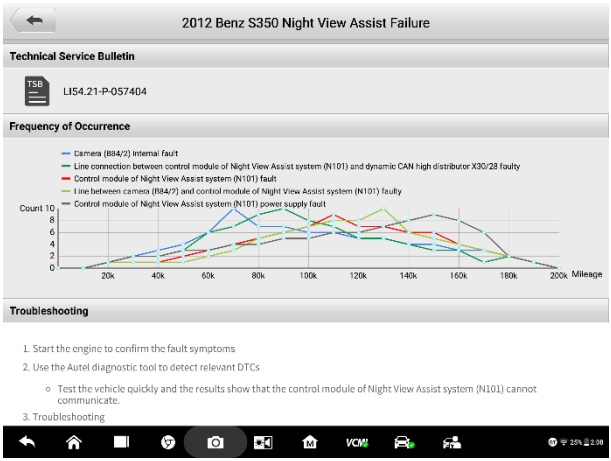


Figure 5-7 *Sample Frequency of Occurrence Graph*

Graph example: Certain faults occur at greater frequency as vehicle mileage increases. This graph depicts the fault occurrence frequency for the Night View Assist system at vehicle mileage intervals. Before the mileage reaches 100k miles, the camera internal fault occurs more frequently than other fault types, with its highest frequency of 10 coming at 70k miles, while line connection fault between control module of Night View Assist system (N101) and dynamic CAN high distributor X30/28 occurs as frequently as 10 at 90k miles. As the mileage approaches 110k miles, the occurrence of the two faults drops, giving way to Night View Assist system control module fault which, after reaching 9 at 110k miles, starts to decline at the same point. Another line fault between camera (B84/2) and control module of Night View Assist (N101), poses not much threat in the previous 110k miles, but it boasts a maximum occurrence of 8 when the vehicle travels 130k miles. Similarly, the power supply fault of control module of Night View Assist (N101) becomes most worrisome at 150k miles.

In conclusion, the graph provides a convenient reference for locating possible faults of the Night View Assist function in accordance with the driving mileage.

5.6 Troubleshooting

Troubleshooting presents a series of diagnostic and repair steps from confirming fault symptoms to clearing the faults. The troubleshooting steps are provided in text and video guides.

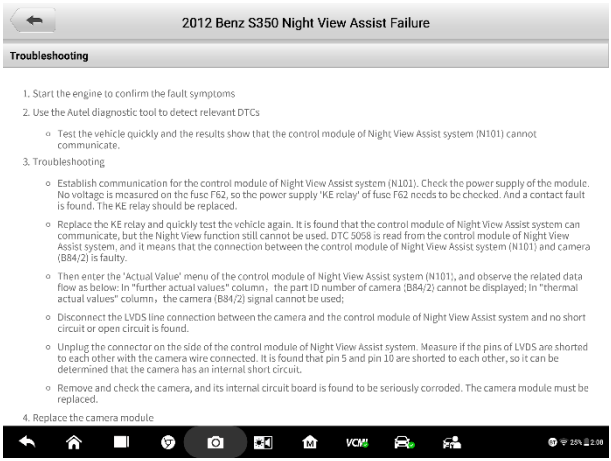


Figure 5-8 ***Sample Troubleshooting Description 1 (Words)***

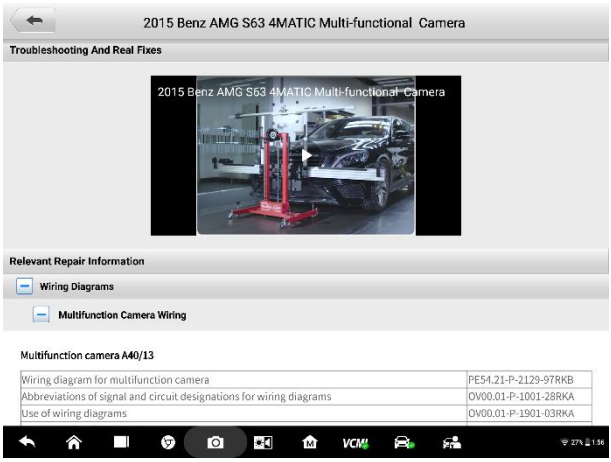


Figure 5-9 ***Sample Troubleshooting Description 2 (Video)***

5.7 Real Fixes

Real fixes gives a brief introduction of real repair operations. Follow these steps and start your repair tests.

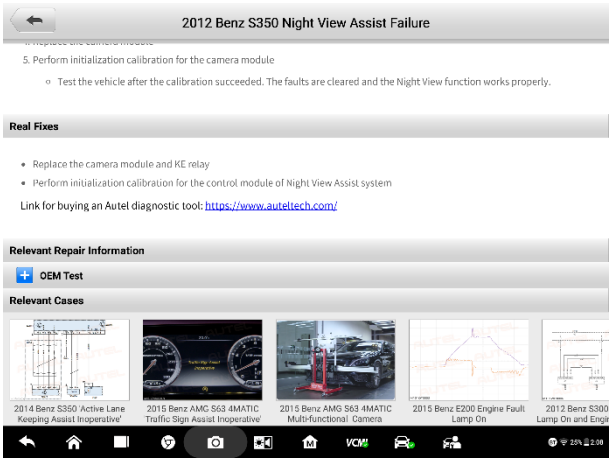


Figure 5-10 *Sample Repair Fixes Steps Screen*

When a diagnostic tool is required during the repair process, tap the following link to the official Autel website to purchase the tools you need. Https://www.auteltech.com/

5.8 Relevant Repair Information

This feature displays OEM-recommended procedures and tests. This section may include relevant circuit or wiring diagrams, tables, vehicle structures analysis, components separation, and detailed notation to aid the technician in diagnostics and repairs.

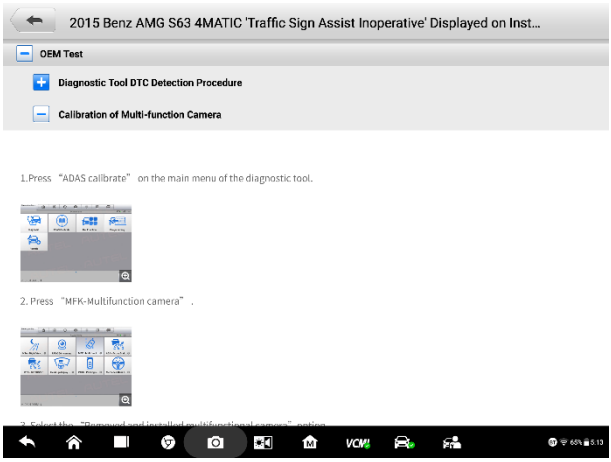


Figure 5-11 *Sample Relevant Repair Info Screen 1*

Figure 5-12 *Sample Relevant Repair Info Screen 2*

5.9 Relevant Cases

This section offers repair cases that be relevant to the current vehicle and/or the current fault. Tap the related case to review.

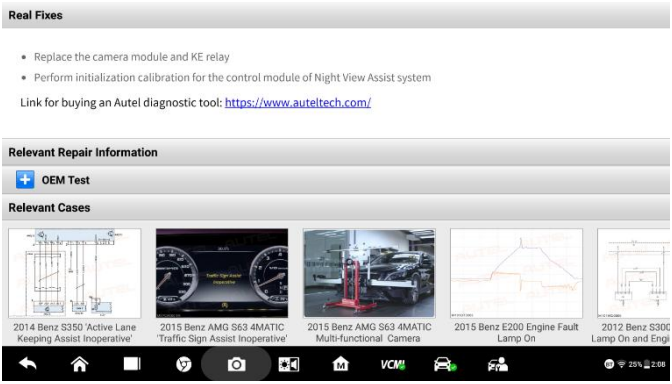


Figure 5-13 *Sample Relevant Repair Info Screen 2*

➢ To review relevant cases information

1. Tap the repair case icon to display main page.
2. Scroll through the page and to locate relevant information.
3. Tap the arrow icon at the left top and return to the previous repair case page.

6 Service

The **Service** section is specially designed to provide quick access to the vehicle systems for various scheduled service and maintenance tasks. The typical service operation screen is a series of menu driven executive commands. Follow on-screen instructions to select appropriate execution options, enter correct values or data, and perform necessary actions. The application will display detailed instructions to complete selected service operations.

After entering each special function, the screen will display two application choices: **Diagnosis** and **Hot Functions**. The **Diagnosis** enables the reading and clearing of codes which is sometimes necessary after completing certain special functions. **Hot Functions** consists of sub functions of the selected special function.

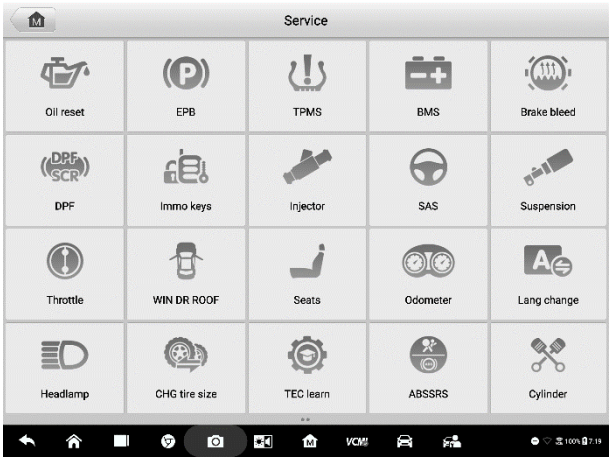


Figure 6-1 ***Sample Service Menu***

Several most commonly used services are described in this chapter.

6.1 Oil Reset Service

Perform reset for the Engine Oil Life system, which calculates an optimal oil life change interval depending on the vehicle driving conditions and climate. The Oil Life Reminder must be reset each time the oil is changed, so the system can calculate when the next oil change is required.

NOTE

1. Always reset the engine oil life to 100% after every oil change.

2. All required work must be carried out before the service indicators are reset. Failure to do so may result in incorrect service values and cause DTCs to be stored by the relevant control module.
3. For some vehicles, the scan tool can reset additional service lights such as maintenance cycle and service interval. On BMW vehicles for example, service resets include engine oil, spark plugs, front/rear brakes, coolant, particle filter, brake fluid, micro filter, vehicle inspection, exhaust emission inspection and vehicle checks.

6.2 Electric Parking Brake (EPB) Service

This function has a multitude of usages to maintain the electronic braking system safely and effectively. The applications include deactivating and activating the brake control system, assisting with brake fluid control, opening and closing brake pads, and setting brakes after disc or pad replacement.

6.2.1 EPB Safety

It can be dangerous to perform Electric Parking Brake (EPB) system maintenance, so before you begin the service work, please keep these rules in mind.

- ✓ Ensure that you are fully familiar with the braking system and its operation before commencing any work.
- ✓ The EPB control system may be required to be deactivated before carrying out any maintenance/diagnostic work on the brake system. This can be done from the tool menu.
- ✓ Only perform maintenance work when the vehicle is stationary and on level ground.
- ✓ Ensure that the EPB control system is reactivated after the maintenance work has been completed.

NOTE

Autel accepts no responsibility for any accident or injury arising from the maintenance of the Electric Parking Brake system.

6.3 Tire Pressure Monitoring System (TPMS) Service

This function allows you to quickly look up the tire sensor IDs from the vehicle's ECU, as well as to perform TPMS replacement and reset procedures after tire sensors are replaced.

