User Manual

Handheld Digital Storage Oscilloscope & Multimeter Model MS400

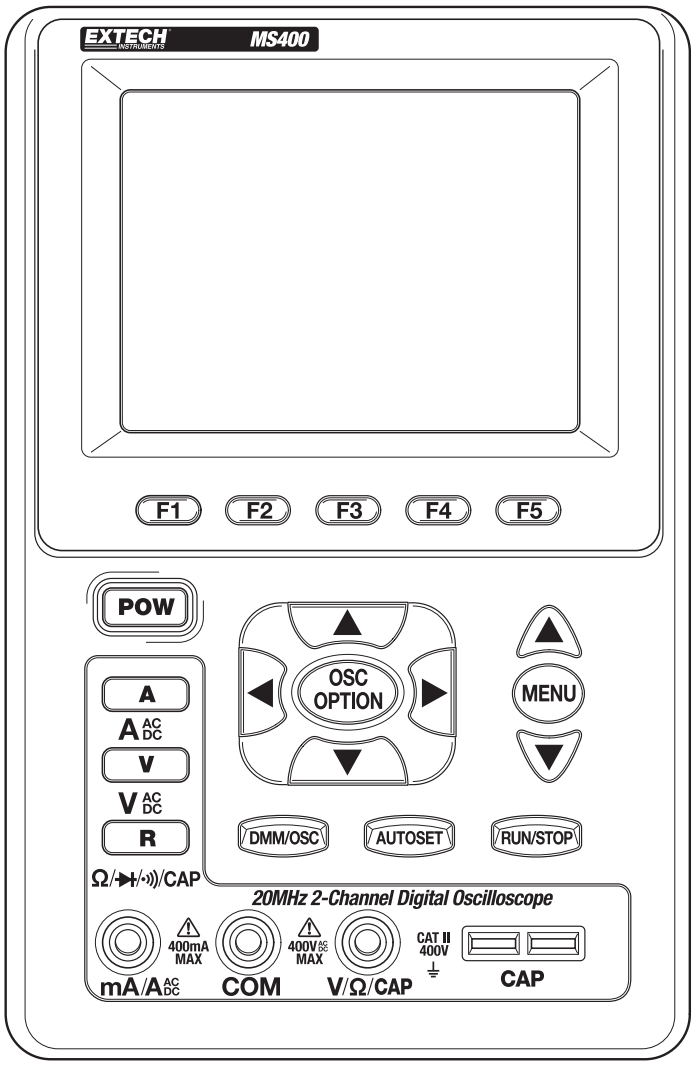


Figure 1 – Meter Faceplate

Warranty

EXTECH INSTRUMENTS CORPORATION *warrants this instrument to be free of defects in parts and workmanship for* ***one year*** *from date of shipment (a six month limited warranty applies to sensors and cables). If it should become necessary to return the instrument for service during or beyond the warranty period, contact the Customer Service Department at (781) 890-7440 ext. 210 for authorization or visit our website www.extech.com for contact information. A Return Authorization (RA) number must be issued before any product is returned to Extech. The sender is responsible for shipping charges, freight, insurance and proper packaging to prevent damage in transit. This warranty does not apply to defects resulting from action of the user such as misuse, improper wiring, operation outside of specification, improper maintenance or repair, or unauthorized modification. Extech specifically disclaims any implied warranties or merchantability or fitness for a specific purpose and will not be liable for any direct, indirect, incidental or consequential damages. Extech's total liability is limited to repair or replacement of the product. The warranty set forth above is inclusive and no other warranty, whether written or oral, is expressed or implied.*

Calibration and Repair Services

Extech offers repair and calibration services for the products we sell. Extech also provides NIST certification for most products. Call the Customer Care Department for information on calibration services available for this product. Extech recommends that annual calibrations be performed to verify meter performance and accuracy.

Support line (781) 890-7440

Technical Support: Extension 200; E-mail: support@extech.com

Repair & Returns: Extension 210; E-mail: repair@extech.com

Product specifications subject to change without notice

For the latest version of this User's Guide, Software updates, and other up-to-the-minute product information, visit our website: www.extech.com

Extech Instruments Corporation, 285 Bear Hill Rd., Waltham, MA 02451

Table of Contents

Safety Information

Note: Please read this user manual *prior* to operating the unit.

Safety Terms and Symbols

Specific Warning and Caution terms that appear throughout the manual

Warning: "Warning" identifies conditions and actions that pose hazards to users.

Caution: "Caution" identifies conditions and actions that may damage the product.

Terms printed on the meter and contained in this manual

The following terms may appear on the product or anywhere throughout the associated manuals:

Danger: The term "Danger" is used in this manual to indicate that serious injury or death may result if the safety instructions are not followed.

Warning: The term "Warning" is used in this manual to indicate that personal injury may result if instructions are not followed.

Notice: The term "Notice" is used in this manual to indicate that damages to product, other properties, or accessories may result if instructions are not followed.

Symbols Used on this Product and in the documentation

The following symbols may be found on the meter and in associated documentation:

General Safety Information

Carefully read the following safety information in order to avoid any personal injury and damage to this product or to any products associated with its use. In order to lessen the chances of any possible dangers that may occur in connection with the use of this product, the product should only be used in the specified applications the product was designed and intended for.

Warning:

To avoid fire or electrical shock please use the proper power adapter. Use only the power adapter recommended by the manufacturer.

Warning:

If test tool inputs are connected to more than 42V peak (30Vrms) or used in circuits of more than 4800VA, adhere to the following guidelines in order to avoid fire or electrical shock:

- **Use only insulated voltage probes, test leads and the adapter supplied with the test tool, or indicated by Extech as suitable for the Oscilloscope & Multimeter.**
- **Before use inspect voltage probes, test leads and accessories for mechanical damage and replace when required.**
- **Remove all probes, test leads and accessories that are not in use.**

- **Always connect the power adapter first to the AC outlet before connecting it to the Oscilloscope & Multimeter.**
- **Do not apply voltages that differ more than 400V from earth ground to any input when measuring in a CAT III environment.**
- **Do not apply voltages that differ more than 400V from earth ground to any input when measuring in a CAT II environment.**
- **Do not apply voltages that differ more than 400V from each other to the isolated input when measuring in a CAT III environment.**
- **Do not apply voltages that differ more than 400V from each other to the isolated inputs when measuring in a CAT II environment.**
- **Do not apply input voltages above the rating of the instrument. Use caution when using 1:1 test leads because the probe tip voltage will be directly transmitted to the Oscilloscope & Multimeter.**
- **Do not use exposed metal BNC or banana plug connectors. Do not insert metal objects into connectors.**
- **Always use the Oscilloscope & Multimeter only in the manner specified.**
- **Voltage ratings that are mentioned in the warning are provided as limits for "working voltage". The representative Vac rms (50-60Hz) indicates AC sine wave applications and as Vdc for DC applications. Overvoltage Category III refers to distribution level and fixed installation circuits inside a building. Overvoltage Category II refers to local levels, which are applicable for appliances and portable equipment.**

Only qualified technical personnel should perform maintenance.

Pay attention to the nominal values of all terminals: To avoid fire or electric shock, please keep a watchful eye on all nominal values and marks specified on this product. Before any connections are made, carefully read the user's manual of the product for further information of nominal values.

DO NOT operate this product without the instrument cover plate in place: If the cover plate or panel has been removed, do not perform any operations with this product.

DO NOT come into contact with bare conductors: When the product is powered on, do not touch any bare joints or parts of the meter.

DO NOT operate this product in case of any undetermined failure: When in doubt of the cause of any damage to this product, consult qualified technical personnel.

Keep the product well ventilated: Refer to the user manual for detailed installation instructions. Make sure the product is operated in a well ventilated area.

DO NOT operate this product in humid conditions.

DO NOT operate this product where explosives are handled or used.

Keep the product surface clean and dry.

General Inspection

After purchasing a new MS400 oscilloscope, it is suggested that a general inspection of the instrument be performed according to the following steps:

Check whether there is any damage to the product caused by shipping

If the packing material, boxes or foam cushions are found in a damaged condition, keep them in a proper place until the complete instrument and accessories have passed electrical and mechanical tests.

Check the Accessories

Double check the accessory list and pictures of the parts and accessories included with your instrument. Check whether there is any accessory loss by referencing the Appendix. In case of any accessory loss, damage or variation in specifications, contact the organization where the product was purchased.

Check the Instrument

If the instrument is apparently damaged, fails in normal operation or in a performance test, consult the place of purchase.
If the instrument is damaged due to shipping, keep the packing material in a proper place and contact the place of purchase.

Contents of the meter kit

Description	Standard	Optional
Meter	●	
Adapter	●	
Two (2) Oscilloscope Probes (grey)	●	
Pair of Test Leads for Multimeter (black and red)	●	
Measuring Extension Module for Low Current	●	
Measuring Module for low range Capacitance	●	
Adjustment Probe Tool	●	
One (1) USB Data Transmission cable	●	
User Manual	●	
One (1) disk that includes the PC interface software	●	
Carrying Case	●	

Input Connections

Figure 2

Description:

1. AC power adapter for AC power supply and battery recharging
2. Multimeter test leads
3. Multimeter input jacks, including three circular banana jacks and two square jacks. The three circular jacks are used for voltage, current and resistance inputs, while the two square jacks are used for capacitance inputs
4. Oscilloscope probes
5. Oscilloscope channel inputs: The upper one is for Channel 1 (CH1) while the lower one is for Channel 2 (CH2)

Description of the Front Panel and the Keypad

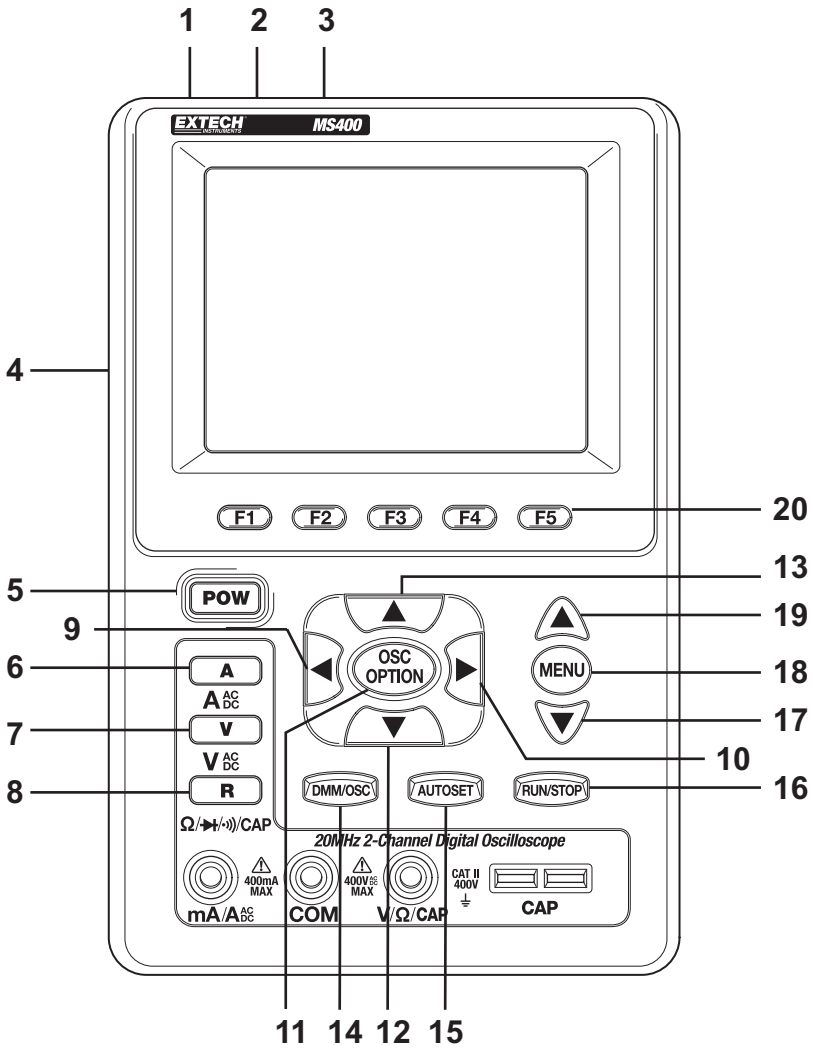


Figure 3

Description:

1. Power adapter jack
2. Serial port
3. USB jack
4. Backlight switch
5. POWER: Power switch
6. A: Multimeter current measurement key
7. V: Multimeter voltage measurement key
8. R: Multimeter resistance, diode, On/Off and capacitance measurement key
9. OSC LEFT: Oscilloscope left-direction adjustment key
10. OSC RIGHT: Oscilloscope right-direction adjustment key
11. OSC OPTION: Oscilloscope setting key

- Using the four keys OSC LEFT, OSC RIGHT, OSC UP and OSC DOWN, users can make the following settings by pressing OSC OPTION. The settings include: Voltage Unit Scale for Channel 1 (CH1 VOL); Voltage Unit Scale for Channel 2 (CH2 VOL); Primary Time base (TIME BASE), zero point position for Channel 1 (CH1 ZERO), zero point position for Channel 2 (CH2 ZERO), trigger horizontal position (TIME) and trigger level position (TRIG).
- When performing Waveform Calculations, users can also adjust and calculate the Display Multiplying Factor of a Waveform (CHM VOL) and the vertical display position (CHM ZERO).
- In cursor measurement mode, users can adjust the positions of Cursor 1 (V1 or T1) and Cursor 2 (V2 or T2).

