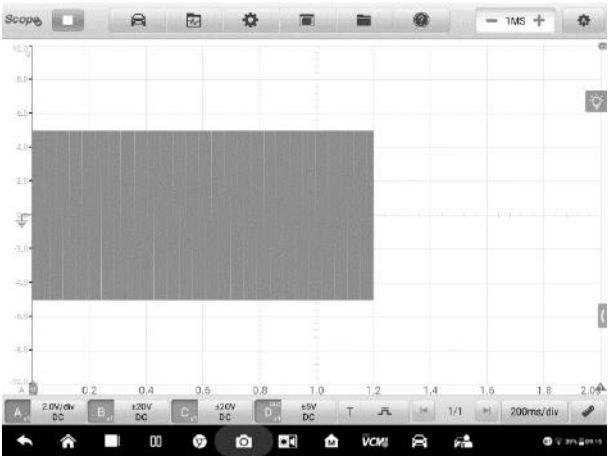


Figure 1-79 ***Sample Time Base Screen 2 (Continuous Mode)***

Measurement

The available measurements for each channel are (from left to right):

Figure 1-80 ***Sample Measurement Screen 1***

- **Maximum** – the highest level that the signal reaches
- **Minimum** – the lowest level that the signal reaches
- **Peak To Peak** – the difference between maximum and minimum
- **Amplitude** – the top value minus the bottom value
- **Period** – the duration of one cycle in a repeated pattern in the waveform
- **Frequency** – the number of signal occurrences per second
- **Positive Duty Ratio** – the ratio of positive pulse width to period width
- **Negative Duty Ratio** –the ratio of negative pulse width to period width
- **Positive Pulse Width** – the amount of time that the signal spends above its average value
- **Negative Pulse Width** – the amount of time that the signal spends below its average value
- **AC RMS** – the root mean square (RMS) value of the waveform minus the DC Average
- **True RMS** – the root mean square (RMS) value of the waveform, including the DC component
- **DC Average** – the average value of the waveform

- **Rising Rate** – the rate at which the signal level rises
- **Falling Rate** – the rate at which the signal level falls
- **Rise Time** – the time the signal takes to rise from the lower threshold to the upper threshold
- **Fall Time** – the time the signal takes to fall from the upper threshold to the lower threshold
- **X@Max** – the corresponding value of X axis when the amplitude is the maximum
- **X@Min** – the corresponding value of X axis when the amplitude is the minimum
- **Positive Acreage** – the waveform acreage measured above the zero baseline
- **Negative Acreage** – the waveform acreage measured below the zero baseline
- **Full Acreage** – the positive acreage plus negative acreage
- **Top Value** – 90% of the waveform maximum value
- **Bottom Value** – 10% of the waveform minimum value
- **Positive Overshoot** – the ratio of the difference between the maximum value and the top value and the amplitude
- **Negative Overshoot** – the ratio of the difference between the bottom value and the minimum value and the amplitude
- **Positive Pre-shoot** – the ratio of the difference between the bottom value and the minimum value and the amplitude
- **Negative Pre-shoot** –the ratio of the difference between the maximum value and the top value and the amplitude

NOTE

When connecting via Wi-Fi，it only supports Maximum, Minimum, Peak To Peak, Amplitude, Period, Frequency, Positive Duty Ratio, Negative Duty Ratio, Positive Pulse Width, Negative Pulse Width, AC RMS, True RMS, DC Average, X@Max, X@Min, Top Value and Bottom Value.

In the **Spectrum View**, the available measurements are as follows.

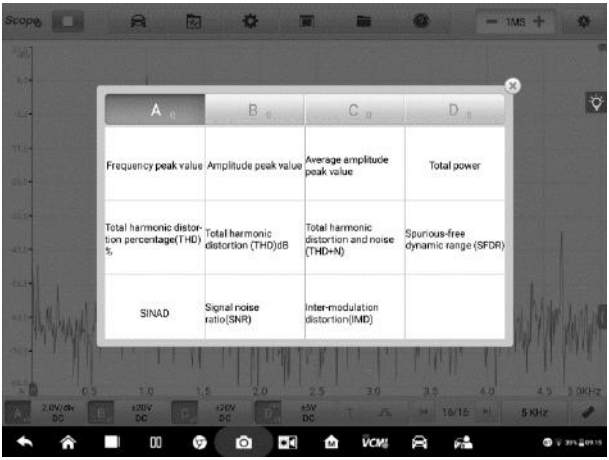


Figure 1-81 ***Sample Measurement Screen 2 (Spectrum View)***

- **Frequency Peak Value** – the frequency of the peak signal value
- **Amplitude Peak Value** – the amplitude of the peak signal value
- **Average Amplitude Peak Value** – the amplitude of the peak signal value captured over multiple times
- **Total Power** – the power of the entire signal captured in the spectrum view
- **Total Harmonic Distortion Percentage (THD)** – the ratio of the sum of harmonic powers to the power of fundamental frequency

$$\mathrm{THD} = \frac{\sqrt{V_1^2 + V_2^2 + V_3^2 + V_4^2 + V_5^2}}{V_f}$$

- **Total Harmonic Distortion (THD) dB:** the ratio of the sum of harmonic powers to the power of fundamental frequency

$$\mathrm{THD} = 10\log_{10}\left(\frac{\sqrt{V_1^2 + V_2^2 + V_3^2 + V_4^2 + V_5^2}}{V_f}\right)$$

- **Total Harmonic Distortion and Noise (THD + N)** – the ratio of the harmonic power plus noise to the fundamental power

$$\mathrm{THD+N} = 10\log_{10}\left(\frac{\mathrm{THD+N}}{\mathrm{V_f}}\right)$$

- **Spurious-free Dynamic Range (SFDR)** - the ratio of the amplitude of the highest peak in the spectrum to that of the second highest peak
- **SINAD** – signal to noise and distortion ratio. The ratio (in decibels) of the signal-plus-noise-plus-distortion to noise-plus-distortion

$$\mathrm{SINAD} = 10\log_{10}\left(\frac{\mathrm{Signal}}{\mathrm{Noise+noise}}\right)$$

- **Signal Noise Ratio (SNR)** – the ratio (in decibels) of average signal power to average noise power

$$\mathrm{SINAD} = 10\log_{10}\left(\frac{\mathrm{Signal}}{\mathrm{Noise}}\right)$$

- **Inter-modulation Distortion (IMD)** - a measure of distortion due to non-linear mixing of two tones

$$\mathrm{IMD} = \sqrt{\frac{\mathrm{F_3^2+F_4^2}}{\mathrm{F_1^2+F_2^2}}}$$

➢ **To set the measurements**

1. Tap the **Measurement** button at the bottom of the screen to open the measurement dialog box.
2. Select the channel to be measured.
3. Select the appropriate measurement options. The **Whole Track** and **Ruler Track** can be toggled through the **Edit** icon in the upper corner of the option.

Figure 1-82 ***Sample Measurement Setting Screen***

4. Close the dialog box, and the corresponding measurement readings are displayed on the right-hand side of the screen. Adjust the whole track or ruler track on the displayed screen or delete the measurement directly by tapping the **X** button.

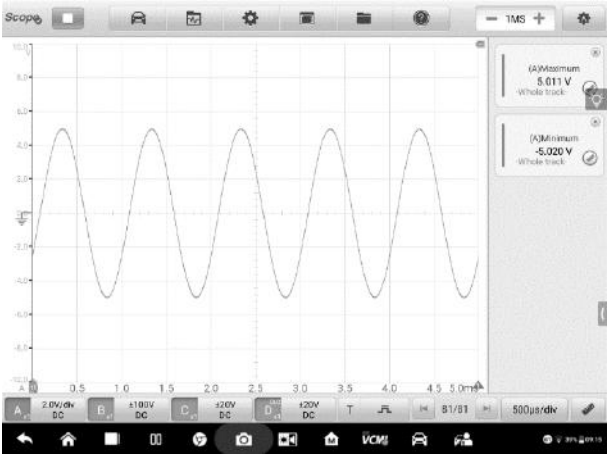


Figure 1-83 ***Sample Measurement Display Screen***

➢ **To set the measurements in Spectrum View**

1. Tap the **Settings** button in the top navigation bar. A dialog box opens. Select the **Mode** option in the dialog box, and then tap to select **Spectrum View.**

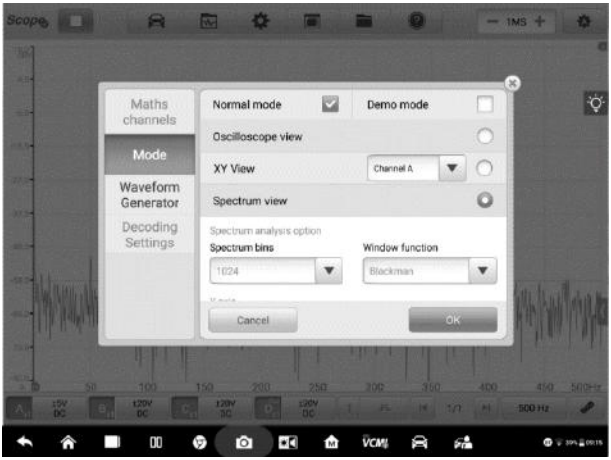


Figure 1-84 ***Sample Spectrum View Selection Screen***

2. Tap the **Measurement** button at the bottom of the screen to open the measurement dialog box.
3. Select the channel to be measured.
4. Select the appropriate measurement options.

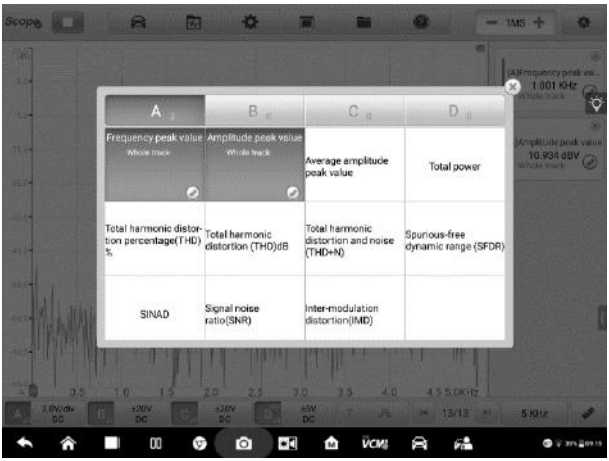


Figure 1-85 ***Sample Measurement Setting Screen (Spectrum View)***

5. Close the dialog box, and the corresponding measurement readings are displayed on the right-hand side of the screen. Delete the measurement

directly by tapping the **X** button.

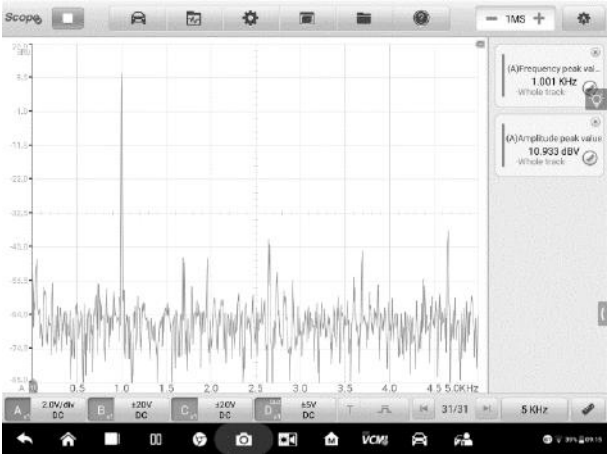


Figure 1-86 ***Sample Measurement Display Screen (Spectrum View)***

1.1.6 Troubleshooting

A. If the oscilloscope cannot communicate with the MaxiSys Tablet:

- Ensure the VCMI device is properly connected to the MaxiSys Tablet via Wi-Fi or with the supplied USB cable.
- Restart the MaxiSys Tablet and reconnect the VCMI device if communication between the two continues to fail.

B. If unwanted signals are displayed or signals are distorted:

- Use only the supplied test leads or probes to connect with the input channels.
- Check the test leads or probes for damage.
- Ensure the polarity of the test leads connections are correct.
- Ensure the signal and ground connections are clean and secure.
- Ensure the ground lead is providing a direct ground from the circuit to the input channel.
- Isolate the test leads from other components, leads, or systems that may induct unwanted noise into the signal being tested including the electric motors, secondary ignition components, relays, alternators.

1.1.7 Glossary

AC/DC Control

Each channel can be set to either AC coupling or DC coupling. With DC coupling, the voltage displayed onscreen is equal to the true voltage of the signal with respect to ground. With AC coupling, any DC component of the signal is filtered out, leaving only the variations in the signal for the AC component.

Aliasing

When the signal frequency gets higher than half the scope's maximum sampling rate and exceeds the limit, a distorted waveform displays. This distortion is called aliasing.

Amplitude

The maximum voltage generated from the zero volts line of the oscilloscope.

Analog Bandwidth

The frequency at which a displayed sine wave has half the power of the input sine wave (about 71% of the amplitude).

Buffer Size/Cache Size

The size of the oscilloscope's buffer memory. The buffer memory is used by the oscilloscope to temporarily store data. This helps to compensate for the differences in data transfer rate from one device to another.

Frequency

The number of signal occurrences per second. Frequency is measured in Hz (hertz).

Peak to peak voltage

The difference in voltage between the minimum and maximum voltages occurring in the waveform.

Time Base

The time interval across the scope display.

Voltage Range

The range between the maximum and minimum voltages that can be accurately captured by the oscilloscope.

Sampling Rate

The number of samples per second captured by the oscilloscope. The faster the sampling rate of the scope, the more frequently it measures the signal voltage, and so the more detailed will be the trace that appears on the scope screen.

1.2 Multimeter

A multimeter is an electronic measuring instrument that is used to measure voltage, resistance, frequency, diode, duty cycle and pulse width and continuity test. The VCMI (Vehicle Communication and Measurement Interface) working with MaxiSys Ultra can function as a multimeter to provide precise measurements.

1.2.1 Safety Information

Follow the instructions below to reduce the risk of injury from electric shock and prevent equipment damage.

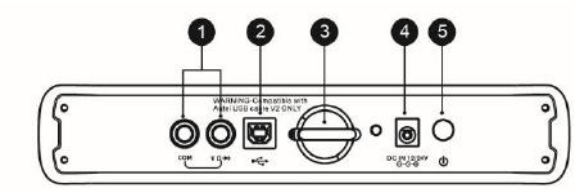
- Use the multimeter only as specified in this manual.
- Do not apply more than the rated voltage between terminals or between any terminal and earth ground.
- Do not input a value beyond the range when measuring. Remember that the limit value range of this multimeter is 200V.
- To prevent injury or death, do not use the multimeter if it appears to be damaged in any way, and stop use immediately if you are concerned with any abnormal operations.
- To prevent injury or death, never ground yourself when taking electrical measurements. Isolate yourself from ground by using dry rubber insulating mats to cover all exposed/grounded metal. Ensure all clothing including gloves are dry. Stand on rubber mats when using tool.
- Use the test leads or probes supplied with the product, or proper and applicable terminals. Inspect the test leads or probes for damage before use.
- When using probes, keep fingers behind the finger guards on the probes.
- Use the supplied replacement fuses or specified replacement parts.
- Always consider electrical and electronic equipment to be energized (live). Never assume any equipment is de-energized.
- When making electrical connections, connect the common test lead before connecting the live test lead; when disconnecting, disconnect the live test lead before disconnecting the common test lead.
- When measuring current, turn off circuit power before connecting the multimeter to the circuit. Remember to place the multimeter in series with the circuit.
- After current measurement is finished, turn off the power to the circuit before removing the test leads and before reconnecting any disconnected wires or devices.

- Do not add voltage to the input terminal when measuring resistance.
- To avoid electric shock, turn off the power to the component before connecting.
- To prevent damage, always use and store your multimeter in appropriate environments.
- Do not use in wet or damp conditions, or around explosive gas or vapor.
- Do not tamper with or disassemble the multimeter, connectors or accessories. Internal damage will affect performance.
- Before carrying out maintenance and cleaning of the multimeter, make sure the unit is NOT connected to a power source, vehicle or computer.
- When cleaning the multimeter, use a damp, soft cloth with mild detergent. Do not allow water to enter the multimeter casing.