6.4 Battery Management System (BMS) Service

The Battery Management System (BMS) allows the tool to evaluate the battery charge state, monitor the close-circuit current, register the battery replacement, activate the rest state of the vehicle, and charge the battery via the diagnostic socket.

NOTE

1. This function is not supported by all vehicles.
2. The sub functions and actual test screens of the BMS may vary by vehicle, please follow the on-screen instructions to make correct option selection.

The vehicle may use either a sealed lead-acid battery or an AGM (Absorbed Glass Mat) battery. Lead acid battery contains liquid sulphuric acid and can spill when overturned. AGM battery (known as VRLA battery, valve regulated lead acid) also contains sulphuric acid, but the acid is contained in glass mats between terminal plates.

It is recommended that the replacement aftermarket battery has the same specifications, such as capacity and type, as the exiting battery. If the original battery is replaced with a different type of battery (e.g. a lead-acid battery is replaced with an AGM battery) or a battery with a different capacity (mAh), the vehicle may require reprogramming of the new battery type, in addition to, performing the battery reset. Consult the vehicle manual for additional vehicle-specific information.

6.5 Diesel Particle Filter (DPF) Service

The Diesel Particle Filter (DPF) function manages DPF regeneration, DPF component replacement teach-in and DPF teach-in after replacing the engine control unit.

The ECM monitors driving style and selects a suitable time to employ regeneration. Cars driven a lot at idling speed and low load will attempt to regenerate earlier than cars driven more with higher load and speed. In order for regeneration to take place, a prolonged high exhaust temperature must be obtained.

In the event of the car being driven in such a way that regeneration is not possible, i.e., frequent short journeys, a diagnostic trouble code will eventually be registered in addition to the DPF light and “Check Engine” indicators displaying. A service regeneration can be requested in the workshop using the diagnostic tool.

Before performing a forced DPF regeneration using the tool, check the following items:

- The fuel light is not on.
- No DPF-relevant faults are stored in system.
- The vehicle has the specified engine oil.
- The oil for diesel is not contaminated.

IMPORTANT

Before diagnosing a problem vehicle and attempting to perform an emergency regeneration, it is important to obtain a full diagnostic log and read out relevant measured value blocks.

NOTE

1. The DPF will not regenerate if the engine management light is on, or there is a faulty EGR valve.
2. The ECU must be re-adapted when replacing the DPF and when topping up the fuel additive Eolys.
3. If the vehicle needs to be driven in order to perform a DPF service, a second person is needed for the function. One person should drive the vehicle while the other person observes the screen on the Tool. Do not attempt to drive and observe the scan tool at the same time. This is dangerous and puts your life and the lives of other motors and pedestrians at risk.

6.6 Immobilizer (IMMO) Service

An immobilizer is an anti-theft mechanism that prevents an automobile's engine from starting unless the correct ignition key or other device is present. This device prevents thieves from starting the car by a method known as hot wiring. Most new vehicles have an immobilizer as standard equipment. An important advantage of this system is that it doesn't require the car owner to activate it; it operates automatically. An immobilizer is considered as providing much more effective anti-theft protection than an audible alarm alone; many auto insurance companies offer lower rates for vehicles that are equipped with an immobilizer.

As an anti-theft device, an immobilizer disables one of the systems needed to start a car's engine, usually the fuel supply or the ignition. This is accomplished by radio frequency identification between a transponder in the ignition key and a device called a radio frequency reader in the steering column. When the key is placed in the ignition, the transponder sends a signal with a unique identification code to the reader, which relays it to a receiver in the vehicle's computer control module. If the code is correct, the computer allows the fuel supply and ignition systems to operate and start the car. If the code is incorrect or absent, the computer disables the system, and the car will be unable to start until the correct key is placed in the ignition.

The IMMO service can disable a lost vehicle key and program the replacement key fob. One or more replacement key fobs can be programmed.

6.7 Steering Angle Sensor (SAS) Service

Steering Angle Sensor Calibration permanently stores the current steering wheel position as the straight-ahead position in the steering angle sensor EEPROM. Therefore, the front wheels and the steering wheel must be set exactly to the straight-ahead position before calibration. In addition, the vehicle identification number (VIN) is also read from the instrument cluster and stored permanently in the steering angle sensor EEPROM. On successful completion of calibration, the steering angle sensor fault memory is automatically cleared.

Calibration must always be carried out after the following operations:

- Steering wheel replacement
- Steering angle sensor replacement
- Any maintenance that involves opening the connector hub from the steering angle sensor to the column
- Any maintenance or repair work on the steering linkage, steering gear or other related mechanism
- Wheel alignment or wheel track adjustment
- Accident repairs where damage to the steering angle sensor or assembly, or any part of the steering system may have occurred

NOTE

1. Autel accepts no responsibility for any accident or injury arising from servicing the SAS system. When interpreting DTCs retrieved from the vehicle, always follow the manufacturer's recommendation for repair.
2. All software screens shown in this manual are examples, actual test screens may vary by test vehicle. Pay attention to the menu titles and onscreen instructions to make correct option selections.
3. Before starting procedure, make sure vehicle has an ESC button. Look for button on dash.

7 MaxiFix

MaxiFix is an online community, based on the ever-expanding cloud database that provides abundant information and resources to help find efficient solutions for all kinds of vehicle troubles. It serves as a forum that enables users to network with other MaxiSys users and with Autel Technicians. Users can post questions and answers, share tips and search for repair cases with proven documented fixes.

MaxiFix is an expanding resource as the database which is updated daily with reported solution cases and advisory reports from MaxiSys users worldwide.

Information in the MaxiFix database is organized into a series of diagnostic tips that are designed to help you locate the cause of particular problems of the test vehicle and quickly find solutions to them.

7.1 Getting Started

Tap the blue **MaxiFix** icon. You will be automatically logged in as the MaxiFix system identifies the serial number and password of the Ultra tablet and its associated registered user.

7.2 Navigation

The MaxiFix full screen layout will display upon opening, as shown in ***Figure 7-1*** below.

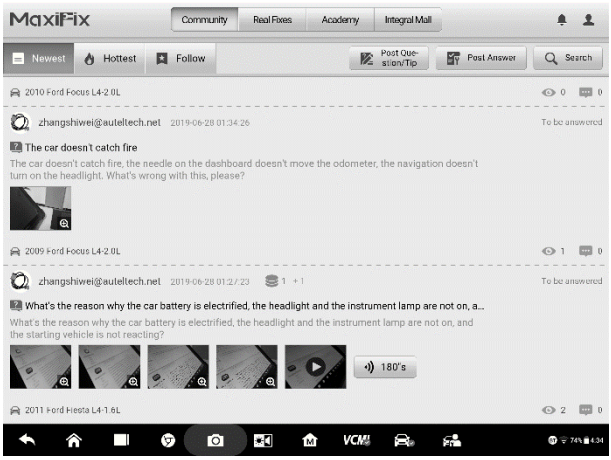


Figure 7-1 ***Sample MaxiFix Home Page***

The MaxiFix screen layout contains 3 main areas:

1. **The Navigation Bar** – the top Navigation Bar allows you to switch between different sections of MaxiFix. Besides, a bell-shaped icon and a bust icon are located in the upper right corner of the screen, which lead to messages and personal information respectively.
2. **The Function Menu** – on the upper left side under the Navigation Bar, the Function Menu displays the submenus of each main menu.
3. **The Main Screen** – occupying the rest of the screen, the Main Screen displays vehicle-related content including problems and corresponding solutions, interactive activities, tips and information posted by Autel MaxiSys Ultra users.

Message Icon & Personal Center Icon

Message Icon

The bell-shaped icon in the upper right corner reminds you of messages about your activities on MaxiFix.

Tap the icon to enter the **My Messages** page where you can see a list of messages read or unread. If a piece of message is not read, the entry is in dark black; otherwise, the entry turns to gray.

These unread messages can be set as read once you tap the **All set as read** button. If there are too many messages, you can tap the **Clear** button to clear the message history.

Personal Center Icon

Next to the message icon, the bust icon leads to **Personal Center**.

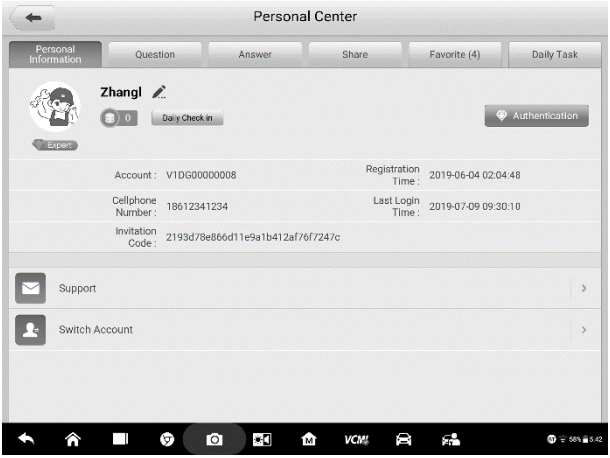


Figure 7-2 *Sample Personal Center Page*

Personal Center consists of six tab pages, with **Personal Information, Question, Answer, Share, Favorite,** and **Daily Task** being their respective tab tile. Each tab page shows a different aspect of the user's activities on MaxiFix.

Personal Information –contains the account registration, Support and Switch account functions. In the upper right corner opposite to the account name, there is a blue button, where you can apply for technician authentication

- **To apply for the authentication**

  1. Tap the **Authentication** button and enter the Technician Accreditation page.
  2. Fill in the information required in each empty box.
  3. Do not forget to upload HD pictures of certificate.
  4. Tap **Submit** to send your application.
  5. After all has been done, please wait for verification. As long as your information meets the required standards, you will get a successful authentication soon.

Back to the main screen of Personal Information, **Support** offers a feedback channel for sharing user experience on MaxiFix and viewing FAQs. MaxiFix allows other accounts to log in. You can tap **Switch Account** to switch to another account.

Question – records the posted questions in the MaxiFix community.

Answer – records your answers to others' questions.

Share –presents analysis of troubleshooting vehicles and tips for diagnosis shared by yourself.

Favorite – collects questions, shares, and repair cases you saved before.

Daily task – provides various tasks with reward coins. You can do daily tasks to earn coins and community experience values. The daily tasks include sharing tips, posting questions, and answering pending questions. The detailed operation is explained in *Community.*

7.3 Operations

The top navigation bar consists of Home, Real Fixes, Academy and Integral Mall, the functions of which are shown below:

Community – shows questions and answers about vehicle problems and fault code solutions. Moreover, this section offers a good chance to join the MaxiFix community.

Real Fixes – presents real cases collected from actual shop repair orders and described in an easy-to-understand and professional manner.

Academy – offers an online learning and help platform for vehicle diagnosis technicians, with videos concerning various specific topics and query tools for searching vehicle information.

Integral Mall – displays a series of Autel diagnostic products, including diagnostic tablets, endoscope, and oscilloscope, and other diagnostic components, etc. These products can be exchanged with reward coins that you won from daily tasks and other tasks. For detailed exchange steps, see *Integral Mall*.

7.3.1 Community

The Community menu showcases the MaxiFix community with three tab pages.

