ETSCOPE

User Manual

⚠ WARNING

To reduce the risk of injury, read and understand these safety warnings and instructions before using the tool. Keep these instructions with the tool for future reference. If you have any questions, contact your **MAC TOOLS** representative or distributor.

INTRODUCTION

The **Mac Tools™ ETSCOPE** is an automotive scope, designed for professionals. This scope will deliver efficient, dependable service when used correctly and with care. As with any electronics equipment, for best performance the manufacturer's instructions must be followed. Please study this manual before operating the tool and understand the safety warnings and instructions. The instructions on installation, operation and maintenance should be read carefully, and the manuals kept for reference. NOTE: Additional safety measures may be required because of your particular application of the tool. Contact your **Mac Tools** representative or distributor with any questions concerning the tool and its use.

Mac Tools
4380 Old Roberts Rd
Columbus, Ohio 43228

WARRANTY

Please refer to Warranty Statement document provided separately.

Made in USA with globally sourced components.

All users must read and understand the user manual before operating this tool.

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1. SAFETY PRECAUTIONS

1.1 EXPLANATION OF SAFETY SIGNAL WORDS IN THIS MANUAL

The safety signal word designates the degree or level of hazard seriousness:

DANGER: Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING: Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTICE: Indicates a potentially hazardous situation which, if not avoided, may result in property damage.

1.2 SAFETY SIGNS ON THE DEVICE

	WARNING: Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury
	Chassis Ground

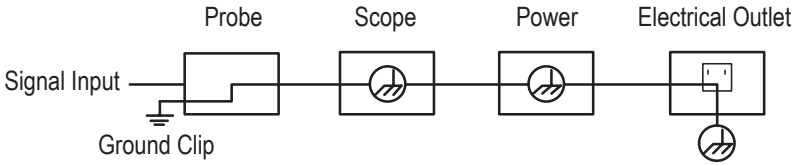
1.3 ETSCOPE ELECTRICAL WARNINGS

To avoid personal injury and/or equipment damage, read the following safety information:

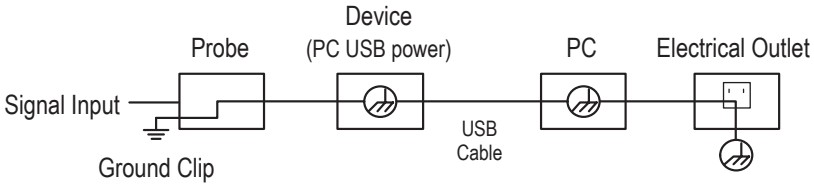
⚠ WARNING:

- To avoid any potential short circuit or electric shock, use the power adapter supplied with the ETSCOPE.
- The channels of the device are non-isolated electrically. Thus, when using the scope, the grounds of multiple probes are NOT allowed to connect to 2 different grounds.

The illustration of the device's built-in wire connection. See below:



When the device is communicating with the PC via USB communication interface (with PC powered by AC power source), the following illustrates the ground wire connection:



DO NOT measure AC power when the device is powered by an AC power source through the adapter, or when the device is powered by the PC through a USB connection, while the PC is connected to an AC power source.

⚠ WARNING:

When the device input is larger than 42 Vp-p (30Vrms), to avoid any potential short circuit or electric shock use the following precautions:

- Use the probes and adapters that come with the ETSCOPE.
- Check probes and accessories carefully to ensure there is not any mechanical or electrical damage.
- When working this device in a CAT II environment;
  - DO NOT connect the 40+ V input voltage from earth ground through any non-isolated input.
  - DO NOT connect the 40+ V input voltage through any non-isolated input.
- DO NOT input any voltage larger than the rated voltage, especially when probe attenuation is set in 1:1.
- DO NOT touch the exposed part of the metal BNC terminal.
- DO NOT insert any metal object into connectors.

1.4 GENERAL SAFETY REQUIREMENTS

BEFORE OPERATING THIS TOOL, ALL OPERATORS SHOULD READ AND UNDERSTAND THIS DOCUMENT AND FOLLOW ALL SAFETY WARNINGS AND INSTRUCTIONS.
KEEP THESE INSTRUCTIONS WITH THE TOOL FOR FUTURE REFERENCE. IF YOU HAVE ANY QUESTIONS, CONTACT YOUR MAC TOOLS REPRESENTATIVE OR DISTRIBUTOR.
FAILURE TO FOLLOW THE WARNINGS AND INSTRUCTIONS MAY RESULT IN ELECTRIC SHOCK, FIRE, AND/OR SERIOUS INJURY.

⚠ DANGER:

When an engine is operating, keep the service area well ventilated or attach a building exhaust removal system to the engine exhaust system. Engines produce carbon monoxide, an odorless, poisonous gas that causes slower reaction time and can lead to death or serious personal injury.

⚠ WARNING:

- Read all safety warnings, instructions, and cautionary markings for the product. Failure to follow the warnings and instructions may result in electric shock, fire and/or serious injury.
- NEVER force a charger cord plug into the tool.
- DO NOT splash or immerse in water or other liquids.
- DO NOT allow water or any liquid to enter tool.
- DO NOT store or use the tool in locations where the temperature may reach or exceed 40 °C (104 °F) (such as outside sheds or metal buildings in summer). For best life store tools in a cool, dry location.
- Never attempt to open the tool for any reason. If the tool case is cracked or damaged, do not charge. Do not crush, drop or damage the tool. Do not use a tool or USB cable that has received a sharp blow, been dropped, run over or damaged in any way (e.g., pierced with a nail, hit with a hammer, stepped on). Damaged tools should be returned to the service center for recycling.
- Use only with the Listed/Certified Information Technology (computer) Equipment.
- Pull by the plugs rather than the cord when disconnecting the USB cable. This will reduce the risk of damage to the plugs and cord.
- Make sure that the cord is located so that it will not be stepped on, tripped over or otherwise subjected to damage or stress.
- Foreign materials of a conductive nature, such as, but not limited to, grinding dust, metal chips, steel wool, aluminum foil or any buildup of metallic particles should be kept away from the USB and micro USB plugs and port.
- Always unplug the USB cable from the power supply when there is no tool attached to it.
- Before using the ETSCOPE, refer to the user manual for allowed operating ratings.
- To avoid potential short circuits or electrical shock, do not exceed electrical ratings of the connectors.
- Do not use the ETSCOPE in an explosive environment.
- Wear an American National Standards Institute (ANSI) Z87.1 approved eye shield when testing or repairing vehicles.
- Objects propelled by whirling engine components or pressurized liquids escaping may cause personal injury.
- Set the parking brake and block the wheels before testing or repairing a vehicle. It is especially important to block the wheels on front-wheel drive vehicles because the parking brake does not hold the drive wheels.
- Do not drive the vehicle and operate the software at the same time.
- Maintain adequate clearance around moving components or belts during testing.

- Moving components and belts can catch loose clothing, body parts, or test equipment and cause serious personal injury or tool damage.
- Automotive batteries contain sulfuric acid and produce explosive gases that can result in serious injury due to ignition of gases. Keep lit cigarettes, sparks, flames, and other ignition sources away from the battery at all times.
- Refer to the service manual for the vehicle being serviced. Adhere to all diagnostic procedures and precautions. Failure to do so could result in personal injury or otherwise unneeded repairs.
- Do not operate the tool with a damaged cord or connector. Replace damaged cords and connectors immediately.
- Do not operate the power supply if it has received a sharp blow, been dropped, or otherwise damaged in any way.
- Do not disassemble the scope or any included accessories. Incorrect reassembly may result in electric shock or fire.
- Do not expose tool to rain, moisture, or snow.
- Verify that cords are located where they will not be stepped on, tripped over, or otherwise become a safety hazard or subjected to damage or stress.

NOTICE:

- Do not place the tool on the distributor of a vehicle. Strong electromagnetic interference can damage the tool.
- Read all Instructions.

Storage Recommendations

- The best storage place is one that is cool and dry, away from direct sunlight and excess heat or cold.

Tool Disposal

- The tool can be taken for disposal to an Authorized Service Center. Some local retailers are also participating in a national recycling program (refer to RBRC®). Call your local retailer for details. If you bring the tool to an Authorized Service Center, the Center will arrange to recycle the tool. Or, contact your local municipality for proper disposal instructions in your city/town.