12. OSC DOWN: Oscilloscope display downward adjustment key.
13. OSC UP: Oscilloscope display upward adjustment key.
14. OSC/DMM: Press to switch between oscilloscope and multimeter.
15. AUTO SET:

- In the Multimeter Mode, when performing a current or voltage measurement, the user can switch between AC and DC with this key; when performing a resistance measurement, the user can select resistance, diode, On/Off or a capacitance measurement with this key.
- This key is used for auto setting in the oscilloscope operation mode.

16. RUN/STOP: key for starting or stopping an operation.
17. MENU DOWN: Move down the menu list.
18. MENU: Show / Hide the menu.
19. MENU UP: Move up the menu list.
20. F1～F5: Switch or Adjustment options for each menu

Using the Scope

About this Chapter

This chapter provides a step-by-step introduction to the oscilloscope's functionality. The introduction does not cover all of the capabilities of the scope functions but gives basic examples to show how to use the menus and perform basic operations.

Power-Up the Oscilloscope

- Connect the oscilloscope to AC power via the power adapter as shown in Figure 2
- Turn the oscilloscope on by pressing the power on/off key POW.
- The instrument then performs a self-check. A greeting window with "press any key to continue." displays after the self-check.
- The user can press any key to enter the measurement functions.
- The oscilloscope powers up in the last setup configuration.

Oscilloscope Operation Window

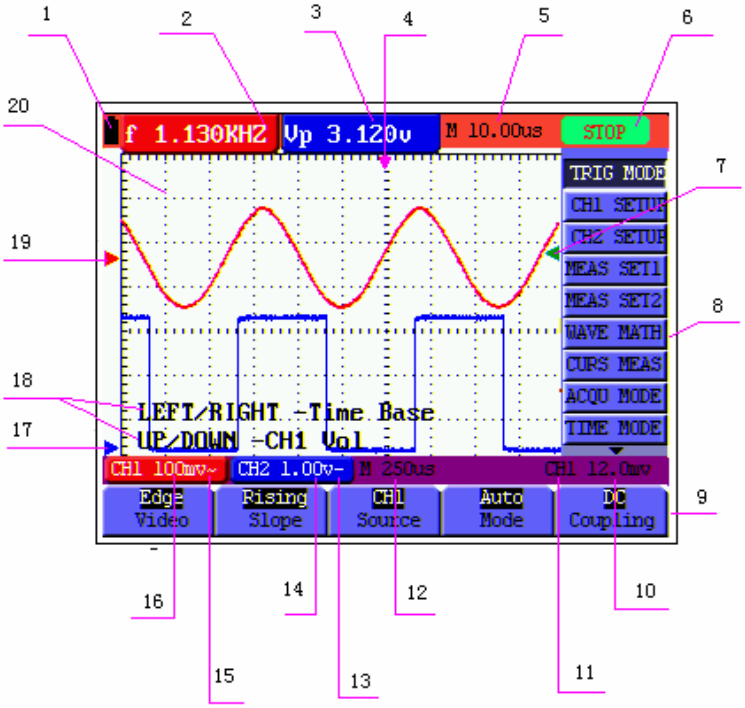


Figure 4: Oscilloscope Operation Window

1. Battery power level indicator symbols, including  ,  ,  and  .
2. Auto measurement window No. 1 where “f” is frequency, “T” is cycle, “V” is the average value, “Vp” the peak-peak value and “Vk” the root-mean-square value.
3. Auto measurement window No. 2.
4. The pointer indicates the horizontal triggering position.
5. This reading gives the time difference between the horizontal triggering position and the screen centerline. It reads zero when the pointer is in the center of the screen.
6. The trigger state indicates the following information:

   Auto: The oscilloscope is in the automatic mode and displaying the waveform in the non-trigger mode.

   Trig’d: The oscilloscope has detected a trigger and is collecting the information generated after the trigger.

   Ready: All pre-triggered data have been captured and the oscilloscope is ready to receive trigger signals.

   Scan: The oscilloscope can gather/display the waveform data continuously in scan mode.

   Stop: The oscilloscope has stopped collecting the waveform data.
7. The green pointer shows the trigger voltage level.
8. A hidden-style menu: With the **MENU** key pressed, the user can view or hide the menu.
9. Menu setting options: Various setting options for available menus.
10. The value of the trigger voltage level.
11. The display shows the trigger signal source.
12. The reading gives the value of the primary time base.
13. These graphics present the coupling modes of channel 2 (CH2). The graphic “～” indicates AC, the graphic “—” indicates DC.
14. This reading shows the vertical Voltage Unit Scale of CH2.
15. These graphics show the coupling mode of CH1, the graphic “～” expresses and indicates AC, the graphic “—” indicates DC.
16. This reading shows the vertical Voltage Unit Scale of CH1.
17. The blue pointer gives the grounding data point for the waveform on CH2, which is the zero position of CH2. If this pointer does not display then the channel has not been opened.
18. OSC OPTION operation prompt: There are various prompts for the available OSC OPTION operations.
19. The red pointer gives the grounding data point for the waveform on CH1, which is the zero position of CH1. No display of this pointer indicates that the channel has not been opened.
20. Waveform display area. Red waveform represents CH1, blue waveform represents CH2.

Navigating a Menu

The following example shows how to use the tool's menus to select a function, as shown in figure 5:

1. Press the **MENU** key to display the Function Menu on the right of the screen and the corresponding optional settings on the bottom. Press **MENU** again to hide the Function Menu.
2. Press the **MENU UP** or **MENU DOWN** key to select various function menus.
3. Choose a key from **F1** to **F5** to change the function setting.

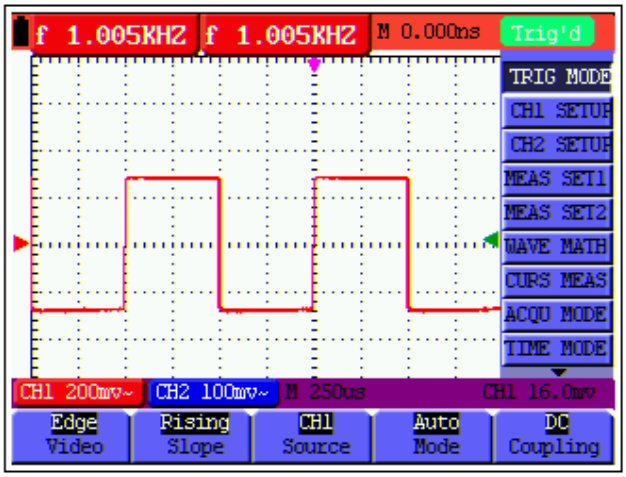


Figure 5: the Tool's Menus

Manually Setting the Vertical System, Horizontal System and Trigger Position

Using the four keys **OSC LEFT**, **OSC RIGHT**, **OSC UP** and **OSC DOWN**, the user can make the following settings by pressing **OSC OPTION.** The settings include: Voltage Unit Scale for Channel 1 (**CH1 VOL**), Voltage Unit Scale for Channel 2 (**CH2 VOL**), Primary Time base (**TIME BASE**), zero point position for Channel 1 (**CH1 ZERO**), zero point position of channel 2 (**CH2 ZERO**), trigger horizontal position (**TIME**) and trigger level position (**TRIG**).

The following example shows how to use the **OSC OPTION** key:

1. Press the **OSC OPTION** key once; the following is displayed at the bottom left side of the screen, as shown in figure 6:

   LEFT/RIGHT – Time Base

   UP/DOWN – CH1 Volts/Div

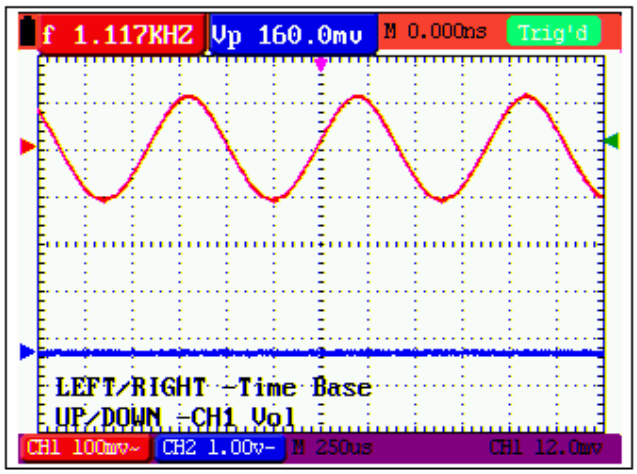


Figure 6: Voltage Unit Scale of Channel 1

2. Press the key **OSC UP** or **OSC DOWN** to adjust the vertical scale of Channel 1 and press **OSC LIFT** or **OSC RIGHT** to adjust the horizontal time scale.
3. Press **OSC OPTION** once again, the following display is visible at bottom left side of the screen as shown in figure 7:

   LEFT/RIGHT – Time Base

   UP/DOWN – CH2 Volts/Div

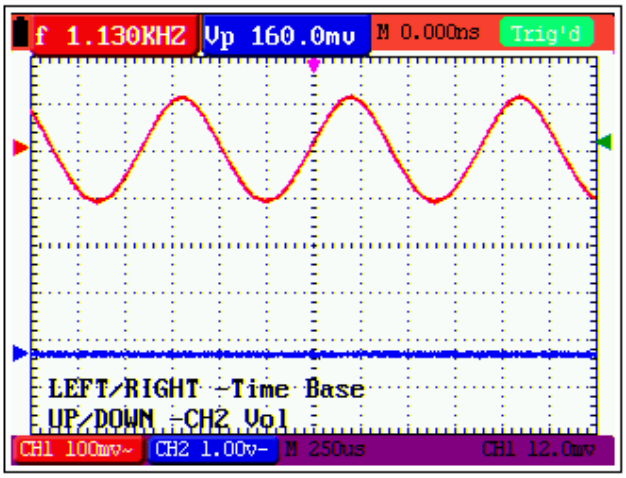


Figure 7: Voltage Unit Scale of Channel 2

4. Press the **OSC UP** or **OSC DOWN** key to adjust the vertical scale of Channel 2 and press the **OSC LIFT** or **OSC RIGHT** key to adjust the horizontal time scale.

5. Press the **OSC OPTION** key one more time, and the following display is visible at the bottom left side of the screen, shown in figure 8.

   LEFT/RIGHT – Time

   UP/DOWN – CH1 Zero

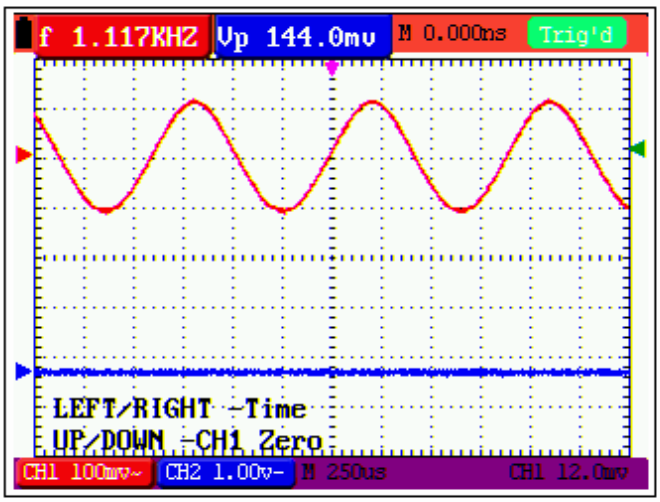


Figure 8: Zero Point Position of Channel 1

6. Press **OSC UP** or **OSC DOWN** key to adjust the zero position of Channel 1 in the vertical direction and press **OSC LIFT** or **OSC RIGHT** key to adjust the horizontal position.