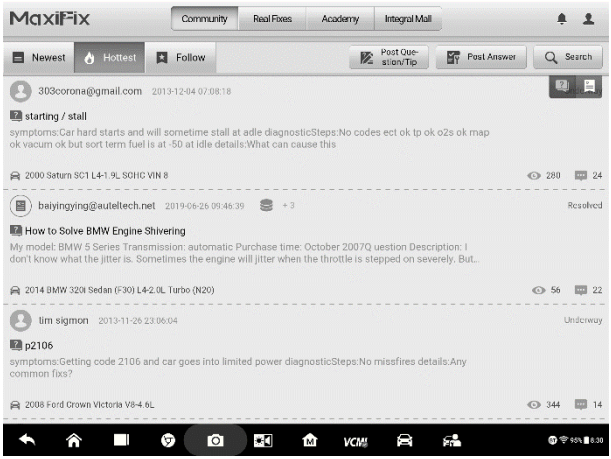


Figure 7-3 *Sample Community Page*

Three tab pages:

- **Newest** – contains questions and tips about exact vehicle faults posted by the MaxiSys Ultra users in chronological order. The icon with a question mark leads to a question posted by MaxiSys Ultra users; while the bookmark icon represents that the following is a service tip shared by MaxiSys Ultra users.

Table 7-1: Table of Small Icons in MaxiFix

Icon	Description
	Signifying that what follows is a question.
	Signifying that what follows is a service tip.
	Signifying the number of views.
	Signifying the number of adoptions for the service tip.

Icon	Description
	Signifying the number of answers to the question.
	Signifying the number of reward coins.

Each **question** is accompanied with two icons indicating the number of views and answers respectively. Similarly, each **repair tip** is accompanied with two icons indicating the number of views and adoptions.

Some of the questions are attached with a coin icon, indicating the number of reward coins provided for the best answer. The questioner can raise the number of reward coins to stimulate better solutions.

To the right of the questions, the orange phrase **Underway** indicates that the question has been answered by experts or technicians but not confirmed by the questioner; while a green word **Resolved** indicating that the questioner has been confirmed with the best answer.

- **Hottest** – displays hot questions with the most replies from experts or other professional MaxiSys Ultra users, along with the most views.

For viewing convenience, entries under the **Hottest** menu are divided to be shown in two modes. Tap the question mark icon, and the screen only displays questions posted by users. Tap the bookmark icon, and the screen only shows service tips shared by users. (For icon meanings, *see Table 7-1: Table of Small Icons in MaxiFix*)

- **Follow** – displays the questions and tips that you are following. The **Select Vehicle** button to the left allows you to make a quick selection of specific vehicles.

➢ **To select a vehicle**

1. Tap the blue ***Select Vehicle*** button to the left.
2. Select ***Brand*** of the vehicle from the list.
3. Select ***Model*** of the vehicle from the list.

After finishing the vehicle selection procedure, the identified vehicle is shown in the **Follow** tab page, with related user-posted questions and tips, matched and displayed together with user IDs. Tap one of the matched entries to see the details.

Three Function Buttons:

The three function buttons in the upper right corner are designed to enable online communication between MaxiSys Ultra users and Autel experts.

- **Post Question/Tip** – This button provides a channel to ask questions about vehicle faults and share good solutions to diagnostic troubles.

➢ **To post a question/tip**

1. Tap the **Post Question/Tip** button to enter the **Post Question** and **Sharing Tip** page.
2. Tap the **Select Vehicle** button, select **Year, Brand, Model,** and **Engine** from the list.
3. Fill in the **Subject** in short phrases or a short question with keyword.
4. Fill in **Credit Reward** as a reward for the best answer.
5. Write your question or expression about vehicle faults in the **Content** box. (Three different posting ways are available, including picture, video and voice.)
6. After all have done above, tap **Submit** in the upper right corner. And your question will be uploaded soon on the list of the Newest.

NOTE

The steps of posting a sharing tip are similar to posting a question, except that step 4 is not included in **Sharing Tip**.

Once a question has been posted, the entry is presented with the **Question icon**. While a tip has been posted, the entry is presented with the **Service Tip icon**.

- **Post Answer** – This button is for answering questions posted by other MaxiSys Ultra users.

➢ **To post an answer**

1. Tap the Post Answer button to enter the Pending Questions page.
2. Select **To be answered**, and you will see a list of unanswered questions. Select **Underway**, and you will see a list of questions with some but no best answers.
3. Tap one question entry, and enter a page with a blue **Post Answer** button to the right.
4. Tap the **Post Answer** button to enter the **Reply** page.
5. Post your analysis and insights in the **Content** box.

NOTE

Three different posting methods are available: still images (maximum 5 still images), video (maximum length of 15 seconds, or a voice (up to 3 minutes).

Answer adopted by the questioner will automatically receive reward coins. If your answer is confirmed as the Best Answer, you will receive reward coins from both the system and the questioner.

NOTE
You can add to answer via the **Continue Answer** button.

- **Search** – This button enables you to search for answers and solutions.

NOTE
The most-used keywords will be added into **Hot Search. Search History** records the keywords you input.

7.3.2 Real Fixes

In **Real Fixes,** a list of repair cases and troubleshooting tips are collected by way of content instructions and graph analysis. Additionally, some repair cases are attached with videos showing the whole process of troubleshooting.

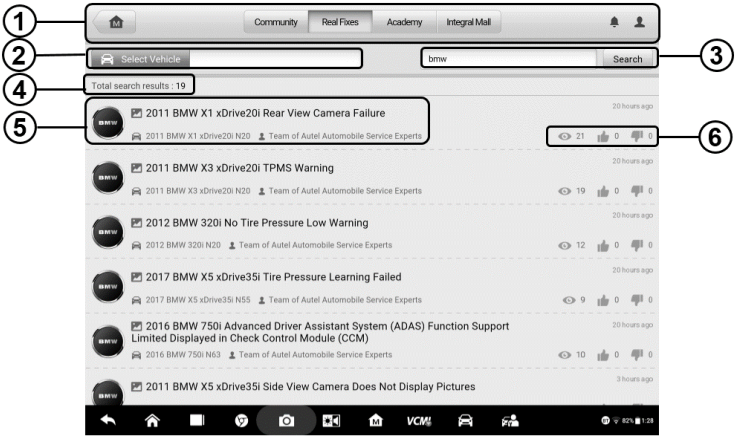


Figure 7-4 *Sample Real Fixes Page 1*

There are six function parts in Real Fixes, as explained below:

1. Signifies the navigation bar
2. Signifies the vehicle selection button
3. Signifies the keywords search for repair fixes
4. Signifies the total search results of keywords searching
5. Signifies the repair fixes title and vehicle specification
6. Signifies the views and satisfaction for the repair case in MaxiFix community

In the list of real cases, three icons are attached to each fixes entry, making it possible for viewers to evaluate each case entry. For icon meanings, see Table 7-2 Icons on Real Fixes.

Table 7-2 Icons on Real Fixes

Button	Description
	Repair case includes text and images.
	Repair case is accompanied with a video for explaining vehicle principles and diagnostic troubles.
	Vehicle identification, including brand and model.
	The number of views for each repair case.
	Tap this icon if you find the repair case helpful.
	Tap this icon if you find the repair case not helpful.

The **Select Vehicle** button in the upper left half allows you to choose the vehicle model and search for relevant repair information.

➢ **To Search for a real fix**

1. Tap the blue ***Select Vehicle*** button on the left.
2. Select ***Year*** of the vehicle from the list.
3. Select ***Brand*** of the vehicle from the list.
4. Select ***Model*** of the vehicle from the list.
5. Select ***Engine*** of the vehicle from the list.
6. After all selections have been done, the system will match the identified vehicle with a list of repair case entries.
7. Press one entry of them and enter the real fix page with diagnostic description in detail (Figure 7-5).

Real Fixes in Detail

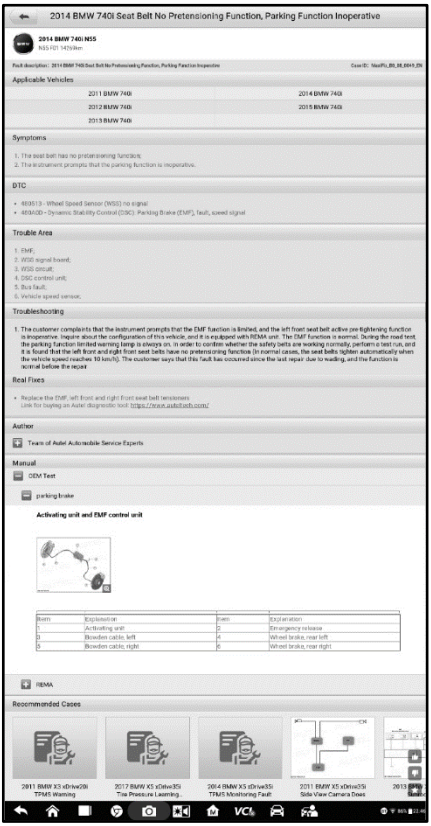


Figure 7-5 *Sample Real Fixes Page 2*

This page comprises a series of diagnostic operations, from finding vehicle faults, locating errors, to providing suggested solutions. It is based on a great deal of real repair cases with relevant graphs and videos, to present a complete maintenance database for the reference of MaxiSys Ultra users.

Each repair case includes nine main parts:

1. **Applicable Vehicles** – matches different types of vehicles that this repair case analysis can be applicable to.

2. **Symptoms** – points out the fault symptoms of the vehicle, which provides a reference to confirm the vehicle problems.

3. **DTC** – matches relevant fault codes for further resolving. This is based on a large DTC database commonly used worldwide.

4. **Trouble Area** – indicates the exact position of the vehicle problems. This part helps to locate the vehicle problems accurately.

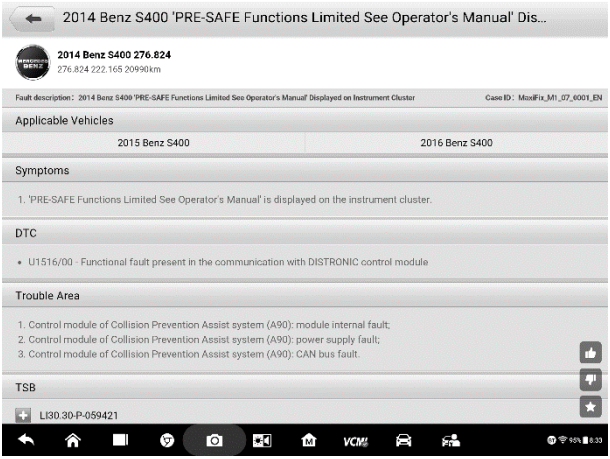


Figure 7-6 *Sample Trouble Area Page*

5. **Troubleshooting** –illustrates the detailed diagnostic operations in a vivid format.

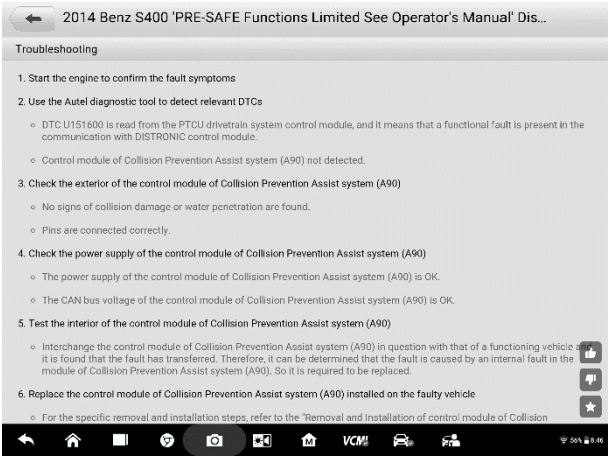


Figure 7-7 *Sample Troubleshooting Page 1*

Troubleshooting is usually only presented as text. However, instructional videos are sometimes provided.

