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All information, specifications and illustrations in this manual are based on the latest information available at the time of printing.

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Autel will not be liable for any direct, special, incidental, indirect damages or any economic consequential damages (including lost profits).

❶ IMPORTANT

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

For Services and Support:

pro.autel.com
www.autel.com

1-855-288-3587/1-855-AUTELUS (North America)
0086-755-86147779 (China)

support@autel.com

For details, please refer to the *Service Procedures* in this manual.

Safety Information

For your own safety and the safety of others, and to prevent possible electrical shock, fire, or damage to the device, your computer or the MaxiSys tablet on which it is applied, it is important that the safety instructions herein presented throughout this manual be read and understood by all persons operating, or coming into contact with, the device.

Before using the device, always refer to and follow the safety messages. Read, understand, and follow all safety messages and instructions in this manual. Safety protection built in the device may cease to function if the device is used incorrectly. This could cause damage to your device, or lead to injury to yourself and others. In addition, follow all generally accepted safety practices and procedures for working with and around electricity.

Symbols

These safety and electrical symbols may appear on the product or in this manual.

Symbols	Description
⎓	Direct current.
∿	Alternating current.
⏚	Chassis ground terminal.
▣	Device protected throughout by double insulation or reinforced insulation.
⚡	Possibility of electric shock.
⚠	Warning.
⚠	Static awareness. Static discharge can damage parts.
CAT	EN61010 measurement category.
♺	Do not dispose of this product as unsorted municipal waste.

Safety Messages

Safety messages are provided to help prevent personal injury and equipment damage. All safety messages are introduced by a signal word indicating the hazard level.

DANGER: Indicates conditions or practices that could result in death or serious injury to the operator or to bystanders.

WARNING: Indicates conditions or practices that could result in damage to the product or equipment to which it is connected.

Safety Instructions

The safety messages herein cover situations Autel is aware of. Autel cannot know, evaluate or advise you as to all of the possible hazards. You must be certain that any condition or service procedure encountered do not jeopardize your personal safety.

Maximum input ranges

Observe all terminal ratings and warnings marked on the product.

DANGER:

- To prevent electric shock, operate within the safe input range for the scope, refer to *Technical Specifications* on page 4.
- To prevent electric shock, take all necessary safety precautions when working on equipment where voltages above the specified input range may be present. 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 mains (line power). To measure mains voltages, use a differential isolating probe specifically rated for mains use.

WARNING:

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

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 it.

⚠ 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.

External connections

⚠ DANGER:

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

Environment

⚠ DANGER:

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

⚠ WARNING:

● To prevent damage, always use and store your oscilloscope in appropriate environments. For detailed information on temperature and humidity specifications for both the storage and usage of the oscilloscope, see *Technical Specifications* on page 4.

Product Maintenance

The product contains no user-serviceable parts. Repair, servicing and calibration require specialized test equipment and must only 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, and stop use immediately if you are concerned by any abnormal operations.

⚠ 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 as overheating will cause damage to the oscilloscope.
- When cleaning the oscilloscope, use wet soft cloth with mild detergent in water. Do not allow water to enter the oscilloscope casing, as this will cause damage to the electronics inside.

CONTENTS

1 Using This Manual

This manual contains device usage instructions.

Some illustrations shown in this manual may contain features and optional equipment that are not included on your system. Contact your sales representative for availability of other features and optional tools or accessories.

Conventions

The following conventions are used.

Bold Text

Bold text is used to highlight selectable items such as buttons and menu options.

Example:

- Click **OK**.

Terminology

The term "select" means highlighting a button or menu item and clicking it to confirm the selection.

Notes and Important Messages

The following messages are used.

Notes

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

A "*****" or "******" symbol indicates that a related **NOTE** is written following the specific content.

Important

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

Hyperlinks

Hyperlinks or links that take you to other related articles, procedures, and illustrations are available in electronic documents. Blue italic text indicates a selectable hyperlink and blue underlined text indicates a website link or an email address link.

Illustrations

Illustrations used in this manual are samples, and the actual testing screen may vary for each vehicle being tested. Observe the menu titles and on-screen instructions to make correct option selection.

Procedures

An arrow icon indicates a procedure.

Example:

➢ **To install the Setup.exe program**

1. Download the MaxiScope PC Suite from www.autel.com > Products > MaxiScope MP408 > Downloads.
2. Click on **Next** on the welcome page.
3. Click the **Change** button, and select a destination folder to install the program, and click **Next** to continue. Or directly click **Next** to continue without changing the default installation folder.
4. Click **Install** and the Setup.exe program will be installed onto the computer.

2 **General Introduction**

The MaxiScope™ MP408 is a Windows PC based 4-channel automotive oscilloscope. It works in combination with your PC or MaxiSys Tablet, which turns into a powerful diagnostic tool, showing you what is really going on with a vehicle's electronic circuits. The system can be used to measure and test almost all of the electrical and electronic components and circuits in any modern vehicles.

Power for the MaxiScope MP408 Module comes directly from the USB port of the connected PC, so no batteries or power leads are required, making the system very versatile and portable to use.

This manual describes the construction and operation of the product and how it works to deliver test results.

MP408 Scope Module

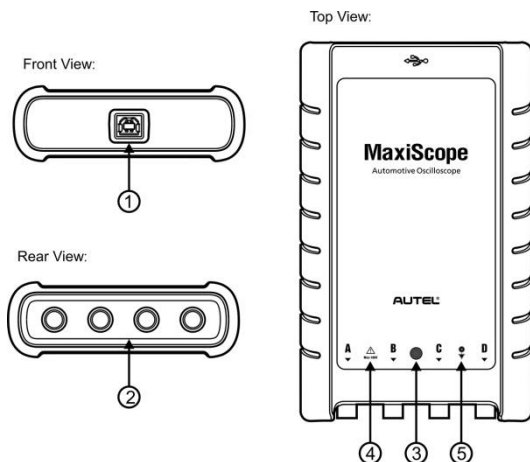### **Functional Description**

Figure 2-1 *Front, Rear, and Top View*

1. **USB Port Connector**

2. **Input Channel A/B/C/D**
3. **LED Breath Light** – lights up when powered on, blinks when communicating, and shimmers when error occurs
4. **Warning Triangle** – indicates potential safety hazard that exists on the indicated connections, and appropriate precautions should be taken. Make sure you read through the *Safety Information* before using.
5. **Equipotential Symbol** – indicates the outer shells of the indicated BNC connectors are all at the same potential. Therefore, necessary precautions should be taken to avoid applying a potential through the return connections of the indicated BNC terminals, as this may result in a large current flow, causing damage to the product and the connected equipment.

Power Source

The MaxiScope MP408 Scope Module is powered directly by the USB port of the connected PC, no batteries or power leads are required, making it suitable for use both for workshop-based and mobile automotive diagnostics.

Technical Specifications

Table 2-1 *Specifications*

Main Features	Description
Vertical resolution	12 bits
Channels	4
Bandwidth	20MHz
Accuracy	1%
Sensitivity	10mV/div to 20V/div
Input Ranges (full scale)	±50mV to ±100V in 11 ranges
Input Impedance	1MΩ in parallel with 22pF
Input Type	Single-ended, BNC connector
Input Coupling	Software selectable AC/DC
Overload Protection	±200V on single input

Maximum Sampling Rate (Single Shot)	
1 and 2, or 3 and 4 channels in use	20MS/s*
1 and 3 or 4, 2 and 3 or 4 channels in use	80MS/s
Buffer Memory	32M samples shared among active channels
Waveform Buffer	Up to 1000 waveforms
Timebase Ranges	100ns/div to 1000s/div
Advanced Features	Math channels, Measurements
Triggers	**Description**
Source	Any input channel
Basic Triggers	Auto, Repeat, Single, None
Advanced Triggers	Rising edge, Falling edge
Environmental	**Description**
Operating Temp. Range	0 to 50°C (15 to 40°C for quoted accuracy)
Storage Temp. Range	-20 to +60°C
Storage Humidity Range	5 to 95%RH, Non-condensing
Physical Characteristics	**Description**
Dimensions (Protection rubber case included)	190x115x38 mm
Weight	<0.5 kg
General	**Description**
PC Interface	USB 2.0 – cable supplied
Power Requirements	Powered from USB port
Compliance	FCC (EMC), CE (EMC and LVD), RoHS
Warranty	1 year

NOTE*
Reduced to 20MS/s if channels A and B, or C and D, are enabled.

Accessory Kit

The table below gives descriptions of the hardware and accessories supplied with the package.

Table 2-2 *Accessories*

Image	Description & Quantity
	1.5m USB Cable - X1 Connects the Scope Module to the computer.
	3m (10ft) Screened Test Leads - X4 BNC to 4mm. Connects the Scope Module to a test probe. Screened to keep out electrical interference.
	Secondary Ignition Pickup - X1 For safe probing of HT leads without danger from high voltages.
	2-pin Breakout Lead - X1 For standard 2-pin sensors and actuators. With 4mm plugs to connect to MaxiScope test leads.
	Attenuators 20:1 - X2 Extends the range of the MaxiScope up to ±400V to deal with primary ignition. See more information at *Attenuators* on page 7.
	Large Crocodile Clip Set - X1 Pair For hands-free probing of wires and small terminals.
	Small Crocodile Clip Set - X1 Pair For hands-free probing of wires and small terminals.
	Acupuncture Probe Set - X1 For back-probing connectors without cutting or piercing the insulation. Accepts 4mm plugs.
	Multimeter Probes – X1 Pair For making voltage measurements. Accepts 4mm plugs.

Image	Description & Quantity
	HT306 6-Way Universal Breakout Leads (optional) Break into almost any connector up to 6 ways. Accepts 4mm plugs. (4 sizes supplied: 0.6 mm / 1.5 mm / 2.3 mm / 2.8 mm)
	60cm Spark Plug Extension Lead (With Ground Leads) (optional) Fits between coil pack and spark plug to give access to the HT lead. Suitable for use with secondary ignition pickup.
	65A Current Clamp (optional) Screened cable with BNC connector to keep out electrical interference.
	650A Current Clamp (optional) Screened cable with BNC connector to keep out electrical interference.
	60MHz High-speed Probe (optional) For accurate measurement of fast signals like CAN bus and FlexRay. Standard BNC plug.
	Fuse Extension Lead (20A/30A) (optional) In both mini and standard sizes. Plug the original fuse into the lead; plug the lead in the fuse socket, then use a current clamp to measure fuse current.