7. Again, press **OSC OPTION** key and the following appears at the bottom left side of the screen, shown as the following figure 9:
   LEFT/RIGHT – Time
   UP/DOWN – CH2 Zero

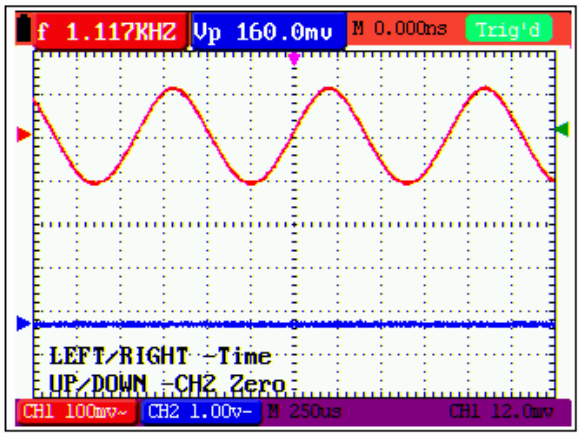


Figure 9: Zero Point Position of Channel 2

8. Press the **OSC UP** or **OSC DOWN** key to adjust the zero position of Channel 2 in the vertical direction and press **OSC LEFT** or **OSC RIGHT** key to adjust the horizontal position.
9. Press **OSC OPTION** key once more and the following appears at the bottom left of the screen, shown as the following figure 10:
   LEFT/RIGHT – Time
   UP/DOWN – Trig

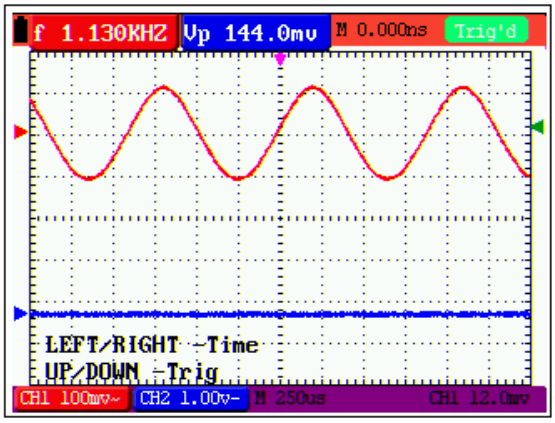


Figure 10: Trigger Level Position

10. Press the **OSC UP** or **OSC DOWN** key to adjust the trigger position of Channel 2 and press **OSC LIFT** or **OSC RIGHT** key to adjust the horizontal position.
11. Press the **OSC OPTION** key again and return back to step 1.

Term Glossary

- **Vertical scale factor** is the voltage amplitude represented by a division in the vertical direction of the display area. The user can amplify or attenuate the signal with this scale factor and thus regulate the signal amplitude for the expected range.
- **Vertical zero position** is referred to as the grounding data point through the adjustment of which one can regulate the display position of the waveform on the screen.
- **Primary time base** refers to the time values represented by a division in the horizontal direction of the display area.
- **Trigger horizontal position** is the time deviation between the actual trigger point and the screen central line which will be displayed as 0 at the center point of the screen.
- **Trigger level position** represents the voltage deviation between the actual trigger level and the zero position of the triggering signal source channel.

Resetting the Oscilloscope

To reset the Oscilloscope to the factory default settings:

1. Press the **MENU** key. The function menu appears on the right side of the screen
2. Press the **MENU UP** or **MENU DOWN** key to select FUNCTION. Three options will be visible at the bottom of the screen.
3. Press **F1** to select Factory Settings. The oscilloscope will revert to the factory settings.

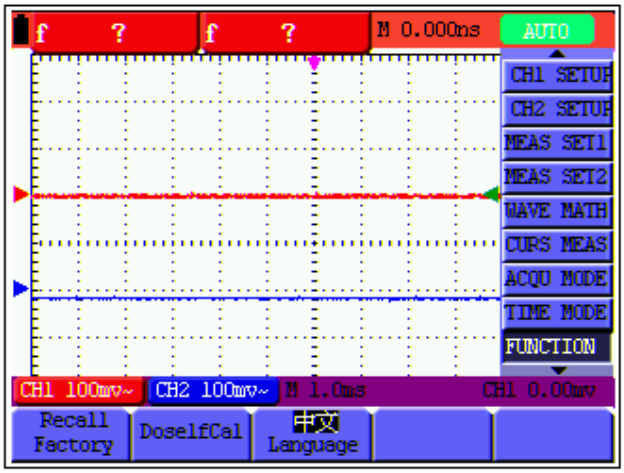


Figure 11: Reset the Oscilloscope

Input Connections (fig. 2)

Examine the bottom and the right side of the Oscilloscope. The Oscilloscope has seven signal inputs: two safety BNC jack inputs (CH1 and CH2) for scope measurements, three safety 4-mm banana jack inputs for Multimeter R, V and A measurements, and two square jack inputs for Multimeter capacitance measurements.

Isolated inputs allow independent floating measurements between Multimeter and Scope.

Displaying an Unknown Signal with Auto Set

The Auto-Set feature allows the Oscilloscope to display and measure unknown signals automatically. This function optimizes the position, range, time-base, and triggering and assures a stable display of virtually any waveform. This feature is especially useful for quickly checking multiple signals.

To enable the Auto-Set feature:

1. Connect the test probe to the signals under test.
2. Press the **AUTOSET** key. The Oscilloscope is now in the automatic measurement mode. The tested signals appear on the screen.

Automatic Zero-Returning of Trigger Horizontal Position and Trigger Level Position

When the trigger horizontal position and trigger level position are adjusted to maximum, they will become positioned off-screen. The following steps will allow the trigger horizontal position and trigger level position to return to zero automatically:

1. Press the OSC LEFT key and the OSC RIGHT key simultaneously, the trigger horizontal position automatically returns to zero.
2. Press the OSC UP and the OSC DOWN buttons simultaneously, the trigger level position automatically returns to zero.

Automatic Measurements

The Oscilloscope offers 5 ranges of automatic scope measurements. Two numeric readings can be displayed: **measurement 1** and **measurement 2**. These readings are selectable independently and the measurements can be performed on the input CH1 or input CH2 waveform.

To choose a frequency for CHI1:

1. Press the **MENU** key. The function menu appears on the right side of the screen.
2. Press the **MENU UP** or the **MENU DOWN** key to select **MEAS SET1**. Five selectable items are visible at the bottom of the screen.
3. Press the **F1** key and select **Freq CH1** from the mean square root value item. The **measurement 1** window turns red in color and shows the frequency for input CH1.

To choose a Peak-Peak measurement for Input CH2:

1. Press the **MENU** key. The function menu is displayed on the right side of the screen.
2. Press the **MENU UP** or the **MENU DOWN** key and select **MEAS SET2**, with 5 selectable items displayed at the bottom of the screen.
3. Press the **F4** key to select PK-PK CH2 from Peak-Peak item. The **measurement 2** window turns blue in color and shows the peak-peak value for input CH2.

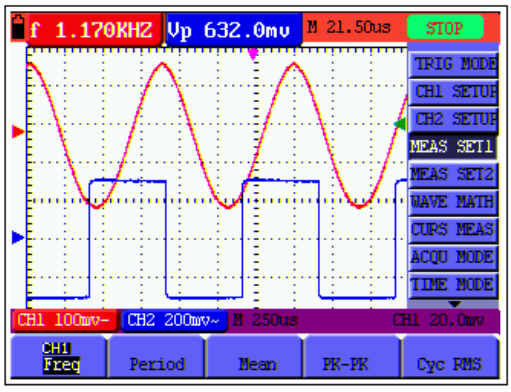


Figure 12: Automatic Scope Measurements

Freezing the Screen

1. Press the RUN/STOP key to freeze the screen. STOP appears at top right side of the screen.
2. Press the RUN/STOP key once more to resume measurement.

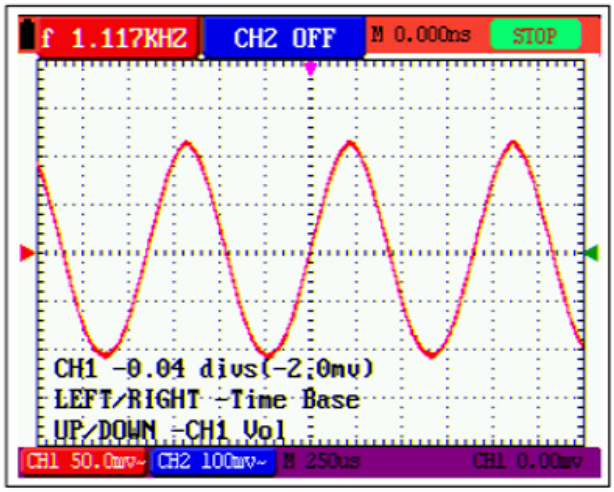


Figure 13: Freezing the Screen

Using Average for Smoothing Waveforms

To smooth the Waveform:

1. Press the **MENU** key and the function menu will appear on the right side of the screen.
2. Press the **MENU UP** or the **MENU DOWN** key to select **ACQU** mode, with four selectable items displayed at the bottom of the screen.
3. Press the **F3** key to select Average Factors, then, press **F4** to jump to Averages. This averages the outcomes of 4, 16, 64, or 128 acquisitions and shows the final averaging result on the screen, shown as in the following figures.

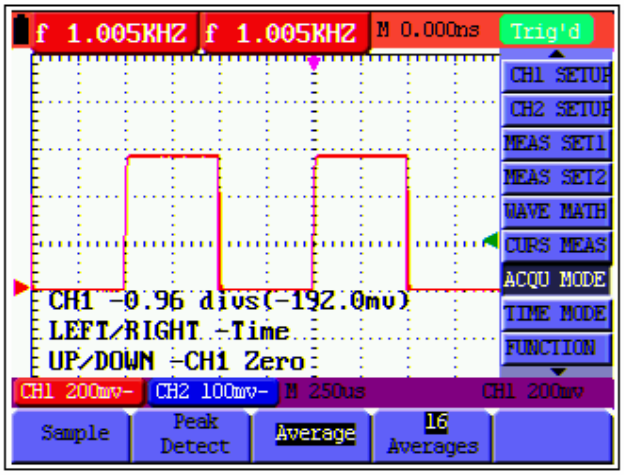


Figure 14: Average Factor Sampling Mode

Using Persistence to Display Waveforms

You can use Persistence to observe dynamic signals:

1. Press the **MENU** key and the function menu will appear on the right side of the screen.
2. Press the **MENU UP** or the **MENU DOWN** key to select **DISP SET**. Four selectable items are displayed at the bottom of the screen.
3. Press the **F2** key to select Persist 1 sec, 2 sec, and 5 sec, Infinite or OFF. In this case, jump to Infinite and the observed dynamic is kept on the screen continuously. When the item OFF is selected, the Persistence function is switched off.

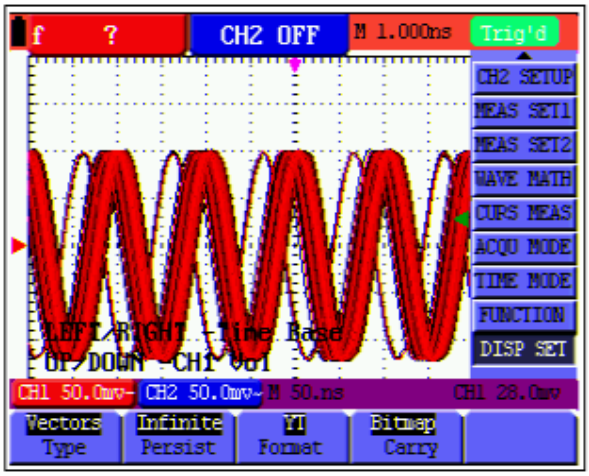


Figure 15: Using 'Persistence' to Observe Dynamic Signals

Using Peak Detection to Display Glitches

The user can use this function to display events (glitches or other asynchronous waveforms) of 50 ns or wider:

1. Press the **MENU** key and the function menu will appear at the right side of the screen.
2. Press the **MENU UP** or the **MENU DOWN** key to select the **ACQU MODE**. Four selectable items are displayed at the bottom of the screen.
3. Press the **F2** key and jump to Peak Detect.

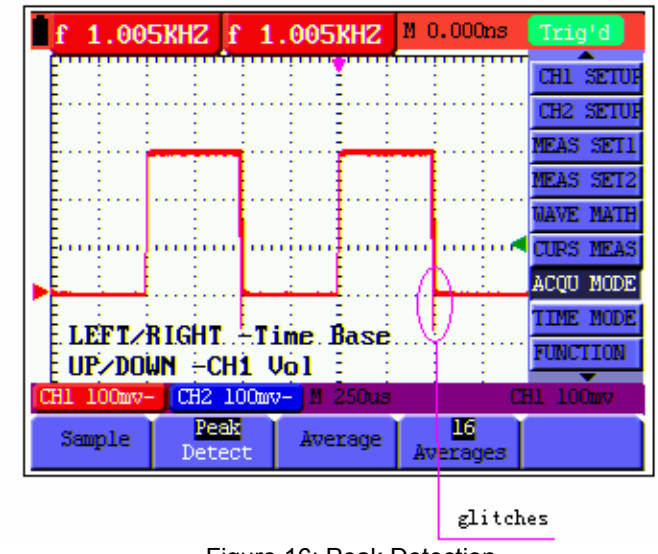


Figure 16: Peak Detection

Term Glossary

Collecting mode: The oscilloscope transforms the collected analog data into a digital form after it is gathered in the following three modes: sampling, peak value detection and averaging values.

Sampling: The oscilloscope takes samples from the signal at equal time intervals to reconstruct the waveform. In this mode, the analog signal can be expressed correctly in most cases. However, rapid changes cannot be detected between two sampling time intervals.