Figure 7-8 *Sample Troubleshooting Page 2*

6. **Real Fixes** – displays suggested vehicle repairs. Purchase diagnostic devices directly by tapping associated link and access the Autel website.

7. **Author** – identifies the author of the professional repair case. Some of them are authenticated technicians, while most are from the team of Autel Automobile Service Experts with long-term diagnostic experience and technical skills.

8. **Manual** – presents relevant operations on components during the diagnosis.

9. **Recommended cases** – associates other repair cases that share similar faults or keywords with this case

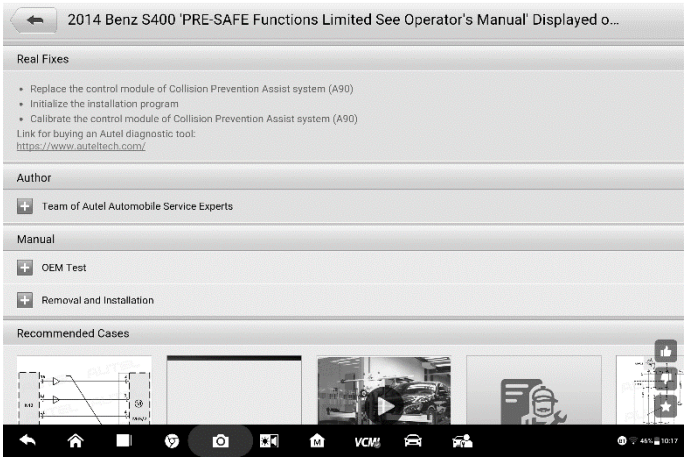


Figure 7-9 *Sample Recommended Cases Page*

For some vehicles repair case, a TSB file is added for further analysis, shown as below.

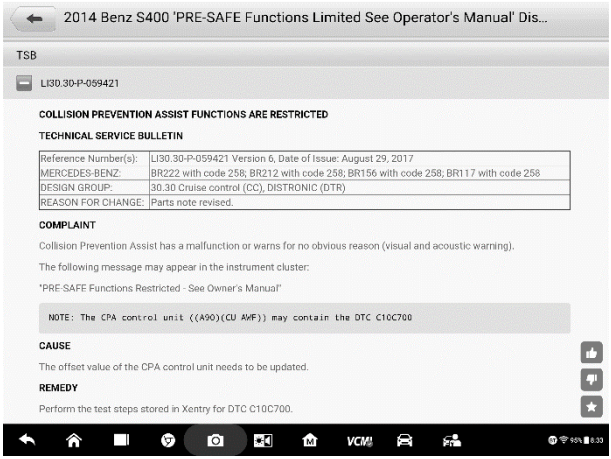


Figure 7-10 ***Sample TSB Page***

Quick search: To search for relevant vehicle symptoms and repair issues, use the **Search** box in the upper right corner of the **Real Fixes** section. Input keywords and tap the Search button, and the system will match all relevant entries for reference. The more keywords, the more precise the matching results.

7.3.3 Academy

The third section of MaxiFix is Academy, a platform for technicians to enrich their knowledge and improve operating skills. Academy contains two main parts, Featured Videos and Query Tools.

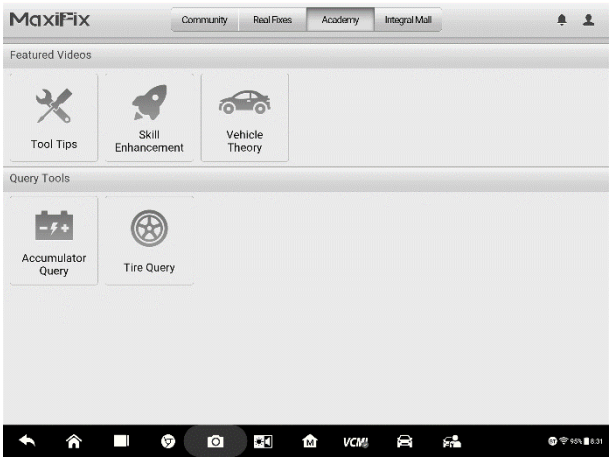


Figure 7-11 ***Sample Academy Page***

Featured Videos – are intended to help the technicians, namely the MaxiSys Ultra users, to improve their diagnostics skills and enhance their overall vehicle repair and servicing knowledge.

1. **Tool Tips**: Videos on Tool Tips present introductory knowledge on diagnostic tools and diagnostic processes.
2. **Skill Enhancement**: Videos on Skill Enhancement display diagnostic procedures in real repair environments and share the expertise of senior technicians.
3. **Vehicle Theory**: Videos on Vehicle Theory are recorded to impart vehicle theories or principles by experts in vehicle structure and maintenance.

Query Tools – provides large volumes of vehicle data for quick query. The Accumulator Query is for searching for vehicle battery information, while the Tire Query is for searching for tire information.

- **To run a query (using Tire Query for example)**

    1. Tap the **Tire Query** icon to enter the Select Vehicle page.
    2. Tap the **Select Vehicle** to select from the four rows of menus that display.
    3. Select **Year, Brand, Model**, and **Engine**.
    4. After all selections have been done, the corresponding tire specifications will be displayed.

7.3.4 Integral Mall

The Integral Mall is built as a coins reward system for awarding the useful answers and perfect repairing tips. It is a new menu of MaxiFix, which, in other hand, enhances the interaction and communication between technicians and Autel support.

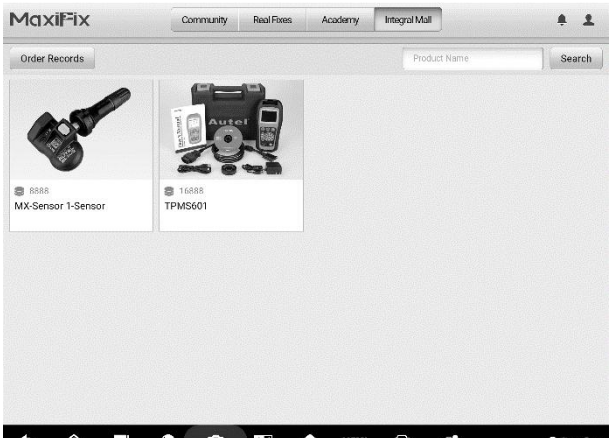


Figure 7-12 *Sample Integral Mall Page*

In the Integral mall, the reward coins can be used as coupons for exchanging specific products or devices. If you are keen on some of them, just make an order for the exchange with the required number of coins. You will get a reduction of payment with the coins.

- **To make an order (take MaixiTPMS TS601 for example)**

1. Enter the Integral Mall, and you will see the products priced in reward coins.
2. In the product list, tap MaixiTPMS TS601 and enter the **Product Detail** page.
3. Read the information about the main functions of the product, pay attention to the number of coins needed for exchange, and then choose the quantity of exchange. Product pictures are showcased in the carousel, below which there are two buttons. **Detailed Introduction** describes the product characteristics, while **Specification Parameter** explains data for product configuration.

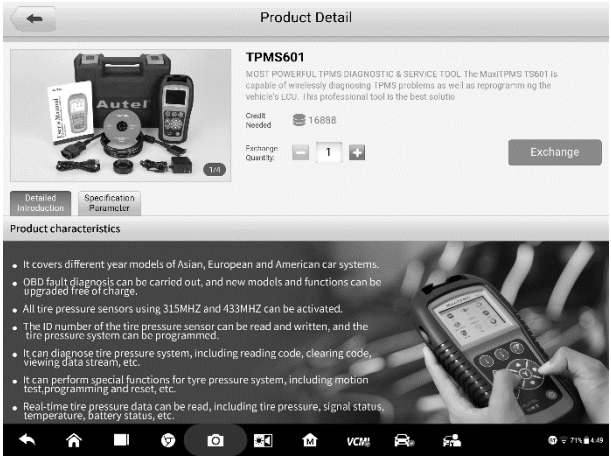


Figure 7-13 ***Sample Product Detail Page***

4. Tap the **Exchange** button in orange to enter the Exchange Confirmation page

5. Check the order details carefully and tap the **Confirm** button in the upper right corner. The exchange is completed when the Exchange Success notice appears.

6. Tap **Done** to complete the process.

NOTE

For more information about the orders you have made, please switch to the Integral Mall page, and tap **Order Records**, you will see all the orders you have made in Integral Mall.

8 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 signal generator, a multimeter and a digital OBDII breakout box.

8.1 Oscilloscope Operation

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.

8.1.1 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.

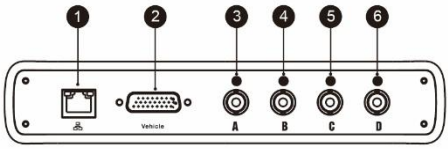
WARNING:

- 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.

8.1.2 General Introduction

8.1.2.1 Component Locations

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

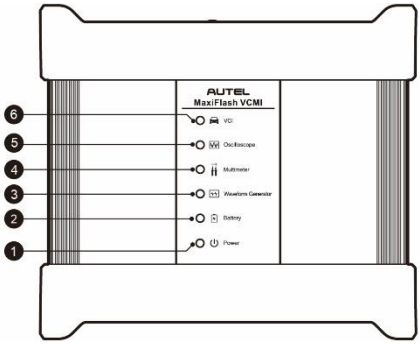


VCMI Bottom View

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 lights green when operating in the oscilloscope mode, and blinks green when the VCMI is communicating.



VCMI Front View

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

8.1.2.2 Technical Specifications

Table 8-1 *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 To reach the speed with two channels, please select one channel in channel A or B, the other channel in channel C or D.
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

8.1.2.3 Accessories

USB 2.0 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)

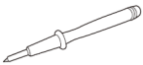
Enables easy access to existing automotive wiring harness connectors for obtaining signals of various sensors. Four sizes are available: 0.6 mm, 1.5 mm, 2.3 mm and 2.8 mm.

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.

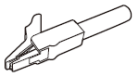
Back-pinning Probe Set (SA051)

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)

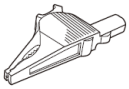
Designed for connecting exposed wires or terminals.



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

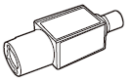
Used to connect exposed wires or terminals. SA059 (red) and SA060 (black) for larger terminals.

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.

8.1.3 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. For more information, see *Establish Vehicle Communication* on page 20.

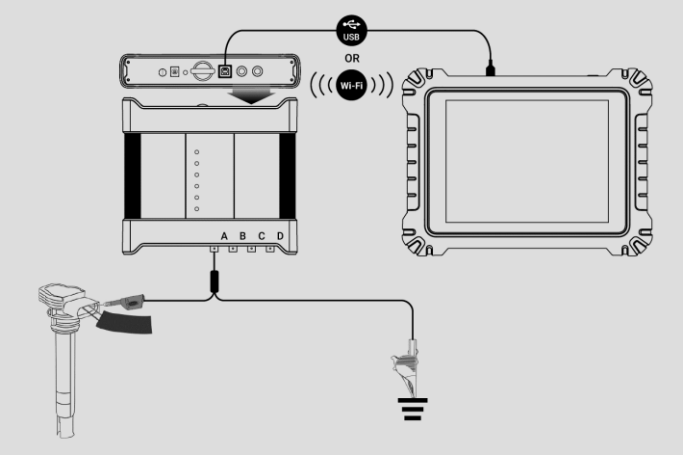


Figure 8-1 *Sample Connection Diagram*

➢ **To open the oscilloscope application**

1. Insert the applicable test lead or probe terminal ends into the input channel(s) to complete the connection.
2. Tap the **Measure** 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 lights green when operating in the oscilloscope mode and blinks green when communicating.