Attenuators

The attenuator supplied with the MaxiScope kit is a small adapter, usually connected to the BNC connectors between the Scope Module and the test lead; it is used to scale down the voltage input to the scope module when the measured voltage is likely to exceed 100 volts.

Each channel fitted with an attenuator must be configured using the Probes Menu. This ensures that the voltages displayed by MaxiScope are correct.

The AC/DC dropdown menu is available on each of the control pane which allows users to select AC or DC measurements.

3 Getting Started

The MaxiScope MP408 is a Windows PC based automotive oscilloscope. Make sure to install the MaxiScope PC software before connecting the scope module for the first time.

Some illustrations shown in this manual may contain options or functions that are not included on your system. Contact your sales representative for availability of these features.

System Requirements

To ensure the MaxiScope operates correctly, use a computer with at least the minimum system requirements as shown in the table below. A more powerful PC will improve the performance of the MaxiScope software.

Table 3-1 *System Requirements*

Item	Minimum Specification	Recommended Specification
Operating System	Windows XP (SP3), Windows 7, and Windows 8, Windows 10. 32-bit or 64-bit (not for Windows RT)	
Processor	300MHz	1GHz
Memory	256MB	512MB
Free disk Space*	1GB	2GB
Ports	USB 1.1 Port	USB 2.0/3.0 Port

⌀ NOTE*

1. The operating systems should be Professional and higher versions. The MaxiScope software is not supported by Home version of operating systems.
2. The MaxiScope software does not use all the disk space specified in the table. The free space is required to make Windows run efficiently.

Install MaxiScope Software

The MaxiScope Software is a processing program that runs on the computer, which presents as an operating interface displaying waveforms and menus, allowing you to set the testing options, triggers, probe types and various configurations.

➢ **To install the Setup.exe program**

1. Download the MaxiScope PC Suite from www.autel.com > Products > MaxiScope MP408 > Downloads.

2. Unzip the downloaded file, and click **setup.exe** to install the software, and then click **Next** to continue.

3. Click the **Browse** button, and select a destination folder to install the program, and click **Next** to continue. Or directly click **Next** to continue without changing the default installation folder.

4. Click **Install** and the Setup.exe program will be installed onto the computer.

Power Up

After the software is successfully installed, connect the Scope Module to the computer using the USB cable supplied. The LED breath light on the top of the module will light solid green when powered up.

When connecting the MaxiScope to the computer for the first time, the **New Hardware Found Wizard** window will pop up. Follow its instructions onscreen to finish the process, which runs automatically. You can install the driver manually from the Device Manager if the automatic installation failed.

Select **MaxiScope** from the Windows **Start** menu.

If the Scope Module has a probe connected, touching the probe tip with a finger will show a small 50Hz or 60Hz signal on the operating interface.

Power Down

The Scope Module is automatically powered off when disconnected from the computer. To make sure all test results are collected and recorded, always close the MaxiScope Software before disconnecting the Scope Module.

Troubleshooting

This part describes problems you may encounter while using the device.

PC Communication Error

If you cannot communicate the Scope Module to the computer, you need to do the following check-ups:

- ✓ Check if the USB connection is properly connected between the Scope Module and the PC.
- ✓ Check if the LED breath light on the Scope Module is illuminated. If the LED light is shimmering, this indicates that a communication error has occurred. In this case, unplug the Scope Module and re-connect it to the computer.
- ✓ Check if there is any firewall software interfering with the connection port.

4 **Software Operations**

The main purpose of oscilloscope MaxiScope MP408 is to display electronic signals, transfer electronic signals into waveform curves. By observing the waveform curves, users can determine whether the electronic component is working properly. It can be used in a wide range of industries, including Computer Science, Automotive Electronics, Mobile Phone Manufacture, Military Aviation, Power Supply and other industries related with electronic signals. Below is the introduction of the layout of the MaxiScope main screen, other functions will be described in the following sections.
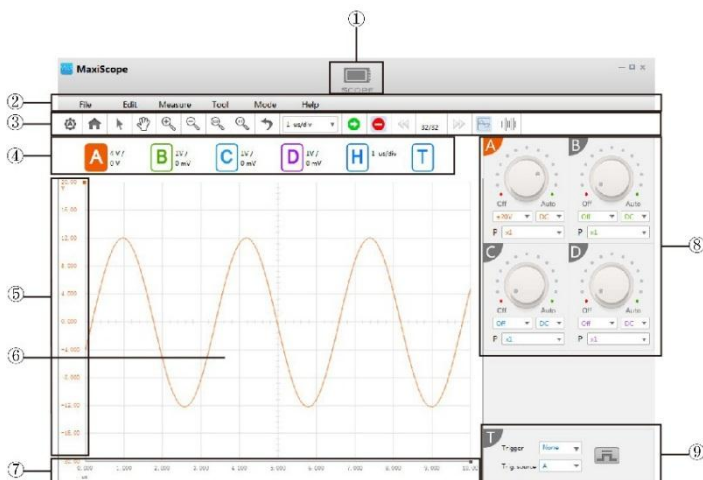
Software Layout

Figure 4-1 *MaxiScope MP408 Software Layout*

1. Connection Status Icon
2. Menu Bar
3. Tool Bar
4. Channel Status Bar
5. Amplitude Coordinate

6. Waveform Display Section
7. Time Coordinate
8. Channel Setting Pane
9. Trigger Setting Pane

MaxiScope Basics

Connection Status Icon

The Connection Status Icon displays in two modes: Blue indicates the MaxiScope MP408 is connected to the PC software; Gray indicates disconnection. The figure below shows the disconnection status.
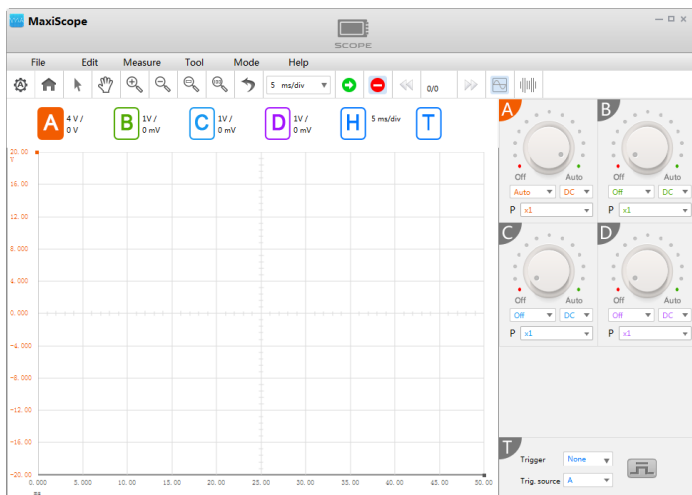

Figure 4-2 *Disconnection Status*

MaxiScope Window

The MaxiScope Window shows a block of data captured from the oscilloscope using four channels. The captured data will display in waveform in multiple windows (64 at most). The image below shows all the basic information of the MaxiScope Window.
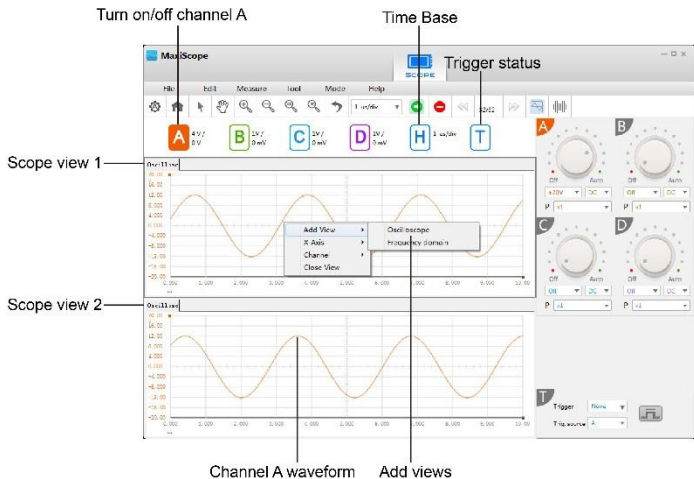
Turn on/off channel A

Time Base

Scope view 1 ──── Channel A waveform

Scope view 2 ──── Add views

Figure 4-3 *MaxiScope Window*

Turn on/off channel A: Click A/B/C/D icon to turn on/off the selected channel. Channel A is turned on while others off by default.

Time base: The time length indicated by the measurement unit.

Trigger status: Trigger on/off. Please refer to *Trigger Setting Pane* on page 17 for details.

Scope view: Add more views by right click and select **Add View**.

MaxiScope View Mode

Normal Mode

In Normal Mode, waveforms are captured when the time base is shorter than 200ms/div, and incontinuous between screens.

Continuous Mode

In Continuous Mode, waveforms are captured when the time base is longer than 200ms/div, and continuous between screens.

XY Mode

In XY Mode, the oscilloscope shows a graph of one channel plotted against another. XY Mode is useful for demonstrating the relationship between

periodic signals (using Lissajous figures) and for plotting I-V (current-voltage) characteristics of electronic components.