Peak value detection: The oscilloscope takes samples from the maximum and minimum of signals in each sampling interval and shows the Waveform with the sampled data. Thus, the oscilloscope may capture narrow pulses that could not be detected in sampling mode.

Averaging values: The oscilloscope collects several Waveforms, averages them, and displays the averaged Waveform. In this mode random noise can be reduced.

Duration time: When a new Waveform is displayed, the previous Waveform shown on the screen does not disappear immediately but will continue to be displayed for a period of time. This period of time is referred to as the duration time. Thus, a display similar to that shown by an analog oscilloscope can be achieved.

Roll scan mode: The oscilloscope updates the Waveform sampling points by scrolling through the screen from left to right (only applicable to the primary time base setting above 50ms).

Selecting AC-Coupling

After a reset, the Oscilloscope is dc-coupled so that ac and dc voltages appear on the screen. Use ac-coupling to observe small ac signals that ride on a dc signal. To select ac-coupling:

1. Press the **MENU** key and the function menu will appear at the right side of the screen.
2. Press the **MENU UP** or the **MENU DOWN** key to select the **CH1 SETUP**. Four selectable items are visible at the bottom of the screen.
3. Press the **F1** key and jump to AC. The bottom left side of the screen displays the ac-coupling icon.

The user can view a screen that looks similar to the following Figure 17.

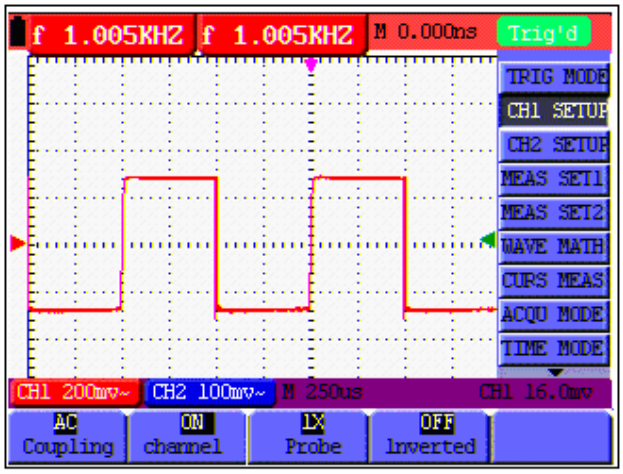


Figure 17: AC-Coupling

Reversing the Polarity of the Displayed Waveform

To invert the input CH1 waveform, do the following:

1. Press the **MENU** key and the function menu will appear at the right side of the screen.
2. Press the **MENU UP** or **MENU DOWN** key to select **CH1 SETUP**. Four selectable items are displayed at the bottom of the screen.
3. Press the **F4** key to jump to Inverted. The inverted waveform of CH1 is displayed on the screen.

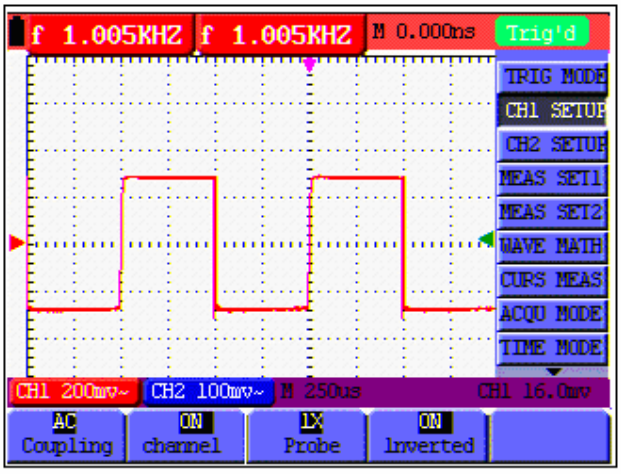


Figure 18: Inverted

Using Waveform Mathematical Functions

When adding (CH1 + CH2), subtracting (CH1 – CH2, CH2 – CH1), multiplying (CH1 * CH2) or dividing（CH1 / CH2) the input Waveforms of CHI and CH2, the Oscilloscope will display the mathematical result Waveform M and the input Waveforms of CH1 and CH2 on the screen. The Mathematical functions perform a point-to-point calculation on Waveforms for CH1 and CH2.

To use a Mathematical function:

1. Press the **MENU** key and the function menu will display at the right side of the screen.
2. Press the **MENU UP** or **MENU DOWN** key to select the **WAVE MATH**. Five selectable items appear at the bottom of the screen.
3. Press **F3** to select CH1+CH2 and the calculated waveform M (green) appears on the screen. Press the **F3** key to close the Waveform Calculation.
4. Press the **OSC OPTION** key and the following will be visible at the bottom left side of the screen.

   LEFT/RIGHT Time

   UP/DOWN CHM Zero

   Then press the **OSC UP** or the **OSC DOWN** key to adjust the vertical position of the calculated waveform M displayed on the screen.
5. Press the **OSC OPTION** key and the following will appear at the bottom left side of the screen.

   LEFT/RIGHT Time Base

   UP/DOWN CHM Vol

   Press the **OSC UP** or **OSC DOWN** key to adjust the displayed amplitude of the calculated waveform M.

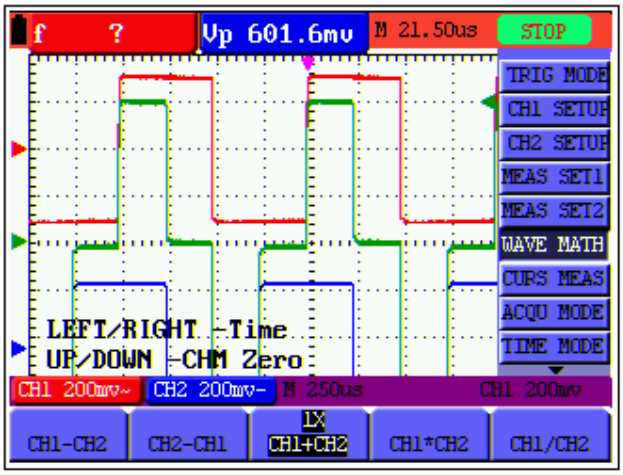


Figure 19: Waveform Mathematics

Using the Multimeter

About this Chapter

This chapter provides step-by-step introductions for the multi-meter functions. The introduction gives basic examples on how to use the menus and perform basic operations.

Meter Connections

Use the three 4-mm safety banana jack inputs for the Meter functions: COM, V/Ω, mA.

Two square capacitance jacks: CX

See Figure 2 for the proper connections.

Multimeter Operation Window

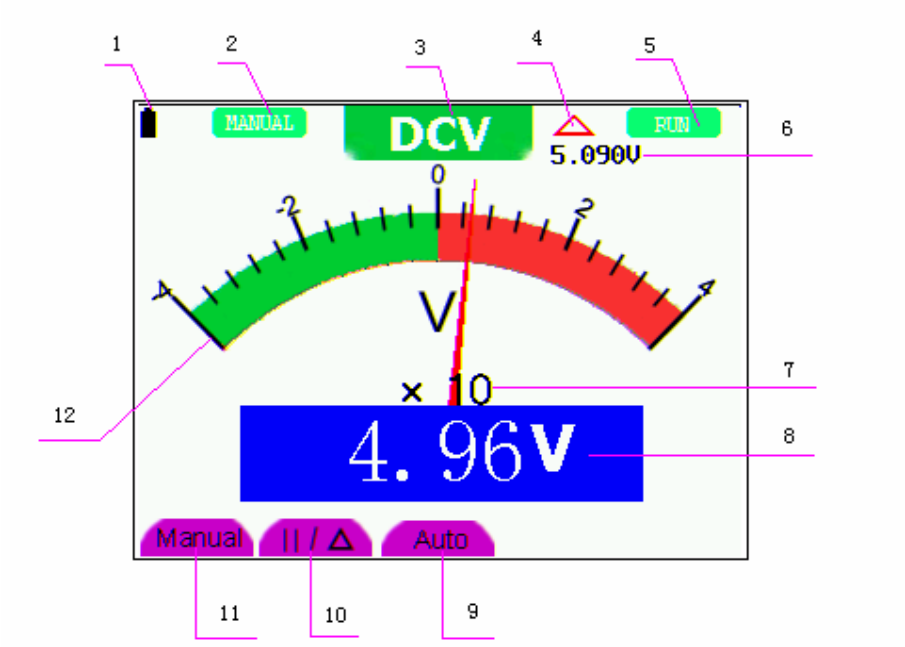


Figure 20: Multimeter Operation Window

Description:

1. Battery power level indictor.
2. Manual/Auto range indictors: Manual refers to the measuring range in manual operation mode and Auto refers to the measuring range in automatic operation mode.
3. Measurement mode indicators:

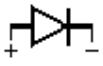
   DCV: Direct voltage measurement

   ACV: Alternating voltage measurement

   DCA: Direct current measurement

   ACA: Alternating current measurement

   R: Resistance measurement

    : Diode measurement

    : Audible Continuity measurement

   C: Capacitance measurement

4. The relative magnitude measurement indicator
5. Running state indicators, among which RUN expresses continuous update and STOP represents the screen lock
6. The reference value of the relative magnitude measurement
7. The multiplying power of the dial indication. Multiplying the reading of the dial pointer by the power will yield the measurement result
8. The measurement reading
9. Automatic control measuring range
10. Absolute / Relative magnitude measuring control: The sign “||” expresses the absolute magnitude measuring control and “□” represents the relative magnitude measuring control
11. Manual measurement range control
12. Test lead indicates the scale of a reading; different test modes use various colors

Multimeter Measurements

By pressing the **DMM/OSC** key the oscilloscope will switch to the Multimeter mode. The screen will display the multimeter windows, and, at the same time, prompt to correctly insert the test leads. At this time press any key to enter the multimeter measurement mode.

Measuring Resistance Values

To measure a resistance, do the following:

1. Press the **R** key and **R** appears at the top of the screen.
2. Insert the black lead into the COM banana jack input and the red lead into the V/Ω banana jack input.
3. Connect the red and black test leads to the resistor. The resistor value is displayed on the screen in Ohms.

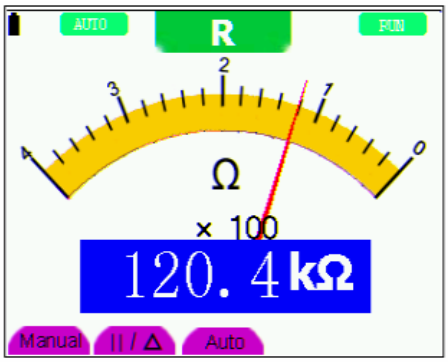


Figure 21: Resistance Measurement

Making a Diode Measurement

To make a diode measurement:

1. Press the **R** key and **R** appears at the top of the screen.
2. Press the **AUTO SET** key until the following is displayed +|◁|−.
3. Insert the black lead into the **COM** banana jack input and the red lead into the V/Ω banana jack input.
4. Connect the red and black leads to the diode and the reading is displayed on the screen in **V**.

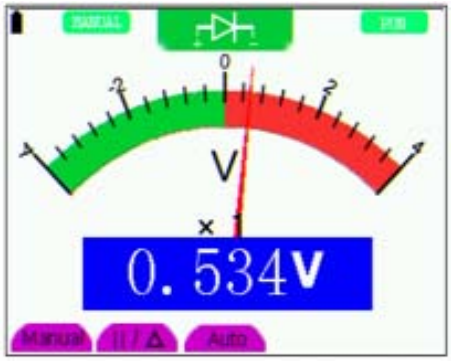


Figure 22: Diode measurement.

Making Continuity Tests

To perform a Continuity Test, do the following:

1. Press the **R** key and **R** appears on the top of the screen.
2. Press the **AUTO SET** key until the following is shown on the screen. 🔊
3. Insert the black lead into the COM banana jack input and the red lead into the V/Ω banana jack input.
4. Connect the red and black test leads to the test points. If the resistance value of the tested point is less than 50Ω an audible beep will sound.

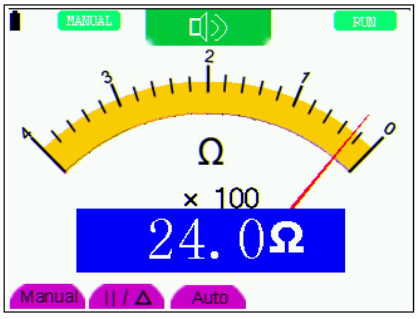


Figure 23: Continuity.

Making a Capacitance Measurement

To measure a capacitance:

1. Press the **R** key and **R** appears on the top of the screen
2. Press the **AUTO SET** key till **C** appears at the top of the screen.
3. Insert the capacitor into the square jack and the screen will show the capacitance reading.

Note: When the measured value is less than 5nF, use the low capacitance mode of the multimeter and the relative value measuring mode to improve measurement precision. If the capacitance measurement is larger than 40uF the calculation will take about thirty seconds.