1.2.2 General Introduction

1.2.2.1 Component Locations

The multimeter jacks are located on the top of the VCMI device while the input channels are located at the bottom.



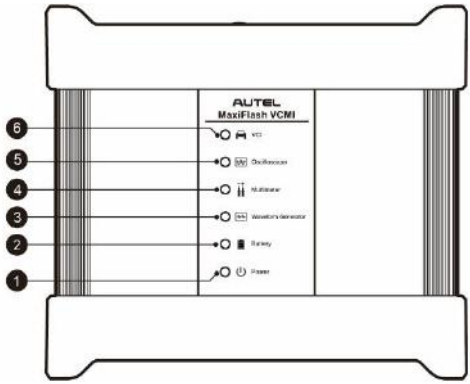
VCMI Top View

1. Multimeter Jacks – for ground and signal cables
2. USB Port
3. Hook
4. DC Power Supply Input Port
5. Power Button

IMPORTANT

When using the multimeter function, please insert the supplied multimeter probes to the multimeter probe jacks. The input channel A is assigned when measuring current.

The multimeter LED is located on the front panel of the VCMI device. When the VCMI is properly connected and powered on, the multimeter LED lights green when operating in the multimeter mode.



VCMI Front View

1. Power LED
2. Battery LED
3. Waveform Generator LED
4. Multimeter LED
5. Oscilloscope LED
6. Vehicle LED

1.2.2.2 Technical Specifications

Item	Description
Voltage Range	VDC 200V VAC 200V $_{RMS}$
Resistance Range	1Ω to 10MΩ
Diode	2V
Frequency Range	1Hz to 1MHz
Duty Cycle Range	1% to 99%
Pulse Width Range	1us to 1000ms

Item	Description
Current Range	● 0 to 65A (65A current clamp) ● 0 to 650A (650A current clamp)

1.2.2.3 Accessories

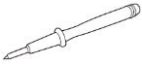
The following accessories are compatible with the multimeter and oscilloscope. Please refer to *Accessories* on page 5 for details.

65A current clamp

650A current clamp

Large Dolphin Clip

Small Crocodile Clip



Multimeter Probe

Back-pinning Probe

Flexible Back-pinning Probe

Breakout Lead

Battery Clip

The two multimeter test leads (Red: SA015 / Black: SA016) are standard for the multimeter and waveform generator.

Multimeter Test Lead

Used to connect the multimeter and multimeter probe.

1.2.3 Getting Started

Before opening the Multimeter application, ensure the VCMI device is connected to the tablet via Wi-Fi network or with the supplied USB cable.

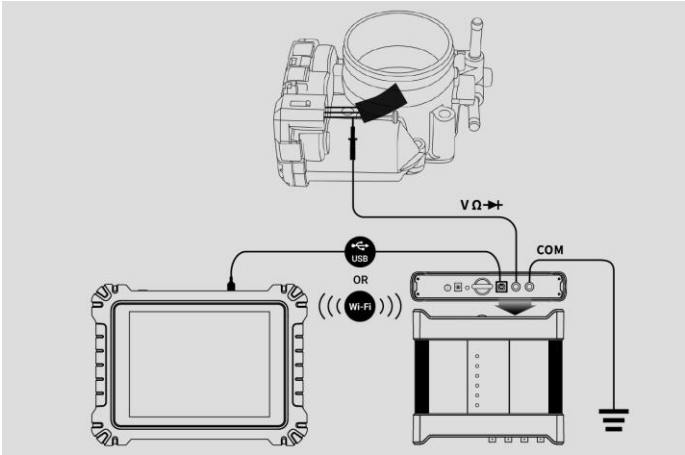


Figure 1-1 ***Sample Connection Diagram***

➢ **To open the multimeter application**

1. Insert the applicable test leads or probe terminal ends into the multimeter jacks to complete the connection.
2. Tap the **Measurement** icon on the Home screen of the MaxiSys Ultra Tablet. The Measurement screen opens.
3. Tap the **Multimeter** icon to open the Multimeter Menu.
4. Select a test to continue.

NOTE

Please check the multimeter LED status indicator on the front panel of VCMI device. The multimeter LED lights green when operating in the multimeter mode.

1.2.4 Multimeter Update

The operating software of the multimeter is continually optimized. Tap the Help button in the upper half of the screen to update.

Before update the multimeter software, please ensure the tablet has a stable Internet connection.

1.2.4.1 APK Update

NOTE

The acronym APK (Android Package Kit) is used on the tablet and in this manual. This file contains all the assets of a particular app. To update the APK, is to install the latest version of the app on your tablet.

➢ **To update the APK**

1. Tap the **Help** button on the upper half of the screen. A dropdown menu displays.

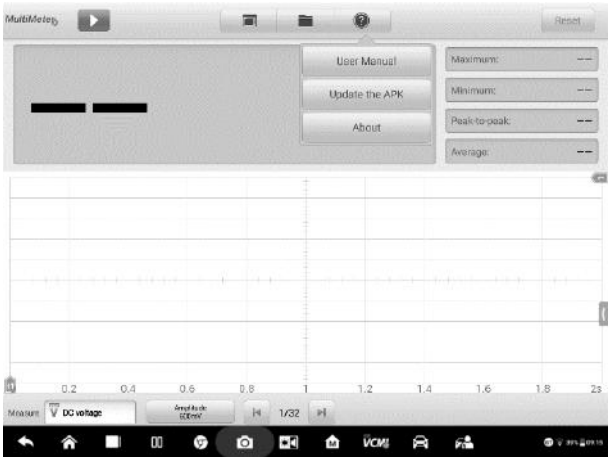


Figure 1-2 ***Sample Help Screen***

2. Tap the **Update the APK** in the dropdown menu. A confirmation message displays.

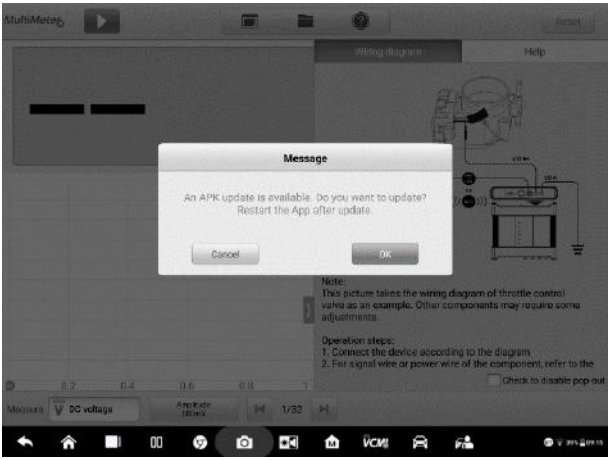


Figure 1-3 ***Sample Update Confirmation Screen***

3. Tap **OK** to update the software or tap **Cancel** to exit.

1.2.5 Screen Layout and Operations

Tap the **Measurement** icon on the home screen then tap the **Multimeter** icon in the menu, the multimeter page displays. The screen typically includes the following button sections.

NOTE

The Multimeter application can also be opened via the Android home screen. Tap the **Measurement** icon at the top of the Android home screen. Tap **Multimeter** icon.

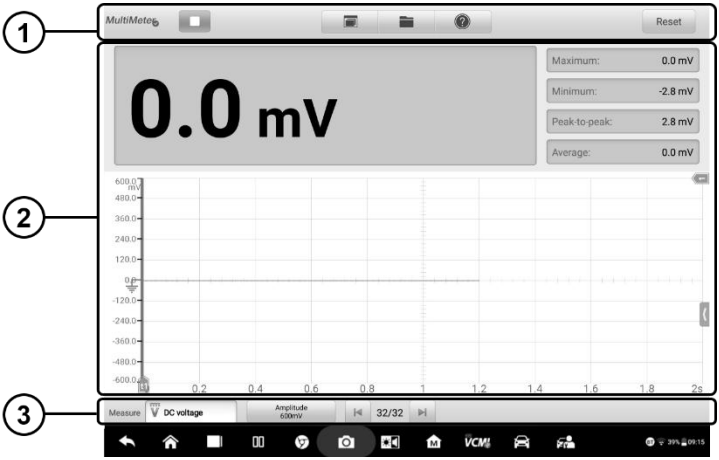


Figure 1-4 ***Sample Multimeter Menu Screen***

1. Upper Toolbar Buttons - see *Upper Toolbar Buttons* on page 90 for details.

2. Main View Section – see *Main View Section* on page 94 for details.

3. Lower Toolbar Buttons - see *Lower Toolbar Buttons* on page 100 for details.

1.2.5.1 Upper Toolbar Buttons

The upper toolbar buttons are used for configurations of various settings and operations. The following table provides brief descriptions of each button:

Table 1-1 ***Upper Toolbar Buttons***

Name	Button	Description
Multimeter Icon	MultiMeter	Displays the multimeter connection status. See *Multimeter Button* on page 91 for more information.
Start/Stop		Start or stop the multimeter device. See *Start/Stop Button* on page 91 for more information.
Display Mode		Set the display mode. See *Display Mode Menu* on page 91 for more information.
File		Print, open and save the waveform data. See *File Menu* on page 92 for more information.

Name	Button	Description
Help		View the user manual, update the APK and firmware. See *Help Menu* on page 94 for more information.
Reset	Reset	Reset the digital readouts displayed in the figure mode.

Multimeter Button

This **Multimeter status button** displays the multimeter connection status. A **green** check mark means the tablet and the Multimeter are connected; a **red X** means the device and the tablet are not connected.

Start/Stop Button

Press this **Start/Stop Button** icon to start and stop the multimeter device.

Name	Button	Description
Start		Tap to start the multimeter.
Stop		Tap to stop the multimeter.

Display Mode Menu

The position of the digital readouts and waveform in the main view section can be selected in the Display Mode Menu.

➢ **To set the display mode**

1. Tap the **Display Mode** button in the top navigation bar. A submenu opens.

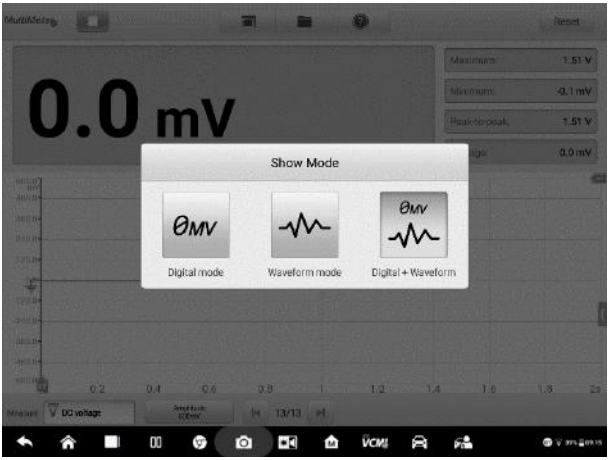


Figure 1-5 ***Sample Display Mode Menu Screen***

2. Select one of the three display modes.
3. The corresponding display mode will be shown on the screen.

Table 1-2 ***Display Mode Table***

Icon	Mode	Description
	Digital Mode	Displays the digital readouts only.
	Waveform Mode	Displays the waveform only.
	Digital + Waveform Mode	Displays both the digital readouts and waveform.

File Menu

The file menu supports the following functions.

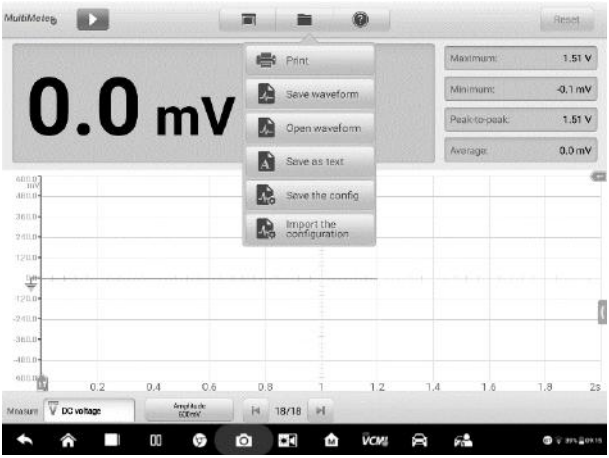


Figure 1-6 ***Sample File Menu Screen***

- **Print –** Tap to create and print a temporary PNG picture of the current waveforms.

NOTE

Ensure the tablet is configure to print (see Printer setup instructions) and is connected to the printer. Ensure the tablet and printer share the same network.

- **Waveform File Operation**

Save and open the waveform files in this section. Only **Waveform** mode and **Digital + Waveform** mode support this operation.

Save Waveform – Tap to capture and save the current waveforms. On the Save File screen, tap each item to input the corresponding information and then tap **Save** or **Save Default** to finish.

NOTE

The file name is required when saving waveforms.

Open Waveform – Tap to retrieve the saved waveforms. Tap the **Edit** button in the upper right corner of the screen to select and/or delete the saved waveform.

Save as text – Tap to save the current waveform data to a text file. Use the ES File Explorer app on the Android home screen to review file: **Home > ES File Explorer > Local > Internal Storage > Scan > Data > Multimeter > txt.**

- **Configuration Operation**

The configurations can be saved and imported.

Save the Configuration – Tap to save the configuration settings (i.e., the amplitude, the time base, the number of samples) of waveforms on the current screen.

Import the Configuration – Tap to import the saved configuration settings for waveforms.

Help Menu

The Help Menu allows you to view the user manual, update the software, and view versions of the device.

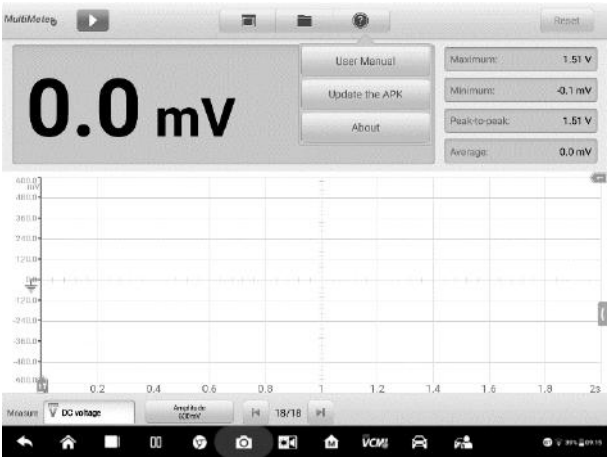


Figure 1-7 ***Sample Help Menu Screen***

User Manual – displays instruction for the prosper use of the multimeter.

Update the APK – connects to the Autel server to check for latest application software.

About – displays the model number of the multimeter and version numbers of the installed software and firmware.

1.2.5.2 Main View Section

The main view section displays differently depending on the selected mode.

Digital Mode

The main view section in the digital mode displays only the digital readouts such as values of current measurement, maximum measurement, minimum measurement, peak to peak measurement and average measurement.

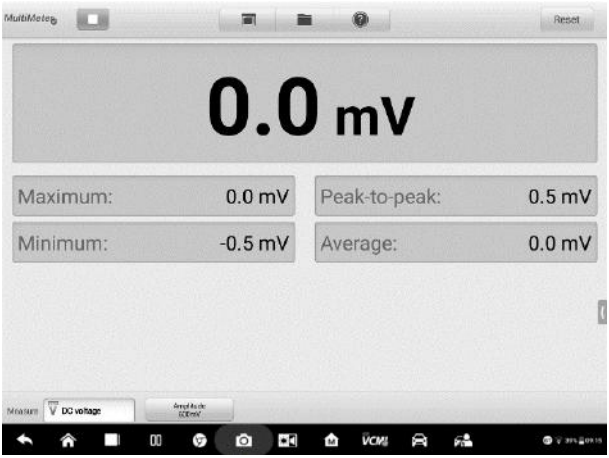


Figure 1-8 ***Sample Main View Section Screen (Digital Mode)***

- **Current Value**: the current value can be the AC voltage, DC voltage, resistance, frequency, or duty cycle
- **Maximum:** the recorded maximum value of the measurement
- **Minimum**: the recorded minimum value of the measurement
- **Peak to Peak:** the difference between the maximum and minimum values
- **Average:** the average value of the measurements

Waveform Mode

The main view section in the scope mode only displays the waveform.

Figure 1-9 ***Sample Main View Section Screen (Waveform Mode)***

The main view section features a coordinate grid with the **X-axis** representing the time duration and the **Y-axis** representing the voltage level.