The figure below shows the comparison between XY mode view and Normal mode view.
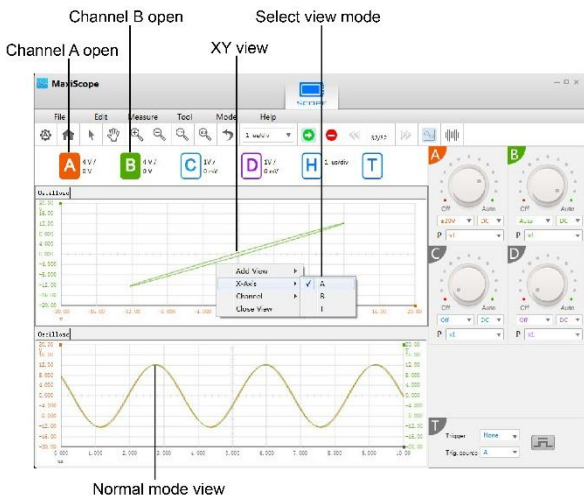

Figure 4-4 *MaxiScope View*

In Figure 4-4, the same periodic signals have been fed into two input channels: Channel A and Channel B. The smooth curvature of the trace cell shows that inputs are sine waves. From one loop of the trace, we can see the frequencies of Channel A and Channel B are the same.

MaxiScope Channel Status Bar

It shows the ON/OFF status of each channel. Every channel displays in a unique color. The screenshot below shows the views with four channels open.

Figure 4-5 *Views with Four Channels*
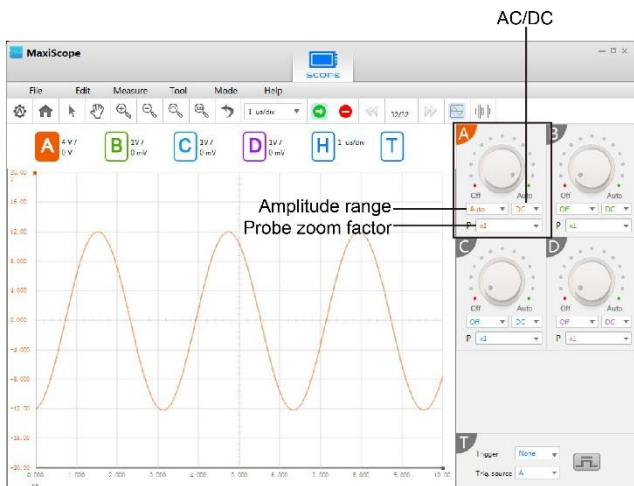
MaxiScope Channel Setting Pane

Figure 4-6 *Channel Setting Pane*

Channel settings: Change channel settings including Amplitude, Probe and AC/DC settings.

Amplitude range: Set the coordinate range of Y-axis.

AC/DC: Alternative current/direct current.

Probe zoom scale: Set the scale based on the specific probe being used.
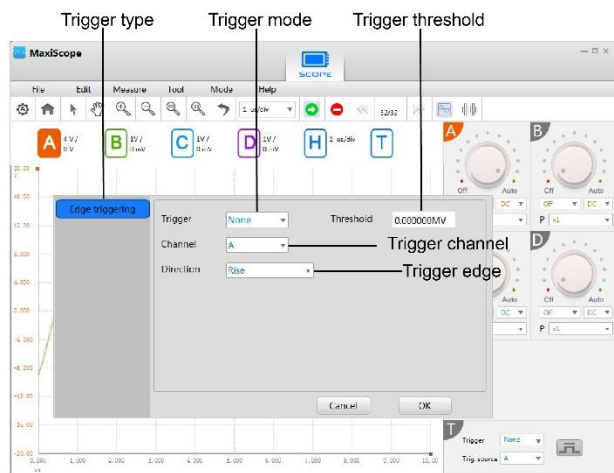
Trigger Setting Pane

Figure 4-7 *Trigger Setting Pane*

Trigger: Used to filter and capture the specified waveform data.

Trigger type: The specified trigger type, it the case above, the trigger type is Edge Triggering.

Trigger mode: There are four trigger modes: None, Auto, Repeat, and Single.

1) None: Capture the data repeatedly and no need to wait for the waveform for triggering.

2) Auto: Automatically start to capture data if the triggered waveform is not captured in a reasonable scale of time.

3) Repeat: Wait for trigger waveform indefinitely before displaying data.

4) Single: Stop to capture data once one waveform is captured.

Trigger threshold: The amplitude of the trigger point.

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Trigger edge: Includes Rise and Fall.

1) **Rise**: Waveform is triggered on Rise edge.
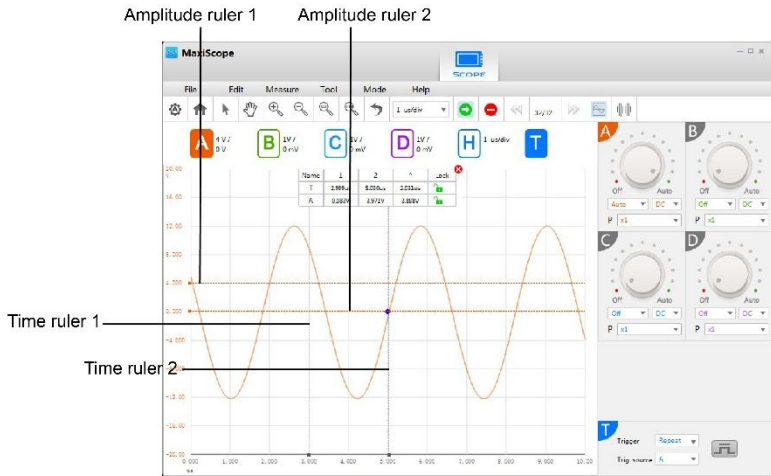2) **Fall**: Waveform is triggered on Fall edge.

Measurement Rulers

Figure 4-8 *Measurement Rulers*

Amplitude ruler: Used to measure relative or absolute signals.

Time ruler: Used to measure relative or absolute time.

MaxiScope Tool Bar

Auto Setup

Click it to set the range of X-axis and Y-axis, and generally waveforms of 3 to 5 periods will display. The range of X-axis and Y-axis will be set at the same time, and time base and amplitude can be set manually for waveform viewing.
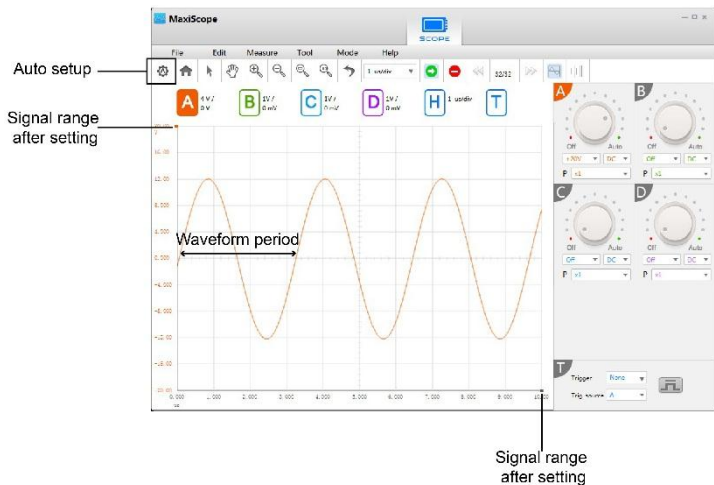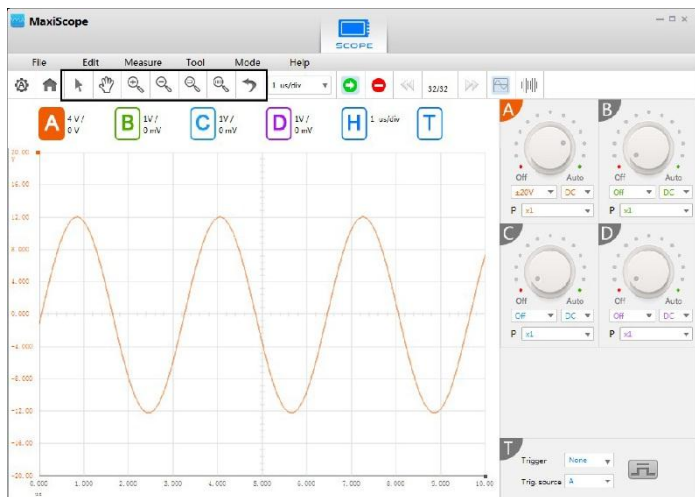
Figure 4-9 *Auto Setup*

Zooming Bar

Figure 4-10 *Zooming Bar*

⌐ **Normal selection tool**: It is used to click buttons, drag rulers, etc. in the MaxiScope window.

- ✋ **Hand tool**: It is used to drag the view vertically and horizontally.

- 🔍 **Zoom-in tool**: It is used to zoom in a specified location.

- 🔍 **Zoom-out tool**: It is used to zoom out a specified location.

- 🔍 **Marquee zoom tool**: It is used to draw a box (a marquee) on the view and MaxiScope will magnify that box to fill the view.

- 🔍 **Zoom to full tool**: It is used to reset the view to normal size.

- ↩ **Undo tool**: It is used to cancel the current operation and return the views to the previous zoom and pan settings.

Time Base

The time for collect one measurement unit of data.

Normal mode: The time base is shorter than 200ms/div.

Continuous mode: The time base is longer than 200ms/div.
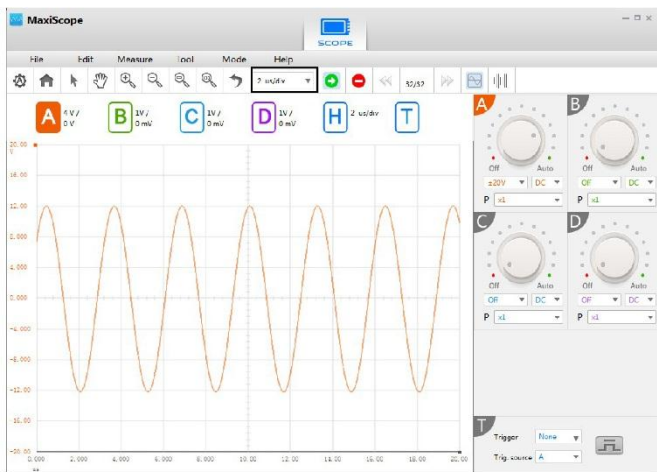
Figure 4-11 *Time Base*

Start/Stop

- 🟢 Click it to start data collection.

- 🔴 Click it to stop data collection.