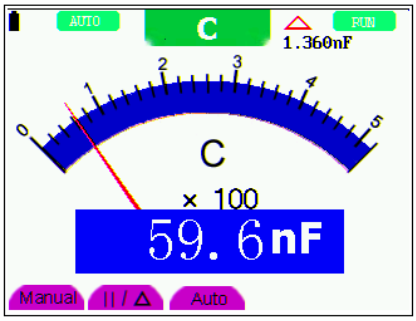


Figure 24: Capacitance Measurement

Making a DC Voltage Measurement

To measure a DC voltage, do the following:

1. Press the **V** key and **DCV** appears at the top of the screen.
2. Insert the black lead into the COM banana jack input and the red lead into the V/Ω banana jack input.
3. Connect the red and black test leads to the measurement points and the measured voltage value will display on the screen.

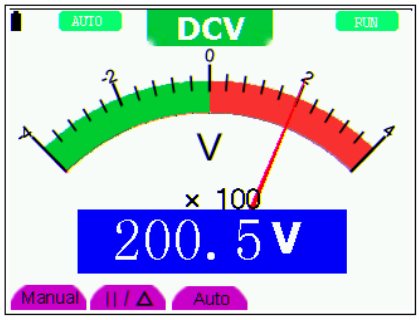


Figure 25: DC Voltage Measurement

Making a AC Voltage Measurement

To measure AC voltage:

1. Press the V key and DCV appears at the top of the screen.
2. Press the AUTO SET key and ACV appears at the top of the screen.
3. Insert the black lead into the COM banana jack input and the red lead into the V/Ω banana jack input.
4. Connect the red and black test leads to the measurement points and the AC voltage value will be displayed on the screen.

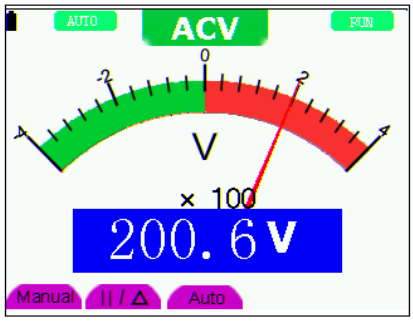


Figure 26: AC Voltage Measurement.

Making a DC Current Measurement

To measure DC current less than 400 mA:

1. Press the **A** key and **DCA** appears at the top of the screen. The units on the main reading screen are **mA** and **20A**, press **F4** or **F5** to switch the measurement between **mA** and **20A**.
2. Insert the black lead into the COM banana jack input and the red lead into the mA banana jack input.
3. Connect the red and black test leads in series to the measurement points and the DC current value will be displayed on the screen.

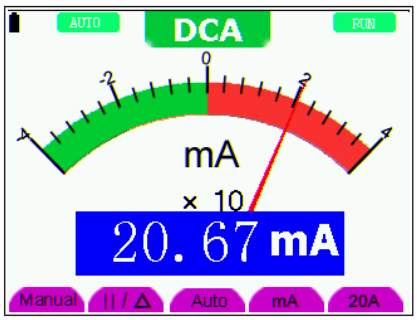


Figure 27: DC Current Measurement.

To measure DC current larger than 400mA:

1. Press the **A** key and **DCA** appears at the top of the screen. The units on the main reading screen will be mA.
2. Press **F5** to change to the **20A** measurement mode, the units on the main reading screen will be **A**.
3. Plug the 20A current shunt into the current measure jack, and then plug the probe in the module.
4. Connect the red and black test leads in series to the measurement points and the DC current value will be displayed on the screen.
5. Press **F4** to return to the 400mA measurement mode.

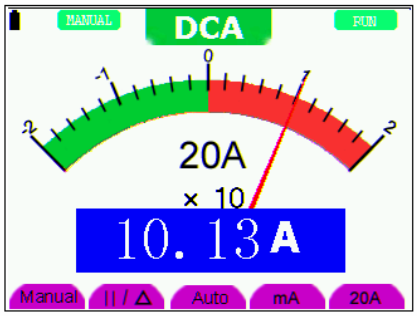


Figure 28: DC Current Measurement.

Making an AC Current Measurement

To measure AC current less than 400mA:

1. Press the **A** key and **DCA** appears at the top of the screen. The units on the main reading screen are **mA** and **20A**, press **F4** or **F5** to switch the measurement between **mA** and **20A**.
2. Press the **AUTO SET** key once and **ACA** will be visible at the top of the screen.
3. Insert the black lead into the COM banana jack input and the red lead into the mA banana jack input.
4. Connect the red and black test leads to the measurement point and the AC current value will be displayed on the screen.

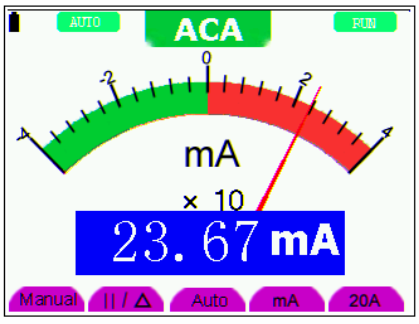


Figure 29: AC Current Measurement

To measure AC current larger than 400mA:

1. Press the **AUTO SET** key once and **ACA** will be visible at the top of the screen.
2. Press **F5** to select **20A**, the units for the main reading window will be **A**.
3. Press the **AUTO SET** key once and **ACA** will be visible at the top of the screen.
4. Plug the current extended module into the current measurement jack, and plug the test leads into the shunt.
5. Connect the red and black test leads in series to the measurement points and the AC current value will be displayed on the screen.
6. Press **F4** to return to the 400mA measurement mode.

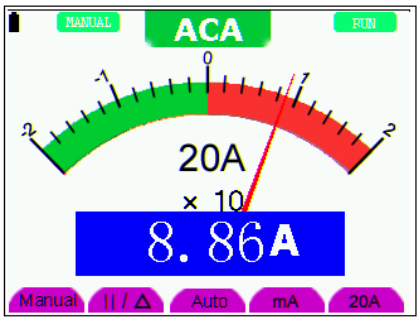


Figure 30: AC Current Measurement for 20A

Freezing a Displayed Reading

Freeze the displayed readings at any time:

1. Press the **RUN /STOP** key to freeze the screen, **STOP** will be displayed at the top right of the screen.
2. Press the **RUN /STOP** key again to resume measurements.

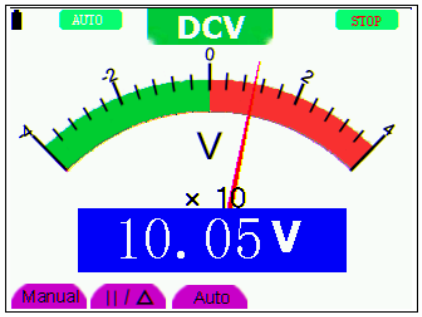


Figure 31: Freezing the Readings

Taking a Relative Measurement

A reading, relative to a reference value, is displayed in the relative measurement mode. The following example shows how to take a relative measurement. First, the user must define a reference value:

1. Press the **R** key and **R** will be displayed on the top of the screen.
2. Press the **AUTO SET** key untill **C** appears at the top of the screen.
3. Plug the capacitance extended module into the capacitance measurement jack.
4. When the reading stabilizes, press **F2** and the triangle icon will be displayed on the top of the screen. The saved reference value is displayed below the triangle
5. All subsequent readings will be displayed relative to the stored reference reading.

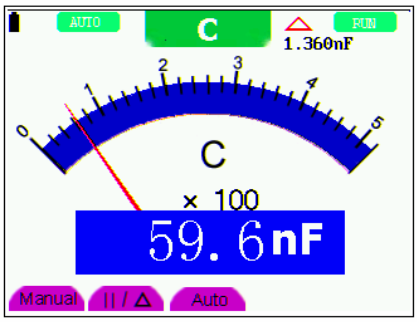


Figure 32: Relative Measurement.

Selecting Automatic/Manual Range

The default range mode is the automatic range mode. To switch to the manual range, perform the following steps:

1. Press the **F1** key and **MANUAL** is displayed on the top left side of the screen.
2. In manual range mode, the measuring range is increased each time **F1** is pressed. After the highest range is reached, the meter will return to the lowest range. To return to automatic mode, Press the **F3** key and **AUTO** is displayed on the top left side of the screen.

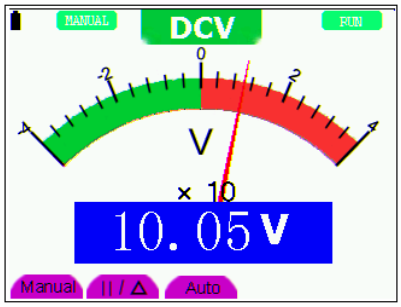


Figure 33: Automatic/Manual Range Adjustment

Advanced Oscilloscope Functions

About this Chapter

This chapter details the advanced oscilloscope functions.

Setting the Vertical CH1 and CH2

Each channel can be set independently.

To change vertical CH1 and CH2 settings:

1. Press the **MENU** key and the function menu will appear at the right of the screen.
2. Press the **MENU UP** or **MENU DOWN** key to jump to **CH1 SETUP** and four options appear at the bottom of the screen.
3. Press any key from the **F1** key through **F4** to adjust the available settings.

The user can view a screen that looks similar to the following Figure 34.

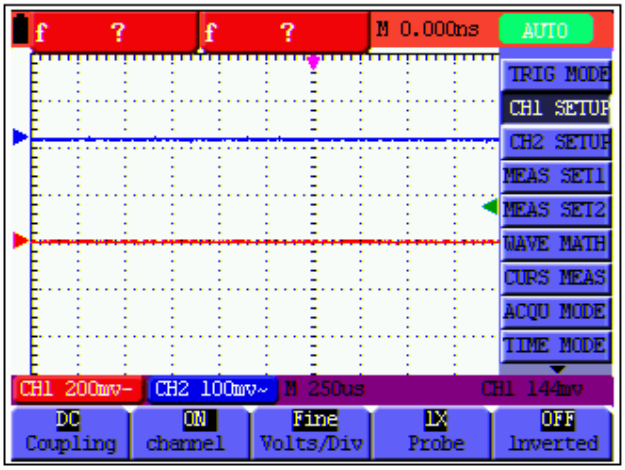


Figure 34: Setting the Vertical

The following Table describes the **Vertical Channel** menu:

Function menu	Setting	Description
Coupling	AC DC	The dc component in the input signal is blocked. The ac and dc components of the input signal are allowed
Channel	Close Open	Close a channel Open a channel
Probe	1X 10X 100X 1000X	Select one setting according to the probe attenuation factor to ensure a correct vertical scale reading.
Invert	Close Open	Waveform is displayed normally. Open the **Invert** function of the Waveform setting.

Setting the Channel Coupling

Example (CH1): Sine wave signal containing a dc offset.

Press **F1 Coupling** first and then press **AC** for an ac coupling setting. The dc component contained in the tested signal is blocked.

Press **F1 Coupling** first and then press **DC** for a dc coupling setting. Both dc and ac components contained in the tested signal are permitted.

The waveform is displayed as in Figures 35 and 36.

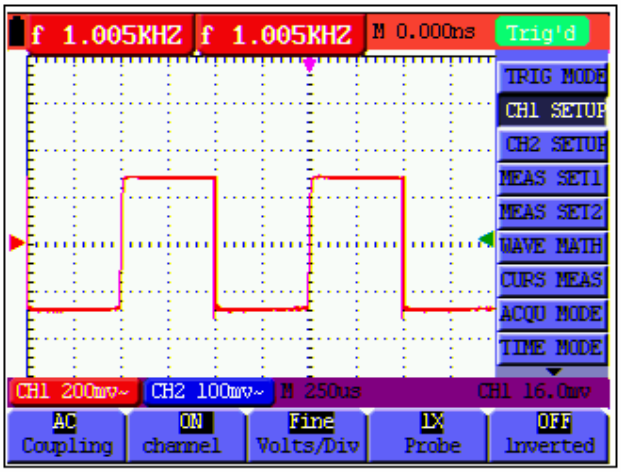


Figure 35: AC Coupling

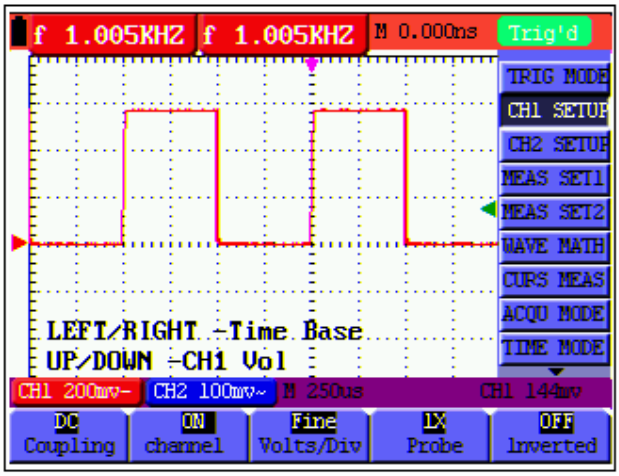


Figure 36: DC Coupling

Enabling the Scope Channels

Example for CH1:
Set the **F2 Channel** key to **OFF** and CH1 will be turned off.
Set the **F2 Channel** key to **ON** and CH1 will be displayed.