FCC Statement

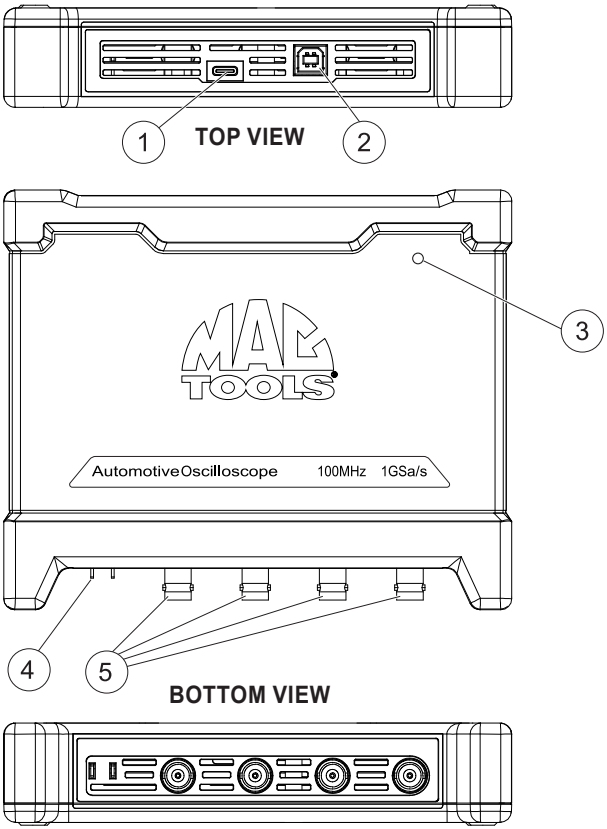
- This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates and radiates radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

ISED Statement

- This device complies with ISED Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

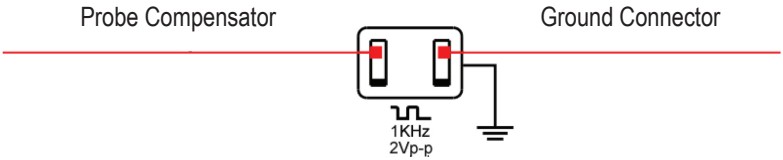
2. GENERAL INFORMATION

2.1 ETSCOPE



1. **DC inport (USB C)**
   - Provides power to the ETSCOPE.
   Note: *This is required when connecting the scope to ET9250 EliteXC.*
2. **Device connection**
   - For PC: provides USB communication and input power.
   - For ET9250 EliteXC: provides USB communications.
3. **Power and communication indicator**
   - Illuminates solid green when powered up.
   - Flashes when communicating with diagnostic tool.
   - Flashes quickly if an error is detected.
4. **Fixed Signal Generator**
   - Generates a square signal with a fixed 1K frequency.
5. **Input Channels 1 thru 4**

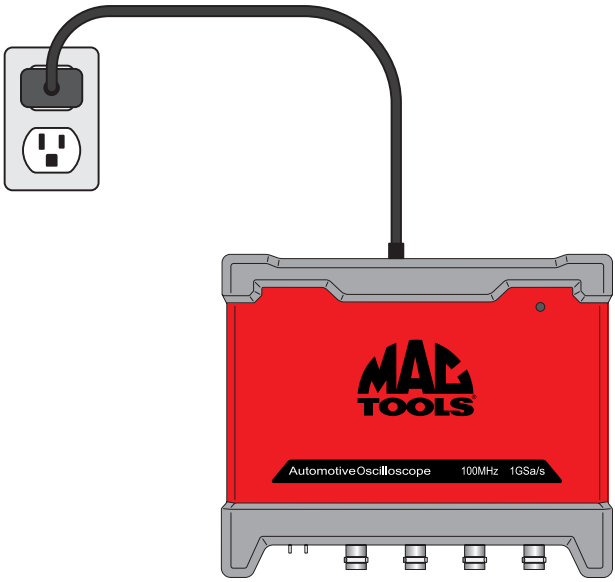
2.2 FIXED SIGNAL GENERATOR SCHEMATIC



3. SETUP

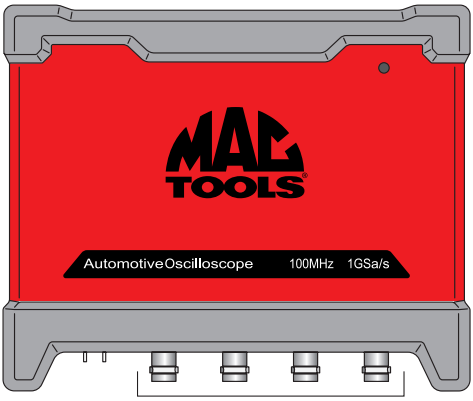
3.1 CONNECTION TO ET9250

1. Locate the power supply. Connect the USB C end of the power supply to the back of the ETSCOPE and plug the other end into a wall outlet. The green LED on the top of the ETSCOPE should illuminate.



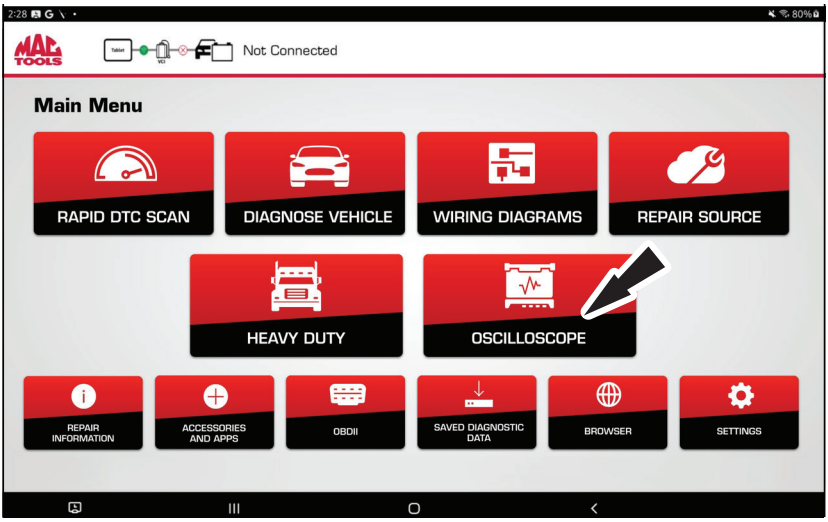
2. Locate the USB B to USB C cable. Connect the USB B to the back of the ETSCOPE and plug the USB C into the top port on the ET9250.