The voltage level on the Y-axis can be configured in the Amplitude Settings while the time duration on the X-axis can be set in the Time Base Settings.

Channel Selection

In the main view section, a channel has two conditions: selected and unselected. A channel must be selected in order for the waveform to be movement, to use the zoom-in or to add voltage rulers.

➢ **To select and unselect the channel**

1. Tap the zero baseline marker or the Y-axis (the line thickens when selected).
2. Tap the zero baseline marker or the Y-axis again to exit the channel selection.

Waveform Zooming

The zooming function allows you to change the size and position of a signal during or after capturing a waveform to examine it in greater details. It does not change the stored data, but the way it displays.

The X-axis and Y-axis can be zoomed using your fingertips. The waveform can be zoomed during or after capturing the signal.

Measurement Rulers

In the coordinate grid, there are two kinds of **measurement rulers**, which allow the voltage and time duration of a waveform to be measured precisely. They are useful when determining signal characteristics such as amplitude at specific points, the cycle time (duration) and frequency.

The vertical **Time Ruler** - Tap the **Ruler Activator** in the bottom left corner of the grid and drag it across the screen to the desired position. A **Time Ruler** is generated.

The horizontal **Y-axis Ruler** - The **Ruler** can be generated in the similar way by tapping the **Ruler Activator** in the upper right corner and dragging it downwards.

NOTE
The horizontal Y-axis ruler varies according to the settings of the voltage, current, frequency, duty cycle, etc.

When Measurement Rulers are generated, a **Ruler Table** showing time and voltage values for the corresponding channels will be displayed. The **Delta** icon refers to the absolute difference between the values of the rulers, which can be locked by tapping the **Lock** icon. Tap the **X** button in the upper right corner of the ruler table to delete all rulers.

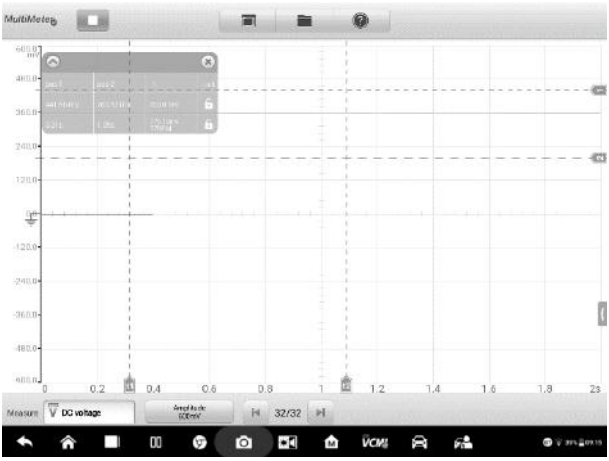


Figure 1-10 ***Sample Measurement Rulers Screen***

Zero Baseline

The zero baseline is marked the 0 value in the Y-axis, showing the ground level of each channel waveform. After the channel is selected, the zero baseline can be adjusted by dragging the baseline marker up/down along the Y-axis, or dragging the waveform up/down or moving the screen up/down in the grid.

NOTE

Tap the baseline marker to make the vertical scale line thinner. In this case, the waveform is unselected and cannot be dragged. Tap the baseline marker again to select.

Figure 1-11 ***Sample Zero Baseline Screen***

Wiring Diagram and Help

Tap the arrow button in the lower right corner of the screen to open the Wiring Diagram and Help window.

The **Wiring Diagram** function provides the connection diagram, operation steps and operation notes.

The **Help** function provides the content-sensitive help, displaying information relevant to the procedure, operation or instructions.

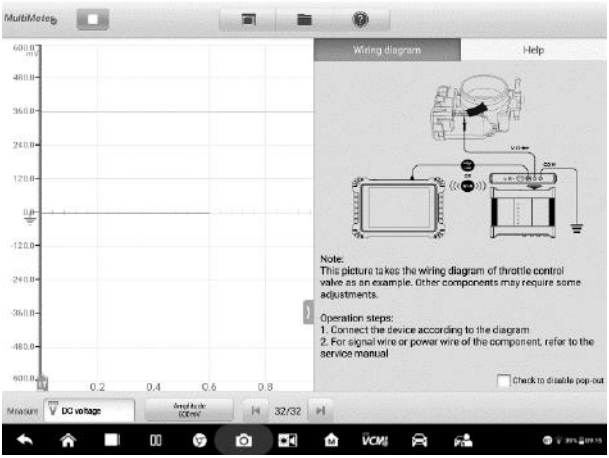


Figure 1-12 ***Sample Wiring Diagram and Help Screen***

➢ **To open and close the Wiring Diagram and Help window**

1. Tap the arrow button on the right-hand side of the screen.

Figure 1-13 ***Arrow Button Position Screen***

2. The **Wiring Diagram and Help** window displays.
3. Tap the arrow button again or tap any space outside of the window.

Digital + Waveform Mode

In this mode, the main view section displays the digital readouts on the top and the waveform in the grid.

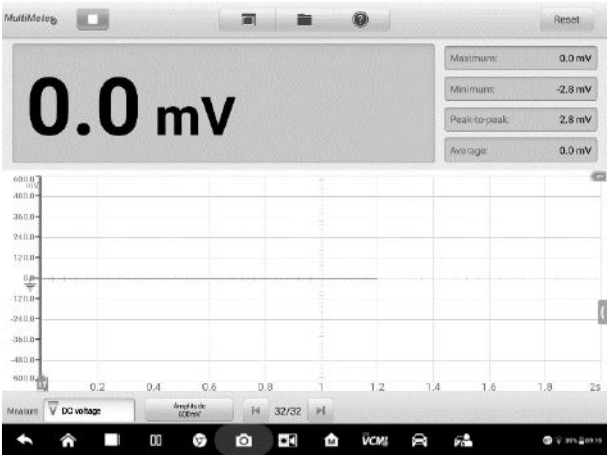


Figure 1-14 ***Sample Main View Section Screen (Digital + Waveform Mode)***

1.2.5.3 Lower Toolbar Buttons

The measurement, buffer and time base can be configured in the lower toolbar.

Table 1-3 ***Lower Toolbar Buttons***

Name	Button	Description
Measurement	Measure V AC voltage	Tap to select an appropriate measurement. See *Measurement Setting* on page 101 for more information.
Amplitude	Amplitude 1V	Tap to select an appropriate amplitude value. See *Amplitude Setting* on page 102 for more information.
Buffer	32/32	Tap the Previous or Next button to switch to the previous or the next waveform. See *Buffer* on page 106 for more information.

Measurement Setting

This multimeter can be used to measure or test AC voltage, DC voltage, resistance, AC electricity, DC electricity, diode, frequency, duty cycle, pulse width, continuity and period.

The measurement types include:

- **AC/DC voltage**: measures the voltage in the electrical circuit
- **Resistance**: measures the resistance of the electrical circuit or the component
- **AC/DC current:** measures current amperage through the input channel A by using the optional current clamp

Note
The type of current clamp can be selected in the dropdown list.

- **Diode:** conducts the diode test of the electrical circuit
- **Frequency:** measures the frequency of the input signal
- **Duty Cycle (+)/(-)**: measures the (+) and (-) duty of the input signal
- **Connectivity**: determines whether a low impedance exists two points in the electrical circuit. If the impedance is less than 100 ohms, the circuit is “closed”, otherwise, the circuit is “open”.
- **Period**: measures the amount the time that one complete cycle of the input signal endures
- **Pulse Width (+)/(-)**: measures the pulse width of the input signal

➢ **To set the measurement setting**

1. Tap the **Measurement Setting** button in the lower left corner of the screen. A dialog box appears.

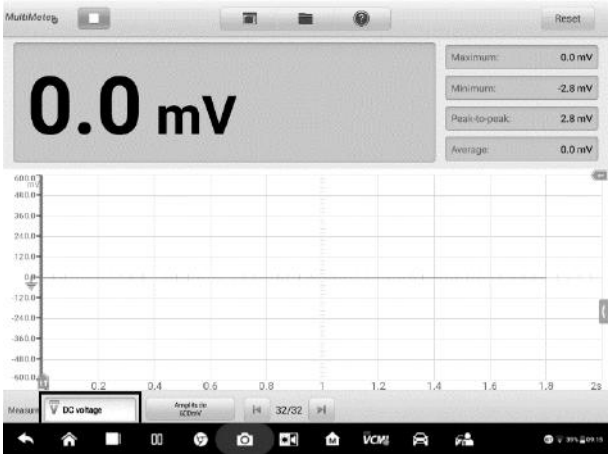


Figure 1-15 ***Sample Measurement Setting Position Screen***

2. Select the **measurement type** you want to measure or test in the right column of the dialog box. The blue color indicates the option is selected.

Figure 1-16 ***Sample Measurement Setting Screen***

3. Close the dialog box, the measurement type you set displays on the screen.

Amplitude Setting

Amplitude value can be configured for the selected measurement type excluding resistance measurement.

The amplitude settings allow you to set up the multimeter to capture signals within the specified range. If the input signal exceeds the selected range, an over-range indicator will be displayed. Select **Auto** to enable the device to adjust the vertical scale automatically.

There are two modes available to set the amplitude value.

Mode 1: For example, selecting DC 10V sets the amplitude to **Voltage 10V** (displays on the amplitude button). The vertical scale range is from -10V to +10V. As the vertical scale is divided into 10 segments, each segment increases by 2V.

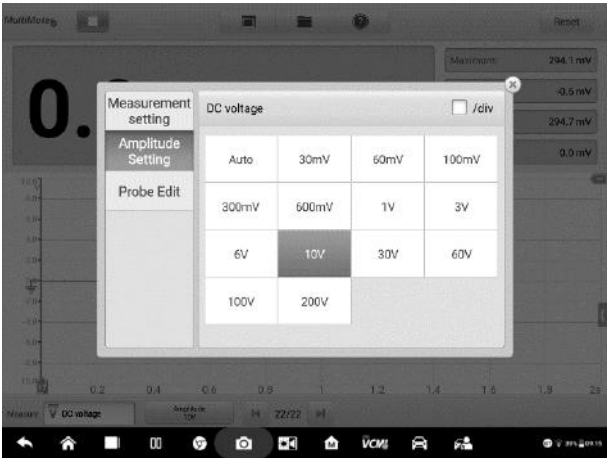


Figure 1-17 ***Channel Setting Dialog Box Screen (DC 10V)***

Mode 2: Select the **## /div** button to adjust the value increments of each division. For example, selecting DC 2.0V/div, sets the amplitude to **Voltage 2.0V/div** (displays on the amplitude button). Each segment increases by 2V. As the vertical scale is divided into 10 segments, the entire vertical scale range is from -10V to +10V.

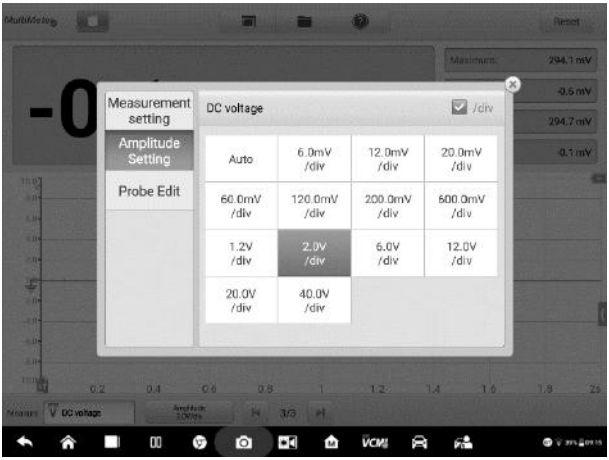


Figure 1-18 ***Sample Amplitude Setting Screen (DC 2.0V/div)***

Testing Procedures

The following section describes how to use the multimeter. The testing procedures are the same for each measurement type.

The following directions are for measuring AC voltage.

➢ **To measure AC voltage**

1. Insert the supplied multimeter probes into the VCMI multimeter jacks.
2. Hold the probes to the correct points of the circuit.
3. Tap the **Measurement Setting** button in the lower left corner of the screen to open the setting dialog box. Select **AC voltage** in the dialog box.
4. Set the proper amplitude value in the **Amplitude Setting** menu in the same dialog box.
5. The voltage displays onscreen.

Note

Use the optional current clamp connected to the input channel A when measuring currents. Use the supplied multimeter probes to connect with the multimeter jacks for other measurement types.

Probe Edit

Use the probe edit menu to add the not included probes into the probe menu.

Figure 1-19 ***Sample Probe Edit Screen 1***

➢ **To add custom probes**

1. Tap the **Measurement Setting** button in the lower left corner of the screen to open the setting dialog box.
2. Select the **Probe Edit** option in the left column of the dialog box.
3. Tap each field to open the virtual keyboard and input the required information.

Figure 1-20 ***Sample Probe Edit Screen 2***

4. Tap **Add** to save the settings, or tap **Clean** to exit without saving.

5. The added probe will be listed in the Measurement Settings window.

Figure 1-21 ***Sample Probe Edit Screen 3***

Buffer

The waveform buffer displays the number of the waveform currently displayed on-screen out of the total number of stored waveforms.

The multimeter can capture and store up to 32 waveforms. Tap the **Previous** or **Next** button to review waveforms.

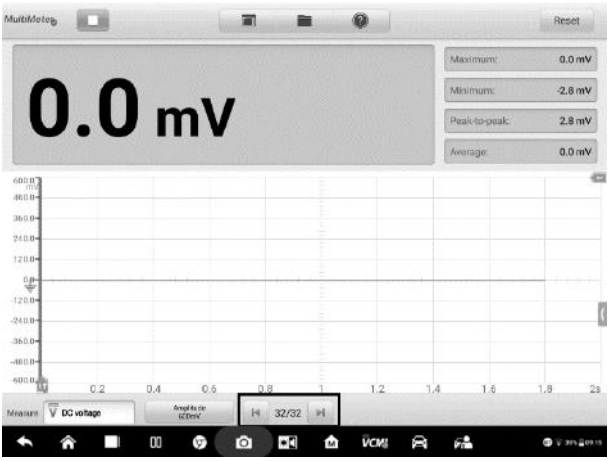


Figure 1-22 ***Sample Buffer Screen***

Name	Button	Description
Previous		Tap to display the previous waveform in the buffer.
Buffer Index	32/32	Displays the number of the waveform currently displayed onscreen out of the total number of buffered waveforms.
Next		Tap to display the next waveform in the buffer.

1.2.6 Troubleshooting

If the multimeter cannot communicate with the MaxiSys Tablet:

- Check if the VCMI device is properly connected to the MaxiSys Tablet via Wi-Fi or the supplied USB cable.
- If the communication between the VCMI device and the MaxiSys still fails, restart the MaxiSys Tablet and reconnect the VCMI device.

1.2.7 Glossary

AC

Alternating Current - electrical current that switches polarity at regular intervals.

DC

Direct Current - electrical current that flows in one direction only.

Amperage

The strength of an electric current, expressed in amperes.

Amplitude

The maximum voltage generated from the zero volts line of the multimeter.

Frequency

The number of signal occurrences per second. Frequency is measured in Hz (hertz).

Duty Cycle

The length of a signals on time. Specified as a percentage (ratio), of the total cycle time.

Peak to Peak

The difference between maximum and minimum value.

Cursor

The onscreen markers used to measure time and amplitude.

Diode

A semiconductor device that allows current flow only in one direction.

Grid

A network of horizontal and vertical scales displayed on the scope screen that aids in the measuring of signal characteristics.

1.3 Waveform Generator

The VCMI (Vehicle Communication and Measurement Interface) working with MaxiSys Ultra can function as a waveform generator to send out electric signals to the vehicle's sensor or actuator for testing or measuring.

1.3.1 Safety Information

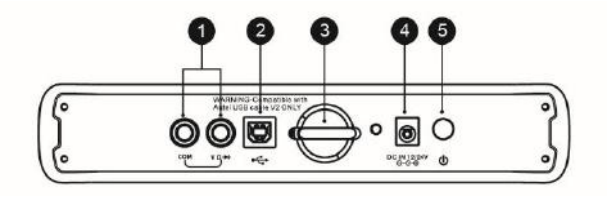
Follow the instructions below to reduce the risk of injury from electric shock and prevent equipment damage.