Adjusting the Probe Scale

If a 10:1 probe is connected, the scale of the input channel on the oscilloscope should be set to **10X** to avoid any error occurring in the displayed scale factor information and tested data.

Press **F3 Probe** to set the correct probe attenuation.

Table: Probe attenuation factors and the corresponding menu setting.

Probe Attenuation Factor	Corresponding Menu Setting
1:1	1X
10:1	10X
100:1	100X
1000:1	1000X

Inverting a Waveform

The displayed signal reverses 180 degrees relative to ground.
Press **F4 Invert** to invert the waveform. Press **F4 Invert** once again to cancel the Inversion.

Math Function Menu Settings

The **MATH** function provides the results for addition, subtraction, multiplication or division calculations on CH1 and CH2 channel waveforms. The result can be shown in grid or cursor modes. The amplitude of the calculated waveform can be adjusted with CHM VOL, which is displayed in the scale factor form. The amplitude ranges are 0.001X, 0.002X, 0.005X and 10X. The position of the calculated waveform can be adjusted up and down with the **CHM Zero** key.

Math Function Table

Setting	**Description**
CH1-CH2	CH1 waveform minus CH2 waveform.
CH2-CH1	CH1 waveform minus CH2 waveform
CH1+CH2	Add CH1 waveform to CH2 waveform
CH1*CH2	Multiply CH1 waveform and CH2 waveform
CH1/CH2	Divide CH1 waveform by CH2 waveform

To perform a **CH1+CH2** waveform calculation:

1. Press the **MENU** key and the function menu will appear at the right of the screen.
2. Press the **MENU UP** or **MENU DOWN** key to select **WAVE MATH**. Five options are displayed at the bottom of the screen.
3. Press the **F3 CH1+CH2** key and the obtained waveform **M** appears on the screen. Press the **F3** key again to close the waveform **M**.
4. Press the **OSC OPTION** key and the following will be displayed on the screen:
   LEFT/RIGHT – Time Base
   UP/DOWN – CH1 Volts/Div
5. Press the **OSC UP** or **OSC DOWN** key to adjust the amplitude of the waveform **M**.
6. Press the **OSC OPTION** key twice and the following will appear:
   LEFT/RIGHT – Time
   UP/DOWN – CHM Zero
7. Press the **OSC UP** or **OSC DOWN** key to adjust the position of waveform **M**.

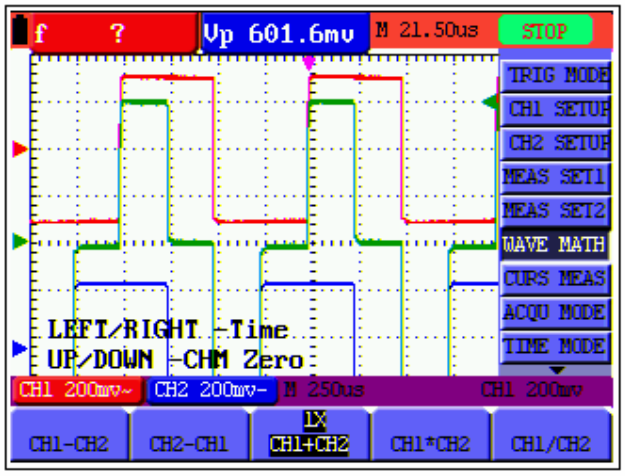


Figure 37: Waveform Mathematics

Setting the Trigger

The trigger defines the start time for data acquisition and waveform display. When beginning to acquire data, the oscilloscope collects sufficient data to draw the waveform at the left side of the triggering point. After a trigger is detected, the oscilloscope gathers enough data to draw the waveform at the right side of the triggering point.

To configure a trigger mode setting:

1. Press the **MENU** key and the function menu will appear at the right of the screen.
2. Press the **MENU UP** or **MENU DOWN** key to select **TRIG MODE** and five selectable items will be displayed at the bottom of the screen.
3. Use the **F1** through **F5** keys to make selections.
4. Press the **OSC OPTION** key and the following will be shown on the screen:
   LEFT/RIGHT – Time
   UP/DOWN – Trig
5. Press the **OSC UP** or **OSC DOWN** key to adjust the trigger level positions.

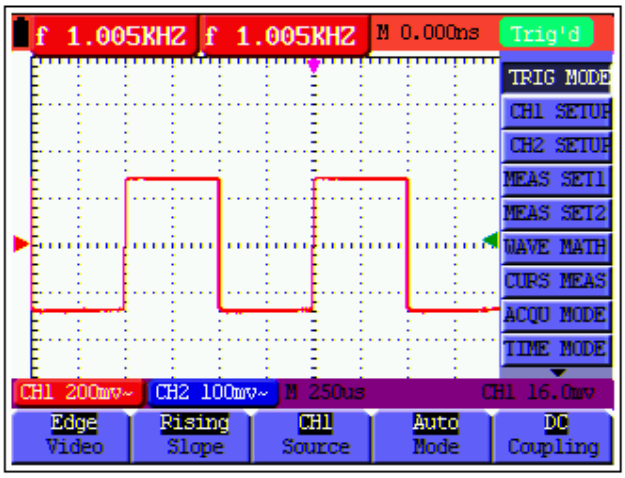


Figure 38: Edge Trigger

Triggering Control

There are two triggering modes: Edge and Video. Each trigger mode is set by menu functions:

Edge triggering occurs when the trigger input passes through a given level in the specified direction.

Video triggering: Perform video field trigger or line trigger on standard video signals.

The following describes the Edge and Video triggering menus respectively.

Edge Triggering

With **Edge triggering** selected, the trigger occurs on the rising or falling edge of the input signal, if the triggering threshold is met.

The **Edge triggering** menu:

Function menu	Settings	Description
Slope	Rise Fall	Triggering on the rising edge of the signal. Triggering on the falling edge of the signal.
Signal source	CH1 CH2	CH1 is used as the trigger source. CH2 is used as the trigger source.
Trigger mode	Auto Normal Single Shot	Acquisition of waveforms is possible even if there is no triggering condition detected. Acquisition of waveforms can only be performed when the triggering condition is satisfied. The sampling is performed on a waveform when one trigger is detected, then sampling ceases.
Coupling	AC DC HF suppression LF suppression	With this mode selected, the DC component is prevented from passing-through. All dc components are allowed to pass. The HF part of the signal is prohibited and only the LF component is allowed. The LF part of the signal is prohibited and only the HF component is allowed to pass

Video Triggering

With **Video triggering** selected, the oscilloscope performs **NTSC, PAL** or **SECAM** standard video signal field and line triggering.

The user can view a screen that looks similar to the following Figures 39 & 40.

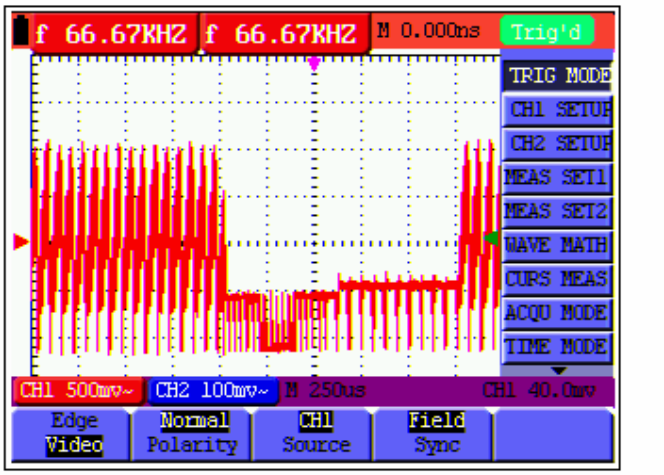


Figure 39: Video Field Trigger

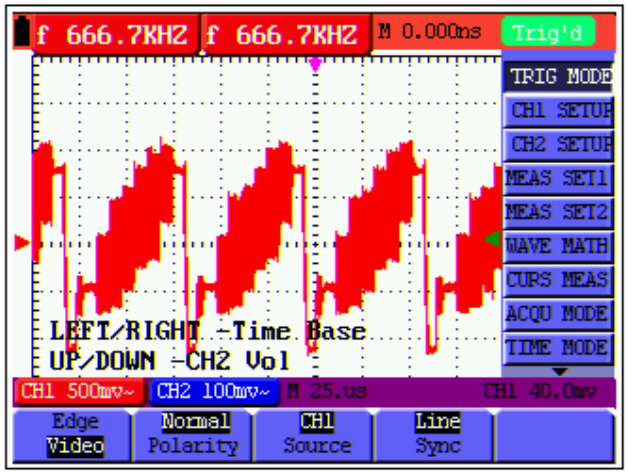


Figure 40: Video Line trigger

The Video triggering menu is described in the following table.

Function menu	Settings	Description
Polarity	Normal Invert	Applicable to the video signal in which the black level is low level. Applicable to the video signal of which the black level is high level.
Signal source	CH1 CH2	Select CH1 as the trigger source. Select CH2 as the trigger source.
SYNC	Line Field	Make a video line trigger synchronization setting Make a video field trigger synchronization setting.

Term Glossary

Trigger modes: There are three kinds of trigger modes available for this oscilloscope-auto, normal and single shot.

Automatic trigger mode: In this mode, the oscilloscope can acquire a Waveform without any triggering condition detected. It will be triggered automatically after waiting a specified period of time. When an invalid trigger is sensed the oscilloscope cannot keep the Waveform in phase.

Normal trigger mode: In this mode the oscilloscope cannot acquire the Waveform until it is triggered. If there is no trigger, the oscilloscope will display the original Waveform without new Waveforms being captured and/or displayed.

Single shot mode: In this mode the oscilloscope will detect a trigger and capture a Waveform each time the operator presses the RUN/STOP key.

Acquiring Mode Settings

The **Acquiring Mode** menu is described in the table shown below:

Function menu	Settings	Description
Sampling		Normal sampling mode.
Peak Detection		Used to detect a glitch.
Average Value		Used to reduce random and unrelated noise. Several average factors are available.
Average Factor	4, 16, 64 or 128	Select the average factor.

Display Settings

The **Display Setting** menu is described in the following table:

Function menu	Settings	Description
Type	Vector Dot	The vector fills the spaces between neighboring sampling points to form a line on the display. Only the sample points are displayed.
Persistence	Close 1s 2s 5s Infinite	Set 'Persistence' time for each sampling point.
Display format	YT XY	Displays the relative relationship between vertical voltage and horizontal time. Display CH1 on the horizontal axis and CH2 on the vertical axis.
Communication	Bitmap Vector	The data is transmitted as a bitmap The data is transmitted as a vector

Display Style

The display styles include **Vector** and **Dot** as shown in Figures 41 & 42.

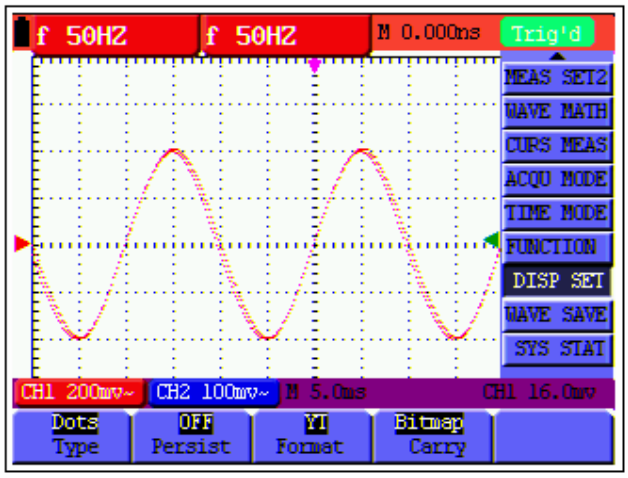


Figure 41: Dot Style

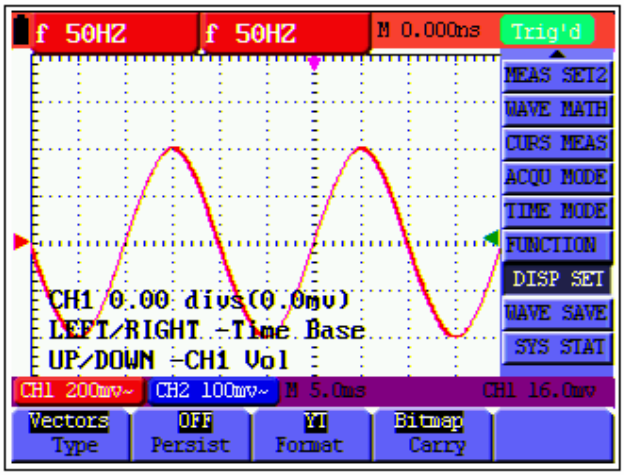


Figure 42: Vector Style

Persistence Mode

With the **Persistence** function selected, the displayed data gradually decays in color and the new data is shown bright in color. In the infinite persistence mode, the recorded points will be kept on the screen until the controlled value is changed.