Waveform Cache

It is used to view the waveform records.
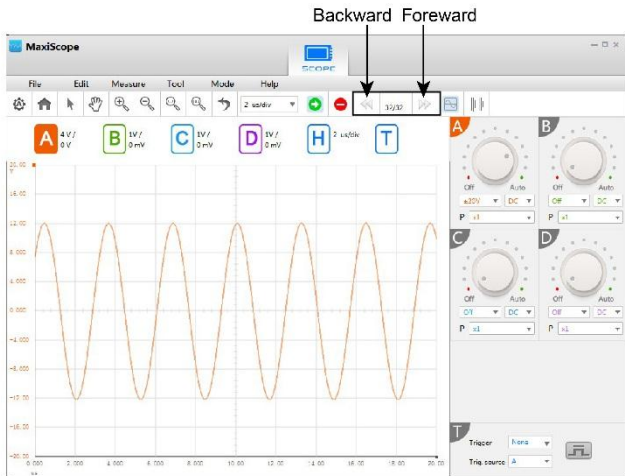
Figure 4-12 *Waveform Cache*

Oscilloscope Mode

It is used with Time Base to set the time of data collection to capture waveform data.
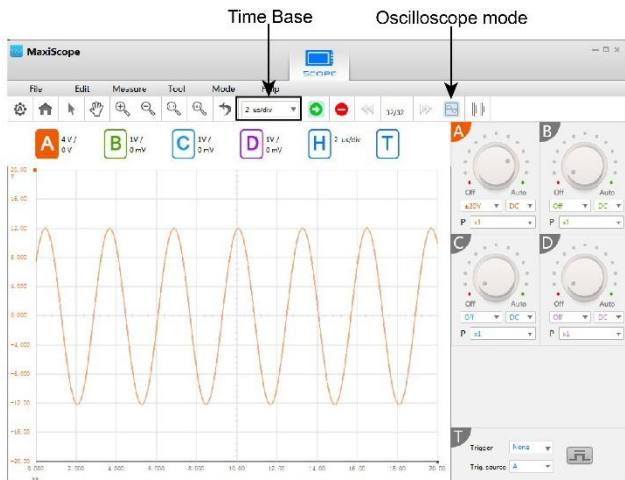
Figure 4-13 *Oscilloscope Mode*

Spectrum Mode

It is used with Current Data Collection Frequency to set the frequency and quantity of data collection. Please refer to *Spectrum Options Dialog* on page 41 for details.
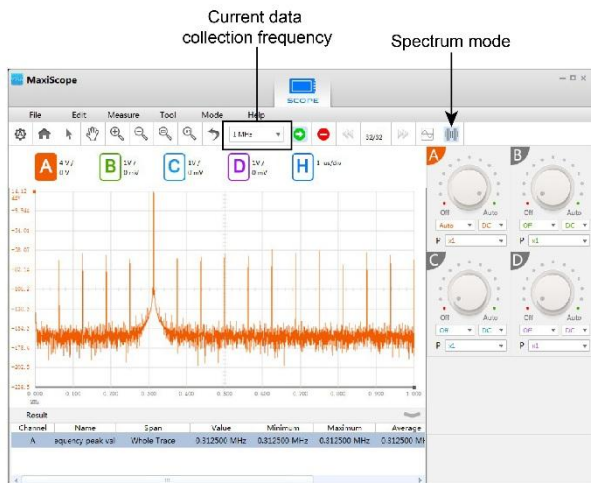
Figure 4-14 *Spectrum Mode*

MaxiScope Menu Bar

File

Connect Device: Used for connecting device, available only when device is not connected.

Open: Load the MSData file saved in MaxiScope and convert the saved data into image.

Save: Save the MSData file.

Save as CSV: Save the CSV file.

Save as text: Save as txt file.

Save as image: Save as BMP or JPG image.

Print and preview: Preview and print the image.

Print: Print the image.

Exit: Exit the MaxiScope application.
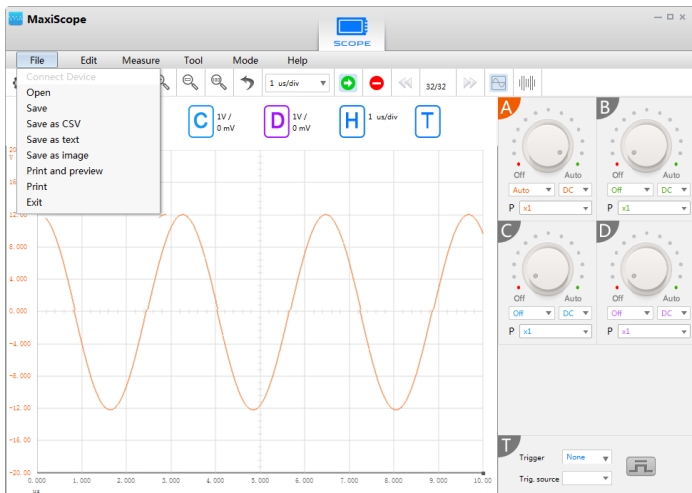
Figure 4-15 *File Tools*

Edit

Copy as Bitmap: Copy the bitmap to clipboard.

Copy as Txt: Copy the waveform data to txt.
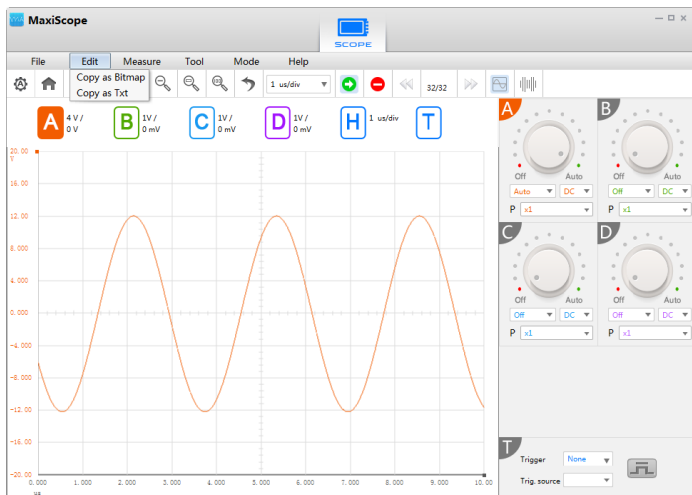
Figure 4-16 *Edit Tools*

Measurement

Right click to **Add Measurement**, **Edit Measurement**, and **Delete Measurement**.
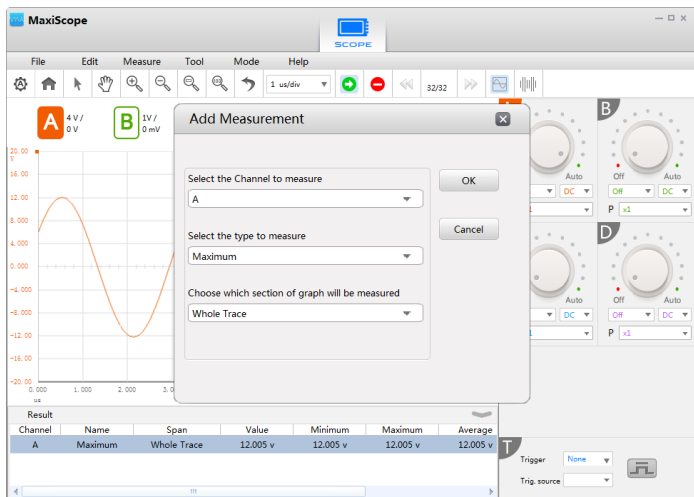
Figure 4-17 *Measurements*

Table 4-1 *Results*

Result	
Channel	Name of the current measurement channel.
Name	Measurement items.
Span	Whole trace of the waveform data.
Value	True value of the current measurement item.
Minimum	The minimum value of the current measurement item since measurement starts.
Maximum	The maximum value of the current measurement item since measurement starts.
Average	The arithmetic average value of 20 captures of the measurement item.
σ	The standard deviation of 20 captures of the measurement item.
Sampling count	Calculate the maximum number of "mean" and "standard deviation" in the measurement results

Table 4-2 *Measurements*

Measurements	
Maximum	The highest level reached by the signal.
Minimum	The lowest level reached by the signal.
Peak to Peak	The difference between Maximum and Minimum.
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.
Cycle Time	The time of a signal cycle.
DC Average	The mean value of the waveform.
Duty Cycle	The amount of time that a signal spends above its mean value, expressed as a percentage of the signal period.
Falling Rate	The rate at which the signal level falls.
Frequency	The number of cycles of the waveform per second.
Rising Rate	The rate at which the signal level rises.
Rising Time	The time the signal takes to rise from the lower threshold to the upper threshold.
Falling Time	The time the signal takes to fall from the upper threshold to the lower threshold.
High Pulse Width	The amount of time that the signal spends above its mean value.
Low Pulse Width	The amount of time that the signal spends below its mean value.
X@Max	The value on the X-axis when the signal on Y-axis reaches to the maximum value.