- Use the waveform generator only as specified in this manual.
- Do not apply more than the rated voltage between terminals or between any terminal and earth ground.
- To minimize shock hazard, please connect the device ground input (chassis) to an electrical ground.
- Do not alter the ground connection. Without the protective ground connection, all accessible conductive parts can render an electric shock.
- To avoid electric shock hazard, disconnect power cable before removing covers.
- To prevent injury or death, do not use the waveform generator if it appears to be damaged in any way, and stop use immediately if you are concerned any abnormal operations.
- Inspect the test leads or probes for damage before use.
- Use the accessories supplied with the product.
- Use the supplied replacement fuses or specified replacement parts.
- To prevent damage, always use and store your waveform generator in appropriate environments.
- Do not place the waveform generator in an area that is directly exposed to sunlight or under high humidity.
- Do not tamper with or disassemble the waveform generator, connectors or accessories. Internal damage will affect performance.
- Disconnect multimeter from power source, vehicle and tablet before cleaning.
- When cleaning the waveform generator, use a damp, soft cloth with mild detergent. Do not allow water to enter the multimeter casing

1.3.2 General Introduction

1.3.2.1 Component Locations

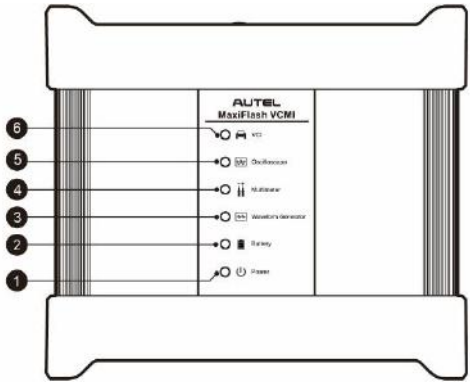
The multimeter jacks are used when operating the waveform generator. The two multimeter jacks are located on the top of the VCMI device.



VCMI Top View

1. Multimeter Jacks – for ground and signal cables
2. USB Port
3. Hook
4. DC Power Supply Input Port
5. Power Button

The waveform generator LED is located on the front panel of the VCMI device. When the VCMI is properly connected and powered on, the waveform generator LED lights green when operating in the waveform generator mode.



VCMI Front View

1. Power LED
2. Battery LED
3. Waveform Generator LED
4. Multimeter LED
5. Oscilloscope LED
6. Vehicle LED

1.3.2.2 Technical Specifications

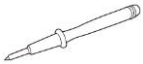
Item	Description
Voltage Range	0.1 to 12V
Frequency Output	1Hz to 30KHz
Duty Cycle Range	1% to 99% (1Hz to 30KHz)

1.3.2.3 Accessories

The following accessories are compatible with the waveform generator and oscilloscope. Please refer to *Accessories* on page 5 for details.

Large Dolphin Clip

Small Crocodile Clip



Multimeter Probe

Back-pinning Probe

Flexible Back-pinning Probe

Breakout Lead

Battery Clip

The multimeter test leads (Red: SA015 / Black: SA016) are standard for the waveform generator and multimeter.

Multimeter Test Lead

Used to connect the waveform generator and the probe.

1.3.3 Getting Started

Before opening the waveform generator application, the VCMI device must be connected to the Tablet via the provided USB cable or Wi-Fi network. For more information, see Establish Vehicle Communication.

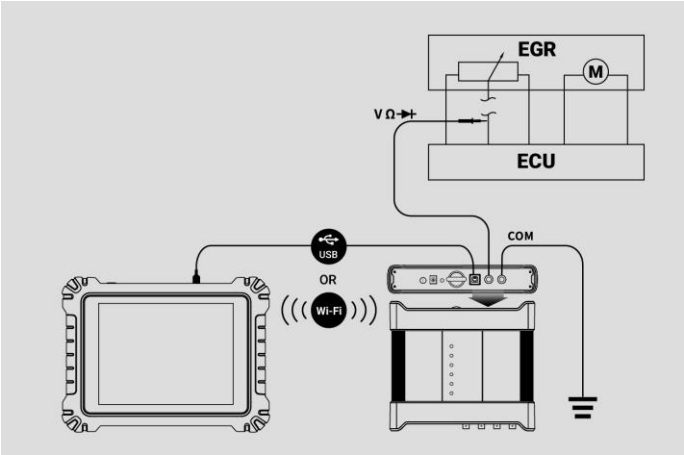


Figure 1-1 ***Sample Connection Diagram***

➢ **To open the waveform generator application**

1. Insert the multimeter test lead ends into the multimeter jacks on the top of the VCMI device to compete the connection.
2. Tap the **Measurement** icon on the Home screen of the MaxiSys Ultra Tablet. The Measurement screen displays.
3. Tap the **Waveform generator** icon to open the waveform generator Menu.
4. Select a test to continue.

NOTE

Please check the waveform generator LED status indicator on the front panel of VCMI device. The waveform generator LED lights green when operating in the waveform generator mode.

1.3.4 Waveform Generator Update

The operating software of the waveform generator is continually optimized. Tap the **Help** button in the upper half of the screen to update.

1.3.4.1 APK Update

NOTE

The acronym APK (Android Package Kit) is used on the tablet and in this manual. This file contains all the assets of a particular app. To update the APK, is to install the latest version of the app on your tablet.

➢ **To update the APK**

1. Tap the **Help** button on the upper half of the screen. A dropdown menu displays.

Figure 1-2 ***Sample Help Screen***

2. Tap the **Update the APK** in the dropdown menu. A confirmation message displays.

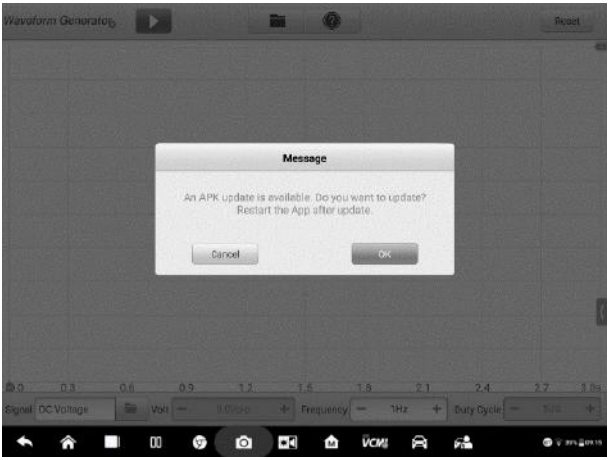


Figure 1-3 ***Sample Update Confirmation Screen***

3. Tap **OK** to update the software or tap **Cancel** to exit.

1.3.5 Screen Layout and Operations

Tap the **Measurement** icon on the home screen and select **Waveform generator** from the menu, the waveform generator page displays. The screen typically includes the following button sections.

NOTE

The **Waveform generator** application can also be opened via the Android home screen. Tap the **Measurement** icon at the top of the Android home screen. Tap **Waveform generator** icon.

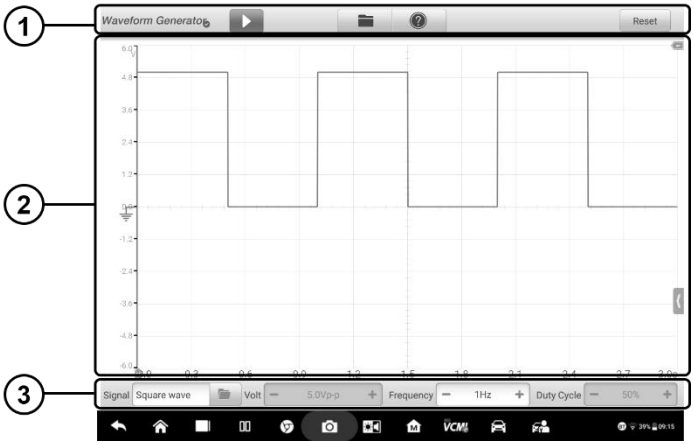


Figure 1-4 ***Sample Waveform Generator Menu Screen***

1. Upper Toolbar Buttons - see *Upper Toolbar Buttons* on page 115 for details.

2. Main View Section – see *Main View Section* on page 118 for details.

3. Lower Toolbar Buttons - see *Lower Toolbar Buttons* on page 121 for details.

1.3.5.1 Upper Toolbar Buttons

The upper toolbar buttons are used to configure settings and operations. The following table provides brief descriptions of each button.

Table 1-1 ***Upper Toolbar Buttons***

Name	Button	Description
Waveform generator Icon		Displays the waveform generator connection status. See *Waveform generator Button* on page 116 for more information.
Start/Stop		Start and stop the waveform generator device. See *Start/Stop Button* on page 116 for more information.
File		Print, open and save the waveform data. See *File* on page 116 for more information.

Name	Button	Description
Help		View the user manual, update the software and view version numbers. See *Help* on page 117 for more information.
Reset	Reset	Reset the configurations and refresh the screen.

Waveform generator Button

This **Waveform generator Icon** displays the waveform generator connection status. A **green** check mark means the tablet and the waveform generator are connected; a **red X** means the device and the tablet are not connected.

Start/Stop Button

You can tap the **Start/Stop Button** icon to start or stop the waveform generator device.

Name	Button	Description
Start		Tap to start the waveform generator.
Stop		Tap to stop the waveform generator.

File Menu

The file menu supports the following functions.

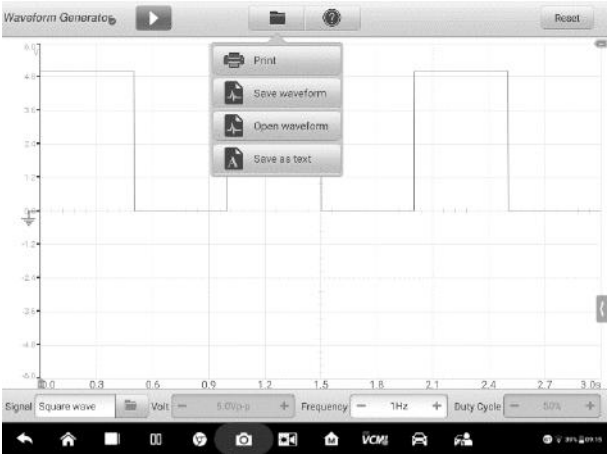


Figure 1-5 Sample File Menu Screen

- **Print –** Tap to create and print a temporary PNG picture of the current waveforms.

NOTE
Ensure the tablet is configure to print (see Printer setup instructions) and is connected to the printer. Ensure the tablet and printer share the same network.

- **Save Waveform** – Tap to capture and save the current waveform. On the Save File screen, tap each item to input the corresponding information and then tap **Save** or **Save Default** to finish.

NOTE
You must name the file to save the waveform.

- **Open Waveform** – Tap to retrieve the saved waveforms. Tap the **Edit** button in the upper right corner of the screen to select and/or delete the saved waveform.
- **Save as text** – Tap to save the current waveform data to a text file. Use the ES File Explorer app on the Android home screen to review file: **Home > ES File Explorer > Local > Internal Storage > Scan > Data > Signal > txt.**

Help Menu

The Help Menu allows you to view the user manual, update the software, and view versions of the device.

Figure 1-6 Sample Help Menu Screen

User Manual – displays instruction for the prosper use of the waveform generator.

Update the APK – connects to the Autel server and check for latest application software.

About – displays the model numbers of the waveform generator and the installed versions of the software and firmware.

1.3.5.2 Main View Section

The main view section screen displays as a coordinate grid with **X-axis** and **Y-axis**, representing the duration and voltage level respectively.

Channel Selection

In the main view section, a channel has two conditions: selected and unselected. A channel must be selected in order for the waveform to be movement, to use the zoom-in or to add voltage rulers.

➢ **To select and unselect the channel**

1. Tap the zero baseline marker or the Y-axis (the line thickens when selected).
2. Tap the zero baseline marker or the Y-axis again to exit the channel selection.

Waveform Zooming

The zooming function allows you to change the size and position of a signal during or after capturing a waveform to examine it in greater details. It does not change the stored data, only the way it displays.

The X-axis and Y-axis can be zoomed using your fingertips. The waveform can be zoomed during or after capturing the signal.

Measurement Ruler

In the coordinate grid, there are two types of **measurement rulers**, which allow the voltage and duration of a waveform to be measured precisely. They are useful when determining signal characteristics such as amplitude at specific points, and the cycle time (duration).

The vertical **Time Ruler** - Tap the **Ruler Activator** in the lower left corner of the grid and drag it across the screen to the desired position. A **Time Ruler** is generated.

The horizontal **Voltage Ruler** - The **Voltage Ruler** can be generated in the similar way by clicking the **Ruler Activator** in the upper right corner and dragging it downwards.

When Measurement Rulers are generated, a **Ruler Table** showing time and voltage values will be displayed. The **Delta** icon refers to the absolute difference between the values of the rulers, which can be locked by tapping the **Lock** icon. Tap the **X** button in the upper right corner of the ruler table to delete all rulers.

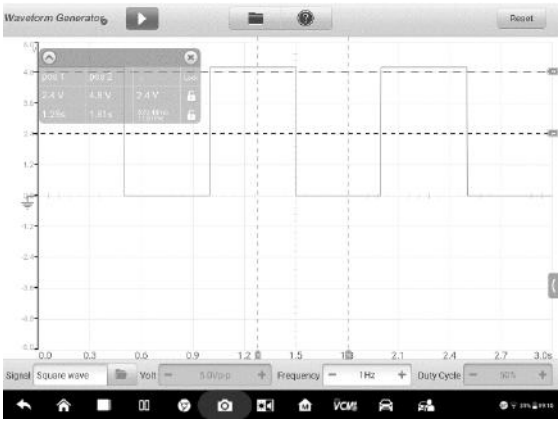


Figure 1-7 ***Sample Measurement Rulers Screen***

Zero Baseline

The zero baseline is marked as the 0 value in the Y-axis, showing the ground level of each channel waveform. After the channel is selected, the Zero Baseline can be adjusted by dragging the zero baseline marker up/down along the Y-axis.

Wiring Diagram and Help

Tap the arrow button in the lower right corner of the screen to open the Wiring Diagram and Help window.

The **Wiring Diagram** function provides the connection diagram, operation steps and operation notes.

The **Help** function provides the content-sensitive help, displaying information relevant to the procedure, operation or instructions.

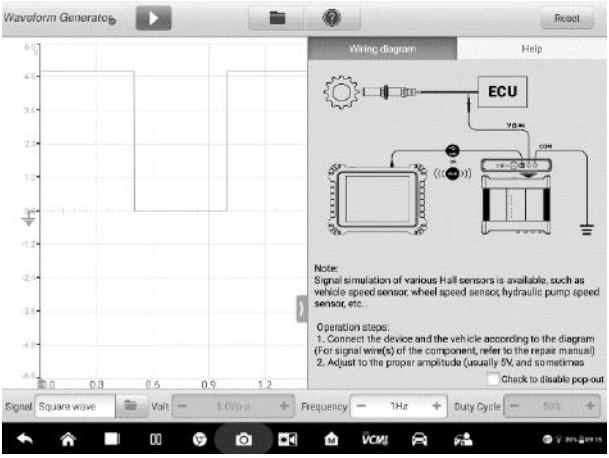


Figure 1-8 ***Sample Wiring Diagram and Help Screen***

➢ **To open and close the Wiring Diagram and Help window**

1. Tap the arrow button on the right-hand side of the screen.

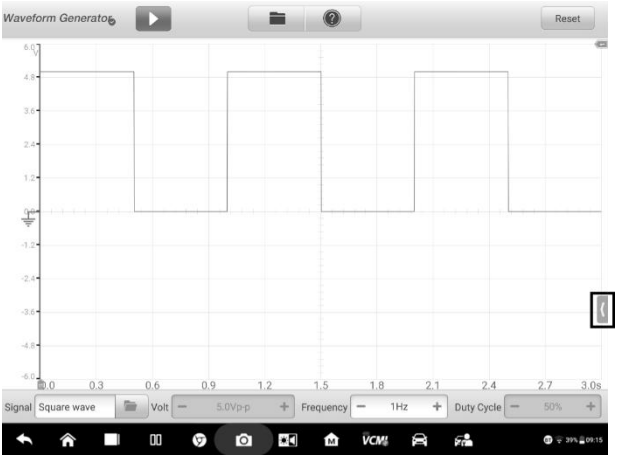


Figure 1-9 ***Arrow Button Position Screen***

2. The Wiring Diagram and Help window displays.
3. Tap the arrow button again or tap any space outside of the window.

1.3.5.3 Lower Toolbar Buttons

The signal mode, voltage, frequency and duty cycle can be configured via the lower toolbar buttons.