XY Mode

With the XY mode selected, CH1 is displayed on the horizontal axis and CH2 displayed on the vertical axis. When the oscilloscope is in a sampling mode in which no trigger is found, the data appear as light spots.

Operation of various control keys:

- **CH1 Volts** and **CH1 Zero** for CH1 are used to set the horizontal scale and position.
- **CH2 Volts** and **CH2 Zero** for CH2 are used to set the vertical scale and position.

The following functions do not work in the XY display mode:

- Reference or digital value waveform
- Cursor
- Auto Setting
- Time base control
- Trigger control

Waveform Saving Setup

The oscilloscope can save four (4) Waveforms all of which can be displayed on the screen with the present Waveform. The recalled Waveform saved in the memory cannot be adjusted.

The **waveform saving /recalling menu** is described in the following list.

Function menu	Setups	Description
Signal source	CH1 CH2 MATH	Select the displayed Waveform to save.
Address	A, B, C and D	Select the address for saving or recalling a Waveform.
Saving		Store the Waveform of a selected signal source into the selected address.
Addresses A, B, C and D	Close Start	Close or start displaying the Waveforms stored in address A, B, C or D.

To save a waveform on CH1 in address A:

1. Press the **MENU** key; the function menu will appear at the right of the screen.
2. Press the **MENU UP** or **MENU DOWN** key to select **Wave Save**. Four selectable items are displayed at the bottom of the screen.
3. Press the **F1** key to select the signal source CH1.
4. Press the **F2** key to select the Address A.
5. Press the **F3** key to save the CH1 Waveform in Address A.

To display the saved Waveform:

Press the **F4** key to select Start for address A. The Waveform saved in address A will be displayed on the screen in green and the zero point of Waveform k, voltage and time, will be purple

The user can view a screen that looks similar to the following Figure 43.

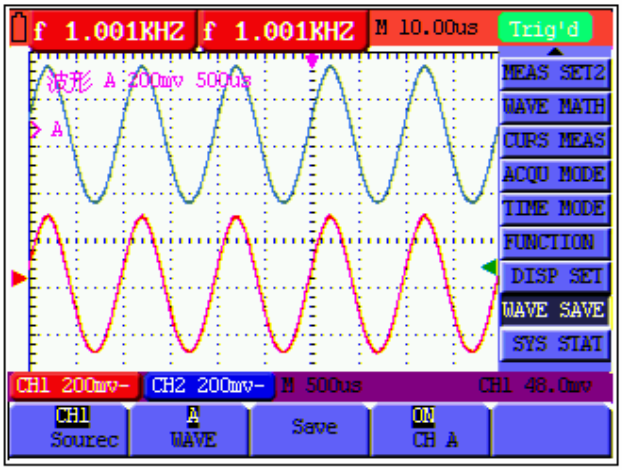


Figure 43: Saving a Waveform

Function Setting Menu

The **Function Setting Menu** is described in the following list:

Function Menu	Setting	Description
Factory setting		Return the instrument to its factory settings.
Self-correcting		Perform a self-correcting procedure.
Language	Chinese English	Select the display language

Self-correcting:

The self-correcting program can improve the accuracy of the oscilloscope if the ambient temperature variation is equal to or larger than 5 degrees Celsius.

Before the self-correcting program is performed, the probe or leads should be disconnected; Press **F2** "**Self-correcting**" to enter the self-correcting program.

Automatic Measurements

The oscilloscope can perform five (5) types of automatic measurements: Frequency, Cycle, Average value, Peak-to-peak value and Root mean square. Two types of measurements can be displayed on the screen simultaneously.

The function menu for automatic measurements is described in the following table:

Function menu	Settings	Description
Frequency	CH1 CH2	Measures the frequency of CH1 Measures the frequency of CH2
Cycle	CH1 CH2	Measures the cycle of CH1 Measures the cycle of CH1
Average value	CH1 CH2	Measures the average value of CH1 Measures the average value of CH2
Peak-to-Peak value	CH1 CH2	Measures the peak-to-peak value of CH1 Measures the peak-to-peak value of CH2
RMS value	CH1 CH2	Measures root mean square (RMS) value of CH1 Measures root mean square (RMS) value of CH2

To measure the frequency of CH1 with **Measurement 1** and the frequency of CH2 with **Measurement 2**, perform the following:

1. Press the **MENU** key; the function menu will be shown at the right of the screen.
2. Press the **MENU UP** or **MENU DOWN** key to select **MEAS SET1**. Five options appear at the bottom of the screen.
3. Press the **F1** key to select the frequency measurement as **CH1.** The measurement window 1 on the screen turns red in color and shows the frequency of CH1.
4. Press the **MENU UP** or **MENU DOWN** key to select **MEAS SET2**. Five options appear at the bottom of the screen.
5. Press the **F4** key to jump to the peak-to-peak measurement symbolized as **CH2**. The measurement window on the screen turns blue in color and shows the peak-to-peak value of CH2.

The user can view a screen that looks similar to the following Figure 44.

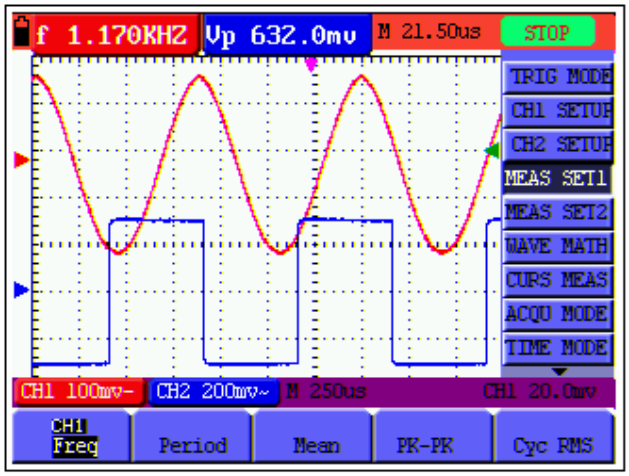


Figure 44: Automatic Measurements

Cursor Measurements

This oscilloscope allows the user to make manual cursor measurements of time and voltage. The signal sources include Channel 1 (CH1), Channel 2 (CH2), MATH, storage Address A and storage Address B.

The cursor measurement menus are listed and described in the following table:

Function menus	Settings	Description
Type	Close Voltage Time	Closes the cursor measurement Displays the voltage cursor and menu Displays the time cursor and menu
Signal sources	CH1, CH2, ATH, address A and address B.	Selects the Waveform channel on which the cursor measurement will be performed

To make a voltage measurement on CH1, perform the following:

1. Press the **MENU** key: the function menu will appear at the right of the screen.
2. Press the **MENU UP** or **MENU DOWN** key to select **CURS MEAS**. Two options are shown at the bottom of the screen.
3. Press the **F1** key to select the measurement type **Voltage**. Two purple crossing dashed lines V1 and V2 are shown on the screen.
4. Press the **F2** key to select the measured channel **CH1**.
5. Press and hold the **OSC OPTION** key till the **UP/DOWN CURSOR 1** is visible on the screen. At this time, adjust **OSC UP** or **OSC DOWN** and the dashed line **V1** is shown moving up and down while the measured voltage value of **V1** relative to the zero position of CH1 appears on the screen.
6. Press and hold the **OSC OPTION** key until the **UP/DOWN CURSOR 2** appears on the screen. Now, adjust **OSC UP** or **OSC DOWN** and the dashed line **V2** will appear moving up and down while the measured voltage value of **V2** relative to the zero position of CH1 is displayed on the screen. Also, the absolute values of **V1** and **V2** can be shown on the screen.

The user can view a screen that looks similar to the following Figure 45.

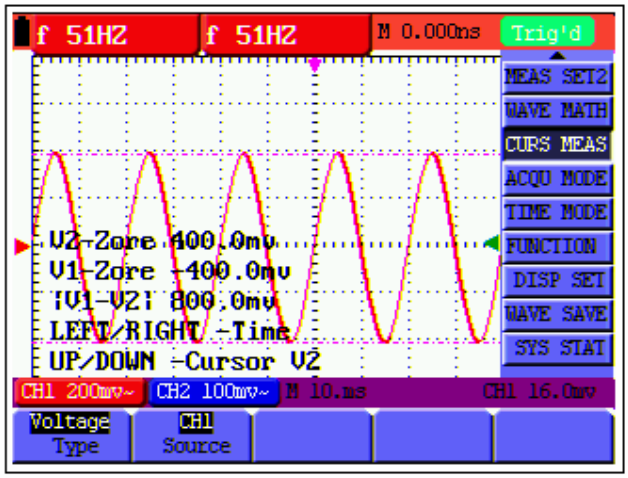


Figure 45: Use the Cursor for a Voltage Measurement

To use the cursor for a time measurement on CH1, perform the following:

1. Press the **MENU** key; the function menu will appear at the right of the screen.
2. Press the **MENU UP** or **MENU DOWN** key to select **Cursor Measurement**. Two key labels are shown at the bottom of the screen.
3. Press the **F1** key for measurement type **Time.** Two vertical dashed lines T1 and T2 appear on the screen.
4. Press the **F2** key to jump to the measured channel **CH1**.
5. Press and hold the **OSC OPTION** key until the **UP/DOWN CURSOR 1** appears on the screen. Then adjust **OSC UP** or **OSC DOWN** to observe the dashed line moving left and right. At the same time, the time value of **T1** relative to the **screen middle point position** will be displayed on the screen.
6. Keep pressing the **OSC OPTION** key until **UP/DOWN CURSOR 2** is displayed on the screen. Then adjust **OSC UP** or **OSC DOWN** so that the dashed line **T2** is moving right and left while the time value of **T1,** relative to the **screen middle point position,** appears on the screen. Observe the absolute time values and frequencies for **T1** and **T2.**

The user can view a screen that looks similar to the following Figure 46.

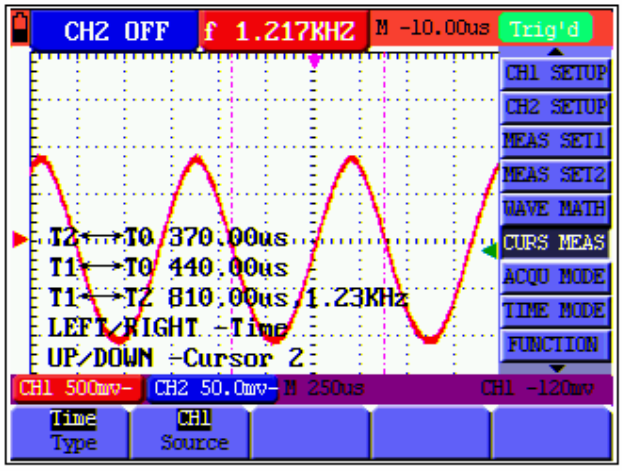


Figure 46: Use the Cursor for Time Measurement

System State Menu

The system state menu is used to display information about the present horizontal system, vertical system, trigger system and others. The operational steps are listed below:

1. Press the **MENU** key; the function menu will appear at the right side of the screen.
2. Press the **MENU UP** or **MENU DOWN** key to select **SYS STAT.** Four options appear at the bottom of the screen.
3. Sequentially press **F1** through **F4** and the corresponding status information will display.

The following Figure 47 will be displayed.

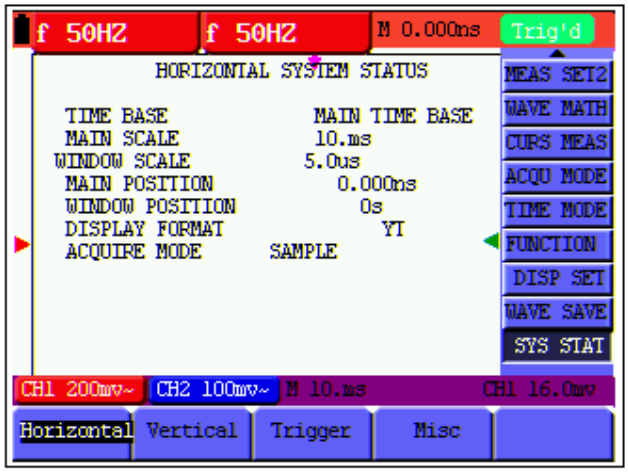


Figure 47: System State

Setting the Time Base Mode

The time base mode menu is detailed in the following table:

Function menu	Explanation
Main time base	Horizontal main time base is used for waveform display
Window setting	Use two cursors to define a window area
Window extension	Expand the defined window to full-screen display

For a Window Extension, use the following steps:

1. Press the **MENU** key; the function menu will appear on the right side of the screen.
2. Press the **MENU UP** or **MENU DOWN** key to select **TIME MODE** (three options appear at the bottom of the display).
3. Press the **F2** key to select the window setting.
4. Press the **OSC OPTION** key to view **TIME BASE**, then use the **OSC LEFT** and **OSC RIGHT** keys to adjust the time base window area defined by two cursors, the window size will vary.
5. Press the **OSC OPTION** key to view the **TIME**, use the **OSC LEFT** and **OSC RIGHT** keys to adjust the window position defined by two cursors, the window position is the time difference of the window center to the main time base's horizontal pointer.
6. Press **F3**, select window extension, the defined window extends to a full-screen display.

