INSTRUCTION MANUAL
MT1009

TRMS Multimeter & Oscilloscope

Contents

MT1009

True RMS Multimeter

User Manual

1. Introduction

MT1009 Professional True RMS Industrial Digital Multimeter with oscilloscope functions and TFT color LCD display, providing fast A/D converting sampling time, high accuracy, built-in data logging and Trend Capture features. These functions enables one to leave the meter as a standalone unit to log events. It is easy to find and solve the problems of the production equipments, using Bluetooth technology and captured data can be transferred to a computer for analysis of the datasheets. The meter comply with safety standards and is housed in a double moulded rubber casing with an IP67 waterproof design. This meter measures AC/DC Voltage, AC/DC Current, Resistance, Capacitance, Frequency (electrical & electronic), Duty Cycle, Diode Test, Insulation Test and Continuity plus Thermocouple Temperature. The meter can store and recall data and features a waterproof, rugged design for heavy duty use. Proper use and care of this meter will provide many years of reliable service.

2. Safety

This symbol adjacent to another symbol, terminal or operating device indicates that the operator must refer to an explanation in the Operating Instructions to avoid personal injury or damage to the meter.

WARNING This WARNING symbol indicates a potentially hazardous situation, which if not avoided, could result in death or serious injury.

CAUTION This CAUTION symbol indicates a potentially hazardous situation, which if not avoided, may result damage to the product.

MAX This symbol advises the user that the terminal(s) so marked must not be connected to a circuit point at which the voltage with respect to earth ground exceeds (in this case) 1000 VAC or VDC.

This symbol adjacent to one or more terminals identifies them as being associated with ranges that may, in normal use, be subjected to particularly hazardous voltages. For maximum safety, the meter and its test leads should not be handled when these terminals are energized.

This symbol indicates that a device is protected throughout by double insulation or reinforced insulation.

PER IEC1010 OVER VOLTAGE INSTALLATION CATEGORY I
OVERVOLTAGE CATEGORY I

Equipment of OVER VOLTAGE CATEGORY I is equipment for connection to circuits in which measures are taken to limit the transient over voltages to an appropriate low level.
Note – *Examples include protected electronic circuits.*

OVERVOLTAGE CATEGORY II

Equipment of OVERVOLTAGE CATEGORY II is energy-consuming equipment to be supplied from the fixed installation.
Note – *Examples include household, office, and laboratory appliances.*

OVERVOLTAGE CATEGORY III

Equipment of OVERVOLTAGE CATEGORY III is equipment in fixed installations.
Note – *Examples include switches in the fixed installation and some equipment for industrial use with permanent connection to the fixed installation.*

OVERVOLTAGE CATEGORY IV

Equipment of OVERVOLTAGE CATEGORY IV is for use at the origin of the installation.
Note – *Examples include electricity meters and primary over-current protection equipment.*

3. Safety Instructions

This meter has been designed for safe use, but must be operated with caution.
The rules listed below must be carefully followed for safe operation.

3-1. NEVER apply voltage or current to the meter that exceeds the specified maximum:

Input Protection Limits	
Function	Maximum Input
V DC or V AC	1000VDC/AC RMS
mA AC/DC	800mA 1000V fast acting fuse
A AC/DC	10A 1000V fast acting fuse (20A for 30 seconds max every 15 minutes)
Frequency, Resistance, Capacitance, Duty Cycle, Diode Test, Continuity	1000VDC/AC rms
Temperature	1000VDC/AC rms
Surge Protection: 8kV peak per IEC 61010	

3-2. USE EXTREME CAUTION when working with high voltages.

3-3. DO NOT measure voltage if the voltage on the "COM" input jack exceeds 1000V above earth ground.

3-4. NEVER connect the meter leads across a voltage source while the function switch is in the current, resistance, or diode mode. Doing so can damage the meter.

3-5. ALWAYS discharge filter capacitors in power supplies and disconnect the power when making resistance or diode tests.

3-6. ALWAYS turn off the power and disconnect the test leads before opening the covers to replace the fuse or batteries.

3-7. NEVER operate the meter unless the back cover and the battery and fuse covers are in place and fastened securely.

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

4. Feature

4-1. Understanding the Push Buttons

The 12 push buttons on the front of the meter activate features that augment the function selected using the rotary switch, navigate menus or control power to meter circuits.
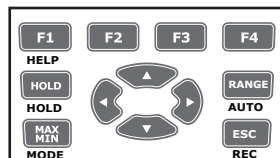
F1 F2 F3 F4 Selects sub-functions and modes related to the rotary switch function.

Cursor buttons select an item in a menu, adjust display contrast, scroll through information and performs data entry.
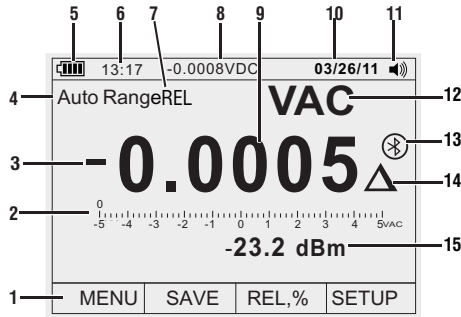
HOLD Freezes the present reading in the display and allows the display to be saved. Also accesses AutoHold.

RANGES switches the meter range mode to manual and then cycles through all ranges. To return to auto ranging, press the button for 1 second.

MIN/MAX Starts and stops MIN/MAX recording.

ESC Return from Power off.

4-2. Understanding the Display

1. Soft key labels indicates the function of the button just below the displayed label.

2. Bargraph analog display of the input signal (See the "Bargraph" section for more information).

3. Minus sign indicates a negative reading.

4. Indicates the range the meter is in and the ranging mode (auto or manual)

5. Battery level indicates the charge level batteries.

6. Time Indicates the time set in the internal clock.

7. Mode annunciators indicates the meter's mode.

8. Mini measurement displays the lightning bolt (when necessary) and the input value when the primary and secondary displays are covered by a menu or pop-up message.

9. Main display shows measurement information about the input signal.

10. Date indicates the date set in the internal clock.

11. Beeper indicates the meter's beeper is enabled (not associated with the continuity beeper).

12. Units indicates the units of measure.

    An Auxiliary Unit indicates unit less measurements like Crest Factor.

13. Blue tooth indicates activity over the communication link.

14. Relative indicates the displayed value is relative to a reference value.

15. Secondary display shows secondary measurement information about the input signal.

4-4. Page Area

The page area of the display is where the main meter content is displayed. The primary display (upper half of the page area) is where the most important value of the selected function is shown. The secondary display contains the bargraph and values that may be measured in addition to the primary function value. For example, with frequency measurement selected in Vac, the frequency value will appear in the primary display with the AC voltage value in the secondary display.

4-5. Softkey Labels

Labels for the four function softkeys **(F1 through F4)** appear in the bottom row of the display. These labels will change based on the function and/or menu selection.

4-6. Understanding the Rotary Switch

Select a primary measurement function by positioning the rotary switch to one of the icons around its perimeter. For each function, the meter presents a standard display for that function (range, measurement units, and modifiers). Button choices made in one function do not carry over into another function.
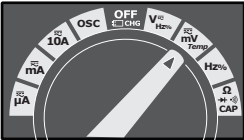
V⎓	DC(AC) and AC+DC voltage measurements AC voltage measurements
m̄V̄	DC(AC) millivolts, AC+DC millivolt measurements
Hz%	Frequency measurements
Ω⁺ᵗCAP	Resistance, Diode test, Capacitance and Continuity measurements Temperature measurements
Ā⌇	AC, DC and AC+DC amps measurements
m̄Ā	AC, DC and AC+DC milliamps measurements
μ̄Ā	AC, DC and AC+DC microampere measurements up to 5,000μA

4-7. Using the Input Terminals

All functions except current use the VOHMSand COM input terminals. The two current input terminals (A and mA/μA) are used as follows: Current from 0 to 500 mA, use the uAmA and COM terminals. Current between 0 and 10 A use the A and COM terminals.
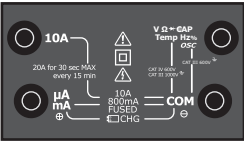
10A	Input for 0 A to 10.00 A current (20VA overload for 30 seconds on, 10 minutes off),
μA mA	Input for 0 A to 500 mA current measurements.
COM	Return terminal for all measurements.
V Ω Hz% CAP Temp	Input for voltage, continuity, resistance, diode test, conductance, capacitance.