X@Min	The value on the X-axis when the signal on Y-axis reaches to the minimum value.
Positive Acreage	The acreage of waveform above the zero reference in N full-cycle waveforms displayed on the screen.
Negative Acreage	The acreage of waveform below the zero reference in N full-cycle waveforms displayed on the screen.
Full Acreage	Full positive acreage + full negative acreage
Positive Duty Ratio	(Positive pulse width/period)*100%
Negative Duty Ratio	(Negative pulse width/period)*100%
Top Value	The voltage value when the waveform top to ground.
Bottom Value	The voltage value when the waveform bottom to ground.
Range	The range from top value to bottom value.
Positive Overshoot	(Local maximum – top value)/amplitude*100%
Negative Overshoot	(Bottom value – local minimum)/amplitude*100%
Positive Pre-shoot	(Bottom value – local minimum)/amplitude*100%
Negative Pre-shoot	(Local maximum – top value)/amplitude*100%

Tools

Mathematic Calculation

Math Channel: Operates some basic calculations on the captured data. Currently, only the data from Channel A and B can be processed and at most 4 calculations can be conducted at the same time.
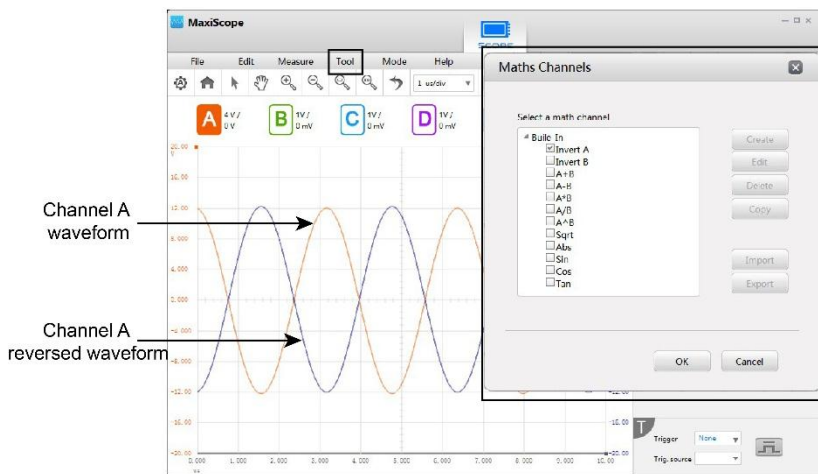
Figure 4-18 *Math Channel*

⊘ **NOTE**

Currently, Sqrt, Abs, Sin, Cos and Tan only support calculations on Channel A data.

Serial Decoding

Decode data from a serial bus, including CAN, LIN, FlexRay, UART/RS232, I²C, SPI, I²S and USB.
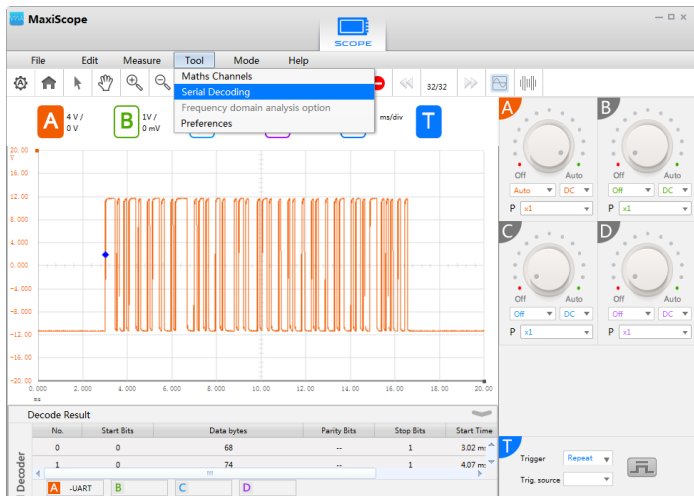
Figure 4-19 *Serial Decoding*

Decoding setting dialog contains three parts: protocol, protocol settings and display setting.

Protocol: There are three options in this table: Channel, Protocol and Enable.

Protocol settings: Set Baud Rate (protocol related), Threshold (for distinguishing high and low electrical levels) and Advanced Settings (protocol related) in this section.

Display settings: Set display format of data in the table.
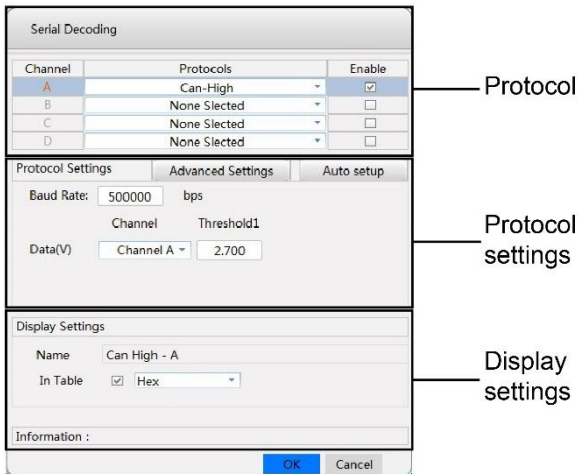
Figure 4-20 *Serial Decoding Settings*

Serial Protocol Introduction

CAN Protocol

CAN (Controller Area Network) is a serial protocol used in automotive and industrial machinery, which allows microcontrollers communicating with each other. MaxiScope can decode CAN_H and CAN_L signals.

Threshold: It is the median between high and low logical electrical levels. It is recommended to set the waveform median as the threshold, or manually adjust this value according to actual condition.

Baud rate: The transmission speed of CAN bus. This value should be set to match the data bus transmission speed.

Display settings: Set the display format of the view.

Figure 4-21 *CAN Protocol Settings*

CAN Protocol Data List

Number (No.): The serial number of frames (decimal). It indicates the CAN protocol frame number that currently decoded.

Frame ID: Identifier (hexadecimal). It is unique for specific data type, the base frame has an 11-bit identifier, and the extended frame has a 29-bit identifier.

RTR: Remote transfer request.

SRR: Used only in extended frame.

IDE: Extended frame identifier.

R0: Reserved bit.

R1: Reserved bit, only for extended frame.

DLC: Data length code. It indicates the number of data bytes.

Data byte: Data content of the packet, DLC byte length (hexadecimal).

CRC sequence: Data cyclic redundancy check (hexadecimal).

CRC delimiter: The fixed bit after the CRC sequence field.

ACK: Node asserts this bit to acknowledge receipt.

ACK delimiter: The fixed bit after ACK field.

Start time: The value of the time base when the frame starts.

End time: The value of the time base when the frame ends.

LIN Protocol

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

Threshold: Used to distinguish the voltage values between high and low logic electrical levels.

Baud rate: Data transmission speed that LIN protocol set in the device.

Display setting: Set the display format of the view.
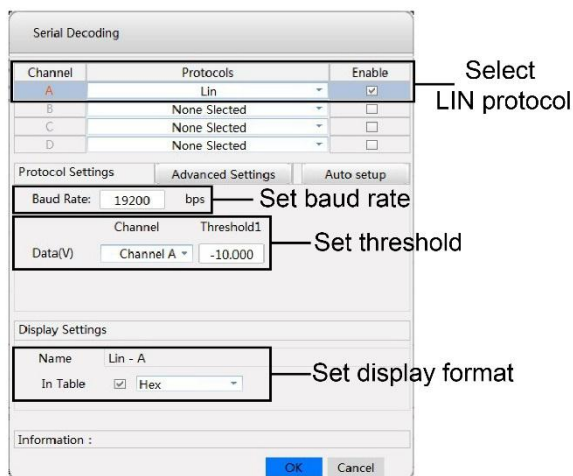
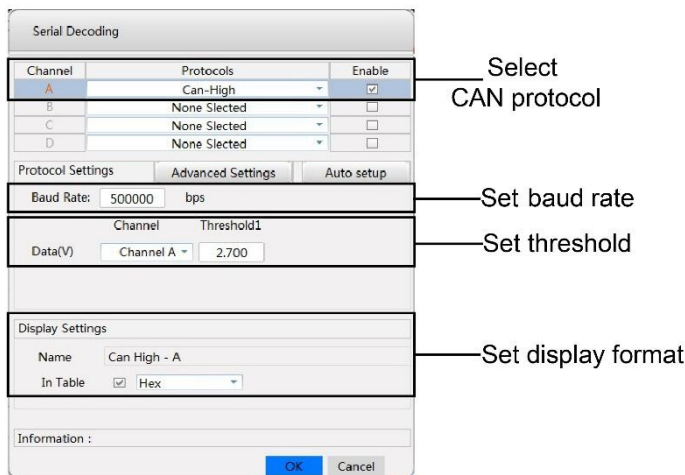**Figure 4-22 *LIN Protocol Settings***

LIN Protocol Data List

Number (No.): The serial number of frames (decimal). It indicates the LIN protocol frame number that currently decoded.

Break: An indicator for frame starting.

Sync: A fixed value (0x55) used for automatic baud rate detection.

Frame ID: Six-bit value of the data type carried by the identification frame.

Data count: The number of bytes of the data in the frame.

Data byte: The data content of the packet.

Checksum: A cyclic redundancy check of the data (hexadecimal).

Start time: The value of the time base when the frame starts.

End time: The value of the time base when the frame ends.

FlexRay Protocol

FlexRay is an automotive network communications protocol for high-speed data. It is designed to be fault-tolerant.

Threshold: Used to distinguish the voltage values between high and low logic electrical levels.

Baud rate: Data transmission speed that FlexRay protocol set in the device.

Display setting: Set the display format of the view.
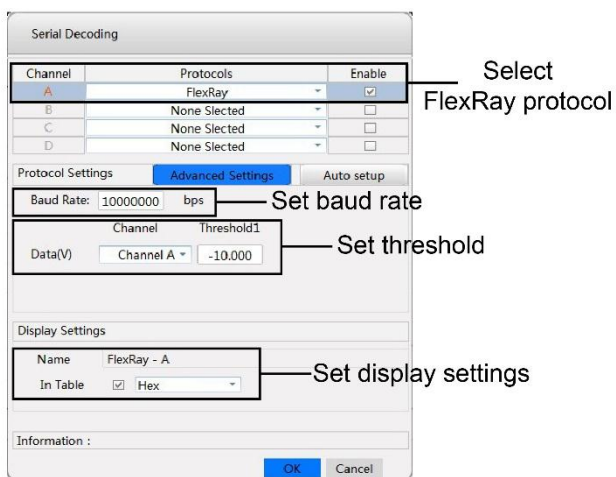
Figure 4-23 *FlexRay Protocol*

FlexRay Protocol Data List

Number (No.): The serial number of frames (decimal). It indicates the FlexRay protocol frame number that currently decoded.

TSS: Transmission starting signal. The frame is bit 0.

FSS: Frame starting signal. The frame is bit 1.

BSS: Byte starting signal. It is a fixed 2-bit code.

Reserved bit: Undefined.

Payload preamble indicator: Indicates the presence of a network management vector or message ID.

Null frame indicator: Indicates that the payload contains no useful payload data.

Sync frame indicator: Indicates whether the frame is a synchronization frame.