Table 1-2 ***Lower Toolbar Buttons***

Name	Button	Description
Signal Mode Setting	Signal Square wave	Tap to select an appropriate signal mode. See *Signal Mode Setting* on page 122 for more information.
Voltage Setting	Volt − 5.0Vp-p +	Tap to select an appropriate voltage value. See *Voltage Setting* on page 126 for more information.
Frequency Setting	Frequency − 2Hz +	Tap to select an appropriate frequency value. See *Frequency Setting* on page 129 for more information.
Duty Cycle Setting	Duty Cycle − 50% +	Tap to select an appropriate duty cycle value. See *Duty Cycle Setting* on page 131 for more information.

Signal Mode Setting

The waveform generator supports numerous signal modes including the DC voltage, square wave, square wave (X+Y), triangle wave, and actuators drive, and arbitrary waveform.

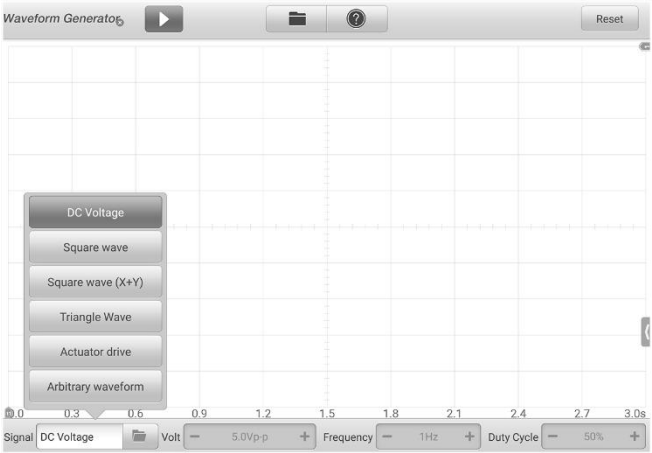


Figure 1-10 ***Signal Mode Setting Screen***

DC Voltage

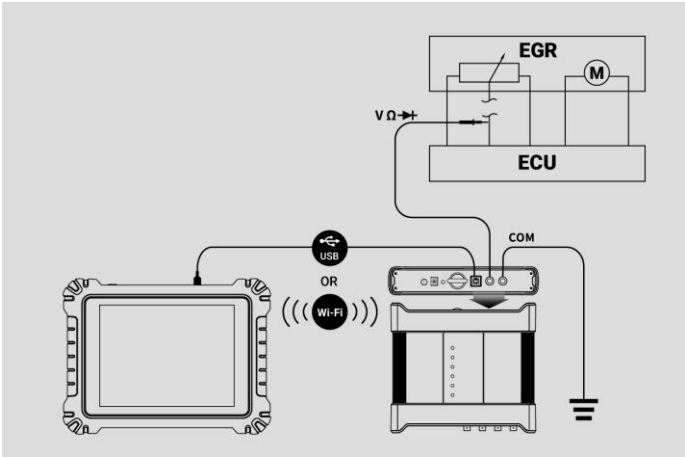


Figure 1-11 ***Sample DC Voltage Connection Diagram***

Set the DC voltage in the waveform generator interface. The waveform generator can simulate the signals of numerous sensors including the water temperature sensor, oil pressure sensor and position sensor and then feed back to the engine ECU.

Actuator Drive

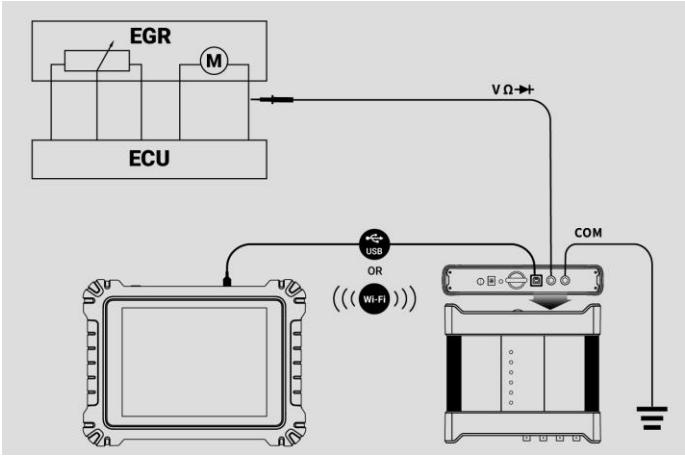


Figure 1-12 ***Sample Actuator Drive Connection Diagram***

This function can drive 2-wire solenoid valve, solenoid coil and low-power motor, including the canister solenoid valve, injector solenoid valve, transmission hydraulic valve, hydraulic control valve, ignition coil, idle motor, and throttle motor.

It can change the operation speed and working time of the actuator by setting the frequency and duty cycle. The higher the frequency, the faster the speed, and the higher the duty cycle, the longer the working time, and vice versa.

NOTE

To avoid damaging the actuator, do not actuate it for a long time, and do not set too high a frequency.

This function needs to be tested on the car. If the actuator is removed, it cannot be driven individually.

NOTE

The maximum current supported by Actuator Drive cannot exceed 2A.

Square Wave

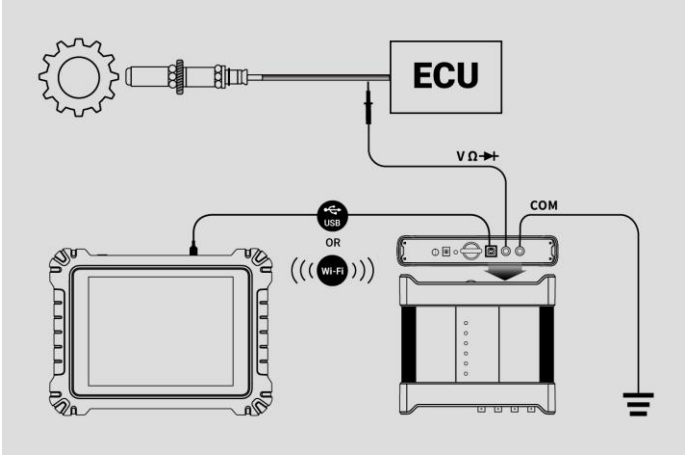


Figure 1-13 ***Sample Square Wave Connection Diagram***

Once the voltage and frequency are set in the waveform generator interface, the square wave signals simulate the signals of various Hall sensors.

Square Wave (X+Y)

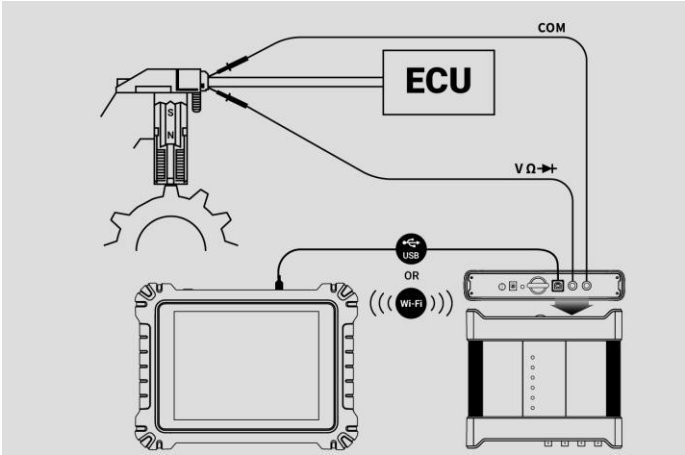


Figure 1-14 ***Sample Square Wave (X+Y) Connection Diagram***

This function is mainly used to simulate the missing tooth signals of Hall-type crankshafts and camshafts. The X value represents the normal tooth signal and the Y represents the missing tooth signal. The default setting is 58+2, which can be adjusted as needed.

Triangle Waveform

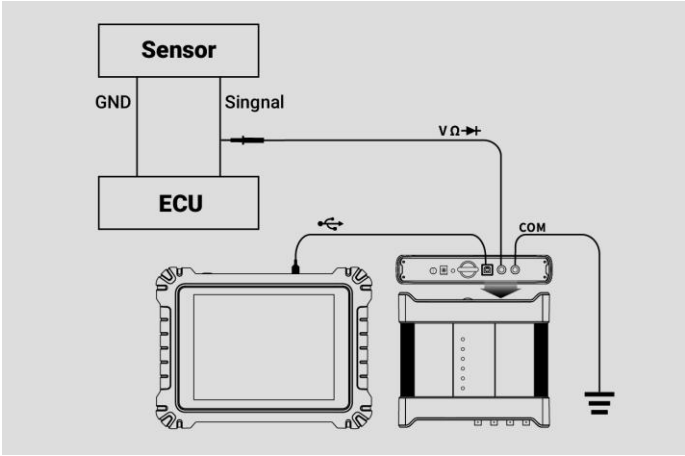


Figure 1-15 ***Sample Triangle Waveform Connection Diagram***

This is a symmetrical triangular waveform, which is mainly used to simulate the triangle wave signals. The amplitude and frequency can be configured in this waveform.

Arbitrary Waveform

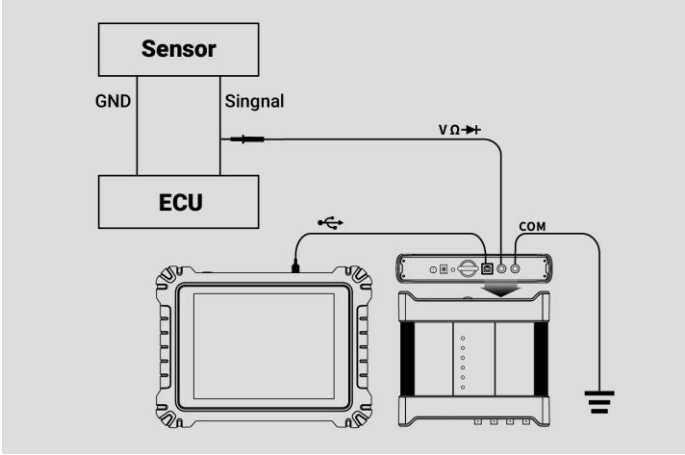


Figure 1-16 ***Sample Arbitrary Waveform Connection Diagram***

Any type of the mentioned waveforms can be loaded again after the waveform and parameter settings are saved.

Voltage Setting

After you select the waveform mode, you can also set the amplitude value for that mode.

There are **three methods** to adjust the voltage value:

Method 1: Tap the **"+" and "-" buttons** at the bottom of the screen in the Voltage Setting.

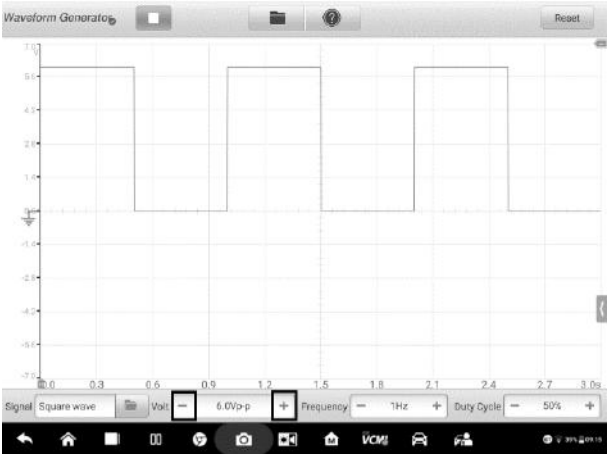


Figure 1-17 ***Sample Voltage Setting Screen 1***

Range	Button	Description
0.1V to 0.9V	+	Raises the voltage by 0.1V
	−	Lowers the voltage by 0.1V
1V to 12V	+	Raises the voltage by 1V
	−	Lowers the voltage by 1V

Method 2: Tap the **Voltage Setting** button at the bottom of the screen to open a dialog box. Adjust the voltage value by tapping the **positive or negative value** at the bottom of the dialog box. Then tap **OK** to confirm or **Cancel** to exit without saving.

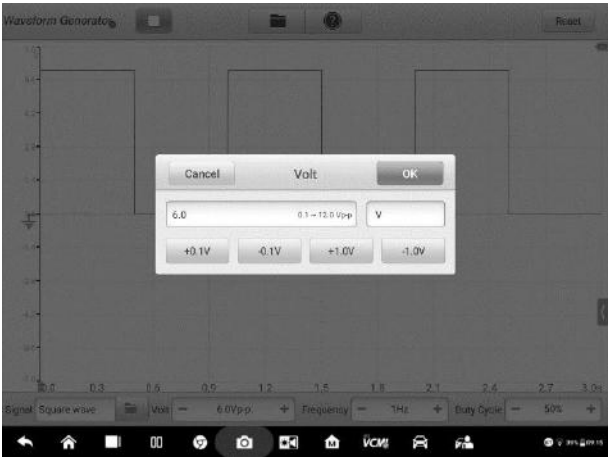


Figure 1-18 ***Sample Voltage Setting Screen 2***

Value	Description
+0.1V	Raises the voltage by 0.1V
-0.1V	Lowers the voltage by 0.1V
+1.0V	Raises the voltage by 1V
-1.0V	Lowers the voltage by 1V

Method 3: Input the voltage value using the virtual keyboard. Tap the voltage field to clear the current value and input the new value. Tap **OK** to confirm or **Cancel** to exit without saving.

Figure 1-19 ***Sample Voltage Setting Screen 3***

Frequency Setting

When the waveform mode is selected and the waveform generator is operating, you can also set the frequency value for that mode.

There are also three methods to adjust the frequency value:

Method 1: Tap the **"+" and "-" buttons** at the bottom of the screen in the Frequency Setting.

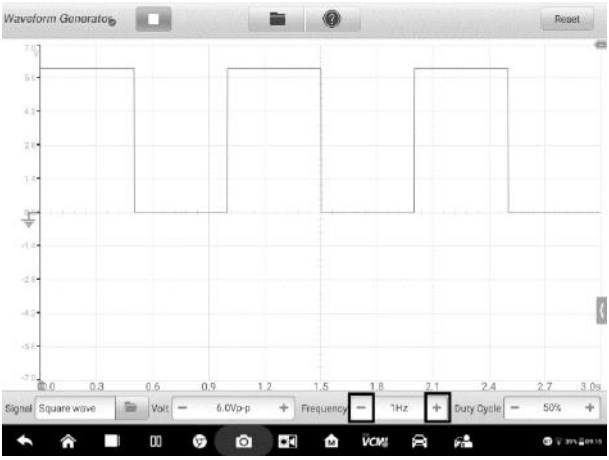


Figure 1-20 ***Sample Frequency Setting Screen 1***

Range	Button	Description
1Hz to 10Hz	+	Raises the frequency by 1Hz
	−	Lowers the frequency by 1Hz
10Hz to 100Hz	+	Raises the frequency by 10Hz
	−	Lowers the frequency by 10Hz
100Hz to 1000Hz	+	Raises the frequency by 100Hz
	−	Lowers the frequency by 100Hz
1.0KHz to 30.0KHz	+	Raises the frequency by 1KHz
	−	Lowers the frequency by 1KHz

Method 2: Tap the **Frequency Setting** button at the bottom of the screen to open a dialog box. Adjust the frequency value by tapping the **positive or negative value** at the bottom of the dialog box. The unit of the frequency can be switched Hz to KHz. Tap **OK** to confirm or **Cancel** to exit without saving.