5. Measurement and Setup

5-1. DC Voltage Measurements

CAUTION: Do not measure DC voltages if a motor on the circuit is being switched ON or OFF. Large voltage surges may occur that can damage the meter.

1. Set the function switch to the green VDC position.

2. Insert the black test lead banana plug into the negative COM jack. Insert the red test lead banana plug into the positive V jack.

3. Read the voltage in the display.
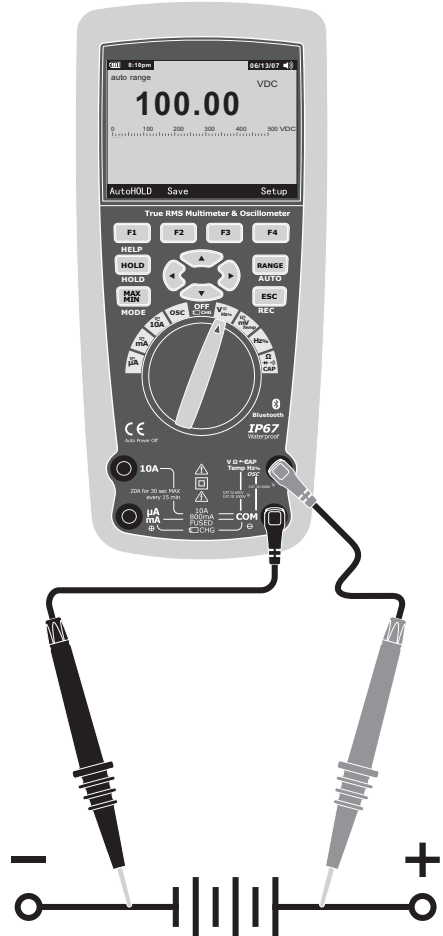
5-2. AC Voltage Measurements

WARNING: Risk of electrocution. The probe tips may not be long enough to contact the live parts inside some 240V outlets for appliances because the contacts are recessed deep in the outlets. As a result, the reading may show 0 volts when the outlet actually has voltage on it. Make sure the probe tips are touching the metal contacts inside the outlet before assuming that no voltage is present.

CAUTION: Do not measure AC voltages if a motor on the circuit is being switched ON or OFF. Large voltage surges may occur that can damage the meter.
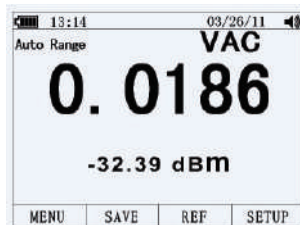
1. Set the function switch to the green VAC position.

2. Press the soft key labeled **Menu**. Move the menu selector to the menu item labeled **VAC**. Press the soft key **VAC**.

3. Insert the black test lead banana plug into the negative COM jack. Insert red test lead banana plug into the positive V jack.

4. Read the voltage in the main display
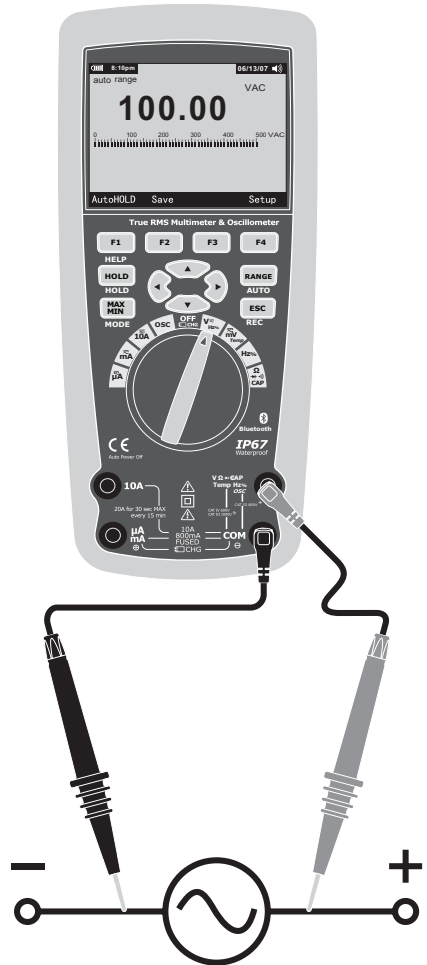
5-3. Making dB Measurements

The meter is capable of displaying voltage as a dB value, either relative to 1 milliwatt (dBm), a reference voltage of 1 volt (dBV) or a user-selectable reference value.

1. Set the function switch to the green VAC position.

2. Press the softkey labeled **Menu**. Move the menu selector to the menu item labeled dBm. Press the softkey **dBm**

3. Insert the black test lead banana plug into the negative COM jack. Insert red test lead banana plug into the positive V jack.

4. Read the voltage in the main display and the dBm in the Secondary display

5. To select another reference value, press the softkey labeled **Ref** to display a message box with the current reference value. Pressing ▲ or ▼, scrolls through the nine predefined references: 4,8,16,25,32,50,75,600 and 1000. Set the reference by pressing the softkey labeled **OK**.

5-4. Low Pass Filter

The meter is equipped with an ac low pass filter. When measuring AC voltage, press the soft key labeled **Menu** to open the function menu, and move the menu selector to the LO item. Next, press the softkey labeled **LO** to toggle the low pass filter mode .
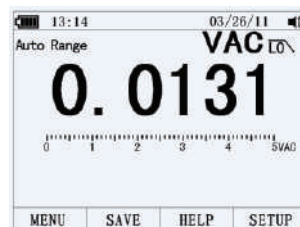
5-5. mV Voltage Measurements

CAUTION: Do not measure mV voltages if a motor on the circuit is being switched ON or OFF. Large voltage surges may occur that can damage the meter.

1. Set the function switch to the green mV position.

2. Press the soft key labeled **Menu.** Move the menu selector to the menu item labeled **mVDC(mVAC)**. Press the soft key **mVDC(mVAC)**.

3. Insert the black test lead banana plug into the negative COM jack. Insert the red test lead banana plug into the positive V jack.

4. Read the mV voltage in the display
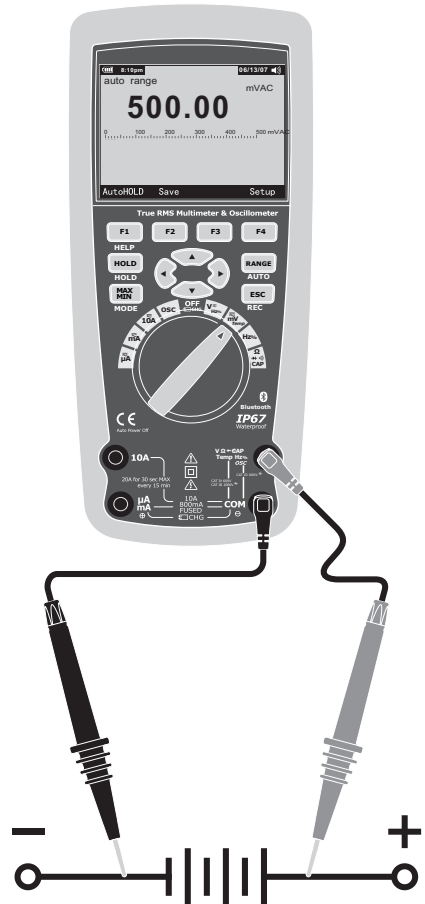
5-6. Temperature Measurements

1. Set the function switch to the green TEMP(°C or °F) position.

2. Press the soft key labeled **Menu**. Move the menu selector to the menu item labeled **TEMP**. Press the soft key **TEMP(C or F).**

3. Insert the Temperature Probe into the input jacks, making sure to observe the correct polarity.

4. Read the temperature in the display

5. To input a temperature offset value, press the softkey labeled Offset to open a message box with the present offset value. Use ◄ and ► to position the cursor over one of the digits or the polarity sign. Use ▲ and ▼ to scroll through the numbers for each digit in the offset or switch between a + or – offset. With the desired value displayed, press the softkey labeled OK to set the temperature offset.