Frame ID: Defines the slot in which the frame is transmitted.

Payload length: The number of payload bytes divided by 2.

Header CRC: Cyclic redundancy check of data from the sync frame indicator to the payload length.

Cycle count: Cycler counter.

Payload: 0-254 bytes of the data.

Payload CRC: Frame CRC.

FES: Frame ending signal.

Start time: The value of the time base when the frame starts.

End time: The value of the time base when the frame ends.

UART/RS232 Protocol

RS232 is the serial data standard used by serial or COM ports UART once commonly found on computers. The full standard uses a voltage range of ±12V. The simplest RS232 connection contains two signals: RX (Receive) and Tx (Send).

Threshold: Used to distinguish the voltage values between high and low logic electrical levels.

Baud rate: Data transmission speed that UART/RS232 protocol set in the device.

Display setting: Set the display format of the view.
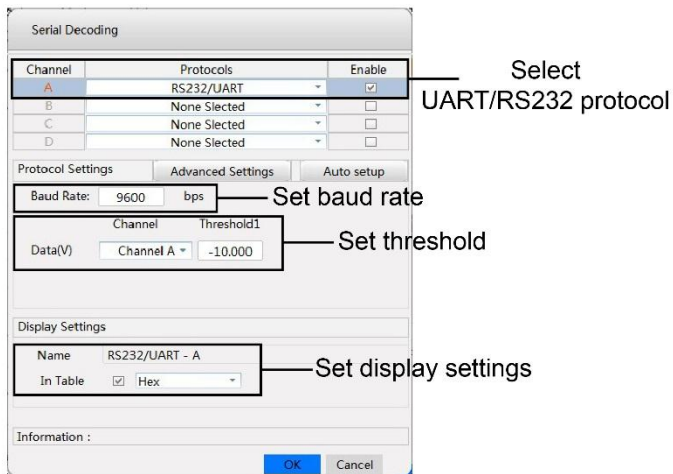
Figure 4-24 *UART/RS232 Protocol*

UART/RS232 Protocol Data List

Number (No.): The serial number of frames (decimal). It indicates the UART/RS232 protocol frame number that currently decoded.

Packet: All packet in this form are classified as data.

Start bit: A fixed bit of 1-bit.

Data byte: The content of the packet.

Parity byte: Error-checking bit at the end of the byte (if available).

End byte: 1-2 bits at the end of the byte.

Start time: The value of the time base when the frame starts.

End time: The value of the time base when the frame ends.

SPI Protocol

SPI (Serial Peripheral Interface) bus is the serial data standard for the communications between microcontrollers and peripherals. It originally used 4-line links, 3-line and 2-line links are also in application, MaxiScope uses 3-line link to analyze this protocol.

CLK: Indicates the channel connected to clock signal.

Clock threshold: Used to distinguish the voltage values between high and low logic electrical levels of the clock signal.

DATA: Indicates the channel connected to data signal.

Data threshold: Used to distinguish the voltage values between high and low logic electrical levels of the data signal.

SEL: Indicates the channel connected to chip select signal.

Chip select threshold: Used to distinguish the voltage values between high and low logic electrical levels of the chip select signal.

Figure 4-25 *SPI Protocol*

SPI Protocol Data List

Number (No.): The serial number of frames (decimal). It indicates the SPI protocol frame number that currently decoded.

Packet: Packet types: start, end, address, data and undefined.

Start bit: The content of the packet.

Start time: The value of the time base when the frame starts.

End time: The value of the time base when the frame ends.

I²S Protocol

I²S (Inter-IC Sound) is a serial protocol used in digital audio devices for communications between circuits such as CD transports and audio DACs. It uses three signals: clock (SCK), word select (WS) and data (SD).

SCL: Indicates the channel connected to clock signal.

Clock threshold: Used to distinguish the voltage values between high and low logic electrical levels of the clock signal.

SDA: Indicates the channel connected to data signal.

Data threshold: Used to distinguish the voltage values between high and low logic electrical levels of the data signal.

WS: indicates the channel connected to word select (WS) signal.

WS threshold: Used to distinguish the voltage values between high and low logic electrical levels of the chip select (WS) signal.
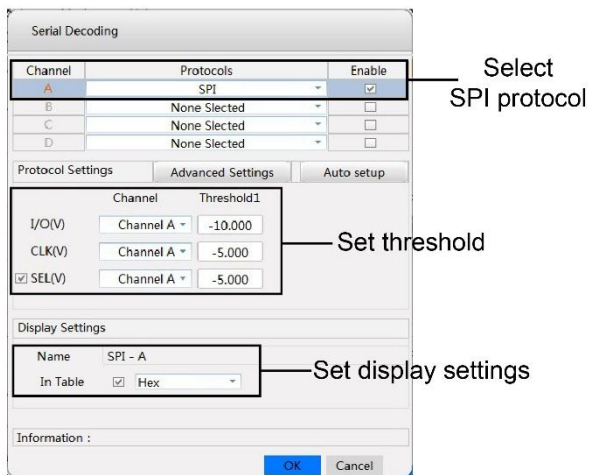
Figure 4-26 *I²S Protocol*

I²S Protocol Data List

Number (No.): The serial number of frames (decimal). It indicates the I²S protocol frame number that currently decoded.

Packet: All packet in this form are classified as data.

Start bit: The content of the packet.

Start time: The value of the time base when the frame starts.

End time: The value of the time base when the frame ends.

I²C Protocol

I²C (Inter-Integrated Circuit) is a serial protocol used in consumer electronics for communications between components on the same electric board and between computers and monitors. It uses two signals: clock (SCL) and data (SDA).

SCL: Indicates the channel connected to clock signal.

Clock threshold: Used to distinguish the voltage values between high and low logic electrical levels of the clock signal.

SDA: Indicates the channel connected to data signal.

Data threshold: Used to distinguish the voltage values between high and low logic electrical levels of the data signal.
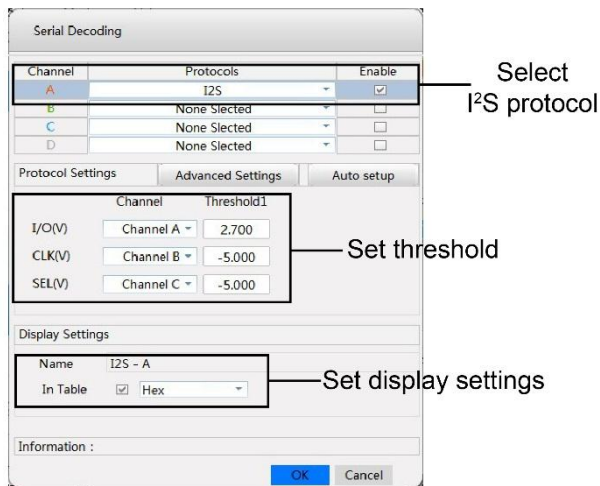

Figure 4-27 I^2C Protocol

I^2C Protocol Data List

Number (No.): The serial number of frames (decimal). It indicates the I^2C protocol frame number that currently decoded.

Packet: Packet types: start, end, address, data and undefined.

Address: Shown for address packets.

R/W: Polarity of the read/write flag.

Data byte: The content of the packet.

ACK: Whether the address confirms the packet.

Start time: The value of the time base when the frame starts.

End time: The value of the time base when the frame ends.

USB Protocol

All USB (Universal Serial Bus) data communications (both uplink communication and downlink communication) are launched by the USB host, therefore the USB host dominates the whole data transmission process. Only one host can exist in the USB system.

D-: Indicates the channel connected to data signal.

Clock threshold: Used to distinguish the voltage values between high and low logic electrical levels of the clock signal.

D+: Indicates the channel connected to data signal.

Data threshold: Used to distinguish the voltage values between high and low logic electrical levels of the data signal.
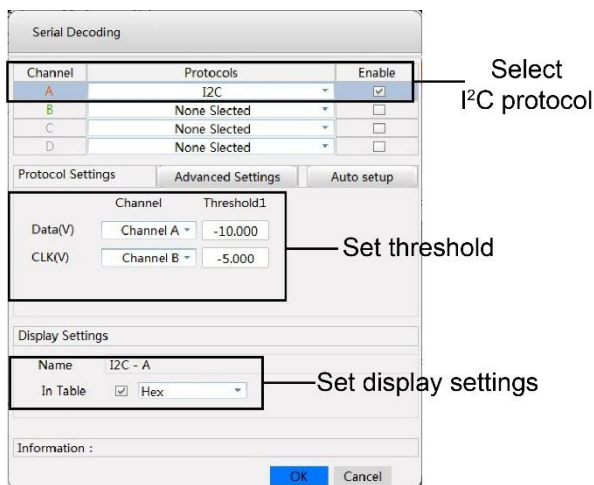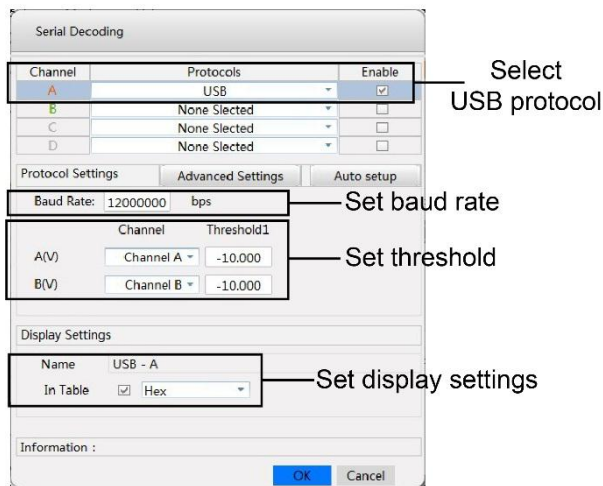

Figure 4-28 *USB Protocol*

USB Protocol Data List

Number (No.): The serial number of frames (decimal). It indicates the USB protocol frame number that currently decoded.

Sync: An 8-bit preamble for each data packet to synchronize the packet transmission rate of the USB device with the bus. The value has a fixed bit 00000001.