8.1.4 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.

8.1.4.1 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.

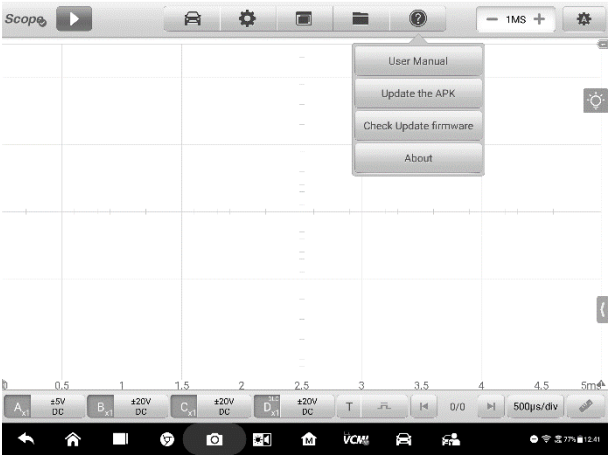


Figure 8-2 *Sample Help Screen*

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

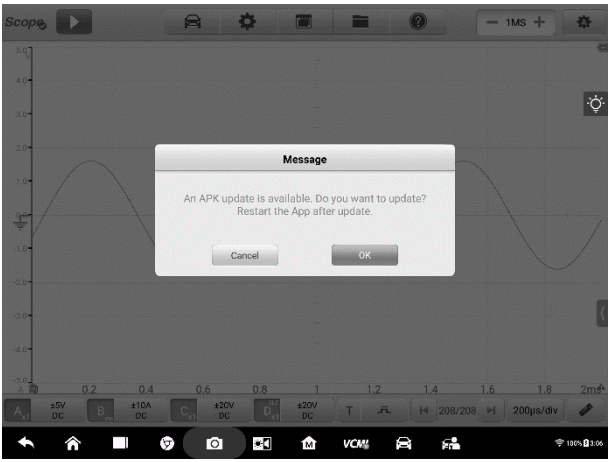


Figure 8-3 *Sample Update Confirmation Screen*

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

8.1.4.2 Firmware Update

➢ **To update the firmware**

1. Tap the **Help** button on the upper half of the screen. A dropdown menu displays. (Figure 8-2)
2. Tap **Check Update Firmware** in the dropdown list. The screen will switch to the **Update** section in the **VCMI Management** application.

Figure 8-4 ***Sample Firmware Update Screen 1***

3. The current version and the latest version of the software will display. Tap **Update Now** to update the software.

Figure 8-5 ***Sample Firmware Update Screen 2***

8.1.5 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 **Scope** in the menu, the oscilloscope page displays. The screen typically includes the following sections.

NOTE

The oscilloscope can be also be accessed via the Android home screen **MaxiScope** icon.

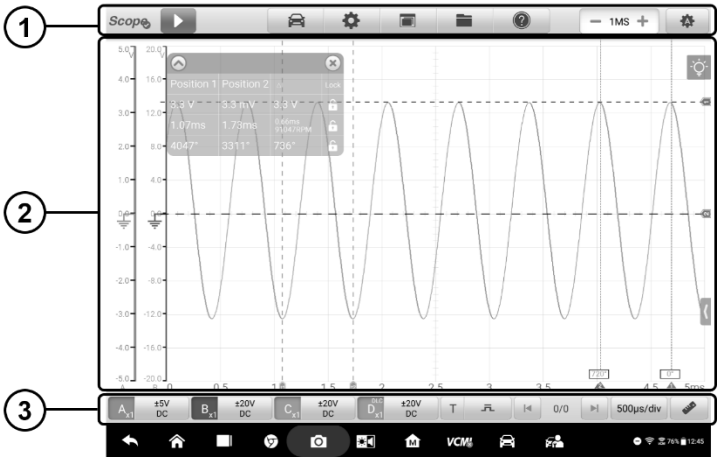


Figure 8-6 ***Sample Oscilloscope Menu Screen***

1. Upper Toolbar Buttons - see *8.1.5.1 Upper Toolbar Buttons* on page 114 for details.

2. Main View Section – see *8.1.5.2 Main View Section* on page 132 for details.

3. Lower Toolbar Buttons - see *8.1.5.3 Lower Toolbar Buttons* on page 139 for details.

8.1.5.1 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 8-2 *Scope Navigation Toolbar Buttons*

Name	Button	Description
Scope Icon		Indicates the oscilloscope connection status. See *Scope Button* on page 115 for more information.
Start/Stop		Start or stop the oscilloscope device. See *Start/Stop Button* on page 116 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 116 for more information.
Settings		Configurations of math channel, mode setting and signal generator. See *Settings Menu* on page 119 for more information.
Window Display		Set the layout and channel position. See *Window Display Menu* on page 124 for more information.
File		Print, open, save, and delete the waveform data. See *File Menu* on page 128 for more information.
Help		View the user manual, update the APK (oscilloscope software) and firmware. See *Help Menu* on page 130 for more information.
Number of Samples		Set the maximum number of samples that will be captured on each channel. See *Number of Samples* on page 131 for more information.
Auto Scale		Set the appropriate time base and amplitude range to display the signal correctly. See *Auto Scale* on page 131 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.
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:

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

➢ **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.

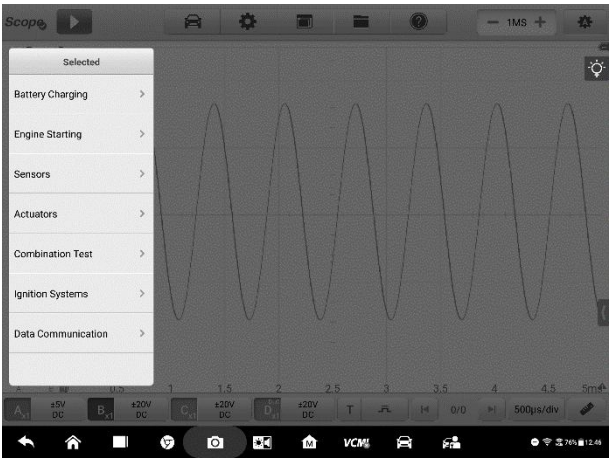


Figure 8-7 *Sample Presets Menu Screen 1*

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

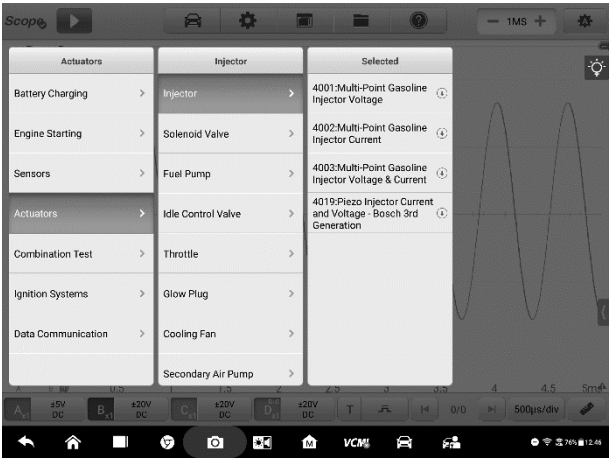


Figure 8-8 *Sample Presets Menu Screen 2*

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.

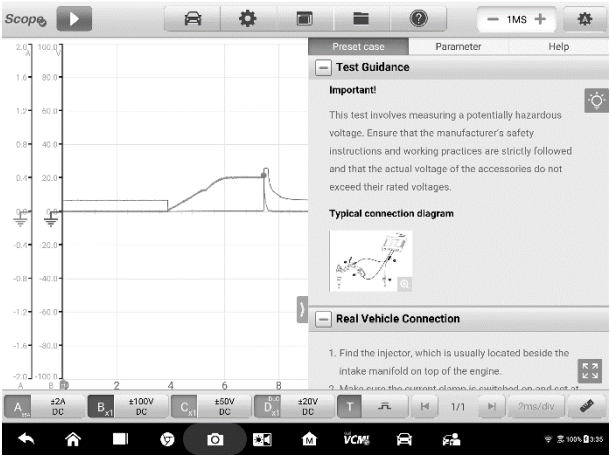


Figure 8-9 *Sample Presets Display Screen*

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

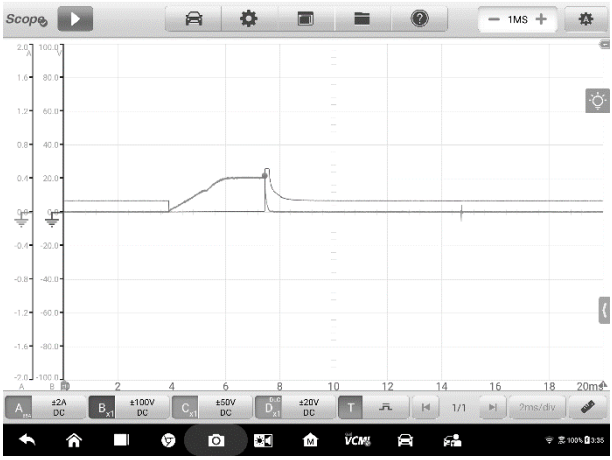


Figure 8-10 *Sample Reference Signal Waveform Display*

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.

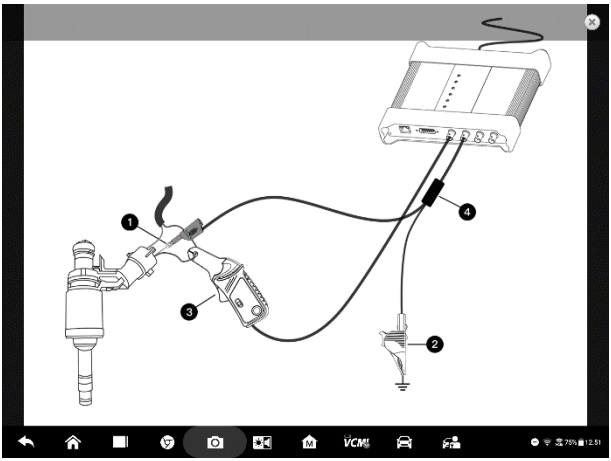


Figure 8-11 ***Sample Image Display (Full Screen)***

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

Settings Menu

Tap the gear icon button in the top navigation bar to open the **Setting Menu**. The **Math Channel**, **Mode Setting** and **Signal Generator** can be manually configured in the menu.

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.

NOTE

The math channel is only available via USB connection.

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

➢ **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.