5-7. Frequency Measurements

1. Set the function switch to the green Hz% position.

2. Insert the black test lead banana plug into the negative COM jack. Insert the red test lead banana plug into the positive V jack.

3. Read the Frequency in the display
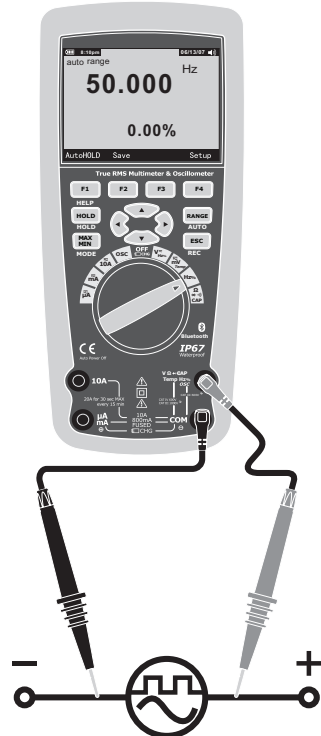
5-8. Resistance Measurements

WARNING: To avoid electric shock, disconnect power to the unit under test and discharge all capacitors before taking any resistance measurements.

Remove the batteries and unplug the line cords.

1. Set the function switch to the green
   Ω CAP ✦ •))) position.

2. Insert the black test lead banana plug into the negative COM jack. Insert the red test lead banana plug into the positive Ω Jack.

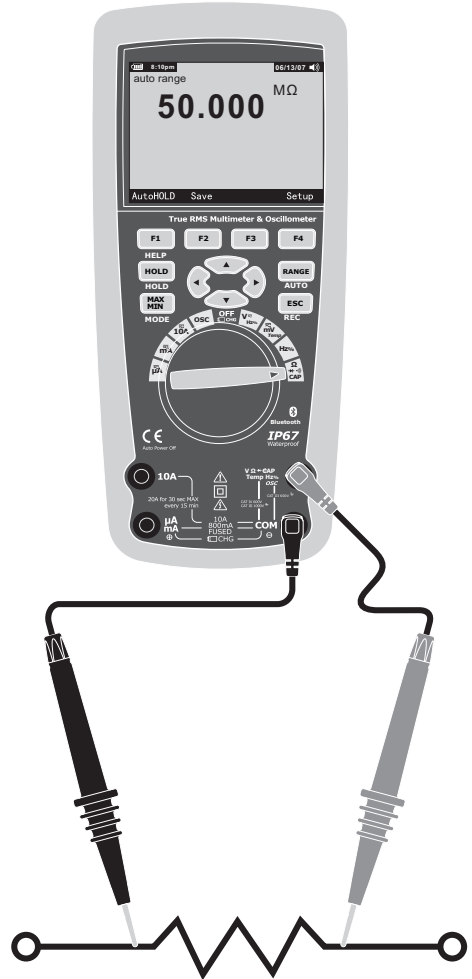3. Read the resistance in the display.

5-9. Continuity Check

WARNING: To avoid electric shock, disconnect power to the unit under test and discharge all capacitors before taking any resistance measurements. Remove the batteries and unplug the line cords.
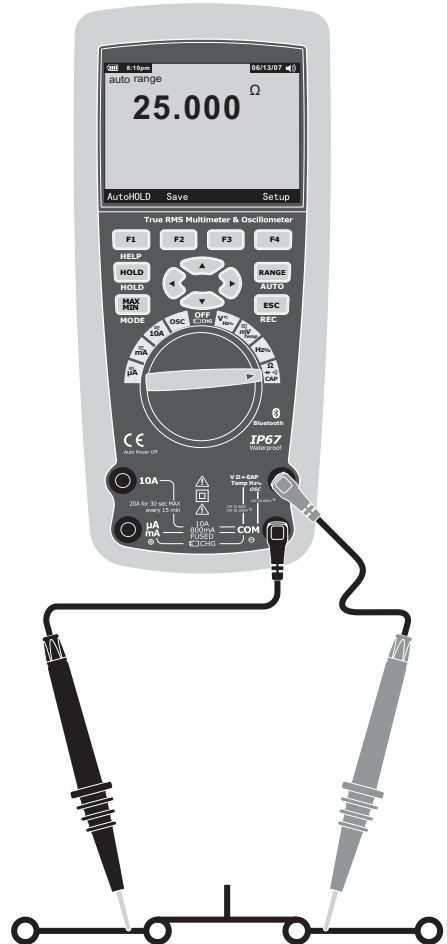
1. Set the function switch to the green Ω CAP ✦ •))) position.

2. Press the soft key labeled **Menu**. Move the menu selector to the menu item labeled **Beeper**. Press the soft key Beeper.

3. Insert the black test lead banana plug into the negative COM jack. Insert the red test lead banana plug into the positive jack.

4. If the resistance is less than approximately 25Ω, the audible signal will sound. If the circuit is open, the display will indicate "OL".

5-10. Diode Test

1. Set the function switch to the green
   Ω CAP ⊣⊢ •⦙⦙ position.

2. Press the soft key labeled **Menu**. Move the menu
   selector to the menu item labeled **Diode**. Press
   the soft key **Diode**.

3. Insert the black test lead banana plug into the
   negative COM jack and the red test lead banana
   plug into the positive V jack.

5. Forward voltage will typically indicate 0.400 to
   3.200V. Reverse voltage will indicate "OL".
   Shorted devices will indicate near 0V and an open
   device will indicate "OL" in both polarities.
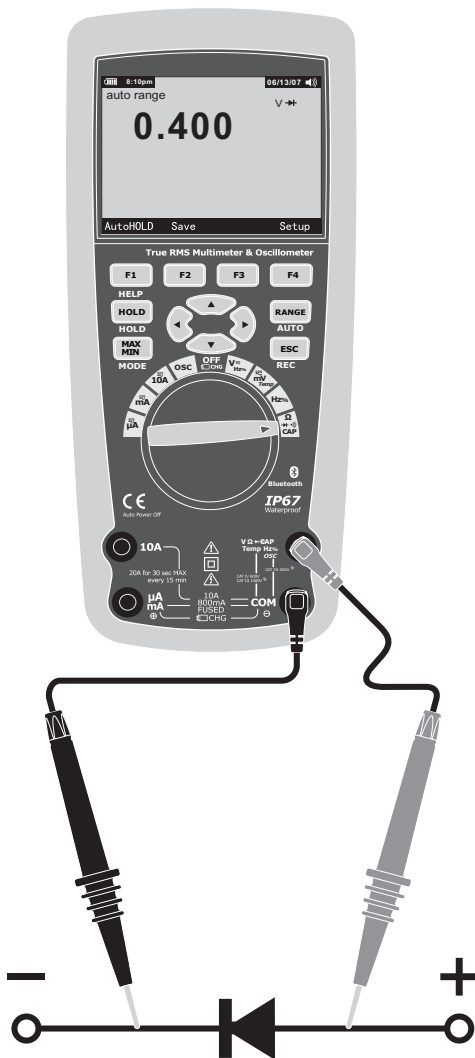
5-11. Capacitance Measurements

WARNING: To avoid electric shock, disconnect power to the unit under test and discharge all capacitors before taking any capacitance measurements. Remove the batteries and unplug the line cords.
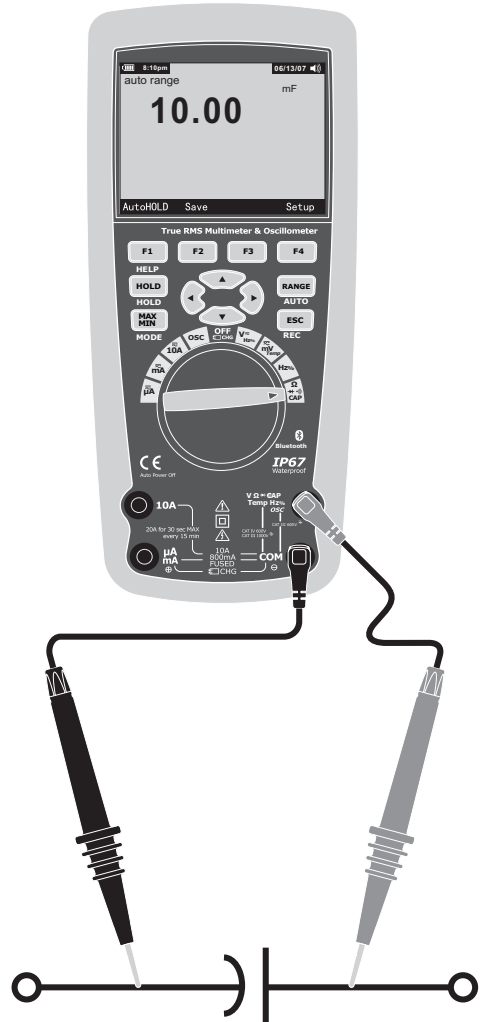
1. Set the rotary function switch to the green Ω CAP ✈ •》 position.