3. Locate the scope probes. Connect one or more of the scope probes to the BNC connectors on the front of the ETSCOPE.



BNC Connectors

4. Start the ETSCOPE application by selecting “OSCILLOSCOPE” from ET9250 as follows:

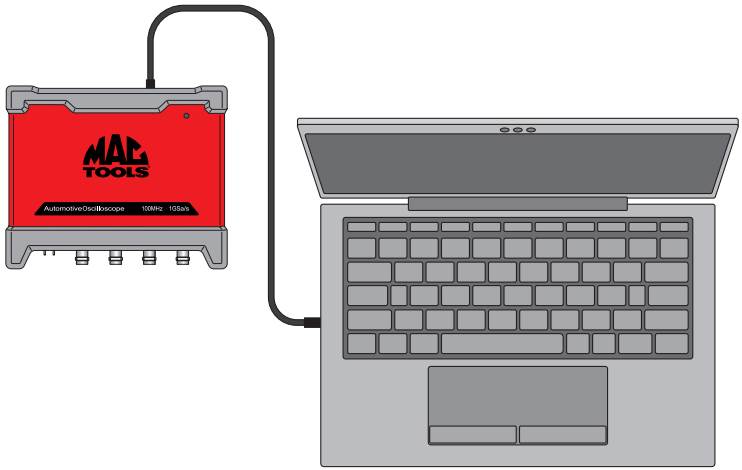


5. See Section 6 for operation of the ETSCOPE application

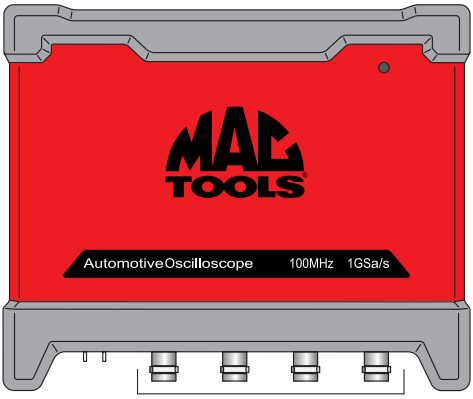
3.2 CONNECTION TO PC

1. Locate the USB B to USB A cable. Connect the USB B to the back of the ETSCOPE and plug the USB A into the Laptop.

   NOTE: *Power supply is not needed when ETSCOPE is connected to a PC.*



2. Locate the scope probes. Connect one or more of the scope probes to the BNC connectors on the front of the ETSCOPE.

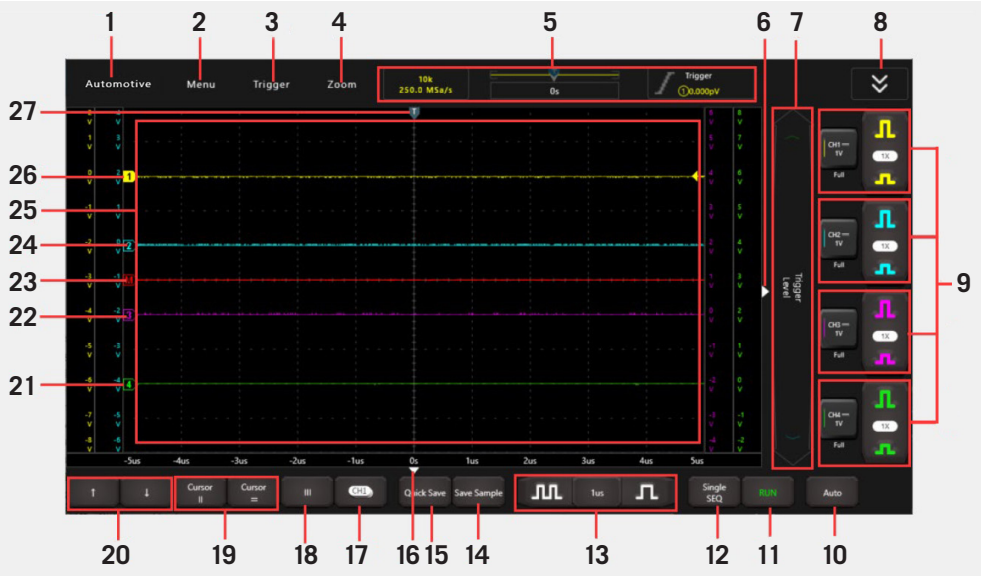


BNC Connectors

3. Install PC Application.
   - A. Download the ETSCOPE PC Application from **https://mactools.service-solutions.com/ET9250/downloads**.
   - B. Double Click on the ETSCOPE installation application "AutoScope_a.b.c.d.e_Setup.exe"
   - C. Follow the install instructions.
4. Start the ETSCOPE application by searching for and executing "AutoScope."
5. See Section 6 for operation of the ETSCOPE application.

4. COMPONENTS AND CONTROLS

4.1 USER INTERFACE



1. **Automotive**
   Provides several testing applications of automotive components (including circuits, sensors, actuators, ignition etc.) and detailed connection methods. Tap button once to enter the sub-menu. Tap again to close the submenu.

2. **Menu**
   Includes the following options.
   - Measure: Provides 23 parametric measurements.
   - Save: Saves the current setup before closing software.
   - Display: Sets display mode of the waveform.
   - Settings: Depth, Factory Reset, Self-Adjust (self-calibration) and Customization.
   - About: Detailed application informaton.

3. **Trigger settings menu**
   Includes the following options.
   - Common: Provides trigger Hold-Off and Mode items.
   - Edge: Sets edge triggering conditions.
   - PulseWidth: Sets pulse width triggering conditions.
   - S1 LIN/CAN: Sets the triggering conditions for the bus1.
   - S2 LIN/CAN: Sets the triggering conditions for the bus2.

4. **Zoom**
   Change the waveform display using Scale and Position.
   - Scale: Increases and decreases the size of the waveform.
   - Save: Saves the current setup before closing software
   - Position: Moves waveform left or right.

5. **Current Status**
   Indicates storage depth, sample rate, cursor position indicator and trigger information.

6. **Hide the menu bar on the right**
   Click on the triangle symbol to hide or unhide the menu bar on the right.

7. **Trigger level position of Channel**
   Slide or click the arrow to move up and down to trigger the level position.

8. **More Channel Settings**
   Sets more channels. Includes: MATH, REF, S1 LIN and S2 LIN. Tap button once to enter the submenu. Tap twice to close the submenu.

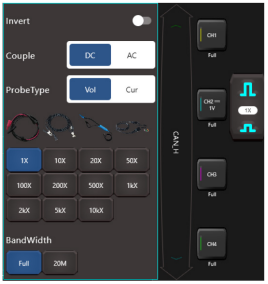
9. **Channels 1, 2, 3, 4 Vertical Settings Panel**
   Controls the amplitude of the displayed signal. User can change Invert, coupling and probe attenuation of the channel. *(Channel 2 example below)*

Tap 

once – turns on the channel and sets it as the current channel.

Tap 

twice – calls out the channel vertical settings.



Tap 

three times - turns off the channel

10. **Auto**
    Automatically adjusts the vertical scale, horizontal scale and trigger settings.

11. **RUN/STOP/WAIT**
    - WAIT: All pre-triggered data has been acquired and the Oscilloscope is ready to accept a trigger.
    - STOP: The Oscilloscope has stopped acquiring waveform data.
    - RUN: The Oscilloscope is running.

12. **Single SEQ**
    This mode only acquires the waveform that generates for the first time the trigger conditions are met–then stops after finishing capture.

13. **Horizontal Settings**
    Controls the time base. Tap button once to enter the submenu. Tap again to close the submenu.

14. **Save sample settings menu**
    Shortcut for "Settings/Customizations" items, which enables quick saving of current oscilloscope acquisition settings for the next recall.

15. **Quick Save**
    Quickly saves the waveforms of all channels as reference waveforms and captures current screen as a screenshot. To change the save path and file type, go to Menu -> Save.

16. **Hide the menu bar below**
    Click on the triangle symbol to hide or unhide the menu bar below.

17. **Channel Selection Button**
    Tap it to select the desired channel. Tap button once, the channel (only the channels that have been turned on) selection pop-up will appear. Tap again to close the submenu.

18. **Phase Ruler**
    - Tap button once to activate.
    - Tab button twice to exit.
    - See section 5.15 for more detail.

19. **Cursor Settings**
    Turns on/off the horizontal/vertical cursor measurement function. When set to ON, two horizontal/vertical reference lines (Y1 & Y2/X1 & X2) will be displayed on the waveform display. The user can use left ←, right →, up ↑ or down ↓ arrows to fine tune the line or drag the line directly to move it.

20. **Fine tunning button**
    Fine tunes the vertical/horizontal reference line. When the horizontal cursor is ON, the fine tuning buttons display ↑ and ↓ . If the vertical cursor is ON, the fine tuning buttons will change into ← and →.

21. **CH4 marker**
    Shows the reference points of the displayed waveforms. If there is no marker, the channel is not displayed. If the marker is displayed as ▷, it indicates the channel is not the current channel. Tap the marker ▷, it will change into ▶; it indicates the channel is the current channel.

22. **CH3 marker**
    Shows the reference points of the displayed waveforms. If there is no marker, the channel is not displayed. If the marker is displayed as ▷, it indicates the channel is not the current channel. Tap the marker ▷, it will change into ▶; it indicates the channel is the current channel.

23. **Math marker**
    Shows the reference points of the displayed waveforms. If there is no marker, the channel is turned off and not displayed. The MATH channel is hidden under the » tab.

24. **CH2 marker**
    Shows the reference points of the displayed waveforms. If there is no marker, the channel is not displayed. If the marker is displayed as ▷, it indicates the channel is not the current channel. Tap the marker ▷, it will change into ▶; it indicates the channel is the current channel.

25. **Waveform display area**

26. **CH1 marker**
    Shows the reference points of the displayed waveforms. If there is no marker, the channel is not displayed. If the marker is displayed as ▷, it indicates the channel is not the current channel. Tap the marker ▷, it will change into ▶; it indicates the channel is the current channel.

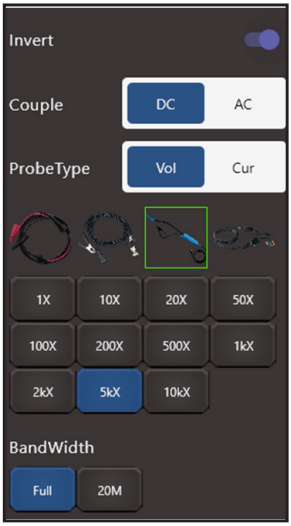
27. **Horizontal trigger position marker**
    Shows the reference position of the trigger.

5. COMPENSATION & CALIBRATION

5.1 PROBE COMPENSATION

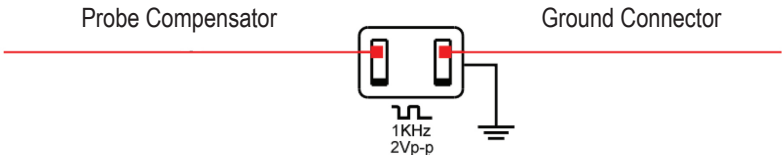
Perform this function to match the characteristics of the probe (optional) and the channel input. A probe that has not been compensated may display measurement tolerance error or a distorted signal.