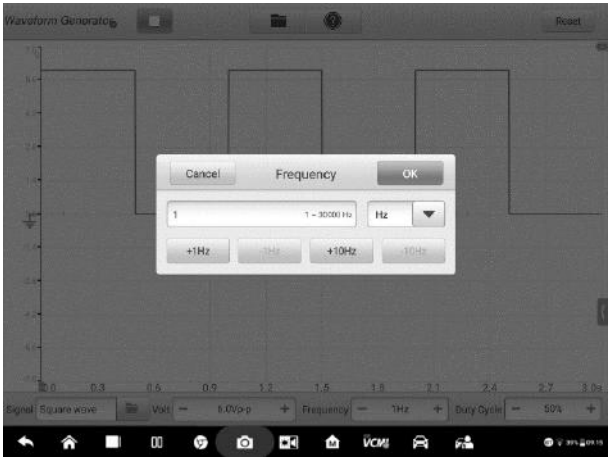


Figure 1-21 ***Sample Frequency Setting Screen 2***

Value	Description
+1.0Hz	Raises the frequency by 1Hz
-1.0Hz	Lowers the frequency by 1Hz
+10.0Hz	Raises the frequency by 10Hz
-10.0Hz	Lowers the frequency by 10Hz
+1.0KHz	Raises the frequency by 1KHz
-1.0KHz	Lowers the frequency by 1KHz
+10.0KHz	Raises the frequency by 10KHz
-10.0KHz	Lowers the frequency by 10KHz

Method 3: Input the frequency value using the virtual keyboard. Tap the frequency field to clear the current value and input the new value. Tap **OK** to confirm or **Cancel** to exit without saving.

Figure 1-22 ***Sample Frequency Setting Screen 3***

Duty Cycle Setting

When the waveform mode is set, you can also set the duty cycle ratio for that mode.

There are three methods to adjust the duty cycle ratio:

Method 1: Tap the **"+" and "-" buttons** at the bottom of the screen in the Duty Cycle Setting.

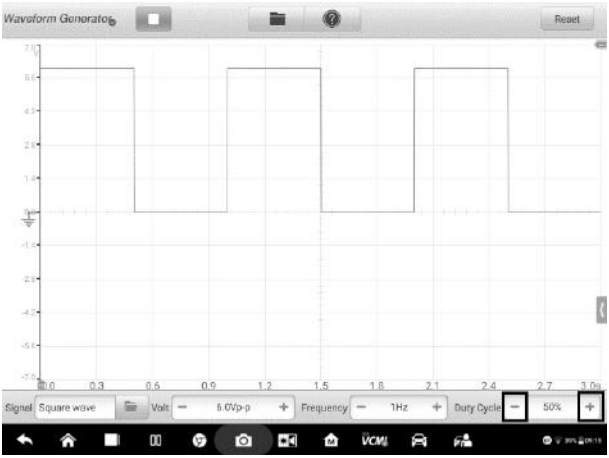


Figure 1-23 ***Sample Duty Cycle Setting Screen 1***

Range	Button	Description
1% to 99%	+	Raises the duty cycle ratio by 1%
	−	Lowers the duty cycle ratio by 1%

Method 2: Tap the **Duty Cycle Setting** button at the bottom of the screen to open a dialog box. Adjust the duty cycle by tapping the **positive or negative ratio** at the bottom of the dialog box. Tap **OK** to confirm or **Cancel** to exit without saving.

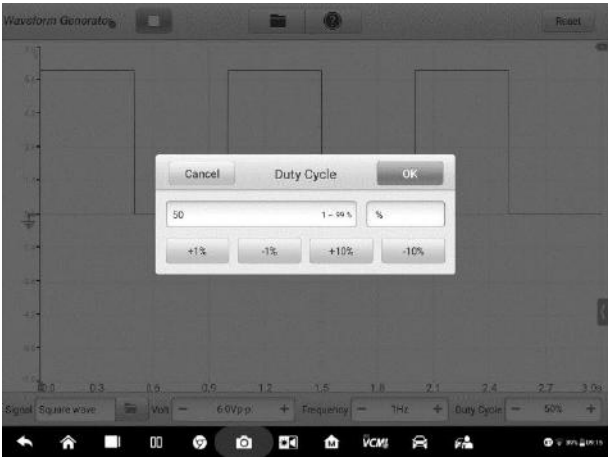


Figure 1-24 ***Sample Duty Cycle Setting Screen 2***

Value	Description
+1.0%	Raises the duty cycle ratio by 1.0%
-1.0%	Lowers the duty cycle ratio by 1.0%
+10.0%	Raises the duty cycle ratio by 10%
-10.0%	Lowers the duty cycle ratio by 10%

Method 3: Input the duty cycle ratio using the virtual keyboard. Tap the duty cycle field to clear the current value and input the new value. Tap **OK** to confirm or **Cancel** to exit without saving.

Figure 1-25 ***Sample Duty Cycle Setting Screen 3***

1.3.6 Troubleshooting

If the waveform generator cannot communicate with the MaxiSys Tablet:

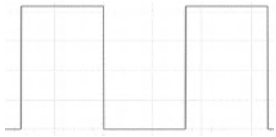
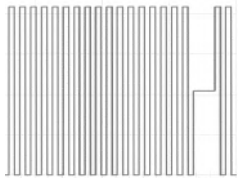
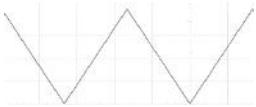
- Check if the VCMI device is properly connected to the MaxiSys Tablet through the supplied USB cable.

IMPORTANT
To avoid damaging the vehicle and/or the equipment, all vehicle communications must be terminated before resetting the connection. The Internet connection may be aborted during resetting.

- If the communication between the VCMI device and the MaxiSys Tablet still fails, restart the MaxiSys Tablet and reconnect the VCMI device.

1.3.7 Glossary

Waveform Type	Description	Sample Waveform
DC Voltage	A waveform with constant voltage	

Waveform Type	Description	Sample Waveform
Square Wave	A non-sinusoidal periodic waveform with the duty cycle of 50%	
Square Wave (X+Y)	A special square waveform with normal and missing teeth signals	
Triangle Wave	A asymmetrical triangular waveform	

1.4 OBDII CAN Bus Check

The VCMI (Vehicle Communication and Measurement Interface) working with MaxiSys Ultra is designed with the OBDII CAN Bus Check function by checking the indicator light illumination status on the tablet screen. The indicator light flashes if the signals are detected. The indicator light displays in gray if no signal is detected.

Generally, the vehicle's electronic control systems are designed to comply with the specific communication protocols. The control units in the electronic control systems communicate with the Tablet through the OBDII (DLC) adapter.

With the OBDII CAN Bus Check function, you can check whether the control units in vehicle's electronic control systems work properly or not with the indicator light according to the condition of sending out the communication signals.

1.4.1 Safety Information

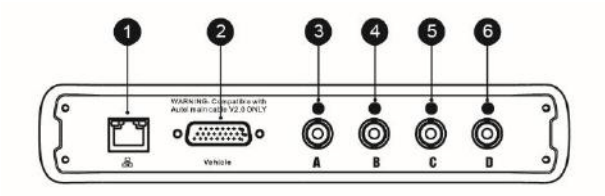
Follow the instructions below to ensure proper CAN Bus check performance.

- Different preconditions for different functions. Before check, please read the inspection guides carefully.
- The pin number for OBDII varies by vehicle modes. Please check and confirm for correct pin number and then proceed inspection.
- Select OBDII connector's signal pins manually if the test vehicle's actual communication signal pins are assigned differently.
- Ensure the DLC main cable is connected to the vehicle before inspection.
- Ensure the ignition key is in ON position when testing the vehicle's communication line.
- If the inspection fails due to no signal input, consult vehicle circuit diagram to ensure correct communications are being tested.
- Do not use in wet or damp conditions, or around explosive gas or vapor.
- Do not tamper with or disassemble the product, connectors or accessories. Internal damage will affect performance.
- Disconnect the product from power source, vehicle and tablet before cleaning.
- When cleaning the product, use a damp, soft cloth with mild detergent. Do not allow water to enter the product casing, as this will cause damage to the electronics inside.

1.4.2 General Introduction

1.4.2.1 Component Locations

The main connectors are located at the bottom of the VCMI device.



1. Ethernet Connector
2. Vehicle Data Connector
3. Input Channel A
4. Input Channel B
5. Input Channel C
6. Input Channel D

1.4.3 Getting Started

Before opening the OBDII CAN Bus Check application, you have to complete three steps below:

1) Connect the VCMI device to the Tablet via Wi-Fi or the supplied USB.
2) Connect the VCMI device to the vehicle's OBDII connector.
3) Place the ignition in the key on position.

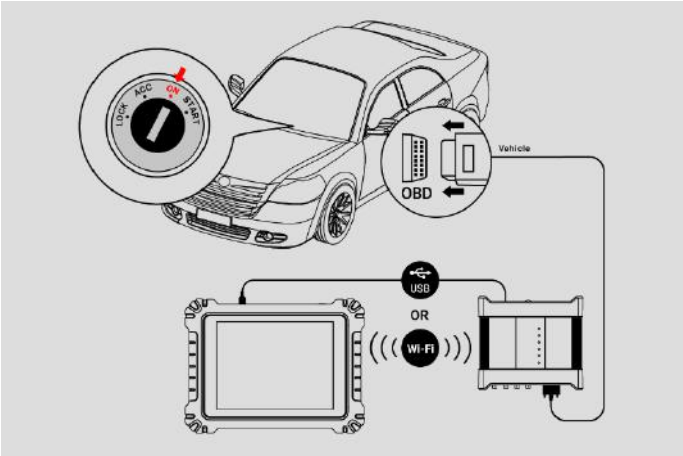


Figure 1-1 ***Sample Connection Diagram***

➢ **To open the OBDII CAN Bus Check application**

1. Please refer to ***Figure 1-1*** *Sample Connection Diagram* to complete the connection. Place the ignition in the key on position.
2. Tap the **Measurement** icon on the Home screen of the MaxiSys Ultra Tablet. The Measurement screen opens.
3. Tap the **OBD** icon to open the OBDII CAN Bus Check Menu.
4. Select a communication protocol to test.

1.4.4 Update

The operating software of the device is continually optimized. Tap the **Help** button in the upper half of the screen.

1.4.4.1 APK Update

NOTE

The acronym APK (Android Package Kit) is used on the tablet and in this manual. This file contains all the assets of a particular app. To update the APK, is to install the latest version of the app on your tablet.

➢ **To update the APK**

1. Tap the **Help** button on the upper half of the screen. A dropdown menu displays.

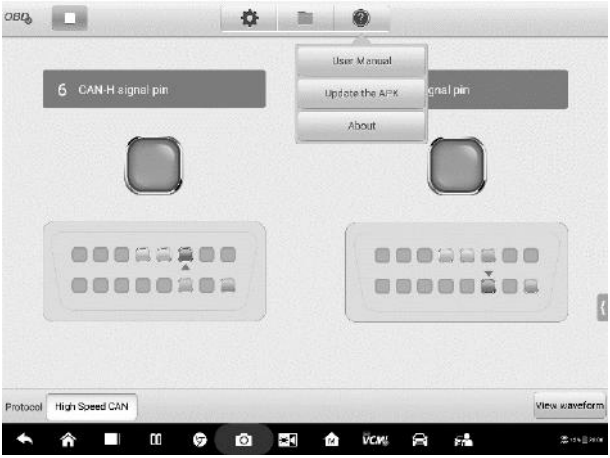


Figure 1-2 ***Sample Help Screen***

2. Tap **Update the APK** in the dropdown menu. A confirmation message displays.

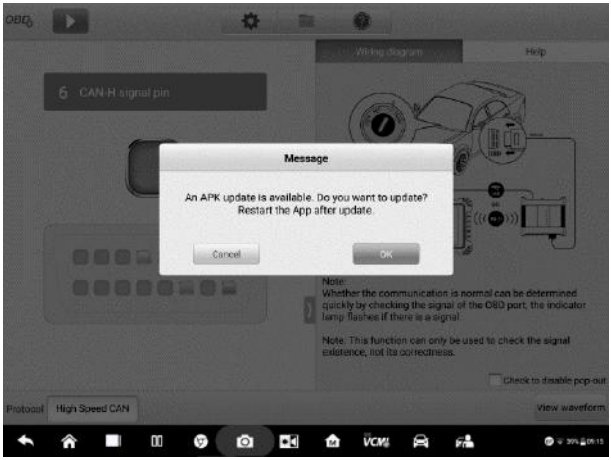


Figure 1-3 ***Sample Update Confirmation Screen***

3. Tap **OK** to update the software or tap **Cancel** to exit.

1.4.5 Screen Layout and Operations

The OBDII CAN Bus Check application allows you to select the communication protocols, the signal pins and voltage value for testing.

Tap the **Measurement** icon on the home screen and select **OBD** in the menu, the OBDII CAN Bus Check window displays. The screen typically includes the following button sections.

NOTE

The OBDII CAN Bus Check application can also be opened via the Android home screen. Tap the **Measurement** icon at the top of the Android home screen. Tap the **OBD** app icon.

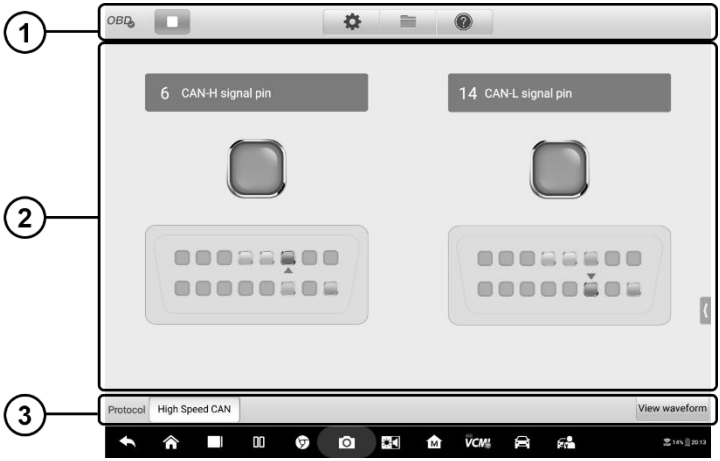


Figure 1-4 ***Sample OBD Communication Line Inspection Menu Screen***

1. Upper Toolbar Buttons - see *Upper Toolbar Button* on page 140 for details.

2. Main View Section – see *Main View Section and Lower Toolbar Buttons* on page 145 for details.

3. Lower Toolbar Buttons – see *Main View Section and Lower Toolbar Buttons* on page 145 for details.

1.4.5.1 Upper Toolbar Buttons

The upper toolbar buttons are used for configurations of various settings and operations. The following table provides brief descriptions of each button.

Table 1-1 *Upper Toolbar Buttons*

Name	Button	Description
OBD Icon		Displays the device connection status. See *OBD Button* on page 141 for more information.
Start/Stop		Start or stop the device. See *Start/Stop Button* on page 141 for more information.
Settings		Set the communication protocol manually. See *Settings Menu* on page 141 for more information.
File		Print, open and save the waveform data. See *File Menu* on page 143 for more information.
Help		View the user manual and update the software. See *Help Menu* on page 144 for more information.

OBD Button

This OBD button indicates the OBD device connection status. A green check mark means the VCMI and the tablet are connected; a red X means no connection has been established.

Start/Stop Button

You can tap the **Start/Stop Button** icon to start or stop the device.

Name	Button	Description
Start		Tap to start the device.
Stop		Tap to stop the device.

Settings Menu

Tap the gear-shaped icon in the top navigation bar to enter the **Settings Menu**.

The pin number for OBDII may be different for different vehicle modes. In Settings Menu, you can select OBDII connector's signal pins manually if the test vehicle's actual communication signal pins are assigned differently.

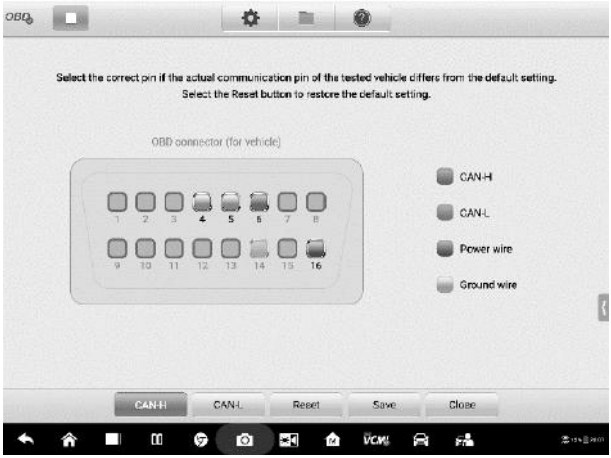


Figure 1-5 ***Sample Settings Menu Screen 1***

At the bottom of the settings menu screen, the **Protocol**, **Reset**, **Save** and **Close** buttons are displayed. The protocol varies according to the protocol you set.