PID field: Used to indicate the packet type, including token, data, handshake and special.

Data field: Used to carry the information to be transited between the host and the device. The content and length vary by identifier and transmission type. In the USB packet, the data segment may contain the device address, endpoint number, frame serial number, data and other content.

CRC: The number of bits in CRC data vary by packet type. Important data uses CRC16 data field while others use CRC5.

Start time: The value of the time base when the frame starts.

End time: The value of the time base when the frame ends.

Spectrum Options Dialog

Click **Tool** > **Frequency domain analysis option** from the Menu Bar and the window below displays.
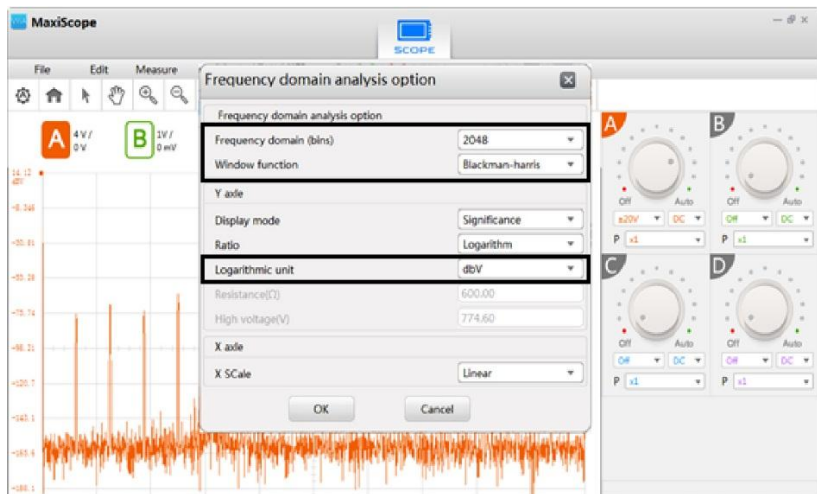

Figure 4-29 *Spectrum Options Dialog*

Generally, the default configuration works for most applications, but occasionally the two highlighted part in the above image need to be configured as well.

Spectrum bins: The number of frequency bins into which the spectrum is divided. It is used to set the maximum number of frequency bins, which the software may or may not be able to provide depending on other settings. The main constraint is that the number of the windows cannot exceed half the number of samples in the source waveform. If the source waveform contains fewer samples that required (that is, fewer than twice the number of the frequency bins), then MaxiSope will zero-pads the waveform up to the next power of two. For example, if the scope view contains 10,000 samples, and you set Spectrum Bins to 16,384, then MaxiScope zero-pads the waveform to 16,384 samples, which is the nearest power of two above 10,000. It then uses 16,384 samples to provide 8192 frequency bins, not the 16,384 requested. If the source waveform contains more samples that required, then MaxiScope uses as many samples as necessary, starting from the beginning of the waveform buffer. For example, if the source waveform contains 100,000 samples and you request 16,384 frequency bins, MaxiScope needs only 2 x 16,384 = 32,768 samples, so it uses the first 32,768 samples from the waveform buffer and ignore the rest.

Window Function: Allows you to choose one standard window function to reduce the effect of operating on a time-limited waveform.

Table 4-3 *Window Function*

Window	Main peak width (bins @-3 dB)	Highest side lobe (dB)	Side lobe roll-off (dB/octave)	Remarks
Blackman	1.68	-58	18	Often used for audio work
Gaussian	1.33 to 1.79	-42 to -69	6	Gives minimal time and frequency errors
Triangular	1.28	-27	12	Also called Bartlett window
Hamming	1.30	-41.9	6	Also called raised sine-squared; used in speech analysis

Hann	1.20 to 1.86	-23 to -47	12 to 30	Also called sine-squared; used for audio and vibration work
Blackman-Harris	1.90	-92	6	General-purpose
Flat-top	2.94	-44	6	Negligible pass-band ripple; used mainly for calibration
Rectangular	0.89	-13.2	6	No fading; maximal sharpness; used for short transients

Display mode: The current version only support importance.

Logarithmic unit: Indicates the logarithmic unit used on Y-axis.

Sampling Frequency Setting

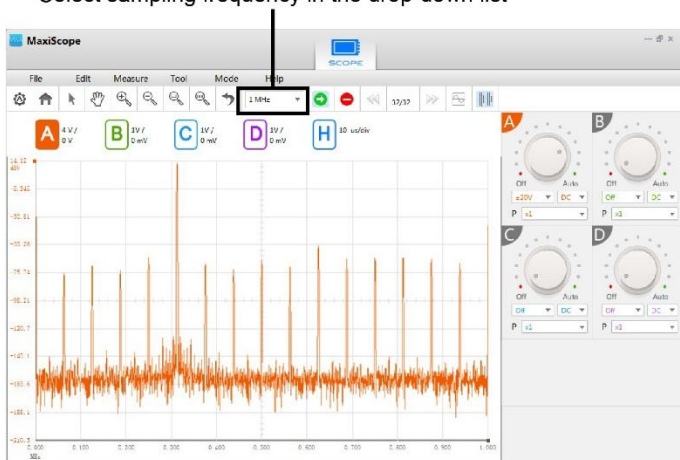Select sampling frequency in the drop-down list

Figure 4-30 *Sampling Frequency Setting*

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It is recommended to use twice the signal frequency (s) as the sampling frequency (fs) to ensure the sampling theorem is met without causing distortion and also eliminate unnecessary noise.

Spectrum Measurements

Select **Spectrum Mode** on the Tool Bar, and then click **Measure** > **Add Measurement** from the Menu Bar, the window below displays.
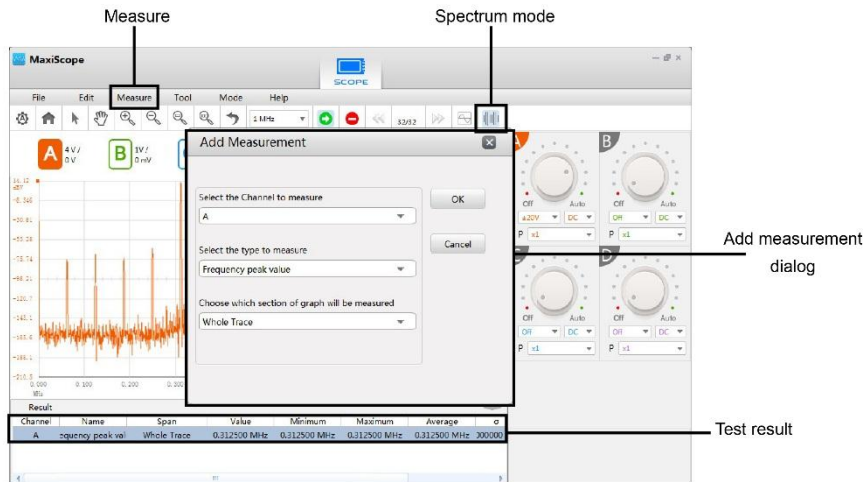
Figure 4-31 *Spectrum Measurements*

Frequency at peak: The frequency at which the peak signal value appears.

Amplitude at peak: The amplitude of the peak signal value.

Average amplitude at peak: The amplitude of the peak signal value averaged over a number of captures.

Total power: The power of the whole signal captured in the spectrum view, calculated by adding the powers in all spectrum bins.

Total harmonic distortion (THD)%: The ratio of the sum of harmonic powers to the power at the fundamental frequency.

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

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Total harmonic distortion dB (THD): The ratio of the sum of harmonic powers to the power at the fundamental frequency.

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

Total harmonic distortion plus noise (THD+N): The ratio of the harmonic power plus noise to the fundamental power. The THD+N values are always greater than the THD values for the same signal.

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

Spurious-free dynamic range (SFOR): This is the ratio of the amplitude of specific point (generally, the highest peak) in the spectrum to that of the second highest peak (it is called the SFDR frequency). SFDR frequency is not necessarily a harmonic of the fundamental frequency. For example, it might be a strong, independent noise signal.

Signal to noise and distortion ratio (SINAD): The ratio, in decibels, of the signal-plus-noise-plus-distortion to noise-plus-distortion.

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

Signal to noise ratio (SNR): The ratio, in decibels, of the signal to noise. Hanning or Blackman windows are recommended because of their low noise.

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

Intermodulation distortion (IMD): A measure of the distortion caused by the nonlinear mixing of two tones. When multiple signals are injected into a device, modulation or nonlinear mixing of these two signals can occur. For input signal at frequencies f1 and f2, the two second-order distortion signals will be found at frequencies: f3 = (f1 + f2) and f4 = (f1 – f2). IMD is expressed

as the dB ratio of the RMS sum of the distortion terms to the RMS sum of the two input tones. IMS can be measured for distortion terms of any order, but the second-order terms are most commonly used. In the second-order case, the intermodulation distortion is given by:

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

Where F_3 AND F_4 are the amplitudes of the two second-order distortion terms (at frequencies f3 and f4 defined above) and F_1 and F_2 are the amplitudes of the input tones (at frequencies f1 and f2, as marked by the frequency rulers in the spectrum window). For reference, the third-order terms are at frequencies $(2F_1 + F_2)$, $(2F_1 - F_2)$, $(F_1 + 2F_2)$ and $(F_1 - 2F_2)$.

✐ **NOTE**

Hanning or Blackman windows are recommended because of their low noise. An FFT size of 4096 or greater is recommended in order to provide adequate spectral resolution for the IMD measurements.

Preferences

Language of the software can be set in **Preferences**, Chinese, English, German and Spanish are supported for now.