1. Connect the ETSCOPE following instructions on Section 3.
2. Launch the scope application either from a laptop or the ET9250 EliteXC
3. From the "Vertical Setting" panel, select the corresponding channel and set the Probe attenuation to 10X



Refer to the following description for attenuation proportion:
1x = 1:1
10x = 10:1
1kx = 1000:1
10kx = 10000:1

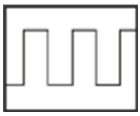
4. Set the switch to "X10" (the default is X1) on the probe and connect it to CH1 of the Oscilloscope.
5. Attach the probe tip to the Probe Compensator and the ground of the reference lead to the ground connector. When using the probe hook-tip, insert the tip onto the probe compensator firmly to ensure a proper connection.



6. Tap the Auto button located on the bottom of the screen, a square wave (approximately 1KHz 2V peak-to-peak) will be displayed within several seconds.

   Note: *The above steps also can be applied to check the signal input of the other Channels (ie: CH2, CH3, and CH4).*

7. Check the shape of the displayed waveform to determine whether the probe is correctly compensated.

   
   :**Correctly Compensated**

   
   :**Over Compensated**

   
   :**Under Compensated**

   Note: *If necessary, use a non-metallic tool to adjust the trimmer capacitor of the probe until the signal appears as the correctly compensated signal shown above.*

   ⚠ **WARNING:** To avoid electric shock while using the probe, ensure insulated cable is free of damage. Do not touch the metallic portions of the probe head while it is connected to a high-voltage source.

8. Inspect CH2, CH3 and CH4 with the same method.

5.2 SELF-CALIBRATION

The self-calibration routine lets you optimize the oscilloscope signal path for measurement accuracy. You can run the routine at any time but you should always run the routine if the ambient temperature changes by 10°C or more.

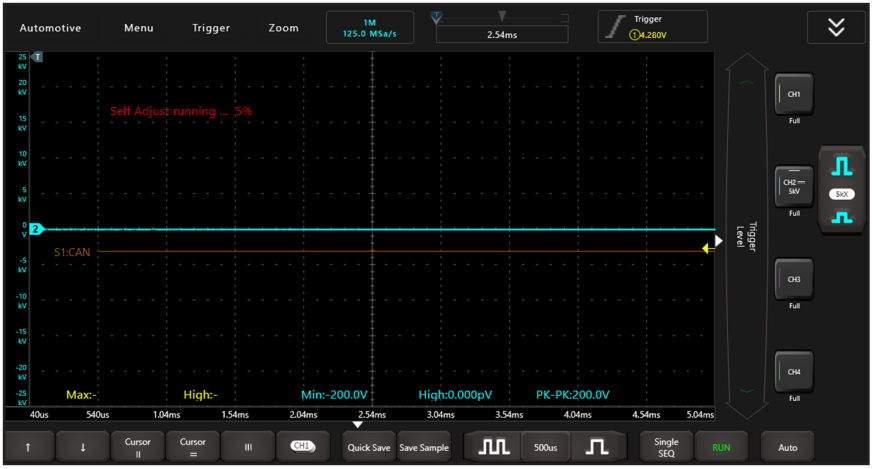
1. For accurate calibration, power on the Oscilloscope and wait twenty minutes to ensure unit is warmed up.

Note: *To compensate the signal path, disconnect any probes or cables from the input connectors. Then, access Menu -> Settings, tap Self Adjust.*

2. Tap **Confirm** on the pop-up message box to start calibration.

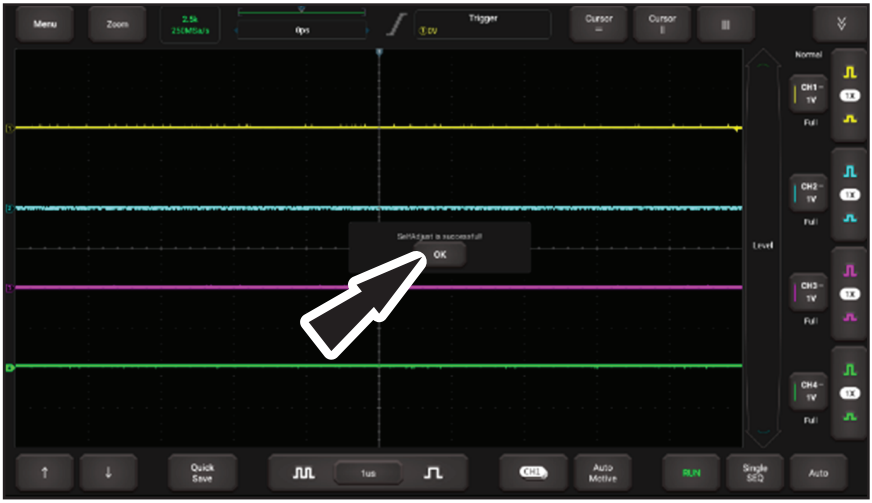
3. The LED on the Oscilloscope starts flashing and the prompt message "Self Adjust is running" will appear on the upper left corner of the screen.

   Note: *While calibrating, a lock icon will appear on the upper right corner of the screen. In this case, no operations are allowed to perform until the calibration process is successfully finished. After the calibration is complete, the lock icon will disappear.*



4. The self-calibration routine takes several minutes. After calibration is complete, the prompt message “Self Adjust is successful” will pop up on the screen. Tap **OK** to finish the self-calibration.

   Note: *ETScope should be calibrated at least once per year.*



6. OPERATION

6.1 SELECTING CHANNELS (CH1, CH2, CH3, CH4)

1. Tap the channel tab shown on the right edge of the screen.

2. Tap the Channel icon 

to select the desired channel. In this mode, only the channels that are turned on can be selected.

   Note: *For easy identification, each channel and waveform are marked in different colors.*

6.2 SELECTING MATH/REF CHANNELS

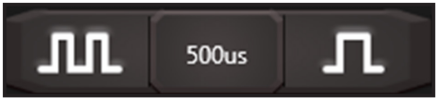
1. Tap the double arrow icon  .

Note: *For detailed instructions on the MATH and REF Channels, refer to Sections 6.15 and 6.16.*

2. The Oscilloscope can display multiple waveforms simultaneously, but only one waveform is allowed to display at top. The top channel is called current channel. The marker of the current channel is displayed as ▶. If the marker is displayed as ▷, it is not the current channel.

6.3 HORIZONTAL SETTINGS

1. User can change the horizontal time/division scale by tapping  or  directly or by tapping the time/division value to select it from the pull-down list.



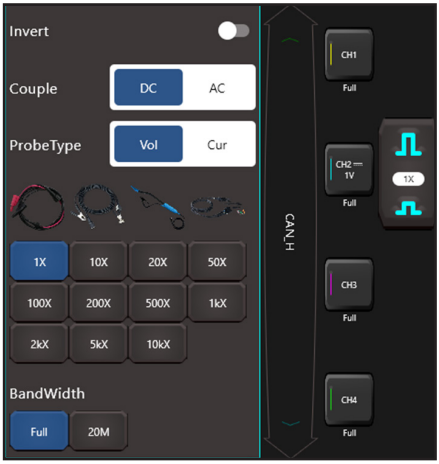
2. If the waveform acquisition is stopped, the time/division selector ( / ) expands or compresses the waveform.

6.4 VERTICAL SETTINGS

The trigger determines when the Oscilloscope starts to acquire data and display a waveform. When a trigger is set up properly, it can convert unstable displays or blank screens into meaningful waveforms.

When the Oscilloscope starts to acquire a waveform, it collects enough data so that it can draw the waveform to the left of the trigger point. The Oscilloscope continues to acquire data while waiting for the trigger condition to occur. After it detects a trigger, the Oscilloscope continues to acquire enough data so that it can draw the waveform to the right of the trigger point.

1. Tap desired channel to enable vertical settings option and choose settings for Invert/Couple/ Probe Type.



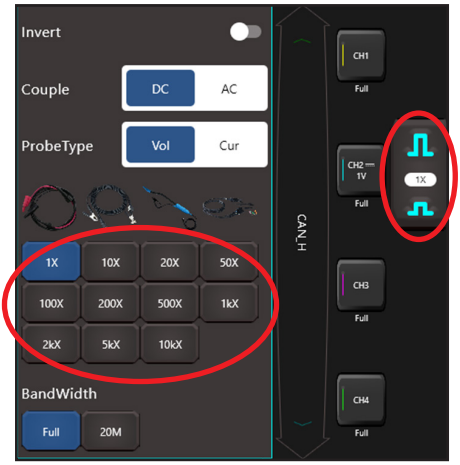
Invert:
- ON—Turn on the invert function.
- OFF—Restore the original display of the waveform.