Take CAN protocol as an example.

CAN-H: select the pin assigned for high speed CAN-bus communication line

CAN-L: select the pin assigned for low speed CAN-bus communication line

Reset: restore the default settings

Save: save the changes when custom pin assignment is set

Close: exit the settings menu screen

- **To select the signal pins manually**

1. Tap the gear-shaped icon in the top navigation bar to enter the **Settings Menu**.
2. Tap **CAN-H** or **CAN-L** to select the communication protocol.

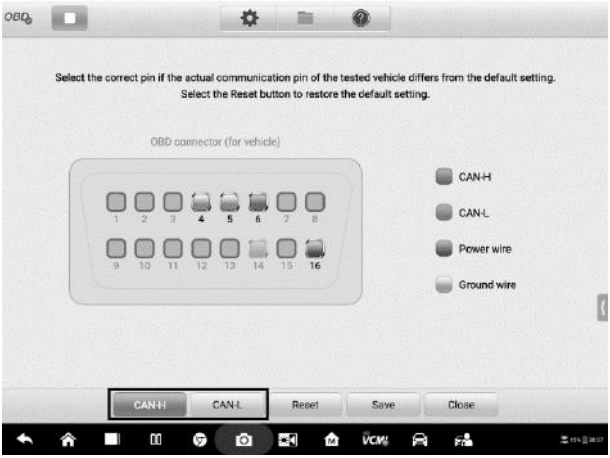


Figure 1-6 ***Sample Settings Menu Screen 2***

3. Tap the correct pin number in the OBDII Connector Assignment image to match the test vehicle's actual communication signal pins.

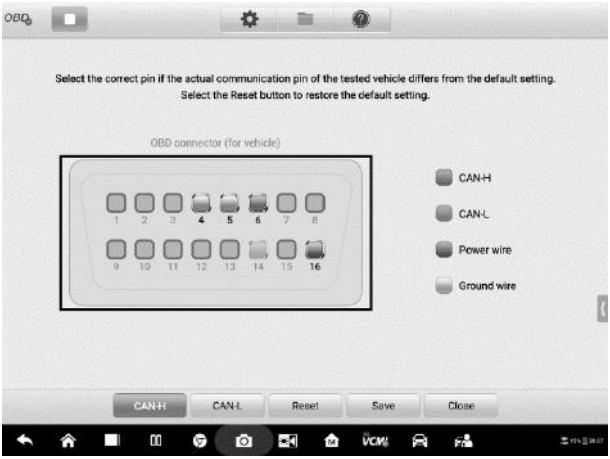


Figure 1-7 ***Sample Settings Menu Screen 3***

4. Tap **Save** to save changes or tap **Close** to exit without saving.

File Menu

The **File** button allows you to print, open and save the waveform data. The **File Menu** is enabled in the **Waveform Mode** and supports the following functions.

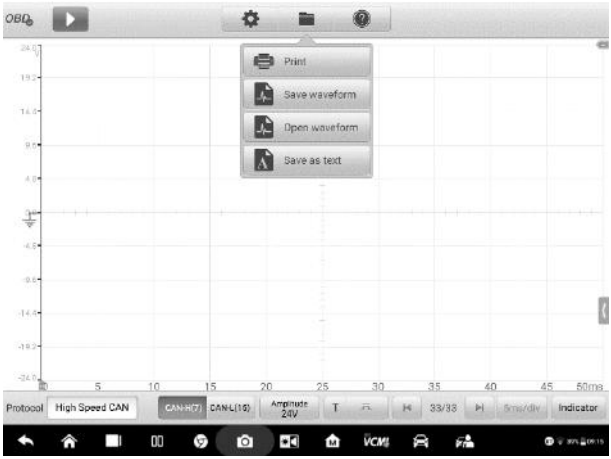


Figure 1-8 ***Sample File Menu Screen***

- **Print –** Tap to create and print a temporary PNG picture of the current waveforms.

NOTE
Ensure the tablet is configure to print (see Printer setup instructions) and is connected to the printer. Ensure the tablet and printer share the same network.

- **Save Waveform** – Tap to capture and save the current waveforms. On the Save File screen, tap each item to input the corresponding information and then tap **Save** or **Save Default** to finish.

NOTE
A file name is required to save the waveform.

- **Open Waveform** – Tap to retrieve the saved waveforms. To select and/or delete the saved waveform, tap the **Edit** button in the upper right corner of the screen.
- **Save as text** – Tap to save the current waveform data to a text file. Use the ES File Explorer app on the Android home screen to review file: **Home > ES File Explorer > Local > Internal Storage > Scan > Data > OBD > txt.**

Help Menu

The Help Menu allows you to view the user manual, update the software, and view versions of the device.

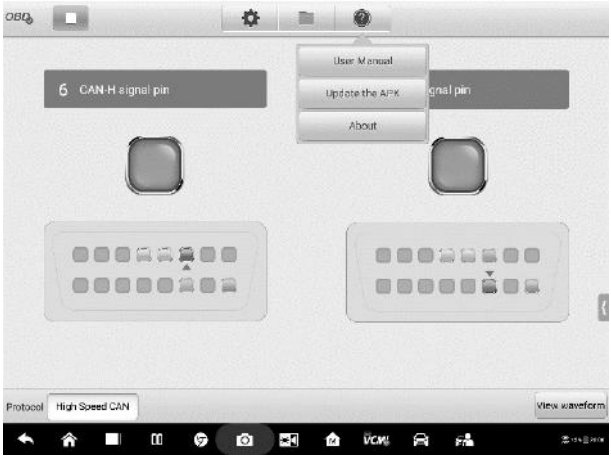


Figure 1-9 ***Sample Help Menu Screen***

User Manual – displays instruction for the prosper use of the OBDII CAN Bus Check application and the Ultra tablet.

Update the APK – connects to the Autel server and check for latest application software.

About – displays the model number of the OBDII CAN Bus Check application and the installed versions of the software and firmware.

1.4.5.2 Main View Section and Lower Toolbar Buttons

Two modes are available in the OBD communication line inspection function: Indicator Mode and Waveform Mode.

Indicator Mode

This mode is designed to show the condition of voltage fluctuation in vehicle's communication lines. In this mode, the indicator light of a selected pin flashes when the electronic control units are sending signals properly.

The Indicator Mode displays by default.

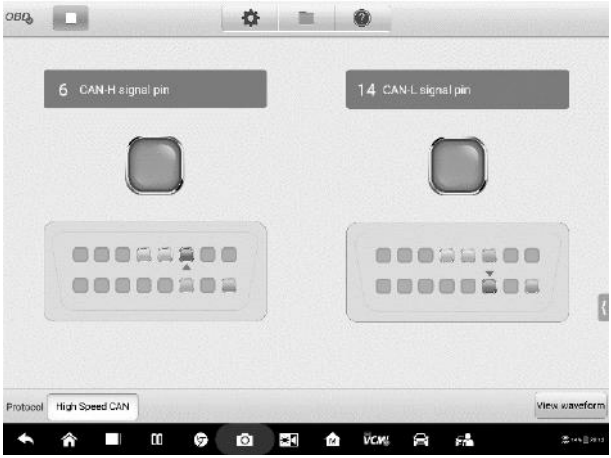


Figure 1-10 ***Sample Indicator Mode Screen***

Main View Section

The **CAN-High** line is assigned to **Pin 6** and the **CAN-Low** line is assigned to **Pin 14** of the OBDII adapter by default according to the **CAN-Bus** standard protocol.

If the test vehicle's actual communication signal pins are assigned differently, you can select OBDII connector's signal pins manually in the *Settings Menu*.

When the electronic control units send out signals properly, the left and right indicator lights will flash consecutively on the screen.

NOTE

The flashing indicator lights serve to confirm only that communication signals have been detected.

Lower Buttons

- **Protocol Button**

In the left lower corner of the screen, you can select the protocol you want to test.

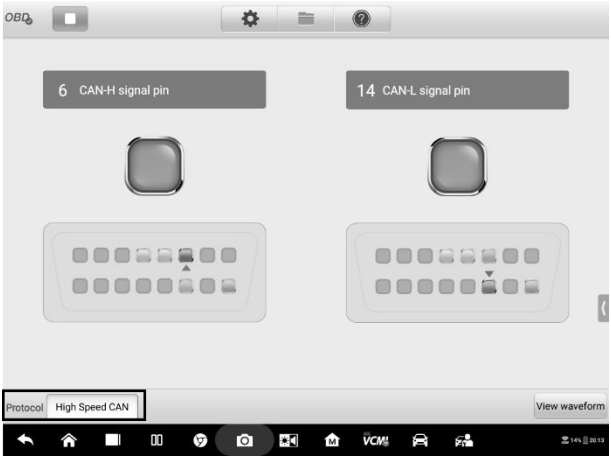


Figure 1-11 ***Sample Protocol Button Screen***

The following protocols are included:

- ✧ **High Speed CAN -** offers baud rates from 40 Kbit/s to 1 Mbit/sec, depending on cable length. This is the most popular standard for the physical layer, since it allows for simple cable connection between devices. High speed CAN networks are terminated with 120 ohm resistors on each end of the network.
- ✧ **Low Speed CAN -** offers baud rates from 40 Kbit/s to 125 Kbits/sec. This standard allows CAN bus communication to continue in case of a wiring failure on the CAN bus lines. In low speed CAN networks, each device has its own termination.
- ✧ **Single CAN -** offers baud rates up to 33.3 Kbit/s (up to 88.3 Kbit/s for high-speed mode)
- ✧ **J1939 CAN -** is used in the commercial vehicle area for communication throughout the vehicle with the physical layer defined in ISO 11898. Under J1939/11 and J1939/15, the data rate is specified as 250 Kbit/s, with J1939/14 specifying 500 Kbit/s.
- ✧ **J1850 (PWM) -** SAE J1850 pulse-width modulation offers baud rates up to 41.6 Kbit/s, standard of the Ford Motor Company
- ✧ **J1850 (VPW) -** SAE J1850 variable pulse width offers baud rates up to 10.4 Kbit/s, standard of the General Motors
- ✧ **J1708 (SAE) -** the standard defines a double-wire 18-gauge cable that can run up to 130 feet (40 m) and operates at 9600 bit/s

- **View Waveform Button**

In the right lower corner of the screen, you can enter to the Waveform Mode by tapping the **View Waveform** button.

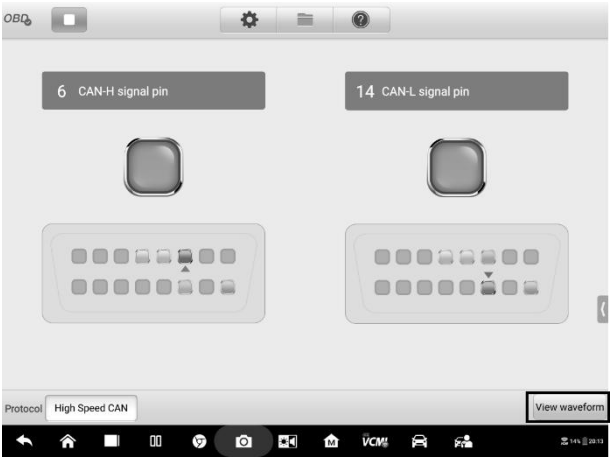


Figure 1-12 ***Sample View Waveform Button Screen***

Test Procedure

The test procedure is the same for all the protocols.

➢ **To test the communication line**

Using High speed CAN-bus line as an example.

1. Make sure the VCMI is connected to the vehicle's OBDII connector. The VCMI is connected with tablet successfully. Please refer to the *Connection Diagram***.**
2. Place the ignition in the key ON position.
3. Select the **High Speed CAN** protocol in the lower corner of the screen.
4. The OBDII connector pin numbers that the signals are using are indicated and the indicator lights flash consecutively.

NOTE

If the indicator lights are not flashing, ensure the ignition is in the key on position and that signal pin assignment is correct.

Waveform Mode

This mode allows you to view the test result in a waveform form. This mode offers greater details and offers a larger number of configuration options.

The screen is displayed in the Indicator mode by default.

Tap the **View Waveform button** in the lower corner of the Indicator Mode screen to switch to the Waveform Mode. The screen is shown as below.

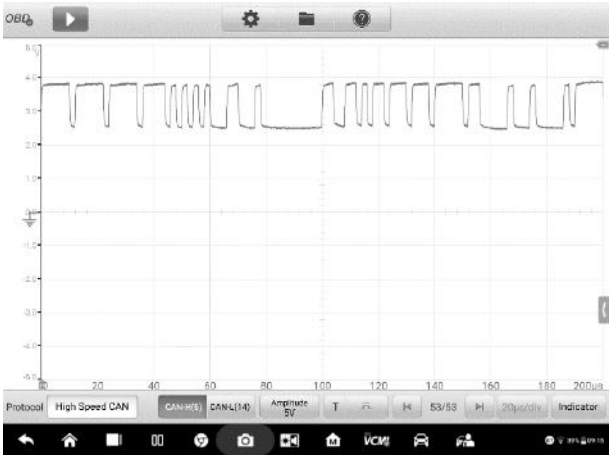


Figure 1-13 ***Sample Waveform Mode Screen***

Main View Section

The main view section features as a coordinate grid with **X-axis** and **Y-axis**, representing the time duration and voltage level respectively. The voltage level can be configured in the Amplitude Settings and the time duration can be set in the Time Base Settings.

Channel Selection

Each channel has two conditions: selected and unselected. Some operations depend on the selected condition of the channel, such as voltage rulers, waveform movements and waveform zooming.

➢ **To select and unselect the channel**

1. Tap the zero baseline marker or the Y-axis (the line thickens when selected).
2. Tap the zero baseline marker or the Y-axis again to exit the channel selection.

Waveform Zooming

The zooming function allows you to change the size and position of a signal during or after capturing a waveform to examine. It does not change the stored data, only the way it displays.

The X-axis and Y-axis can be zoomed using your fingertips. The waveform can be zoomed during or after capturing the signal.

Measurement Rulers

In the coordinate grid, there are two types of **measurement rulers**, which allow the voltage and time duration of a waveform to be measured precisely. They are useful when determining signal characteristics such as amplitude at specific points, the cycle time (duration) and frequency.

The vertical **Time Ruler** - Tap the **Ruler Activator** in the bottom left corner of the grid and drag it across the screen to the desired position. A **Time Ruler** is generated.

The horizontal **Voltage Ruler** - The **Voltage Ruler** can be generated in the similar way by clicking the **Ruler Activator** in the top right corner and dragging it downwards.

When Measurement Rulers are generated, a **Ruler Table** showing time and voltage values for the corresponding channels will be displayed. The **Delta** icon refers to the absolute difference between the values of the rulers, which can be locked by tapping the **Lock** icon. Tap the **X** button in the upper right corner of the ruler table to delete all rulers.

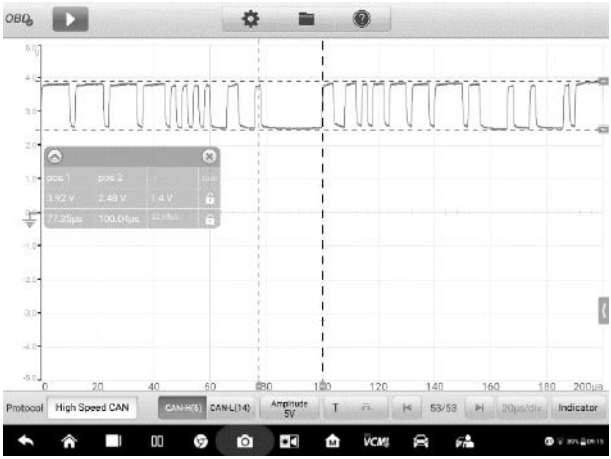


Figure 1-14 ***Sample Measurement Rulers Screen***

Zero Baseline

The zero baseline is marked as the 0 value in the Y-axis, showing the base level of each channel waveform. After the channel is selected, the zero baseline can be adjusted by dragging the baseline marker up/down along the Y-axis, or dragging the waveform up/down or moving the screen up/down in the grid.

NOTE

Tap the baseline marker to unselect (the vertical scale line displays thinner). The waveform cannot be moved once unselected. Tap the baseline marker again to select.