2. Press the soft key labeled **Menu**. Move the menu selector to the menu item labeled **Cap**. Press the soft key Cap.

3. Insert the black test lead banana plug into the negative COM jack. Insert the red test lead banana plug into the positive V jack.

4. Read the capacitance value in the Display

5-12. DC Current Measurements

CAUTION: Do not make 20A current measurements for longer than 30 seconds. Exceeding 30 seconds may cause damage to the meter and/or the test leads.

1. Insert the black test lead banana plug into the negative COM jack.

2. For current measurements up to 5000μA DC, set the function switch to the yellow μA position and insert the red test lead banana plug into the μA/mA jack.

3. For current measurements up to500mA DC, set the function switch to the yellow mA position and insert the red test lead banana plug into the μA/mA jack.

4. For current measurements up to 10A DC, set the function switch to the yellow 10A position and insert the red test lead banana plug into the 10A jack.

5. Press the MODE button to indicate "DC"on the display.

6. Read the current in the display.
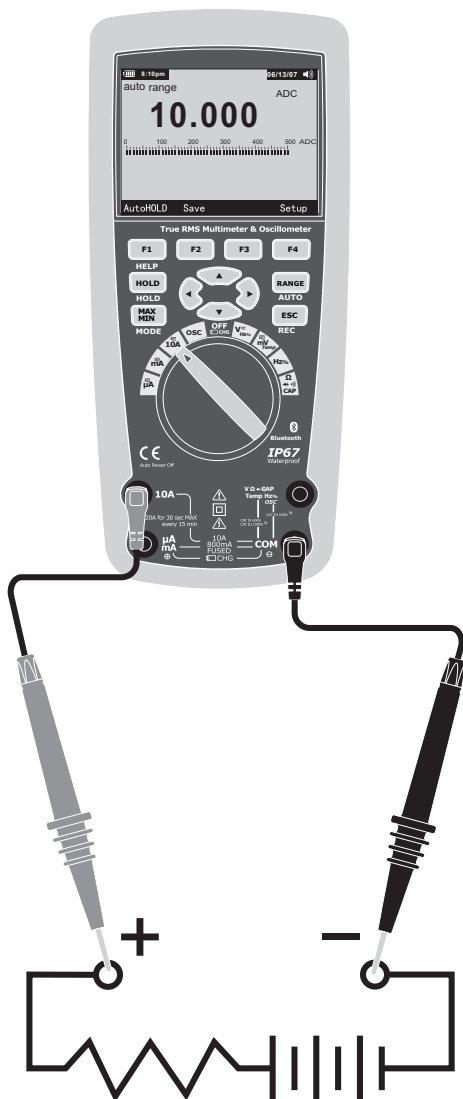
5-13. AC Current Measurements

CAUTION: Do not make 10A current measurements for longer than 30 seconds. Exceeding 30 seconds may cause damage to the meter and/or the test leads.

1. Insert the black test lead banana plug into the negative COM jack.

2. For current measurements up to 5000µA AC, set the function switch to the yellow µA position and insert the red test lead banana plug into the µA/mA jack.

3. For current measurements up to 500mA AC, set the function switch to the yellow mA position and insert the red test lead banana plug into the µA/mA jack.

4. For current measurements up to 20A AC, set the function switch to the yellow 10A position and insert the red test lead banana plug into the 10A jack.

5. Press the soft key labeled **Menu**. Move the menu selector to the menu item labeled **AC**. Press the soft key AC.

6. Read the current in the display
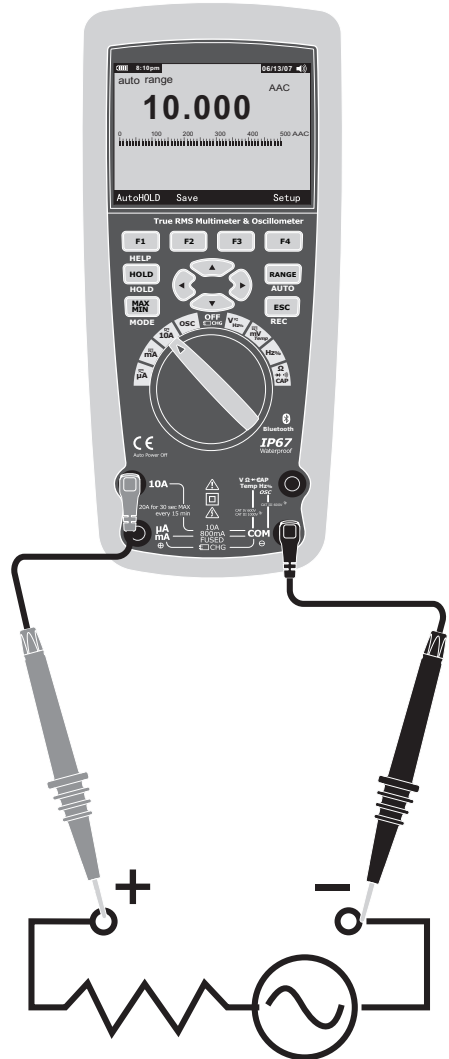
5-14. Understanding Function Menus

Each primary measurement function (rotary switch position) has a number of optional sub-functions or modes accessed by pressing the softkey labeled Menu (F1). A typical menu is shown in the figure below.

Menu selection is indicated by the filled-in black square (hereafter the Menu selector) to the left of a menu item. Use the four front-panel cursor buttons (▲▼ ◄ ►) to position the menu selector next to a menu item. As the menu selector moves between menu items, the four softkeys and their labels change to reflect the available functions and/or modes available for the selection menu item.
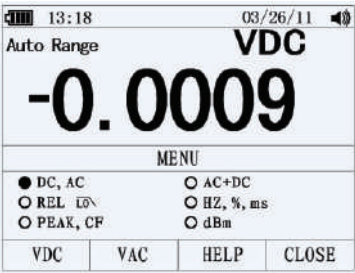
5-15. Using Help

While operating the meter, more information about a selected function, a front-panel button, or a menu item may be necessary. Press soft key **HELP** to open an information window that lists topics covering the functions and modifiers that are available at the time the button is pressed. Each topic provides a brief explanation on a meter function or feature. The number of information topics displayed at any one time may exceed the display area. Use the softkeys labeled **Next** and **Prev** to move from topic to topic. Use the softkey labeled **More** or ▼ and ▲ to scroll through the information a full screen at a time.