Couple: Determines what part of the signal (AC/DC) passes to the trigger circuit.
- AC—Blocks the DC component of the input signal.
- DC—Passes both AC and DC components of the input signal.

Probe Type:
- Vol—Voltage probe
- Cur—Current probe

2. After choosing the desired probe type, the system will automatically configure to the preset attenuation factor. The attenuation factor changes the vertical scaling of the Oscilloscope so that the measurement results reflect the actual voltage levels at the probe tip.

Note: *User can set the factor from the options manually or by tapping the*  *or*  *icons.*



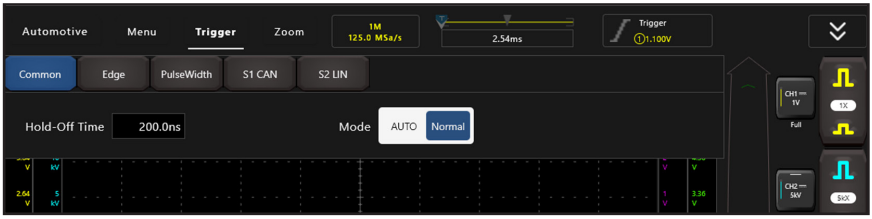
6.5 TRIGGER SETTINGS

Trigger indicates that when certain waveform meets the conditions that are predefined according to the requirements, the Oscilloscope acquires the waveform and its adjacent section, and then presents it on the screen.

1. Go to Trigger, the following screen will appear.

6.5.1 COMMON

Common sets the sweep mode. The sweep mode determines how the Oscilloscope behaves in the absence of a trigger event. The Oscilloscope provides two trigger modes: Auto, Normal.



Auto:

- Allows the Oscilloscope to acquire waveforms even when it does not detect a trigger condition. If no trigger condition occurs while the Oscilloscope is waiting for a specific period, it will force itself to trigger.

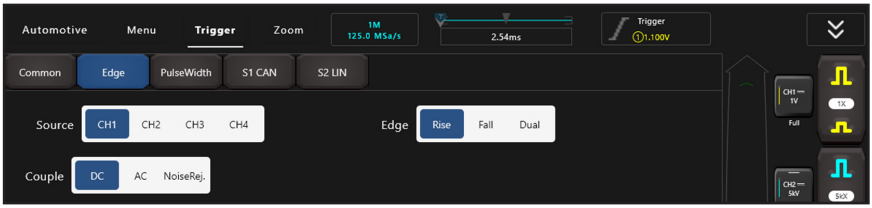
  Note: *When there is no trigger event, the oscilloscope cannot synchronize the waveform and will roll across the screen. If a valid trigger occurs, the waveform will become stable on the screen.*

Normal:

- This mode allows the Oscilloscope to acquire a waveform only when it is triggered. If no trigger occurs, the Oscilloscope keeps waiting, and the previous waveform, if any, will remain on the display.

6.5.2 EDGE

Edge determines whether the Oscilloscope finds the trigger point on the rising/falling/dual edge of a signal.



Source:

- Select which channel is a trigger signal.

Edge:

- Rise—Trigger on rising edge.
- Fall—Trigger on falling edge.
- Dual—Trigger on dual edges.

Couple:

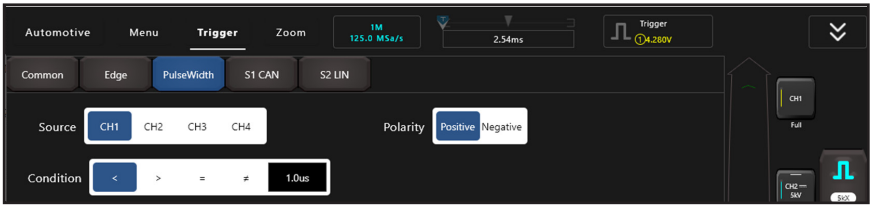
- Trigger coupling determines what part of the signal passes to the trigger circuit.
- OFF—Restore the original display of the waveform.

Noise Rejection:

- Rejects high frequency noise when selected.
- In this mode, the user can set the trigger level by directly dragging the Level scroll bar or the icon on the right side of the waveform display area.

6.5.3 PULSE WIDTH

Pulse Width determines whether the Oscilloscope finds the trigger point on the rising/falling/dual edge of a signal.



Source:

- Select which channel is a trigger signal.

Condition:

- Selects pulse condition. (Includes: <, >, =, ≠)

Pulse Width:

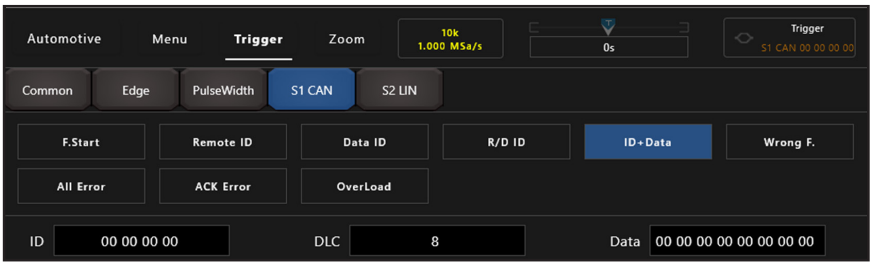
- Sets the trigger pulse width.

Polarity:

- Sets the trigger polarity.

6.5.4 DECODING TRIGGER (S1 CAN)

If decoding trigger (S1/S2) is selected, when the channel setting S1/S2 selects CAN decoding, the S1/S2 in the trigger menu will display as CAN decoding trigger.



Note: *CAN stands for Controller Area Network and is an ISO standardized serial communication protocol.*

The CAN bus, can be triggered based on the frame start, frame type, identifier, data, ID and data, end frame, loss confirmation, or bit padding error of the signal. Please specify the source, signal type, sampling point, and signal rate.

Frame Start:
- Triggered at the beginning of the data frame.

Remote Frame ID:
- Trigger the selection of ID format as extension type.

Data Frame ID:
- Choose the format of the ID as the trigger for standard types.

Remote Frame/Data Frame ID:
- Trigger the selection of ID format as standard or extended type.

Data Frame ID and Data:
- Select ID format as standard type and trigger with correct data.

Error Frame:
- Set the trigger condition as an error frame.

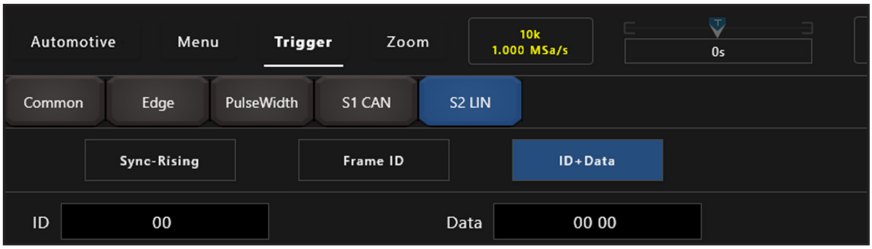
All Errors:
- Set the trigger condition to all errors.

Confirmation Error:
- Set the trigger condition as confirmation error.

Overload Frame:
- Set the triggering condition as overload frame.

6.5.5 DECODING TRIGGER (S2 LIN)

If decoding trigger (S1/S2) is selected, when the channel setting S1/S2 selects LIN decoding, the S1/S2 in the trigger menu will display as LIN decoding trigger.



Synchronous Rising Edge:
- Sets the triggering condition as synchronous rising edge.

Frame ID:
- Sets the trigger condition as frame ID.

Frame ID and Data:
- Sets the triggering conditions as frame ID and data.

Remote Frame/Data Frame ID:
- Trigger the selection of ID format as standard or extended type.

Data Frame ID and Data:
- Select ID format as standard type and trigger with correct data.

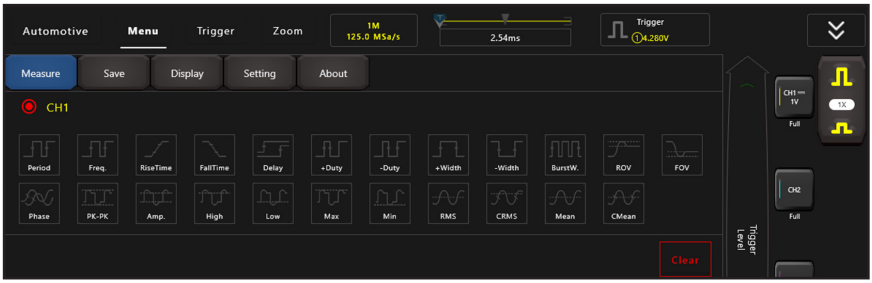
6.6 AUTO-SET

Sets up the Oscilloscope automatically to display the input signal in as a best fit.
Tap **Auto**, the Oscilloscope may change the current settings to display the signal. It automatically adjusts the vertical and horizontal scaling, as well as the trigger coupling, position, slope, level and mode settings.