Figure 4-32 *Preferences*
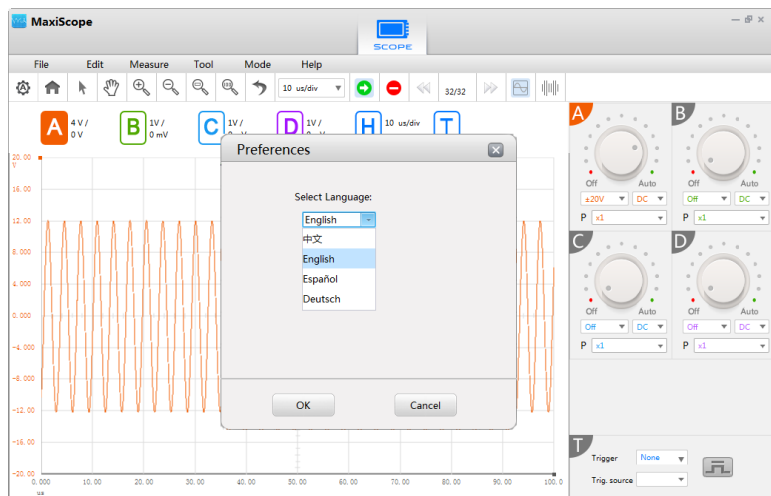
Mode

Normal Mode

It is used to connect to the signal source to capture hardware data and view and waveform. When there is no input signal, the software shows as below.
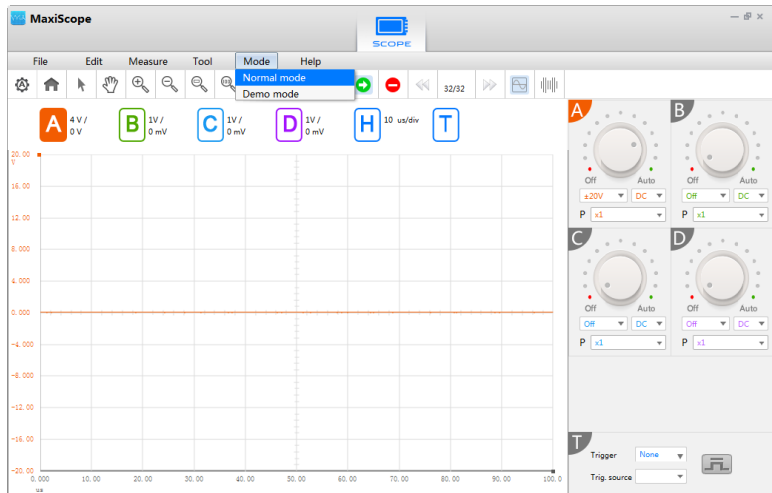

Figure 4-33 *Normal Mode*

Demo Mode

Allows user to use MaxiScope for demonstration when no signal source is connection. The following image shows the status when no signal source is connected.
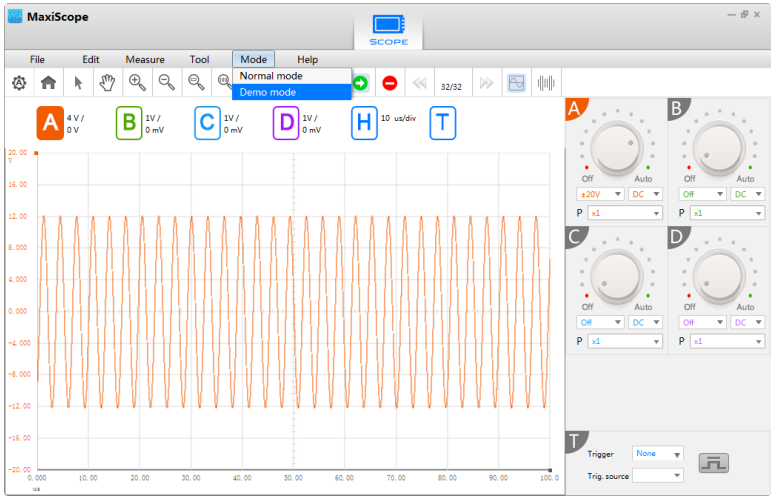
Figure 4-34 *Demo Mode*

Help

About: Used to check the hardware version number and software version number and other information about the device.
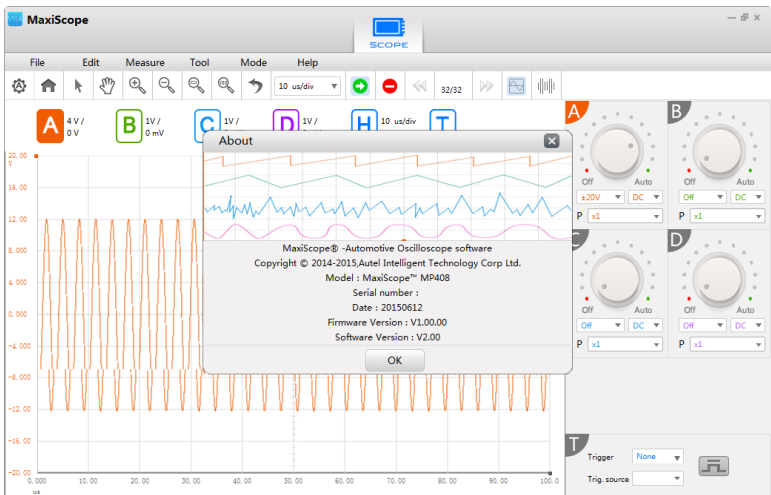
Figure 4-35 *About*

Check update: Provides software and firmware update. Connect to the internet to check new updates are available. Users can choose to update online or download the update file to the computer first and then select local update to complete updating.

Online update: Update the software and firmware online.

Local update: Download the update file to the computer form www.autel.com, then select Local Update to complete updating.

Figure 4-36 *Update*

5 Product Service

This section introduces information for technical support, repair service, and application for replacement or optional parts.

Service Procedures

This section introduces information for technical support, repair service, and application for replacement or optional parts.
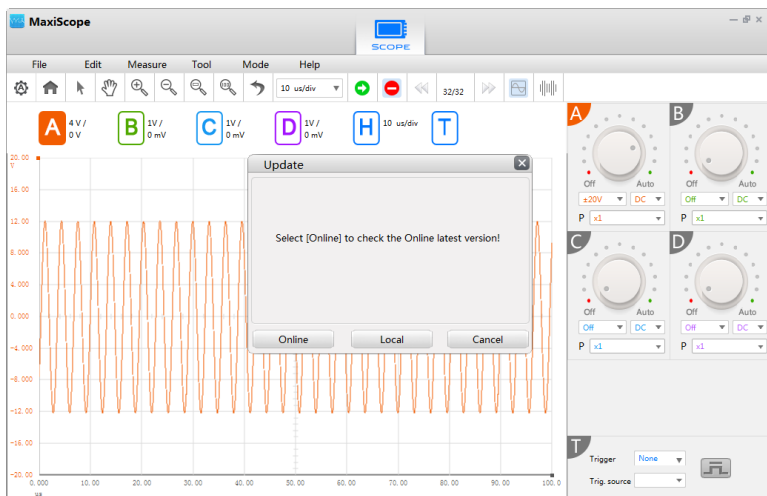
Technical Support

If you have any question or problem on the operation of the product, please contact us.

AUTEL NORTH AMERICA

- **Phone**: 855-AUTEL-US (855-288-3587) Monday-Friday 9am-6pm EST
- **Website**: www.autel.com
- **Email**: ussupport@autel.com
- **Address**: 175 Central Avenue, Suite 200, Farmingdale, New York, USA 11735

AUTEL EUROPE

- **Phone**: 0049 (0) 61032000522
- **Website**: www.autel.eu
- **Email**: sales.eu@autel.com, support.eu@autel.com
- **Address**: Robert-Bosch-Strasse 25, 63225, Langen, Germany

AUTEL CHINA HQ

- **Phone**: 0086-755-86147779
- **Website**: www.autel.com
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AUTEL AUSTRALIA

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- ● **Website**: www.autel.com.au
- ● **Email**: sales@autel.com.au
- ● **Address**: 155 Islington Street, Melbourne, Collingwood, VIC 3066

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

Repair Service

If it becomes necessary to return your device for repair, please download the repair service form from www.autel.com, and fill in the form. The following information must be included:

- ● Contact name
- ● Return address
- ● Telephone number
- ● Product name
- ● Complete description of the problem
- ● Proof-of-purchase for warranty repairs
- ● Preferred method of payment for non-warranty repairs

✐ **NOTE**
For non-warranty repairs, payment can be made with Visa, Master Card, or with approved credit terms.

Send the device to your local agent, or to the below address:

6th-10th Floor, Building B1, Zhiyuan, Xueyuan Road, Xili, Nanshan, Shenzhen, 518055, China

Other Services

You can purchase the optional accessories directly from Autel's authorized tool suppliers, and/or your local distributor or agent.

Your purchase order should include the following information:

- Contact information
- Product or part name
- Item description
- Purchase quantity

6 Compliance Information

FCC Compliance

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.

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

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.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

7 **Warranty**

12-Month Limited Warranty

Autel Intelligent Technology Corp., Ltd. (the Company) warrants to the original retail purchaser of the MaxiScope MP408, that should this product or any part thereof during normal consumer usage and conditions, be proven defective in material or workmanship that results in product failure within twelve (12) months period from the date of delivery, such defect(s) will be repaired, or replaced (with new or rebuilt parts) with Proof of Purchase, at the Company's option, without charge for parts or labor directly related to the defect(s).

The Company shall not be liable for any incidental or consequential damages arising from the use, misuse, or mounting of the device. Some states do not allow limitation on how long an implied warranty lasts, so the above limitations may not apply to you.

This warranty does not apply to:

a) Products subjected to abnormal use or conditions, accident, mishandling, neglect, unauthorized alteration, misuse, improper installation or repair or improper storage;

b) Products whose mechanical serial number or electronic serial number has been removed, altered or defaced;

c) Damage from exposure to excessive temperatures or extreme environmental conditions;

d) Damage resulting from connection to, or use of any accessory or other product not approved or authorized by the Company;

e) Defects in appearance, cosmetic, decorative or structural items such as framing and non-operative parts.

f) Products damaged from external causes such as fire, dirt, sand, battery leakage, blown fuse, theft or improper usage of any electrical source.

❶ IMPORTANT

All contents of the product may be deleted during the process of repair. You should create a back-up copy of any contents of your product before delivering the product for warranty service.