5-16. Measuring AC and DC Signals

The meter is capable of displaying both AC and DC signal components (voltage or current) as two separate readings or one AC+DC(RMS) value combined. As shown in figure , the meter displays AC and DC combinations two ways: DC displayed over AC (DC,AC), and AC combined with dc (AC+DC). Select one of these three displays using the Function and Mode menu. With the rotary switch set to V, mV, A, mA,or uA, press the soft key labeled **Menu**. Move the menu selector to the menu item labeled **AC+DC**. At this point, three different soft key labels indicate AC+DC (F1),and DC,AC (F2). Press the soft key that presents these two signals as needed. While in any of the three AC+DC modes, peak measurements, frequency, duty cycle, relative %, and period measurements are not allowed. In addition to these modes, MIN/MAX, relative.
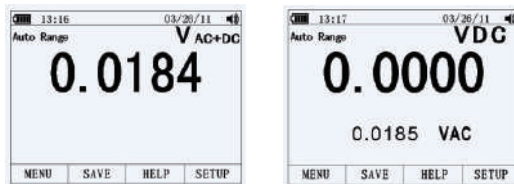
5-17. Capturing Minimum and Maximum Values

The MIN/MAX Record mode captures minimum, average, and maximum input values. When the input goes below the recorded minimum value or above the recorded maximum value, the meter beeps and records the new value. The meter stores the elapsed time since the recording session was started at the same time. The MIN/MAX mode also calculates an average of all readings taken since the MAX MIN mode was activated. This mode is for capturing intermittent readings, recording minimum and maximum readings unattended, or recording readings while equipment operation precludes watching the meter. The MIN MAX mode is best for recording power supply surges, inrush currents, and finding intermittent failures. Response time is the length of time an input must stay at a new value to be captured as a possible new minimum or maximum value.

To activate the MIN/MAX mode, press **MIN/MAX**. As shown in figure, the meter displays "e" at the top of the measurement page, and the MIN/MAX start date and time along the bottom of the page. In addition, the recorded maximum, average, and minimum values appear in the secondary display with their respective elapsed times.

To stop a MIN/MAX recording session, press the softkey labeled **Stop**. The summary information in the display freezes, and the softkeys change function to allow saving the collected data. Pressing the softkey labeled **Close** exits the MIN/MAX record session without saving the collected data.
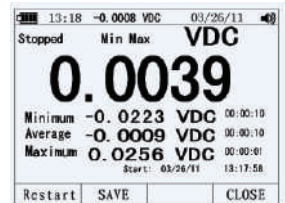
To save the MIN/MAX screen data, the MIN/MAX session must be ended by pressing the softkey labeled **Stop**. Next, press the softkey labeled **Save**. A dialog box opens where the default saved name can be selected or another name assigned. The softkey labeled **Save to store**. Pressing the softkey labeled **Restart** while MIN/MAX is running stops the MIN/MAX session, discards all MIN/MAX data, and immediately starts a new MIN/MAX recording session.

5-18. Capturing Peak Values

To activate the peak mode, press the softkey labeled **Menu**. Move the menu selector next to the menu item labeled **Peak, CF or Peak**. Press the softkey labeled **Peak** to start the peak recording session.
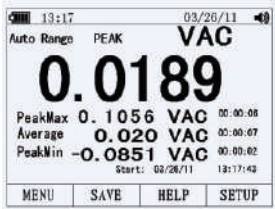
5-19. Relative Values

To activate the peak mode, press the softkey labeled **Menu**. Move the menu selector next to the menu item labeled **REL or Peak**. Press the softkey labeled **REL** to start the peak recording session. If the meter is already in the relative function, pressing Rel% causes the meter to turn off relative and display relative percent.

5-20. Low Pass Filter

The meter is equipped with an ac low pass filter. When measuring AC voltage, press the softkey labeled **Menu** to open the function menu, and move the menu selector to the LO item. Next, press the softkey labeled **LO** to toggle the low pass filter mode.
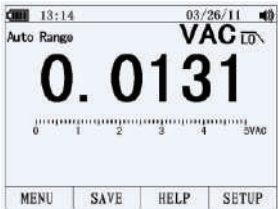
5-21. Hold and AutoHold Mode

To freeze the display for any function, press key **HOLD**. Pressing the softkey labeled **AutoHOLD** activates AutoHold if the meter is not in the Peak, MIN MAX, or Record modes. AutoHold operation monitors the input signal and updates the display and, if enabled, sounds the beeper, whenever a new stable measurement is detected. A stable measurement is one that does not vary more than a selected adjustable percentage (AutoHold threshold) for at least one second. The meter filters out open lead conditions so the meter leads can be moved between test points without triggering a display update.
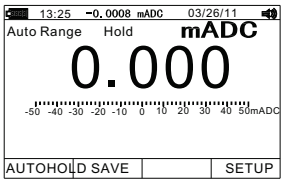
5-22. Storing Individual Measurement Data

For all measurement functions, a snapshot of the screen data is saved by pressing the softkey labeled **Save**. Edit name, then pressing the softkey labeled **Save stored date.**

5-23. Viewing Memory Data

Viewing data stored in the meter's memory is performed through the save menu. Press the softkey labeled **Save**. Position the menu selector next to the menu item labeled **View** measure and press the softkey labeled **View.** If there are previously stored records, press the softkey labeled **Prev** to page back through previously stored records. Press the softkey labeled **Next** to page in the other direction. Press the softkey labeled **Delete** to delete stored records. Press **Close** to return to normal meter operation.

5-24. Viewing Trend Data

Viewing data stored in the meter's memory is performed through the save menu. Press the softkey labeled **Save**. Position the menu selector next to the menu item labeled **View** record and press the softkey labeled **View**. If there are previously stored records, press the softkey labeled **Prev** to page back through previously stored records. Press the softkey labeled **Next** to page in the other direction. Press **Close** to return to normal meter operation.

Press the soft key labeled **Trend** to display the recorded data in a trend-plot view.

Press the softkey labeled **Delete** recorded data
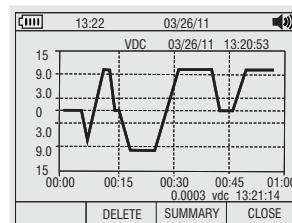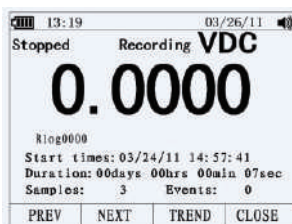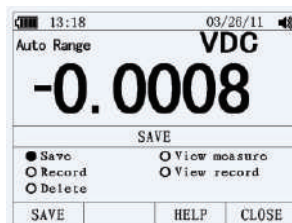
5-25. Recording Measurement Data

The meter's record feature collects measurement information over a user-specified duration. This collection of information is called a recording session. A recording session is made up of one or more measurement records Each record contains measurement summary information covering the duration of the record.

Press the softkey labeled **Save**. Position the menu selector next to the menu item labeled **Record** and press the softkey labeled **Record** to open the configuration display.
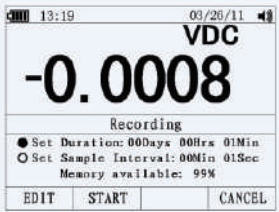
Recording session duration and sample interval duration. Both variables affect the recording length and number of intervals recorded. These two variables may interact, in that setting one variable may adjust the other variable to fit the recording session within the available memory. The percentage of memory available at the beginning of a recording session is displayed below the duration and sample interval settings.

To change either of the two recording variables, use the cursor buttons to position the menu selector next to the desired menu item and press the softkey labeled **Edit**. Use ▲ ▼ ◄ and ► to move between and set each digit of the selected variable.

Press the softkey labeled **Start** to start recording.

The recording session will continue until the allocated memory is used, the batteries expire, the rotary switch is moved or the session is terminated by pressing the softkey labeled **Stop**.

5.26. Zooming in on Trend Data

While viewing trend data, press zoom functions in or out respectively on the data around the cursor. Each press reduces the x-axis time period by one half to reveal more details. Each press doubles the time period until all the recorded data is displayed. The zoom level is displayed in the upper-right hand corner of the display.

5-27. Changing meter Setup Options

The meter has a number of preset features such as date and time formats and battery save mode timeouts and the displayed language. These variables are referred to as meter setup options. Many setup options affect general meter operations and are active in all functions. Others are limited to one function or group of functions.

Access to the setup options is always available through the softkey labeled **Setup**. Information about the meter, such as serial number and mode which is also accessible through the setup menu.
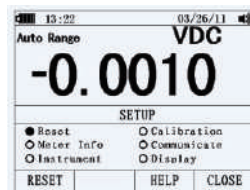
5-28. Resetting meter Setup Options

The meter's setup options can be reset to default values through the setup menu. Open the setup menu by pressing the softkey labeled **Setup**. Position the menu selector next to the menu item labeled **Rese**t and press the softkey labeled **Setup**. A message will appear asking to confirm the reset action. Press the softkey labeled **OK** to perform the reset.