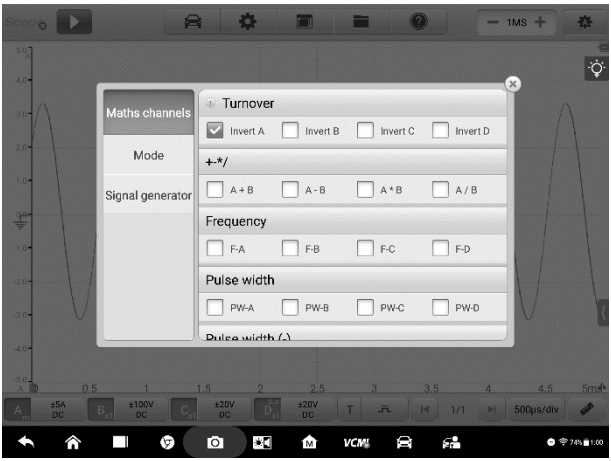


Figure 8-12 *Sample Math Channel Setting Screen*

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

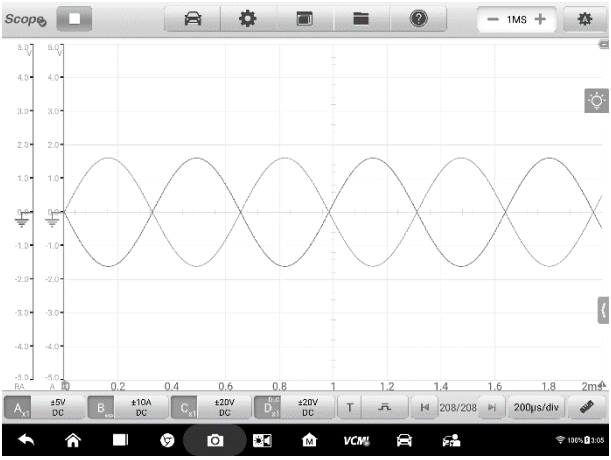


Figure 8-13 *Sample Math Channel Setting Screen*

Mode Settings

Two mode settings are available: normal mode and demo mode.

NOTE

The oscilloscope is required to be connected in any mode.

In normal mode, the actual waveform is displayed on the screen when a test component is connected to the oscilloscope. In demo mode, a demo waveform is displayed on the screen. The user can use this mode to familiarize him or herself with the functions of the oscilloscope.

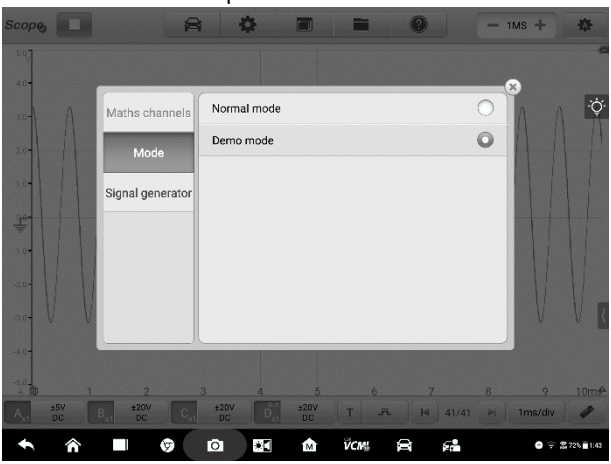


Figure 8-14 *Sample Mode Setting Screen*

Signal Generator Settings

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

Figure 8-15 ***Sample Signal Generator Setting Screen***

➢ **To set the signal generator**

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

Figure 8-16 ***Sample Signal Generator Settings Screen***

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

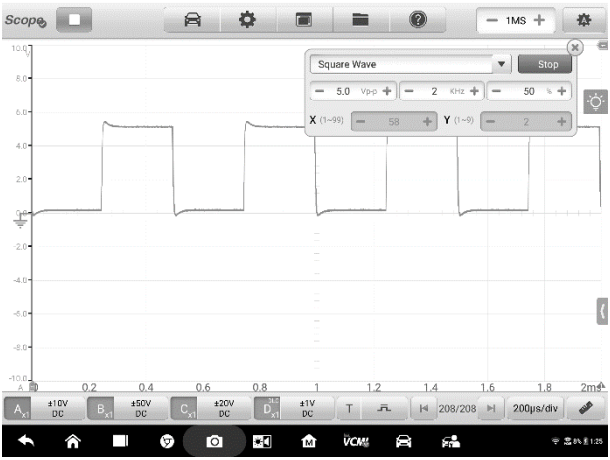


Figure 8-17 ***Sample Signal Generator Display Screen***

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

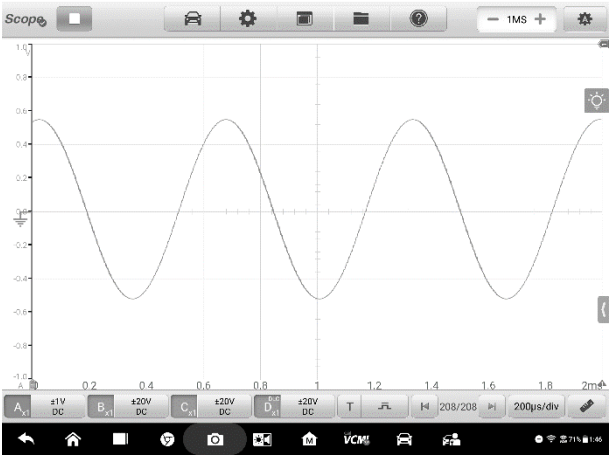


Figure 8-18 ***Sample Single Window Screen***

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

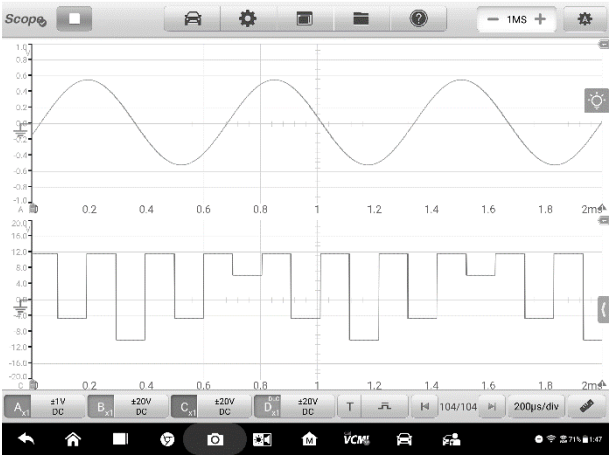


Figure 8-19 ***Sample Double Window Screen***

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

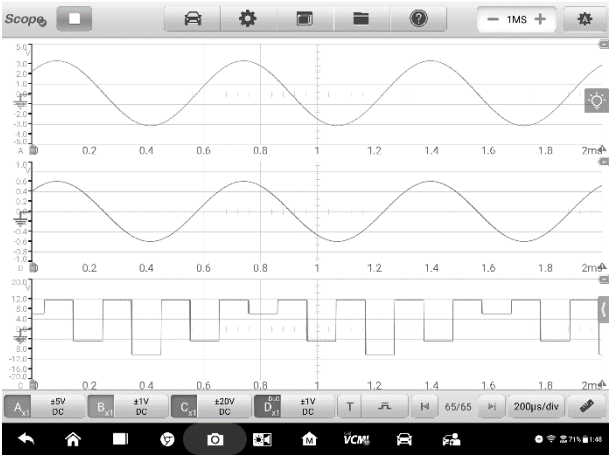


Figure 8-20 *Sample Triple Window Screen*

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

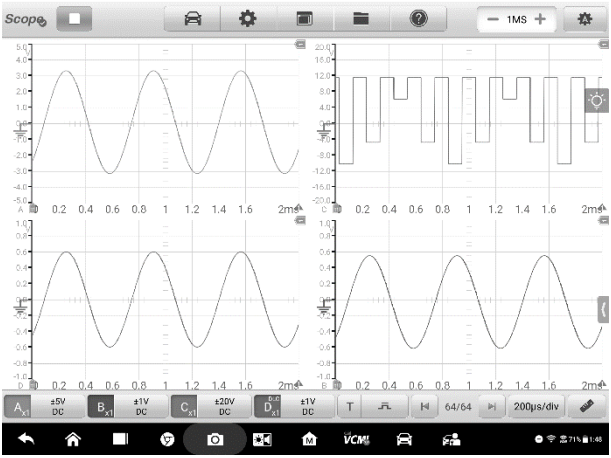


Figure 8-21 *Sample Quadruple Windows Screen*

- **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.

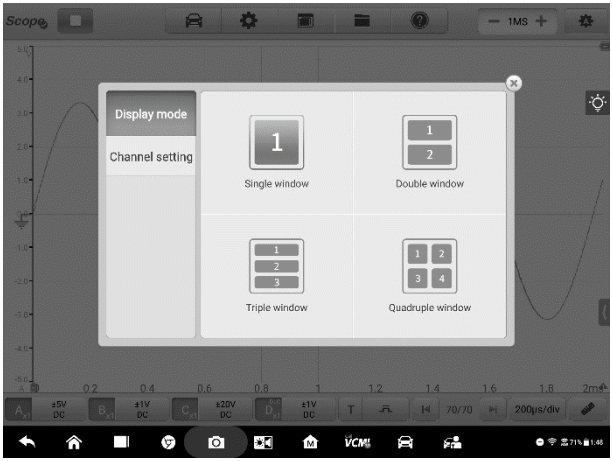


Figure 8-22 *Sample Display Mode Selection Screen*

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 8-23 ***Sample Channel Setting Screen***

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

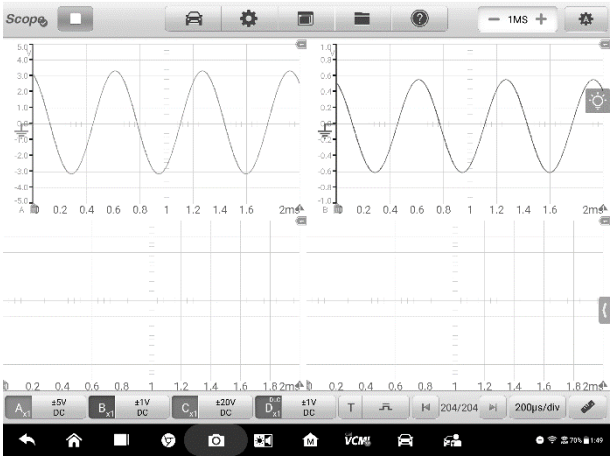


Figure 8-24 ***Sample Channel Display Screen***

File Menu

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

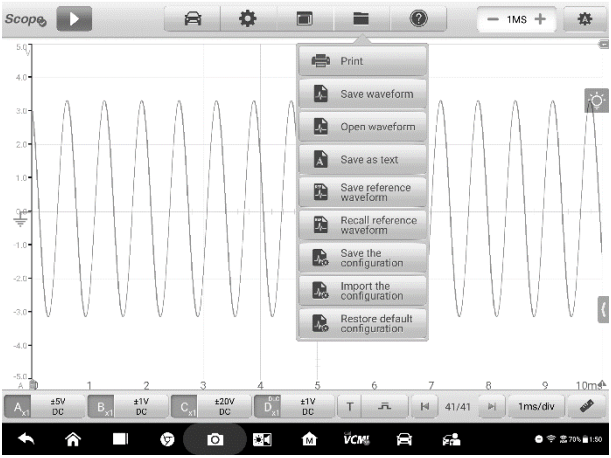


Figure 8-25 ***Sample File Menu Screen***

- **Print –** Tap to create and print a temporary JPG 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.

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.

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 > Scope > txt.**

- **Reference Waveform Operation**

This section allows you to save, open and clear the reference waveforms.

Save reference waveform – Tap to save a copy of an existing signal waveform for future reference. With this function, you can create a waveform library, with normal and abnormal waveforms of various sensors, actuators to enable comparative analysis of waveforms.