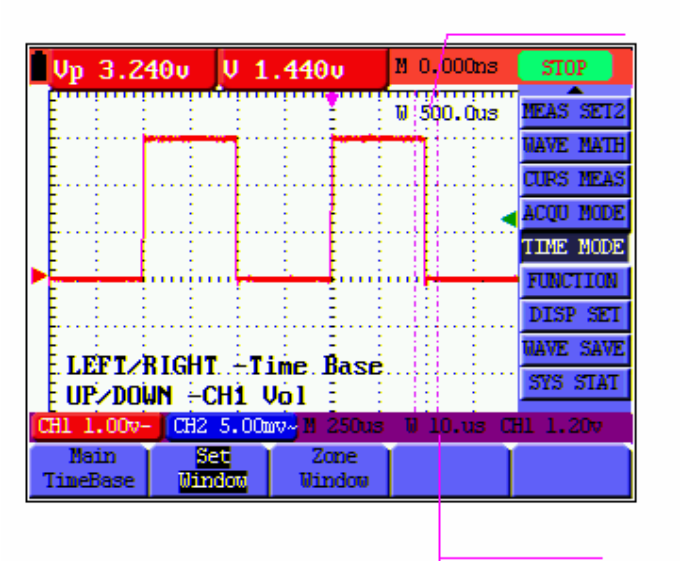


Figure 48: Window Setting

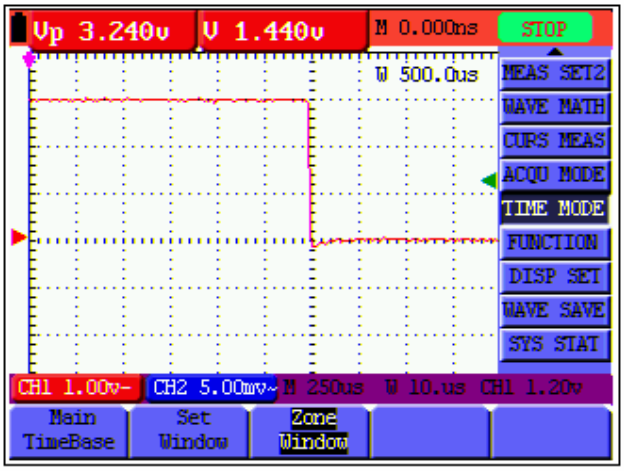


Figure 49: Window Extension

Data Transmission

1. Press the **MENU** key to display the function menu on the right side of the screen.
2. Press the **MENU UP** or the **MENU DOWN** key to select the **DISP SET** mode; four options appear at the bottom of the display.
3. Press the **F4** key and select **Bitmap** or **Vectors** for data transmission.
4. Use the supplied cable to connect the meter to the PC.
5. Open the supplied software program on the PC.
6. Set the parameters according to the Software User Guide or from the Help Utility available inside the software program to start data transmission.

Troubleshooting

1. The oscilloscope will not Power ON

The battery may need recharging. The oscilloscope will not start even if it is powered by the battery charger. First, charge the battery completely and then supply the oscilloscope with power through the battery charger. However, do not switch on the oscilloscope's power for fifteen minutes. If the oscilloscope still will not start, please contact Extech Instruments.

2. The oscilloscope shuts OFF after operating for only several seconds

The battery may need recharging. Check the battery symbol at the upper right of the screen. The ▯ symbol indicates that the battery has run out of power and must be charged.

3. The measurement displays ERR when in the multimeter mode

Make sure the instrument is switched to the measuring mode. Depress any of the three keys V, A or R. The relative measuring mode will then be shown on the screen. If ERR is still displayed, restart the meter.

4. The measured voltage amplitude value is 10 times larger or smaller while in the oscilloscope mode

Check whether the channel attenuation factor matches the actual probe ratio.

5. In the Oscilloscope mode, the Waveform is displayed but is not stable

- Check whether the setting in the trigger mode menu matches the signal channel indicated.
- Check the trigger mode: The edge trigger mode is applicable to normal waveforms and the video trigger mode is applicable to video signals. Only when the proper trigger mode is applied can the Waveform stabilize.
- Change the trigger coupling to HF repression and LF repression in order to filter the HF or LF noise.

6. There is no display on the screen when the RUN/STOP key is pressed while in the oscilloscope mode

Check whether the trigger mode in the trigger mode menu is in the Normal or the Single-Shot mode and whether the trigger level is out of the Waveform range. In such a condition, adjust the middle trigger level or select the non-auto trigger mode. Additionally, press the AUTO SET key.

7. The display speed is unusually slow when attempting to select the average sampling in the sampling mode or while selecting a longer display time in the display mode for the oscilloscope

This is normal.

Appendix

Appendix A: Specifications

Oscilloscope

All technical specifications are applicable with the probe set to the 10X attenuation switch setting (unless otherwise noted). In order for the instrument to maintain these specifications the oscilloscope should meet the following requirements:

- The instrument should operate continuously for more than 30 minutes under specified operating environmental temperatures.
- If the variation in ambient temperature is equal to or greater than 5 degrees Celsius, open the system function menu and perform a “self- calibration”

Sampling:

Sampling modes	Normal sampling Peak detection Average value
Sampling rate	100 MS/s

Input:

Input coupling	DC, AC
Input impedance	1MΩ ±2% connected in parallel with 20pF ±3pF
Probe attenuation coefficient	1X, 10X, 100X, 1000X
Max. Input voltage	400V (peak)
Channel delay time (typical)	150ps

Horizontal:

Sampling rate range	10S/s 100MS/s
Waveform interpolation	(sin x)/x
Record length	6K points on each channel
Scanning speed range (S/div)	5ns/div 5s/div, stepping in the “1-2.5-5” mode
Sampling rate and relay time accuracy	±100ppm(any time interval which is equal to or larger than 1ms)
Time interval (□T)measurement accuracy（full bandwidth）	Single: ±(1 sampling interval time+100ppm×reading+0.6ns) >average 16 : ±(1 sampling interval time +100ppm×reading+0.4ns)

Vertical:

Analog digital converter（A/D）	With a resolution of 8 bits, sampling is performed on both channels synchronously.
Sensitivity range （V/div）	5mV/div～5V/div（at the input BNC）
Displacement range	±50V(500mV~5V),±1V(5mV~200mV)
Analog bandwidth	20M
Single bandwidth	Full bandwidth
Low frequency response (AD coupling, -3dB)	≥5Hz (at the BNC)
Rise time (typical one at the BNC)	≤17.5ns
DC gain accuracy	±5%
DC measurement accuracy (average value sampling mode)	The voltage difference (□V) between any two points on the Waveform after averaging the captured waveforms more than16: ±(5% reading + 0.05 divisions).

Trigger:

Trigger sensitivity (Edge triggering)	DC coupling	CH1 and CH2: 1div(DC~full bandwidth)
	AC coupling	Same as the DC coupling when it is equal to or larger than 50Hz.
Triggering level range		±6 divisions from the screen center
Triggering level accuracy (typical) which is applicable to the signal with rise and fall time equal to or longer than 20ns	±0.3 divisions	
Trigger displacement	655 divisions for pre-triggering and 4 divisions for post-triggering	
Make a 50% level setting (Typical).	Operation with the input signal frequency equal to or larger than 50Hz.	
Trigger sensitivity (Video triggering and typical mode)	2 divisions of peak-to-peak value	
Signal system and line/field frequency (Video triggering mode)	Supports the NTSC, PAL and SECAM broadcasting systems of any field or line frequency.	

Measurement:

Cursor measurement	Voltage difference (□V) and time difference (□T) between cursors
Auto measurement	Peak-to-peak value, average value, root mean square value, frequency and cycle.

Probe:

	1X position	10X position
Bandwidth	Up to 6 MHz (DC)	Up to full bandwidth (DC)
Attenuation rate	1: 1	10: 1
Compensation range	10pf~35pf	
Input resistance	1MΩ±2%	10MΩ±2%
Input impendence	85pf~115pf	14.5pf~17.5pf
Input voltage	150 V DC	300 V DC

Meter

Voltage (VDC)

Input Impedance: 10MΩ.

Max. Input Voltage: 1000V (DC or AC peak-to-peak value)

Range	Accuracy	Resolution
400.0mv	±1%±1 digit	100uV
4.000V		1mV
40.00V		10mV
400.0V		100mV

Voltage (VAC)

Input Impedance: 10MΩ.

Max. Input Voltage: 750V (AC, virtual value)

Frequency range: from 40Hz to 400Hz.

Display: Virtual value of the sine wave

Range	Accuracy	Resolution
4.000V	±1%±3 digits	1mV
40.00V		10mV
400.0V		100mV

Direct Current (DC):

Range	Accuracy	Resolution
40.00mA	±1%±1 digit	10uA
300.0mA	±1.5%±1 digit	100uA
20A (with adaptor)	±3%±3 digits	10mA

Alternating Current (AC):

Range	Accuracy	Resolution
40.00mA	±1.5%±3 digits	10uA
300.0mA	±2%±1 digit	100uA
20A (with adaptor)	±5%±3 digits	10mA

Resistance

Range	Accuracy	Resolution
400.0 Ω	±1%±3 digits	0.1Ω
4.000KΩ	±1%±1 digit	1Ω
40.00KΩ		10Ω
400.0KΩ		100Ω
4.000MΩ		1KΩ
40.00MΩ	±1.5%±1 digit	10KΩ

Capacitance

Range	Accuracy	Resolution
51.20nF	±3%±3 digits	10pF
512.0nF		100pF
5.120uF		1nF
51.20uF		10nF
100uF		100nF

Diode

Voltage reading: 0 V ～1.5 V.

Continuity Test

A beep will sound when the resistance is less than 30Ω

General Specifications

Mechanical dimension	18 cm×11.5cm×4cm
Weight	645 g
Power consumption	<6 W
Display type	3.8" color liquid crystal display
Display resolution	320 (horizontal) ×240 (vertical) pixels
Display color	4096 colors

Power Adapter:

Power supply	100-240 V AC (50/60Hz)
Power output	8.5 VDC
Current output	1500 mA

Ambient Temperature and Relative Humidity:

Temperature (Operational) and Relative Humidity %:

0 to 10°C (32 to 50°F) no condensation

10 to 30°C (50 to 86°F) 95 %

30 to 40°C (86 to 104°F) 75 %

40 to 50 °C (104 to 122°F) 45 %

Temperature (storage) and Relative Humidity %:

-20 to +60°C (-4 to +140°F) no condensation

Appendix B: Maintenance and Cleaning

Common Maintenance

Do not store or place the instrument in locations where the liquid crystal display (LCD) may be exposed to direct sunlight for long periods of time.

In order to avoid damaging the instrument or the probe, do not expose to liquids or solvent agents.

Cleaning:

Inspect the instrument and the probe frequently in accordance with the product's operating manual. Clean the outer surface of the instrument according to the following steps:

1. Wipe off obvious dust on the outside of the instrument and on the probe with a soft, clean cloth. When cleaning the LCD do not scuff the transparent LCD protective screen.
2. Wipe the instrument clean while it is in its power off status. Use a soft cloth that is moistened but not dripping wet. The instrument may be cleaned with mild detergent and fresh water. To prevent damage to the instrument or to the probe do not use abrasive chemicals, strong detergents or cleansers to clean the product.

 **Warning:** Before powering and starting the product, please confirm that the instrument has completely dried so as to avoid electrical short circuit and personal injury.

Storing the Oscilloscope

If the oscilloscope is to be stored for a long time, the lithium battery must be fully charged before storage.

Charging the Oscilloscope

The lithium battery may not arrive fully charged when it is first received by the customer. To properly charge the battery, it must be charged for 4 hours (the oscilloscope must be turned off during charging). The battery can supply power for 4 hours after being charged completely. When utilizing battery power, a battery charge indicator is displayed on the top of the screen to show the battery's remaining power level. The symbols that may appear include  ,  ,  and , where  shows that the battery can only be used for about 5 minutes. To charge the battery and power the instrument, connect the oscilloscope using a power adapter according to Figure 2 to charge the battery. The charging speed can be increased by turning off the oscilloscope.

Notice: To avoid overheating the battery during charging, the environmental temperature should not exceed the temperatures listed in the technical Specifications section.
Note: Once the battery is fully charged, the charger will automatically switch itself to a slower charging rate, thus eliminating the need to turn off the charger at the time the battery is fully charged.

Replacing the Lithium Battery Unit

It is usually not required to replace the battery unit. But when it is required to be replaced only qualified personnel should carry out this operation and the battery should be replaced with the same specified lithium battery.