5-29. Meter Info

The meter Info selection lists the serial number, model number, firmware version, calibration date and calibration counter. Operator name, company name are displayed.

5-30. Setting the Event Threshold Value

Press the softkey labeled **Setup** to access the setup menu. Using the cursor buttons, move the menu selector next to the menu item labeled Instrument and press the softkey labeled **Enter** to open the recording setup screen. Using the cursor buttons, move the menu selector next to the menu item labeled **Event Threshold** for **Recording (AutoHOLD)** and then press the softkey labeled **Edit**. Press ▲ or ▼ to scroll through the event threshold values. With the desired value selected, press the softkey labeled **Close.**

5-31. Calibration

The Calibration selection allows a qualified calibration technician to enter a password that allows the meter to be calibrated. Press the softkey labeled **Setup** to access the setup menu. Using the cursor buttons, move the menu selector next to the menu item labeled Calibration and press the softkey labeled **Calibrate**, then input password, Enter Calibration menu. If change password, Press the softkey labeled **Setup** to access the setup menu. Using the cursor buttons, move the menu selector next to the menu item labeled **Calibration** and press the softkey labeled **Password**, then input current password followed by the new password.

5-32. Using Communications

You can use the Wireless communication link and transfer the contents of a meter's memory to a PC. Press the softkey labeled Setup to access the setup menu. Using the cursor buttons, move the menu selector next to the menu item labeled communicate and press the softkey labeled **ENTER**. Press the softkey labeled **OK** and the communications function will start.

5-33. Setting Date and Time

The meter's internal clock is used in the display and for timestamping recorded measurements. To change the date and time as well as the display format, press the softkey labeled **Setup**. Position the menu selector next to the menu item labeled **Display**. To set the date and time, press the softkey labeled **Date/Time** to open the date/time menu. Next, position the menu selector next to either the Set Date item or Set Time item and press the softkey labeled **Edit**. Using ◄ and ►, position the cursor on the date or time element to adjust. Use ▲ and ▼ to change the selected date or time element value. Press OK to complete the action.

5-34. Auto Power Off

Press the softkey labeled **Setup**. Position the menu selector next to the menu item labeled **Display**. To set Auto Power Off and then press the softkey labeled **Edit**. Use ▲ and ▼ to adjust the time to one of the preset values. **0** Disable the timeout feature. Press the softkey labeled **OK** to set the selected time. Press the softkey labeled **Close** to return.

5-35. Setting Format

Press the softkey labeled **Setup**. Position the menu selector next to the menu item labeled **Format**. Using the cursor buttons, move the menu selector next to the menu item labeled **Numeric(Date\Time)** format, press the softkey labeled **EDIT**, select 0.0000(0,0000) and MM/DD/YY(DD/MM/YY) and 24 HOUR (12 HOUR) format.

5-36. Replacing the Batteries

Refer to Figure and replace the batteries as follows:

1. Turn the meter off and remove the test leads from the terminals.

2. Remove the battery door assembly by using a standard blade screwdriver to turn the battery door screw one-half turn counterclockwise.

3. Replace the batteries with 7.4 volt charge batteries to observe proper polarity.

4. Re-install the battery door assembly and secure it by turning the screw one-half turn clockwise.

5-37. Replacing the Fuses

Referring to Figure, examine or replace the meter's fuses as follows:

1. Turn the meter off and remove the test leads from the terminals.

2. Remove the battery door assembly by using a standard blade screwdriver to turn the battery door screw one-half turn counterclockwise.

3. Remove the fuse by gently prying one end loose, then sliding the fuse out of its bracket.

4. Install only specified replacement fuses.

5. Reinstall the battery door assembly and secure it by turning the screw one-half turn clockwise.
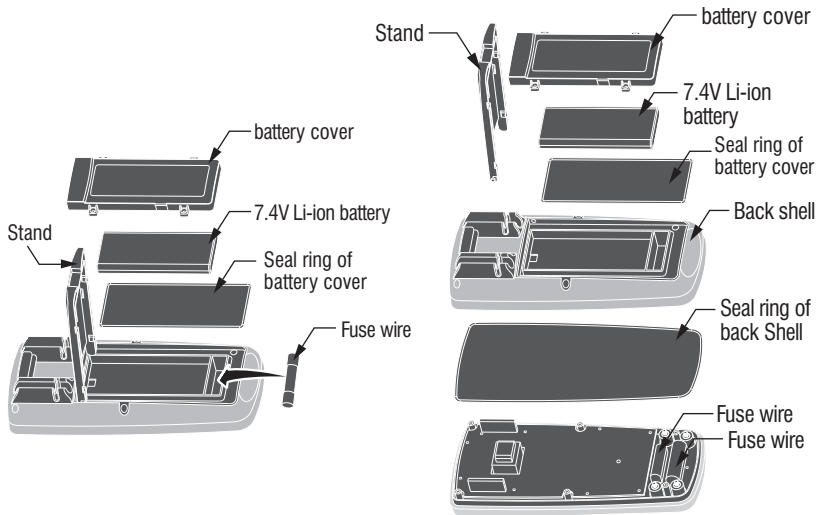
5-38. Li-ion Battery Charge

1. Set the function switch to the OFF/CHG position.

2. Insert the socket into the meter Input port and the Adapter connected to the switch socket. Then Insert the Adapter into Power socket.

3. Display charge symbol in TFT color LCD display.
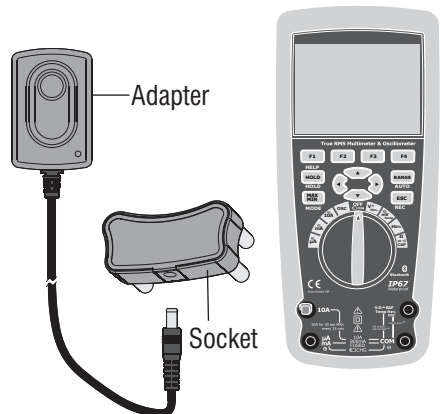
6.General Specification

Enclosure	Double molded, waterproof
Shock (Drop Test)	6.5 feet (2 meters)
Diode Test	Test current of 0.9mA maximum, open circuit voltage 3.2V DC typical
Continuity Check	Audible signal will sound if the resistance is less than 25Ω (approx.), test current <0.35mA
PEAK	Captures peaks >1ms
Temperature Sensor	Requires type K thermocouple
Input Impedance	>10MΩ VDC & >9MΩ VAC
AC Response	True RMS
AC True RMS	The term stands for "Root-Mean-Square" which represents the method of calculation of the voltage or current value. Average responding multimeters are calibrated to read correctly only on sine waves and they will read inaccurately on non-sine wave or distorted signals. True rms meters read accurately on either type of signal.
ACV Bandwidth	50Hz to 100000Hz
Crest Factor	≤3 at full scale up to 500V, decreasing linearly to <1.5 at 1000V
Display	50,000 count backlit liquid crystal with bargraph
Overrange indication	"OL" is displayed
Auto Power Off	5-30minutes (approximately) with disable feature
Polarity	Automatic (no indication for positive); Minus (-) sign for negative
Measurement Rate	20 times per second
Low Battery Indication	"⬛" is displayed if battery voltage drops below operating voltage

Fuses	Fuses are FF 0.8A/1000V+FF 10A/1000V
Operating Temperatur	5°C to 40°C (41°F to 104°F)
Storage Temperature	-20°C to 60°C (-4°F to 140°F)
Operating Humidity	Max 80% up to 31°C (87°F) decreasing linearly to 50% at 40°C (104°F)
Storage Humidity	<80%
Operating Altitude	7000ft. (2000meters) maximum.
Safety	This meter is intended for origin of installation use and protected, against the users, by double insulation per EN61010-1 and IEC61010-1 2nd Edition (2001)to Category IV 600V and Category III 1000V; Pollution Degree 2. The meter also meets UL 61010-1, 2nd Edition (2004), CAN/CSA C22.2 No. 61010-1 2nd Edition (2004),and UL 61010B -2-031, 1st Edition (2003)
Bluetooth specification	Version 2.0+EDR,Frequency range 2400 MHz … 2483.5 MHz.(ISM-Band),Guard band 2 MHz < F < 3.5 MHz.Modulation method GFSK,1 Mbps,0.5 Gaussian; Receiving signal range -82 to -20 dBm; Transmission power Minimum: -18dBm to +4 dBm
Built-in lithium	Diameter: 20.0mm; High 3.2mm; Typical Weight 3.0 grams (0.10 oz.); Designation: ANSI / NEDA-5004LC,IEC-CR2032; Normal Voltage: 3.0 Volts; Typical Capacity: 240 mAh ; Storage 5 Year
Li-ion Battery	Chemical type: Lithium polymer,Standard: GB/T 18287-2000; Normal Voltage: 7.4 Volts; Charge up Voltage: 8.4 Volts; Typical Capacity: 2400 mAh. Cycle life: 500 times ;