On the Save Ref screen, tap inside each input field and enter the corresponding information. Tap Save or Save as default.

NOTE
You must enter a file name when using the Save option; the system will generate a file name when you use the Save as default option.

Recall reference waveform – Tap the checkbox adjacent to the waveform you wish to retrieve from your waveform library. The reference and live waveform will display on the screen simultaneously.

Clear reference waveform – Tap to clear the saved reference waveform from the Main 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.

Restore Default configuration – Tap to cancel the current setting values and refresh the screen to retrieve the default setting values.

Help Menu

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

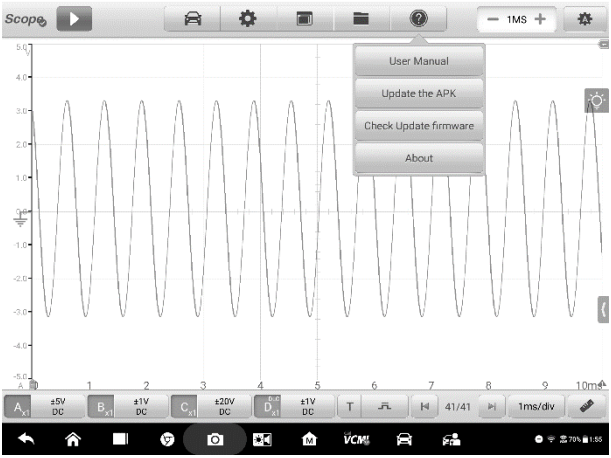


Figure 8-26 *Sample Help Menu Screen*

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.

Check Update Firmware – connects to the Autel server and to check for latest oscilloscope 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 time base and amplitude range to optimize the display of signal.

8.1.5.2 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.

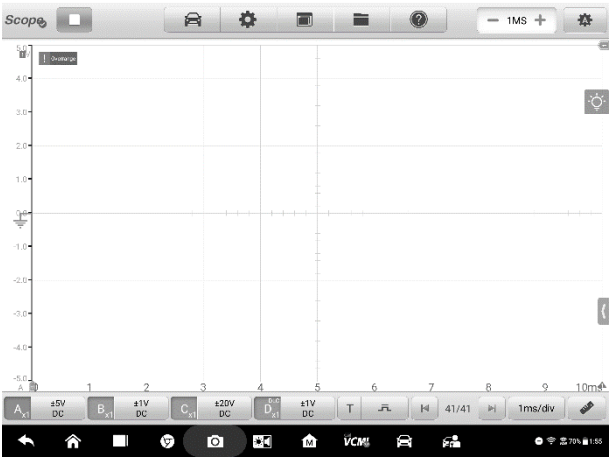


Figure 8-27 ***Sample Over-range Indicator Screen***

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).

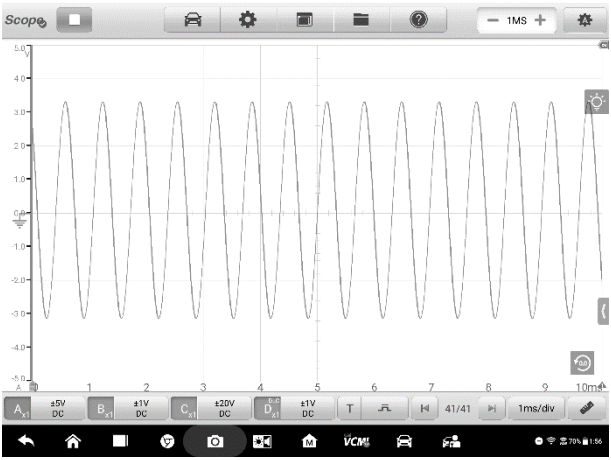


Figure 8-28 ***Sample Channel Selection 1 (Selected)***

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

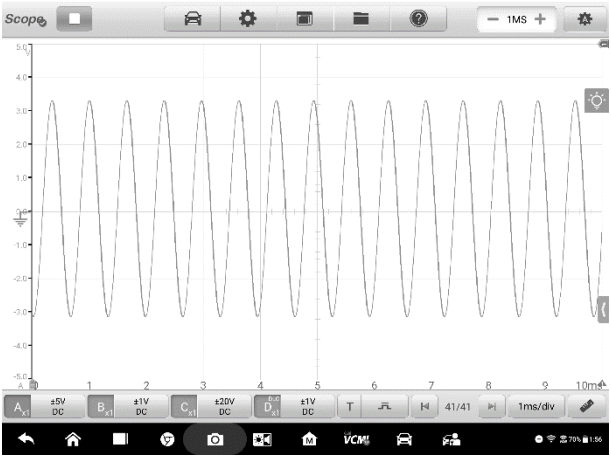


Figure 8-29 ***Sample Channel Selection 1 (Unselected)***

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 Ruler 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.

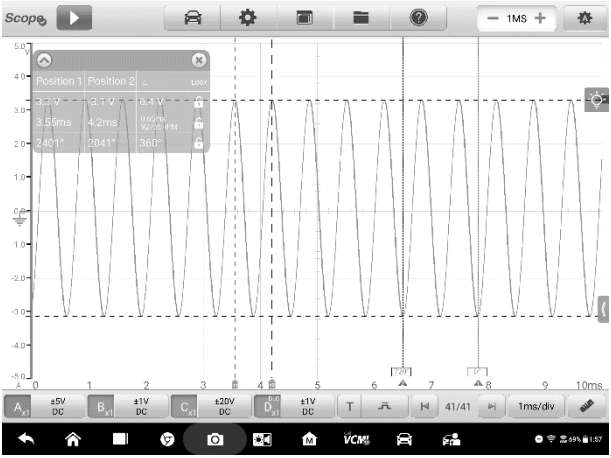


Figure 8-30 *Sample Rulers Display Screen*

- **To configure angle settings**
  1. Drag **Angle Activator** to generate the angle rulers.
  2. Tap the start or end angle value to open the Ruler Setting box.
  3. Input the desired angle value and the angle partition in the field.

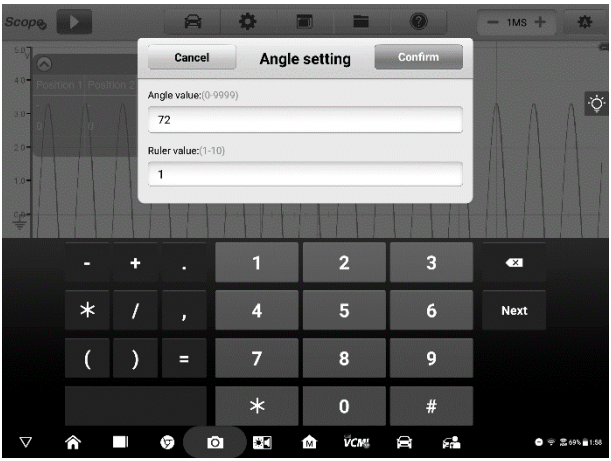


Figure 8-31 *Sample Angle Setting Screen*

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 (Figure 8-32), or dragging the waveform up/down, or moving the screen up/down in the grid (Figure 8-33).

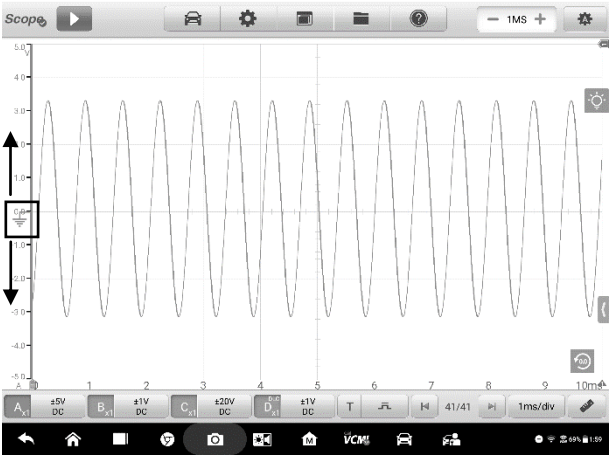


Figure 8-32 ***Sample Dragging Zero Baseline Marker Screen***

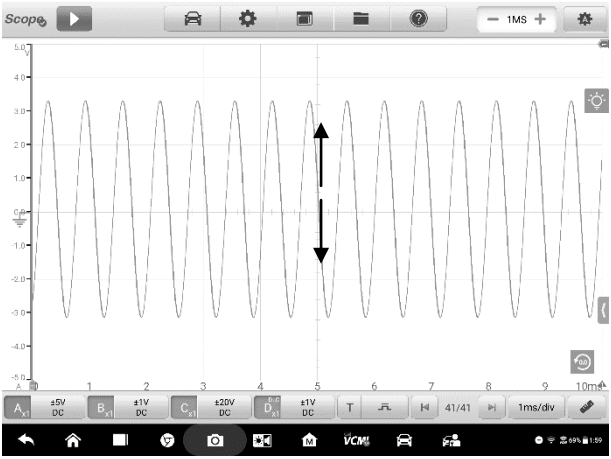


Figure 8-33 ***Sample Dragging Waveform or Moving Screen***

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 relevant Help information and test procedures.

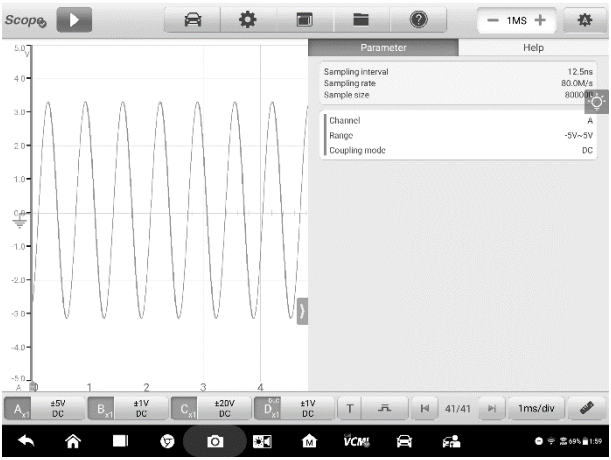


Figure 8-34 *Sample Parameter Screen*

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

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

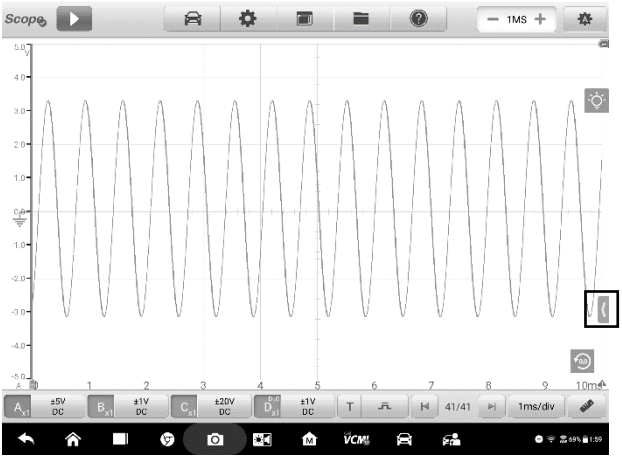


Figure 8-35 *Arrow Button Position Screen*

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.