6.7 MEASURE

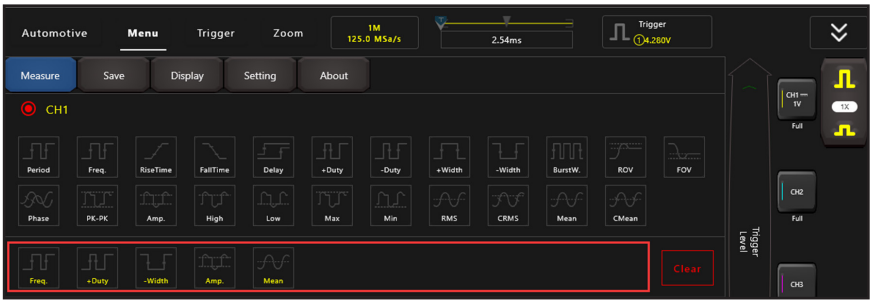
The Oscilloscope provides 23 parametric auto measurements.

1. Tap Measure, the following screen will appear.



2. Tap to select the desired measurement item.

   Note: *10 items can be selected at the same time. All selected items will be shown on the left side (see red field shown below) of the Clear button.*



3. Tap it to remove the measurement item. The values corresponding to the selected items will be displayed on the bottom of the screen.

Period:
- Time for the first signal cycle to complete in the waveform.

Frequency:
- Reciprocal of the period of the first cycle in the waveform.

Rise Time:
- Time taken from lower threshold to upper threshold.

Fall Time:
- Time taken from upper threshold to lower threshold.

+ Duty:
- Positive Duty Cycle = (Positive Pulse Width)/Period x 100%, measured of the first cycle in waveform.

– Duty:
- Negative Duty Cycle = (Negative Pulse Width)/Period x 100%, measured of the first cycle in waveform.

+ Width:
- Measured of the first positive pulse in the waveform. The time between the 50% amplitude points.

– Width:
- Measured of the first negative pulse in the waveform. The time between the 50% amplitude points.

PK-PK:
- Peak-to-peak = Max-Min, measured over the entire waveform.

Amp:
- Amplitude = Base-Top, measured over the entire waveform.

High:
- Voltage of the statistical level, measured over the entire waveform.

Low:
- Voltage of the statistical minimum level, measured over the entire waveform.

Max:
- Voltage of the absolute level, measured over the entire waveform.

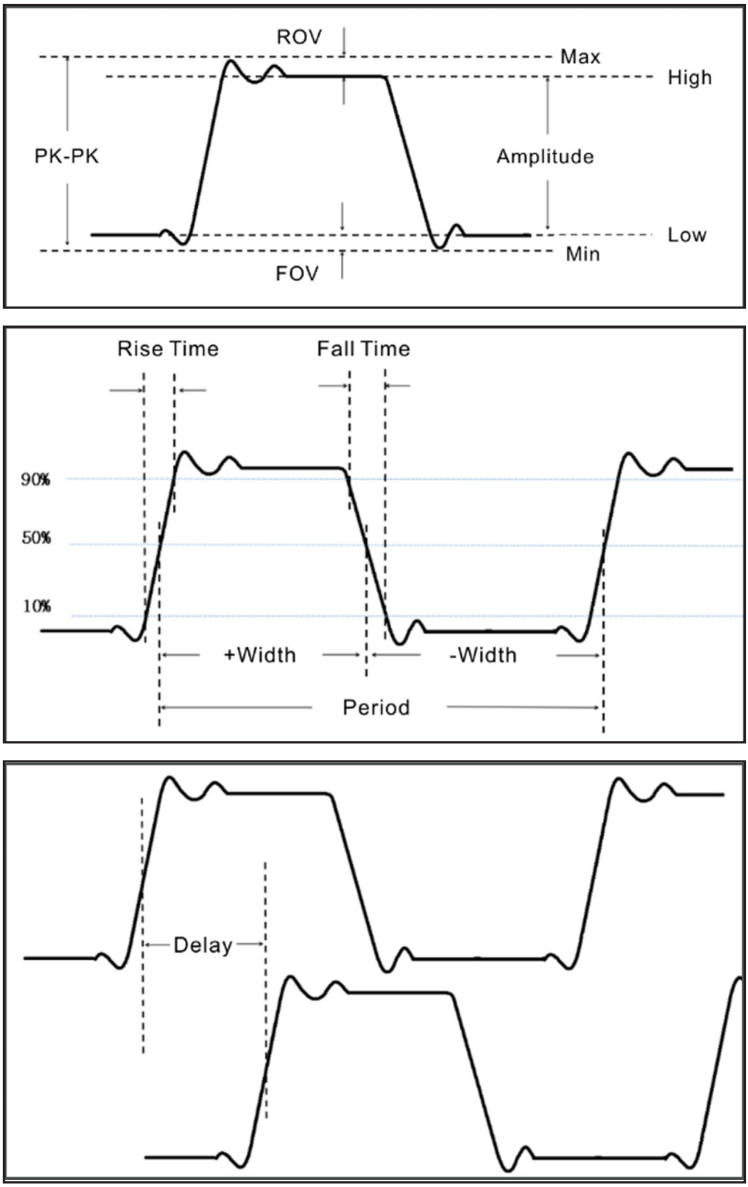
Min:
- Voltage of the absolute minimum level, measured over the entire waveform.

RMS:
- The Root Mean Square voltage over the entire waveform.

Mean:
- The arithmetic mean over the entire waveform.

CMean:
- Cycle Mean. The arithmetic mean over the first cycle in the waveform.

The following illustrations explain some common measurement items for your reference.



4. Tap Clear to clear all measurement items on the screen.
   Note: *The results of the automatic measurements will be displayed on the bottom of the screen. 10 results could be displayed at the same time.*

6.8 SAVE

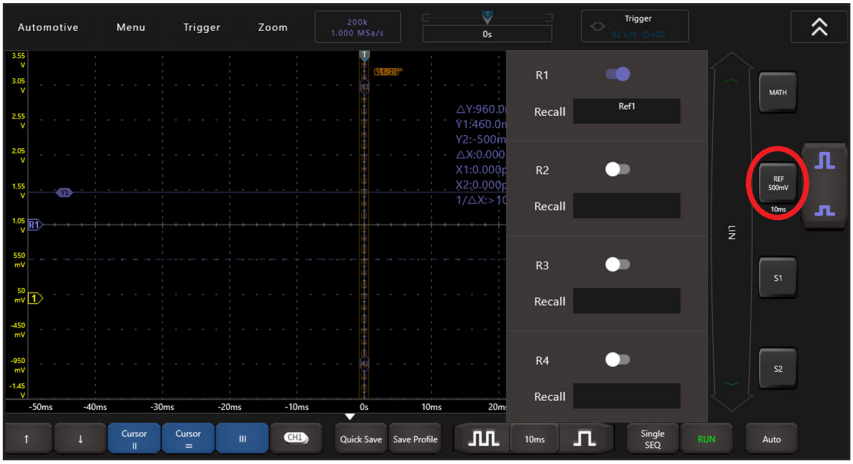
This function saves the waveforms of the channels.

1. Tap Save, the following screen will appear.

2. Select the desired measurement channel.
3. Select the file format type (.WAV or .CSV)
4. Tap the default name to revise it.
5. Tap Save to save it.

If the files are saved under the folder, the user can recall the waveform as follows:

1. Press the double arrows in the upper right corner until they point up  .
2. Select "REF" until the R1-R4 recall menu is shown.



3. Choose the desire reference waveform to recall.

6.9 DISPLAY

This function sets the display form in which the waveforms are displayed.

1. Tap Display, the following screen will appear.

Two Display Options Available:

- Common—Sets the horizontal reference and brightness of the waveform.
- Graticule—Display mode settings (Full, Grid, Retical and Frame) and waveform color intensity.

6.10 USERSET

This function allows for custom system settings.