Figure 1-15 ***Sample Zero Baseline Screen***

Lower Toolbar Buttons

The measurement, buffer and time base can be configured at the lower toolbar.

Table 1-2 ***Lower Toolbar Buttons***

Name	Button	Description
Protocol	Protocol High Speed CAN	Tap to select an appropriate protocol. See *Protocol Setting* on page 152 for more information.
Communication Line	CAN-H(6) CAN-L(14)	Tap to select the appropriate communication line. See *Communication Line* on page 153 for more information.
Amplitude	Amplitude 5V	Tap to select an appropriate amplitude value. See *Amplitude Setting* on page 153 for more information.

Name	Button	Description
Trigger		Tap to open the trigger setting menu. See *Trigger* on page 154 for more information.
Buffer	32/32	Tap the Previous or Next button to switch to the previous or the next waveform. See *Buffer* on page 158 for more information.
Time Base	TimeBase 500ns/div	Tap to select an appropriate time per division. See *Time Base* on page 159 for more information.
Indicator	Indicator	Tap to switch to the Indicator mode.

- **Protocol Setting**

Seven types of communication protocols are available: High Speed CAN, Low Speed CAN, Single CAN, J1939 CAN, J1850 (PWM), J1850 (VPW) and J1708 (SAE).

➢ **To select a protocol**

1. Tap the **Protocol** button in the lower left corner of the screen. A dialog box opens.

Figure 1-16 Sample Protocol Type Button Screen

2. Select the desired **Protocol type** in the dialog box.

Figure 1-17 ***Sample Protocol Setting Screen***

3. Tap the **X** icon to close the dialog box.

- **Communication Line**

The communication line selection varies according to the protocol selected. Tap the appropriate communication line at the bottom of the screen.

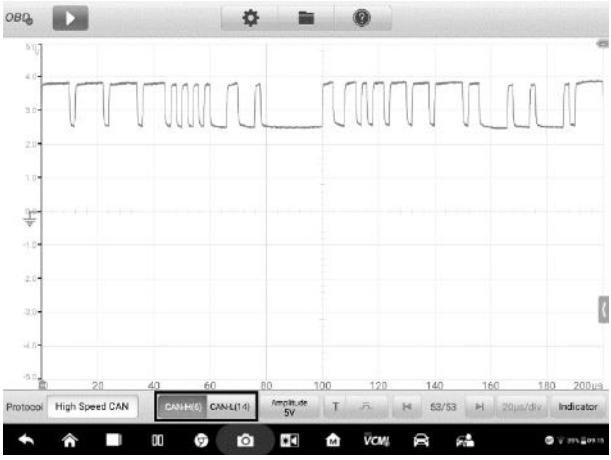


Figure 1-18 ***Sample Communication Line Button Screen***

- **Amplitude Setting**

After selecting the protocol type, you can also set the amplitude value for that type.

➢ **To set the amplitude**

1. Tap the **Amplitude** button at the bottom of the screen. A dialog box displays.

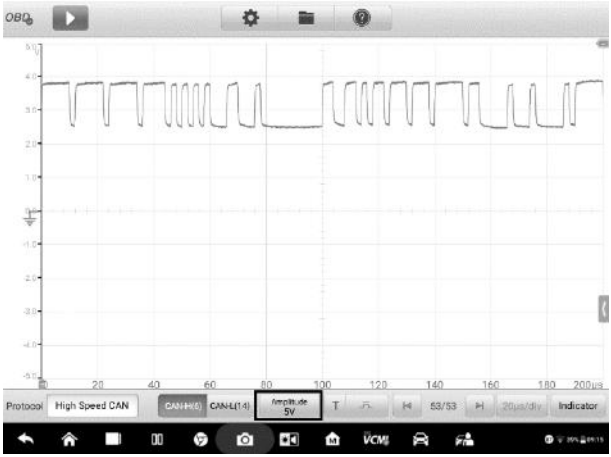


Figure 1-19 ***Sample Amplitude Button Screen***

2. Select the appropriate amplitude for the protocol.

Figure 1-20 ***Sample Amplitude Setting Screen***

3. Tap the **X** icon to close the dialog box.

- **Trigger**

The trigger feature is used to stabilize repetitive waveforms to obtain clear signal characterization.

The device is triggered when the signal crosses a threshold or meets set conditions. When the device is capturing the signal, tap the left column of the **Trigger** button to activate the trigger function. A trigger point displays as a blue point.

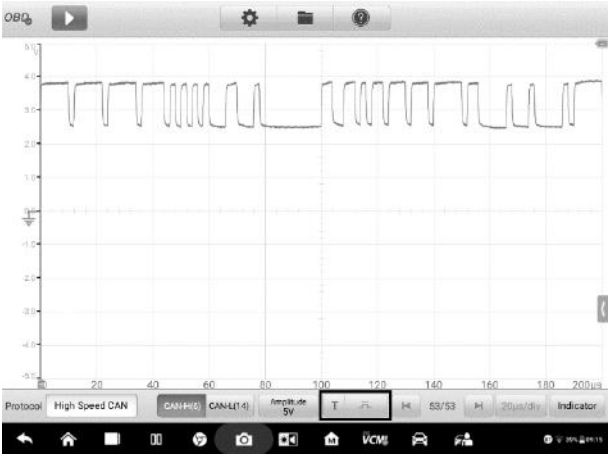


Figure 1-21 ***Sample Trigger Button Screen***

The edge trigger is one of the most common trigger modes and is activated when voltage rises above or falls below a preset threshold. This trigger type allows you to configure the trigger mode, threshold, trigger channel and pulse direction settings. Tap **Done** to save the settings or tap **Cancel** to exit without saving.

When the device is capturing the signal, tap the right column of the **Trigger** button to open the trigger settings dialog box.

Figure 1-22 ***Sample Trigger Settings Screen***

Trigger Mode

Three trigger modes are available: **None, Auto and Repeat**.

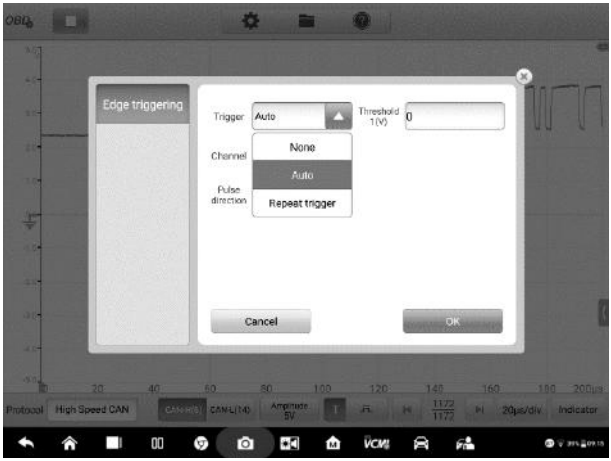


Figure 1-23 ***Sample Trigger Mode Screen***

The table below offers brief description of each trigger mode.

Table 1-3 *Trigger Mode Table*

Trigger Mode	Description
None	The device can continuously capture data, without waiting for a trigger event.
Auto	The device will wait for a trigger before capturing data. It can automatically update after a short period, even if the signal does not cross the trigger point.
Repeat trigger	The device waits until a trigger event occurs. If there is no trigger event, nothing will be displayed on the screen.

Channel

Select the applicable trigger channel from the dropdown menu. The selected channel is the communication line that the device monitors for the trigger condition.

Pulse Direction

Two pulse direction settings are available: **Rise** and **Fall**.

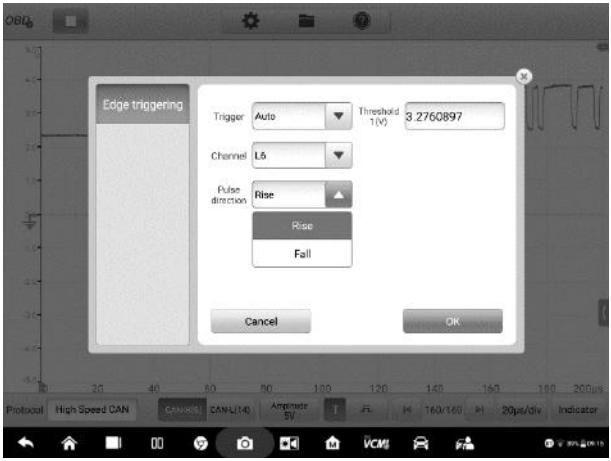


Figure 1-24 *Sample Pulse Direction Screen*

- **Rising Edge Trigger** - Indicates trigger is turned on to start the trace on the rising edge of the waveform.
- **Falling Edge Trigger** – Indicates trigger is turned on to start the trace on the falling edge of the waveform.

Threshold

The **Threshold** allows you to set the voltage threshold for the trigger.

- ✧ To precisely position the trigger point, input the value in the Threshold field in the trigger settings dialog box.
- ✧ To roughly position the trigger point, drag the trigger point to a desired position.

➢ **To configure the trigger settings**

1. Tap the right column of the **Trigger** button to open the trigger settings dialog box.
2. Select the trigger mode, trigger channel and pulse direction in the dropdown list.
3. Input the value in the Threshold field in the trigger settings dialog box.
4. Tap **Done** to save settings or tap **Cancel** to exit without saving.

- **Buffer**

The waveform buffer shows which signal waveform is displayed on the current screen and how many signal waveforms are captured and stored in the buffer memory.

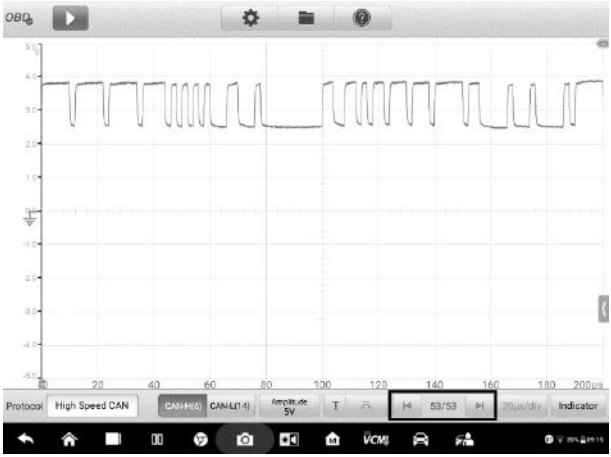


Figure 1-25 ***Sample Buffer Screen***

The device can capture and store waveforms. You can select a waveform from the waveform buffer by tapping the **Previous** or **Next** button.

Name	Button	Description
Previous		Tap to display the previous waveform in the buffer.

Name	Button	Description
Buffer Index	32/32	Shows which waveform is currently being displayed and how many waveforms are in the buffer.
Next		Tap to display the next waveform in the buffer.

- **Time Base**

  The time base controls the time interval across the device display. Tap the **Time Base** button at the bottom to open the setting dialog box.

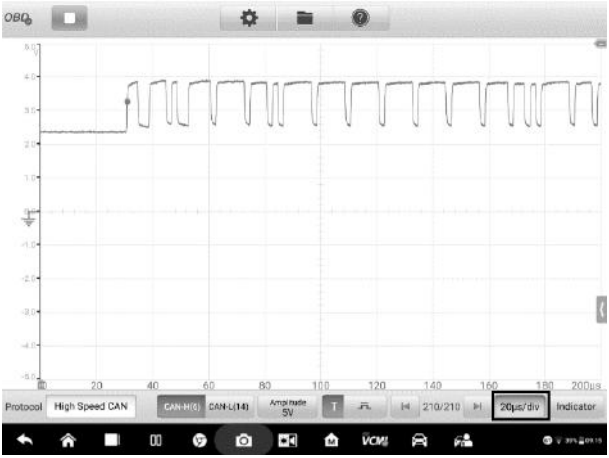


Figure 1-26 ***Sample Time Base Screen 1***

Figure 1-27 ***Sample Time Base Screen 2***

Continuous Mode: if the time base is set to more than or equal to 200ms/div, the device switches to the continuous mode. In this mode, the device updates the trace continuously as each capture progresses, rather than waiting for a complete capture before updating the trace.

- **Indicator Button**

  In the lower corner of the screen, you can enter the Indicator Mode by tapping the **Indicator** button.

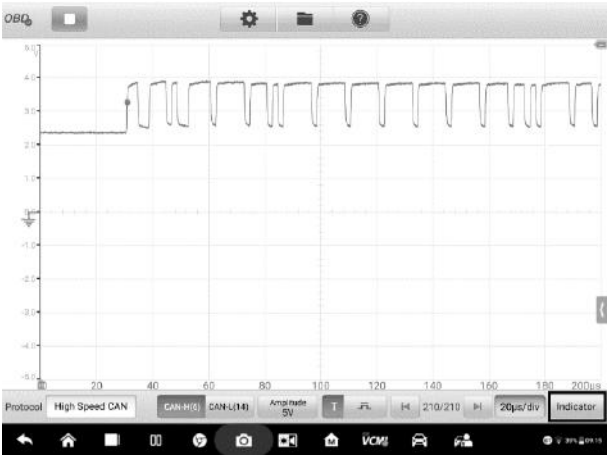


Figure 1-28 ***Sample Indicator Button Screen***

1.4.6 Troubleshooting

If the VCMI device cannot communicate with the MaxiSys Tablet:

- Ensure the VCMI device is properly connected to the MaxiSys Tablet via Wi-Fi or with the supplied USB cable.
- Ensure the pin number is set properly.
- Ensure the ignition is in the Key **ON** position.
- Restart tablet and reconnect the VCMI if communication continues to fail.

1.4.7 Glossary

Vehicle Bus

A vehicle bus is a specialized internal communications network that interconnects components inside a vehicle (e.g., automobile, bus, train, industrial or agricultural

vehicle, ship, or aircraft). Protocols include Controller Area Network (CAN), Local Interconnect Network (LIN) and others.

CAN Bus

A Controller Area Network (CAN bus) is a robust vehicle bus standard designed to allow microcontrollers and devices to communicate with each other in applications without a host computer.

SAE International

Initially established as the Society of Automotive Engineers, is a U.S.-based, globally active professional association and standards developing organization for engineering professionals in various industries. Principal emphasis is placed on transport industries such as automotive, aerospace, and commercial vehicles.

SAE J1708

SAE J1708 is a standard used for serial communications between ECUs on a heavy duty vehicle and also between a computer and the vehicle. With respect to Open System Interconnection model (OSI), J1708 defines the physical layer. Common higher layer protocols that operate on top of J1708 are SAE J1587 and SAE J1922. The protocol is maintained by SAE International.

SAE J1939

Society of Automotive Engineers standard SAE J1939 is the vehicle bus recommended practice used for communication and diagnostics among vehicle components. It is used in the commercial vehicle area for communication throughout the vehicle, with the physical layer defined in ISO 11898.

J1850

Defines a serial data protocol. There are two variants- 10.4 Kbit/s (single wire, VPW) and 41.6 Kbit/s (two wire, PWM). Mainly used by US manufacturers, also known as PCI (Chrysler, 10.4 Kbit/s), Class 2 (GM, 10.4 Kbit/s), and SCP (Ford, 41.6 Kbit/s).

OBD

On-board diagnostics (OBD) is an automotive term referring to a vehicle's self-diagnostic and reporting capability. OBD systems give the vehicle owner or repair technician access to the status of the various vehicle subsystems.

OBD-II diagnostic connector

The OBD-II DLC (post-1996 vehicles) is usually located under the instrument panel on the driver side, though there are several exceptions. The SAE J1962 specification provides for two standardized hardware interfaces, called type A and type B. Both are female, 9-pin (2x8), D-shaped connectors, and both have a groove between the two rows of pins.

DLC

The data link connector (DLC) is the multi-pin diagnostic connection port for automobiles, trucks, and motorcycles used to interface a scan tool with the control modules of a given vehicle and access on-board diagnostics and live data streams.

FCC STATEMENT :

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1)This device may not cause harmful interference, and
(2)This device must accept any interference received, including interference that may cause undesired operation.
Warning: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

Reorient or relocate the receiving antenna.
Increase the separation between the equipment and receiver. Connect the equipment into an outlet on a circuit different from that to

which the receiver is connected.

Consult the dealer or an experienced radio/TV technician for help.

FCC Radiation Exposure Statement:
This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.