7.Specifications

Function	Range	Resolution	Accuracy
DC Voltage	50mV [1]	0.001mV	(0.05% + 20)
	500mV [1]	0.01mV	(0.025% + 5digits)
	5V	0.0001V	(0.025% + 5digits)
	50V	0.001V	(0.025% + 5digits)
	500V	0.01V	(0.05% + 5digits)
	1000V	0.1V	(0.1% + 5)

[1] When using the relative mode (REL Q) to compensate for offsets.

Function	Range	Resolution	Accuracy
AC Voltage			50 to 10000Hz
	50mV	0.001mV	50/60Hz(0.3% + 25)
	500mV	0.01mV	<1KHz(0.5% + 25)
	5V	0.0001V	<5KHz(3% + 25)
	50V	0.001V	
	500V	0.01V	
	1000V	0.1V	
	All AC voltage ranges are specified from 5% of range to 100% of range		

Function	Range	Resolution	Accuracy
(AC+DC)			0 to 1000Hz
	50mV	0.001mV	<1KHZ(1% + 25)
	500mV	0.01mV	<10KHZ(3.5% + 25)
	5V	0.0001V [1]	
	50V	0.001V	
	500V	0.01V	
	1000V	0.1V	
[1] Add 1% above 5k			

Function	Range	Resolution	Accuracy
DC Current	500μA	0.01μA	0.1%+20
	5000μA	0.1μA	
	50mA	0.001mA	
	500mA	0.01mA	0.15%+20
	10A	0.001A	0.3%+20
	(20A: 30 sec max with reduced accuracy)		

Function	Range	Resolution	Accuracy
AC Current			50 to 10000Hz
	500μA	0.01μA	50/60Hz(0.6% + 25)
	5000μA	0.1μA	<1KHz(1.5% + 25)
	50mA	0.001mA	<10KHz(3% + 25)
	500mA	0.01mA	
	10A	0.001A	
	(20A: 30 sec max with reduced accuracy)		
	All AC current ranges are specified from 5% of range to 100% of range		

Function	Range	Resolution	Accuracy
(AC+DC)			0 to 1000Hz
	500μA	0.01μA	(1.0% + 25)
	5000μA	0.1μA	
	50mA	0.001mA	
	500mA	0.01mA	
	10A	0.001A	(1.5% + 40)

Function	Range	Resolution	Accuracy
AC Voltage			5K-100K
(5000+Count)	50mV	0.001mV	(5.0% + 40)
	500mV	0.01mV	
	5V	0.0001V	
	50V	0.001V	(6.0% + 40)

NOTE: Accuracy is stated at 18 to 28°C (65 to 83°F) and less than 75%RH. AC switch according to the calibration of sine wave. It generally increase ±(2% reading + 2% full scale) if non sine wave in the wave crest less than 3.0.

Function	Range	Resolution	Accuracy
Resistance	50Ω[1]	0.001Ω	0.5%+20
	500Ω[1]	0.01Ω	0.05%+10
	5kΩ	0.0001kΩ	0.05%+10
	50kΩ	0.001kΩ	
	500kΩ	0.01kΩ	0.1%+10
	5MΩ	0.0001MΩ	0.2%+20
	50MΩ	0.001MΩ	2%+20

 [1] When using the relative mode (REL Q) to compensate for offsets.

Function	Range	Resolution	Accuracy
Capacitance	5nF[1]	0.001nF	±(2% + 40)
	50nF[1]	0.01nF	
	500nF	0.1nF	±(2% + 40 digits)
	5µF	0.001µF	
	50µF	0.01µF	
	500µF	0.1µF	±(5% +40 digits)
	10mF	0.01mF	

[1] With a film capacitor or better ,using relatiue mode (REL△) to zero residual.

Function	Range	Resolution	Accuracy
Frequency (electronic)	50Hz	0.001Hz	±(0.01% + 10)
	500Hz	0.01Hz	
	5kHz	0.0001kHz	
	50kHz	0.001kHz	
	500kHz	0.01kHz	
	5MHz	0.0001MHz	
	10MHz	0.001MHz	
Frequency (electrical)	Sensitivity: 2V RMS min. @ 20% to 80% duty cycle and <100kHz; 5V RMS min @ 20% to 80% duty cycle and >100kHz.		
	40.00-10kHz	0.01 - 0.001kHz	±(0.5% reading)
	Sensitivity: 2V RMS		

Function	Range	Resolution	Accuracy
Duty Cycle	0.1 to 99.90%	0.01%	±(1.2% reading + 2digits)
	Pulse width: 100µs - 100ms, Frequency: 5Hz to 150kHz		

Function	Range	Resolution	Accuracy
Temp (type-K)	-50 to 1000°C	0.1°C	±(1.0% reading + 2.5°C)
	-58 to 1832°F	0.1°F	±(1.0% reading + 4.5°F) (Probe accuracy not included)

MT1009

Oscilloscope Section

User Manual

Introduction

The MT1009 Digital Oscilloscope, is compact, powerful and easy-to-use. The meter has TFT color LCD display, providing fast A/D converting sample time, high accuracy, built-in data logging and Trend Capture features.

Digital Oscilloscope performs outstandingly, powerful, affordable, with a high cost performance. Its real time sample rate is up to 50 MSa/s, can meet the market needs of high capture speed, complicated signal; supports internal storage and Bluetooth data transmission, customer can take repeated measurements and prints of the data graph by upper computer.

This meter measures AC/DC Voltage, AC/DC Current, Resistance, Capacitance, Frequency (electrical & electronic), Duty Cycle, Diode Test, Insulation Test, and Continuity plus Thermocouple Temperature. It can store and recall data. It features a waterproof, rugged design for heavy duty use. Proper use and care of this meter will provide many years of reliable service.

Features

• Brand new design, compact size, simple portability
• TFT color LCD display, waveform display much more clear and stable
• Real time sample rate: 500Sps—50 Msa/s
• Storage depth: 3Kpts
• Trigger function: rising edge, falling edge
• Waveform record
• Auto search
• 10 set waveform storage/output; waveform data can be transmitted by Bluetooth or wireless
   USB interface to upper computer for further operation
• Cursor test
• Multi-screen display for channel waveform and FFT waveform
• Menu display mode, much flexible and natural operation for customer
• English online help system
• A user manual
• Product warranty card
• Certificate of quality
• One set of 1:1 probe
• One adaptor
• A charger according with user's country standard
• CD (pc software)

General safety requirements

Know about the following safety precautions to avoid personal injury, also to prevent damage generated by connection of this product with any other product. In order to avoid any potential danger, please use the product according to the regulation.

Only qualified technical personnel can take the maintenance procedures.

Prevent fire disaster or personal injury.

Use proper charger. Only special charger for this product confirmed by user's country is available.

Insert and pull out correctly. Don't insert or pull out while test wire is connecting with power cable.

Connect the probe correctly. Probe ground wire is the same as earth potential; please don't connect the ground wire to a high voltage. During the test procedure, please don't touch bare contacts or components.

Check all the terminal ratings. In order to prevent danger of fire and electrical shock, please check all the ratings and notes of this product.

Before connecting the device, please read the user manual for further information of concerned ratings.

Don't operate with the cover opened. If the cover-plate or face-plate is removed, please don't use the device.

Use proper fuse wire. Only the fuse wires which compliances with specified type and ratings of this product can be adopted.