1. Tap Setting, the following screen will appear.

Three Settings Available:

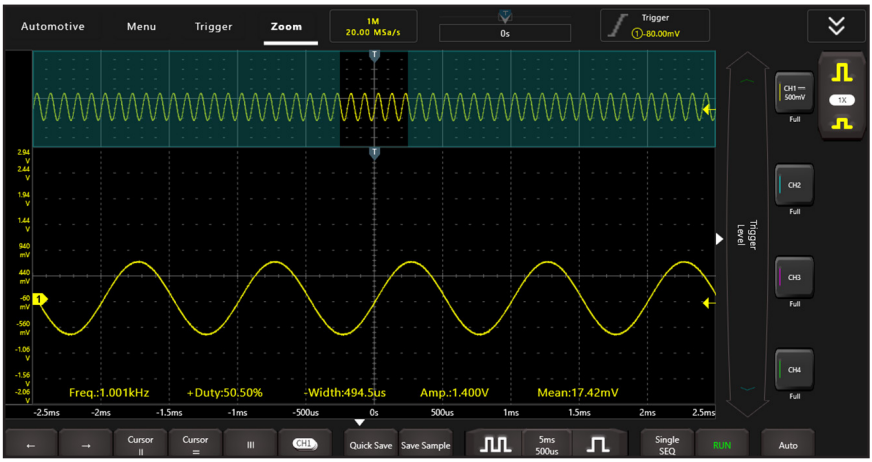
- Factory Reset—The Oscilloscope app is set up for normal operation when it is shipped from the factory. This is the factory setup. This option recalls this setup.
- Self Adjust—The self-calibration routine optimizes the oscilloscope signal path for measurement accuracy. Refer to Section 5.1 for detailed operations.
- Customization—Save allows user to save some settings that have been made as a system configuration file. Recovery allows user to directly recall the configuration file to avoid repeated setups.

6.11 ZOOM

If the displayed waveform contains some valuable information of the collected data, the user can stop acquiring data and zoom in to analyze. Meanwhile, the Zoom mode also allows the user to observe the whole waveform and partial details in case of larger storage depth.

Zoom mode provides one main window and one Zoom window. The selected segment of the main window will be zoomed in and displayed in the Zoom window.

Note: *This function only applies to the acquired data or the data that has been stopped.*



6.12 CURSOR

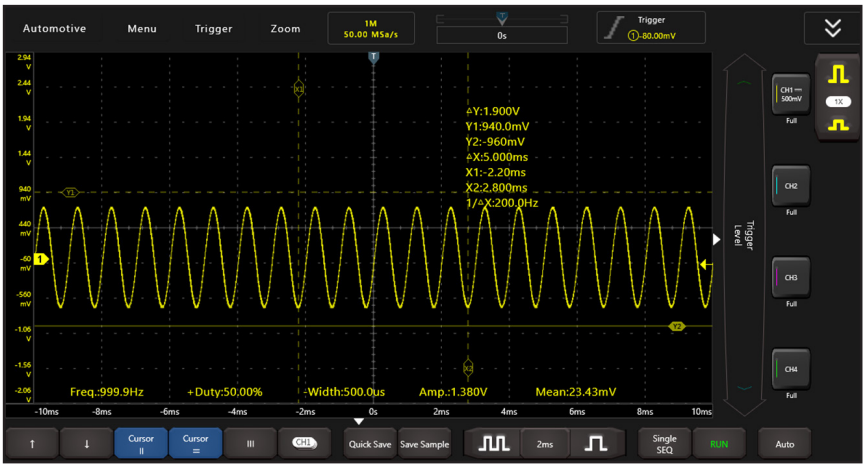
The Cursor function can be used for assisting in measurement.

Tap Cursor / Cursor to turn on the cursor function and place the cursor on the measurement point to read the waveform measurement value.

There are two types of cursors: horizontal cursor and vertical cursor. The horizontal cursor measures the value in the vertical direction, and the vertical cursor can measure the value in the horizontal direction.

When set to ON, two horizontal/vertical reference lines named with Y1 & Y2/X1 & X2 will be displayed on the waveform display area. The user can use ↑ / ↓ or ← / → to fine tune the line or drag the line directly to move it.

Tap Cursor / Cursor again to turn it off.



Notes:

ΔReading indicates the difference between the two cursor points.

The voltage reading after Y1, Y2: indicates the position of the activated cursor in the horizontal cursor relative to the zero level.

The time reading after X1, X2: indicates the position of the activated cursor in the vertical cursor relative to the trigger point.

1/ΔX: Frequency.

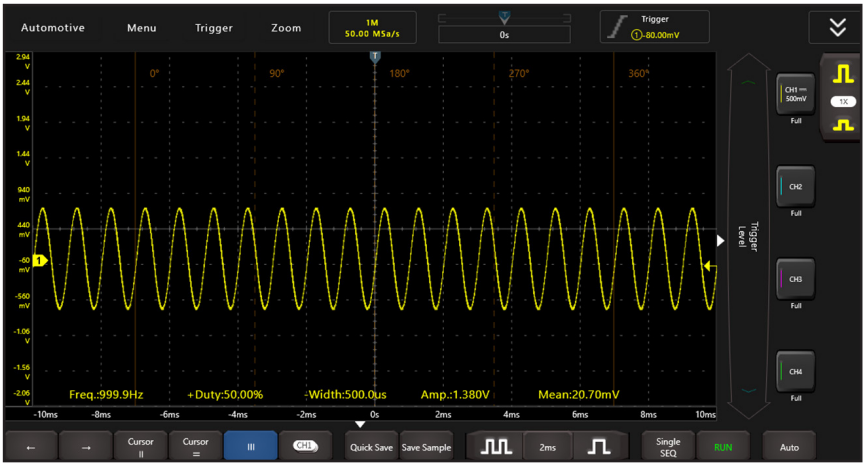
6.13 PHASE RULER

Used to help measure the timing time of the cyclic waveform.

Tap 

, a dialog box will pop up on the screen. Set the number of cylinder and angle, tap **OK** to confirm.

Drag the two phase rulers to the appropriate position to mark the start and end of the loop. The bottom of the ruler shows the default phase start point 0° and end point 360°, which can be edited to any value. For example, when measuring the timing of a four-stroke cylinder, the end of the phase is usually displayed as 720°, because one cycle includes two crankshaft rotations.



6.14 AUTOMOTIVE OPERATIONS

This function provides testing functions related to automotive parts (including circuits, sensors, actuators, ignition etc.) and detailed connection methods.

1. Tap **Automotive**, the following screen will appear:

2. Tap to select the desired automotive function, the system will automatically configure the option to the preset parameters. The user does not need to make any settings. Just follow the on-screen instructions to make connections and proceed.

6.15 MATH

In this function, the user can use the addition, subtraction, multiplication and FFT function to operate and analyze the waveform.

1. Tap **MATH**, the MATH channel will work as the current channel and the marker will appear on the screen:

FFT Convert a time-domain signal into its frequency components (spectrum).

Four Types:

- (A + B)—Add source 1 and source 2.
- (A – B)—Subtract source 2 from source 1.
- (A X B)—Multiply source 1 by source 2.
- (A ÷ B)—Divide source 2 with source 1.

2. Select operate type, Source 1 and 2, then adjust the vertical scale to view the math channel clearly. The mathematic result can be measured by the measure and the cursor.

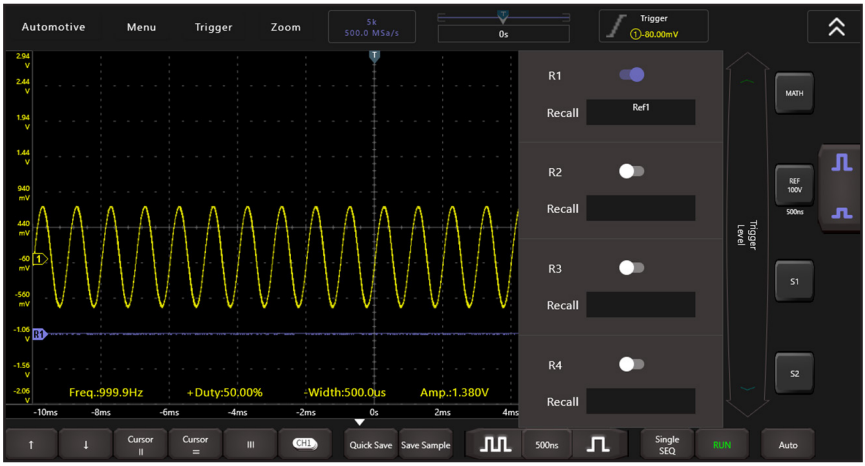
Tips on MATH calculations:

- If the analog channel or math function is clipped (not completely displayed on the screen), the resulting math function will also be clipped
- After the math waveform is displayed, tap the channel marker to close the source channel to better view the math waveform.
- Adjust the vertical sensitivity and offset of each channel participating in the math function to facilitate viewing and measuring math waveforms.
- Use the Cursor and Measure to measure math function waveforms.