8.1.5.3 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 8-3 *Lower Toolbar Buttons*

Name	Button	Description
Channel Control		Tap to configure the settings of each channel. Active channel icons display in color; inactive icons display in gray. See *Channel Control* on page 140 for more information.
Trigger		Tap to open the trigger setting menu. See *Trigger* on page 152 for more information.
Buffer		Tap the Back or Next button to scroll to the previous or the next frame in the waveform. See *Buffer* on page 158 for more information.
Time Base		Tap to select an appropriate time per division. See *Time Base* on page 159 for more information.
Measurement		Tap to select an appropriate measurement. See *Measurement* on page 160 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.

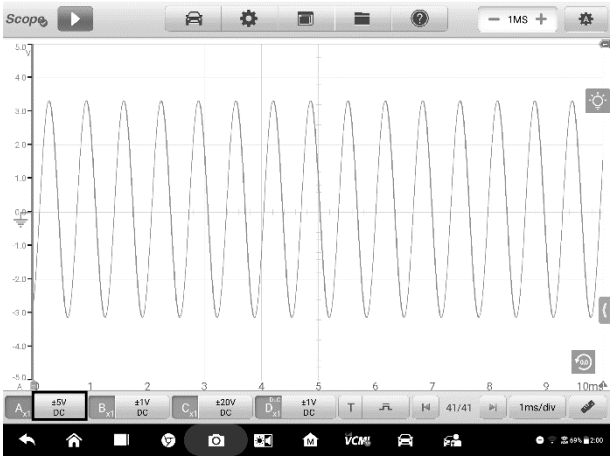


Figure 8-36 *Sample Activate Channel Screen*

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 8-3 *Channel Color Table*

Input Channel	Color
A	Red
B	Green
C	Blue

Input Channel	Color
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 8-37 *Channel Setting Dialog Box Screen*

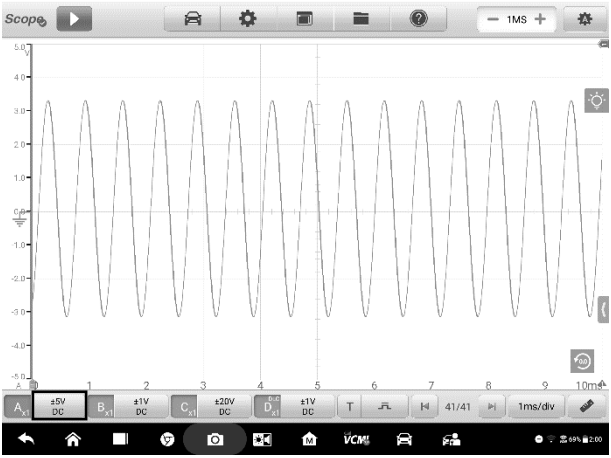


Figure 8-38 ***Sample Amplitude Setting Screen (DC 5V)***

Mode 2: Select the **## /div** button to adjust value incremented by each division. For example, selecting AC 2.0V/div, sets the channel amplitude to **2.0V/div AC** (seen at the right side of the channel control 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.

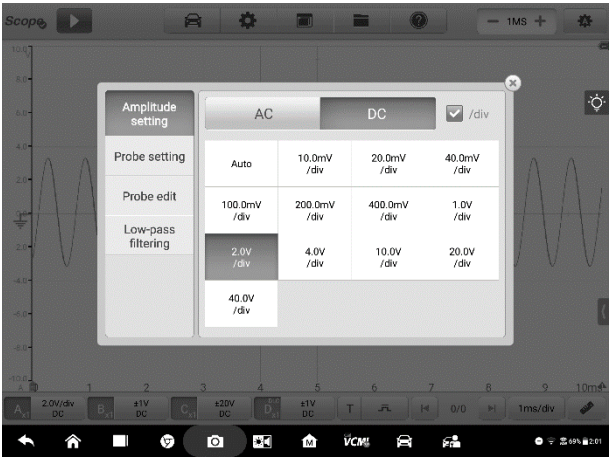


Figure 8-39 ***Sample Amplitude Setting Screen (AC 2.0V/div)***

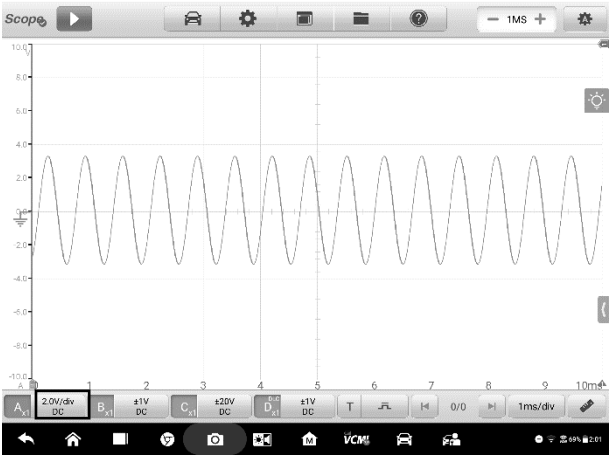


Figure 8-40 ***Sample Amplitude Setting Screen (AC 2.0V/div)***

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[Ign]**: select when using the secondary ignition probe (SA273)
- **Secondary Ignition Probe (Inverted) [I_Ign]**: 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 8-41 *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).

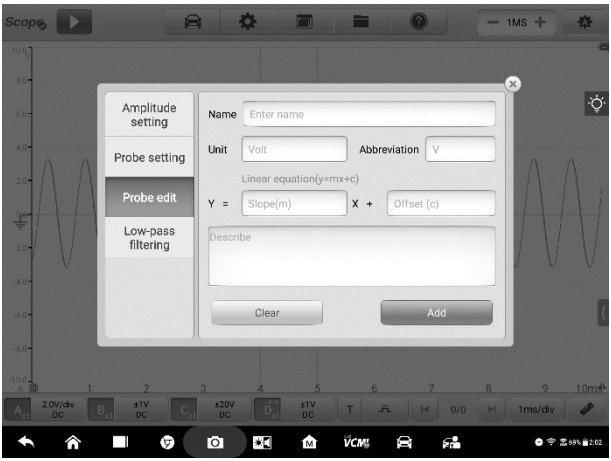


Figure 8-42 *Sample Probe Edit Screen 1*

- **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.

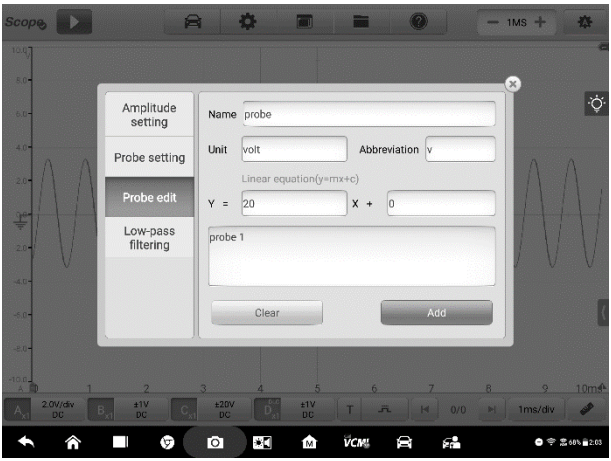


Figure 8-43 *Sample Probe Edit Screen 2*

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.

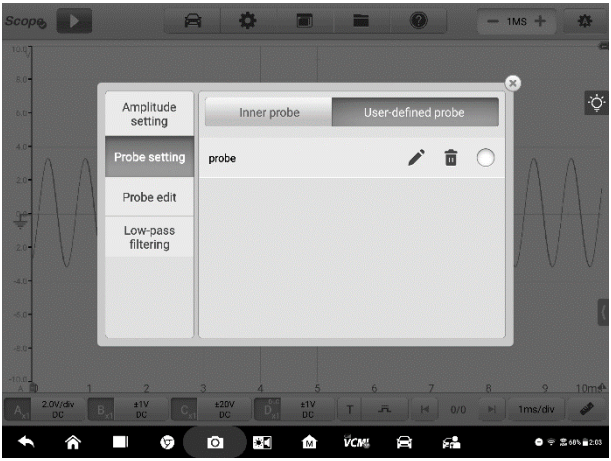


Figure 8-44 *Sample Probe Edit Screen 3*

LPF (Lowpass Filtering)

The lowerpass filtering (LPF) is an independent digital lowpass 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 lowpass filtering. Figures 8-45 and 8-46 show the difference between waveforms with the lowpass filtering and waveforms without the lowpass filtering.

NOTE
The lowerpass filtering (LPF) is only available via USB connection.

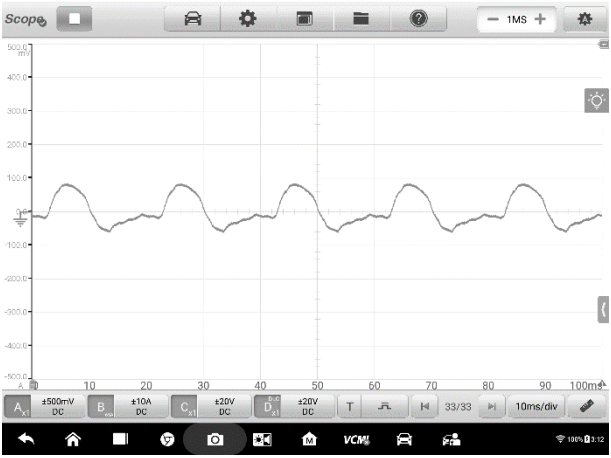


Figure 8-45 ***Before Setting Lowpass Filtering Screen***

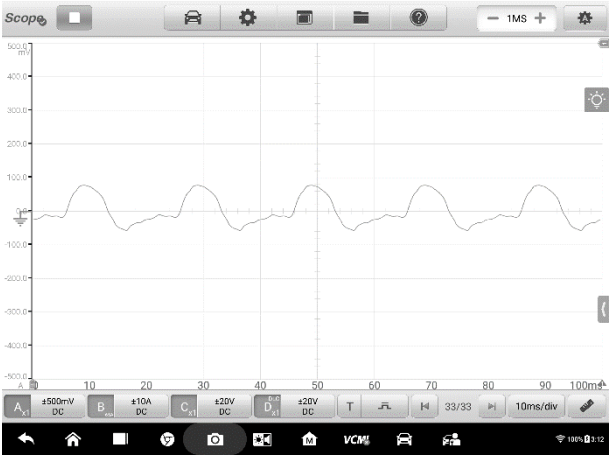


Figure 8-46 ***After Setting Lowpass Filtering Screen***

- **To configure the lowpass filtering settings**

1. Tap the right column of the channel control button to open the setting dialog box.
2. Select the **LPF (Lowpass 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.

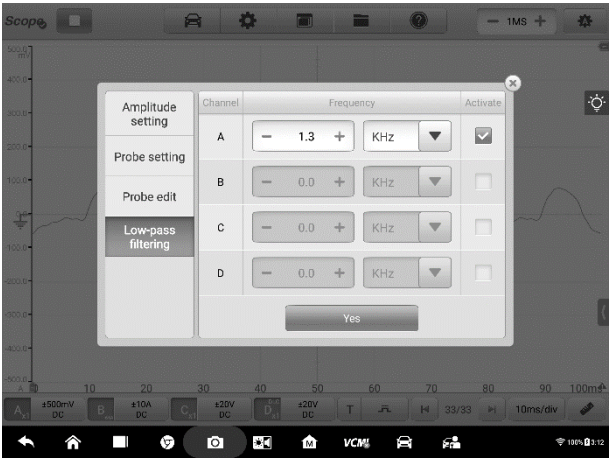


Figure 8-47 *Sample Lowpass Filtering Screen*

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.