6.16 REF

This function enables the user to load the reference waveform from the R1/R2/R3/R4 from the tablet.

1. Tap **REF**, the following screen will appear:

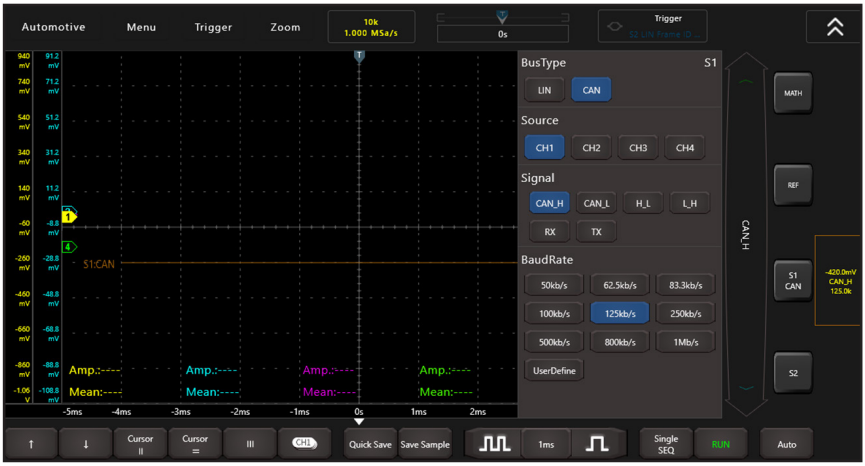


2. Slide the switch of R1/R2/R3/R4, the system will recall the waveform that was previously saved in this folder.
3. Tap the waveform in line with the Recall, a small window displaying this waveform will pop up on the screen.

6.17 BUS DECODINGS (S1/S2)

The decoding channel can be selected and set, and the bus type can be selected as CAN/LIN.

If the bus type is selected as CAN decoding:



Source:

- CH1/CH2/CH3/CH4 can be selected.

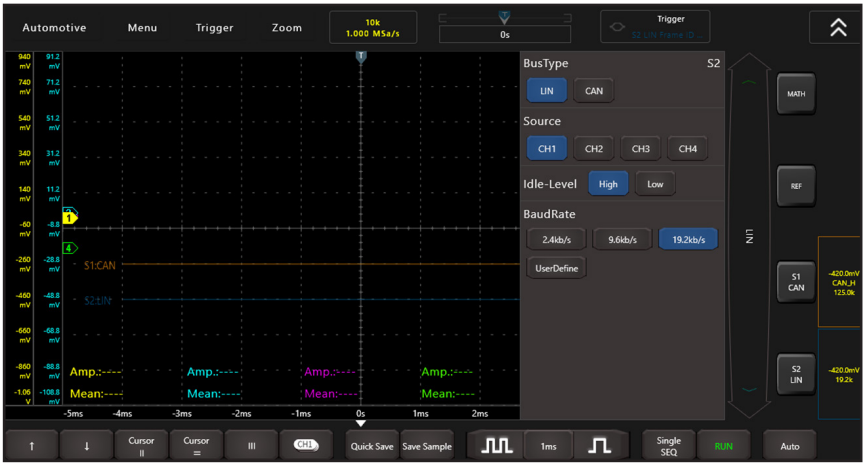
Signal:

- Optional CAN-H, CAN_L, H_L, L_H, RX TX.

Baud Rates:

- Optional 50kb/s, 62.5kb/s, 83.3kb/s, 100kb/s, 125kb/s, 250kb/s, 500kb/s, 800kb/s, 1Mb/s, custom (range 10kb/s -5Mb/s).
- Optional CAN-H, CAN_L, H_L, L_H, RX,TX.

If the bus type is selected as LIN decoding:



Source:

- CH1/CH2/CH3/CH4 can be selected.

Idle Level:

- Idle level can choose high or low.

Baud Rate:

- Optional 2.4kb/s, 9.6kb/s, 19.2kb/s, custom (range 2.4kb/s-625.0kb/s.

7. TECHNICAL SPECIFICATIONS

Bandwidth		100MHz	
Vertical Resolution (A/D)		8 bits	
Channel Quantity		4	
Acquisition	Mode	sample, peak detect	
	Sampling Rate	4-CH working	250 MSa/s
		2-CH working	500 MSa/s
		41-CH working	1 GSa/s
Input	Input Coupling	DC, AC	
	Input Impedance	1 MΩ ± 1.5%, in parallel with 15 pF ± 5 pF	
	Supported Probe	x1, x10, x100, x1000	
	Max Input Voltage	40V (DC + AC Peak)	
	Bandwidth Limit	20MHz, or fullband	
	Channel Isolation	100 : 1 @ 50Hz; 40 : 1 @ 10MHz	
	Time Delay Between Channel (typical)	150 ps	

Horizontal System	Sampling Rate	4-CH working	250 MSa/s
		2-CH working	500 MSa/s
		41-CH working	1 GSa/s
	Interpolation	sin (x)/x	
	Record Length	Auto, 10, 100k, 1M, 10M	
	Scanning Speed (s/div)	1 ns/div - 1k s/div, step by 1 - 2 - 5	
	Sampling Rate / Relay Time Accurachy	±20ppm (typical, Ta = +25ºC)	
	Interval (ΔT) Accuracy (DC - 100MHz)	Single: ±(1 interval time + 20ppm x reading + 0.6ns); Average>16: ±(1 interval time + 20ppm x reading + 0.4ns)	

Acquisition	Sensitivity	5 mV/div - 10 V/div, step by 1 - 2 - 5
	Displacement	± 2.5 V (5 mV/div - 200 mV/div) ± 120 V (500 mV/div - 10 V/div)
	Analog Bandwidth	100 MHz
	Low Frequency (AC coupling, - 3dB)	≥10 Hz (at BNC)
	Rise Time (at BNC, typical)	≤ 3.5 ns
	DC Accuracy	±3%
	DC Accuracy (average)	the voltage difference of any 2 points from the captured signal, after taking the average from ≥16 captured signals (ΔV): ±(2% rdg + 0.05 div)
	waveform inverted ON / OFF	

Measurement	Cursor Measurement	ΔV / ΔT / (ΔV and ΔT) between Cursor 1 and Cursor 2, auto cursor
	Automatic Measurement	Vpp, Vmax, Vmin, Vtop, Vbase, Vamp, Vavg, Vrms, Overshoot, Preshoot, Frequency, Period, Rise Time, Fall Time, Delay A→B , Delay A→B , +Width, -Width, +Duty, -Duty,etc.
Communication Interface	USB device (type-B)	

Trigger

Trigger Level Range	Internal	±5 divisions from the screen centerauto cursor
Trigger Level Accuracy (typical) (working for signal with rise time / fall time ≥ 20ns)	Internal	±0.3 division
Trigger Displacement	changing according to different record length and time base	
Trigger Hold-off Range	100ns - 10s	
Edge Trigger	Slope	rising, falling, either edge
Pulse Trigger	Trigger Condition	positive pulse: >, <, =, ≠ negative pulse: >, <, =, ≠
	Pulse Width Range	30ns - 10s
BUS Trigger	CAN	F.Start, Remote ID, Data ID, R/D ID, ID+Data, Wrong F., All Error, ACK Error, OverLoad
	LIN	Sync-Rising, Frame ID, ID+Data

Power

Power Source	5 VDC / 1.5A
Power Consumption	≤ 8W

Environment

Temperature	working temperature: 0 °C - (+40 °C) storage temperature: (-20 °C) - (+60 °C)
Relative Humidity	≤ 90%

8. APPENDIX B. DEVICE MAINTENANCE

8.1 STORAGE

To avoid any possible damage to the device, and probe, keep these items FAR AWAY from sprays, liquids, or solvents.

8.2 SURFACE CLEANING

Periodically check the device and probe surface for excess dirt and wear.

When cleaning the device / probe surface, follow these precautions:

1. Before surface cleaning, ensure the ETSCOPE is powered off, and no probes or accessories are plugged in or connected to an external power source.
2. Use a non-electrostatic soft cloth to remove the surface dust.
3. For further surface cleaning, use a damp soft cloth with a mild detergent.

Note: *To avoid permanent damage to the surface of device and probe, DO NOT introduce any corrosive chemical cleaner / detergent.*

⚠ WARNING:

After surface cleaning this device, and before each use, ensure device is dry to avoid any short circuit risk, or personal injury caused by electric conduction from the wet surface.

CUSTOMER SERVICE

We at Mac Tools are committed to our customers, please reference the following phone number for a direct contact to one of our customer technicians. They will be more than happy to help with any service or warranty questions you may have about your diagnostic tool.

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