Don't operate while suspecting product malfunction. If suspect any damage of this device, please inform qualified maintenance personnel to examine.

Avoid circuit exposure. Don't touch any bare contact or component after connection of industrial frequency power.

Please don't operate under an inflammable or explosive circumstance.

Keep device surface clean and dry.

Summary

The manual introduces operation information of Digital Oscilloscope which includes the following chapters:

• "Introduction"presents the front panel, user interface, function check and probe of the oscilloscope.

• "Function introduction and operation" makes a detailed introduction of oscilloscope function and operation.

• "Application example: includes many examples of testing, for readers' reference.

• "Appendix 1: daily maintenance and cleaning" briefly presents how to maintain the oscilloscope.

• "Appendix 2: specifications" details the specifications of Digital Oscilloscope.

1.Introduction

Digital Oscilloscope is a small and handy portable device, which can measure by taking suspension ground voltage as reference. Waterproof function, can be used in mobile state.

This section presents how to accomplish the following works:

• Get the general knowledge of front panel and user interface of Digital Oscilloscope.

• Brief function check.

**1-1 General knowledge of front panel and user interface of Digital Oscilloscope.**

Before operating Digital Oscilloscope, need to know the front operational panel of the oscilloscope. The following content makes a brief description and introduction of operation procedures and functions of the meter front panel, enable the user to be familiar with the meter in minimal time.

Digital Oscilloscope provides a simple but with clear function front panel, to make sure the convenience of basic operation to user. The front panel includes 4 function keys (F1-F4), 4 direction keys,4 selection keys (HOLD,MODE,AUTO,REC), user can enter into different functional menus or directly obtain specific function applications by using these keys.

Picture 1-1 operation panel

1. Date and time
2. Status of current waveform windows
3. Remaining power of battery
4. Waveform display area
5. Waveform peak value
6. Signal coupling marks, preset amplitude gear
7. Waveform measured frequency
8. Preset sample rate
9. Trigger mode mark
10. Fast display mark
11. Slow display mark
12. Operation prompt bar
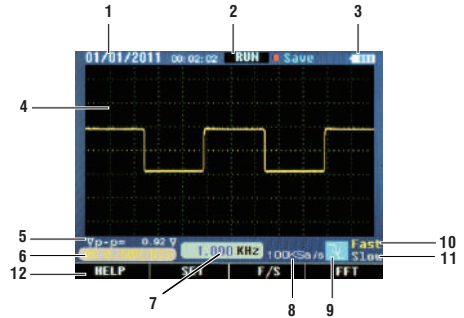
Picture 1-2 interface display

1-2 Brief function examination

Perform a fast function examination to test and verify if the oscilloscope works well or not. Please proceed as follows:

1. Turn the knob, turn on the oscilloscope power.
2. Connect the oscilloscope to signal source. Various AC signal can be adopted, including 110V/220V AC power.
3. Press "AUTO". Corresponding frequency and peak waveform can be detected in several seconds.
4. If connect to 110V/220V AC power, press "▼" directly indicating 100V/div, press "◄" or "►" indicating 1KSa/s, alternating sine wave can be \ observed.
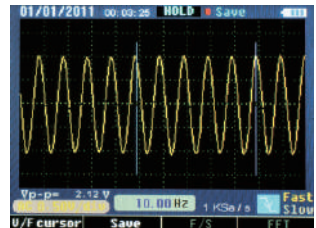
1-3 Probe and connector

1-3-1 Safety of probe and connector

The protective device of probe and connector main part prevents fingers from electric shock.
Picture 1-6
Before any measurement, connect the probe and the connector with the oscilloscope.

Note:
• *To avoid electric shock while using the probe, keep the fingers on the back of protective device of the probe main part.*

• *To avoid electric shock, don't touch the metallic part of the probe top while connecting to voltage source.*
• *Measured signal by the oscilloscope is taken as a reference voltage to the ground, make sure the ground terminal connect to the earth correctly, do not cause a short circuit.*

1-3-2 Probe application

1. Connect the oscilloscope probe with the connector, and insert into the input terminal of the device.
2. If you use the probe hooked head, make sure the hook end is firmly stuck into the probe.
3. Probe connection mode must be adopted while the measuring frequency of the signal is above 1Khz.

2. Function and Operation

In order to operate the oscilloscope efficiently, user needs to know the following functions:

• Interface and buttons
• Connector and probe
• Settings of system
• Vertical system
• Horizontal system
• Trigger system
• Signal capture system
• Display system
• Measuring system
• Memory system
• Auxiliary system
• Online help system

2-1 Interface and Buttons

See the following picture:
Picture 2-1

• Please follow the prompts of display interface for the use of F1-F4.
• HOLD key (freezes all the readings in the display)
• MODE function key switch (switch the cursor and waveform position)
• AUTO auto search key (search waveform of unknown frequency or amplitude)
• REC record key (record current waveform content, the length is 10 pages)
• ▲▼ ◄► direction key (adjust sample rate, preselecting amplitude and etc.)
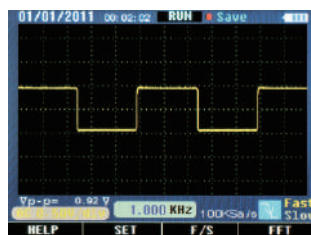
2-2 Connector

• Connector is adopted for the connection of probe and oscilloscope, the probe and connector must be used when the measuring frequency of waveform is above 1KHz.
• When measured signal is a waveform of DC or its measuring frequency is below 1KHZ, the stick of general oscilloscope can be adopted.
• If the device is suspended, you don't need to differentiate phase line or null line when measuring industrial frequency voltage.

2-3 Help Section

For the convenience of user, built-in simple instructions in Digital Oscilloscope is available, part one presents the function of various function keys, part two indicates quick start use.
• Press **F1** (HELP), enter into help section
• Press **F4**, quit from help section
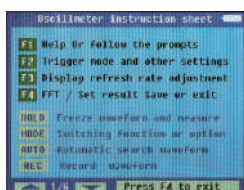
2-4 System Settings

1. Digital Oscilloscope can adjust relative trigger mode according to input signal.
2. Setup the coupling mode according to input signal.
3. Setup the warning tone is activated or not.
Chart 2.4.1

Function	Observations
Trigger mode	Rising edge, falling edge, no trigger
Coupling mode	AC coupling, DC coupling
Warning tone	Key tone, no key tone

Set up by taking the following steps:

1. Running state (RUN), press **F2** according to the prompt (SET), enter into setup interface(SYSTEM SETUP).
2. Press "▲▼" by user's needs to select the function in chart 2.4.1
3. Press "◄ ►" by user's needs to select the observation in chart 2.4.1
4. Press **F4**, save the settings and quit, see picture 2-4-1.
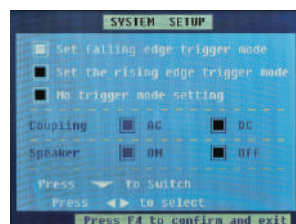
Picture2-4-1

2-5 Fast/slow display

• When the measured signal is unstable, the displayed waveform presents jumping; long-term observation may cause eye fatigue. Digital Oscilloscope offers the selection of fast/slow display function, press **F3 (F/S)**, fast display can be switched to slow display, which can efficiently improve eye fatigue. "Slow" turns to yellow at status bar of interface, means activated.
• If pressed again, it will switch back to fast display, "Fast" turns to yellow, meaning fast display is activated.
• Default fast display after start up.

2-6 Vertical System

• Press "▲▼"to adjust vertical system, default attenuation ratio, that is, preselected frequency (xxV/div) of adjusting input end after start up presents the status of last shutdown.
• While selecting DC coupling, as direct current exist in waveform, it may turn to one side, press **"MODE"**, switch function of "▲▼" to adjust waveform up and down position, make the waveform back to middle position by pressing "▲▼", for convenient observation and measurement.

2-7 Horizontal system

• Press "◀ ▶" to adjust horizontal system, default adjust of sample rate after startup, that is, xxKSa/S.
• Press **"MODE"** then "◀ ▶" if user wants to change the trigger horizontal position in memory (trigger displacement).

2-8 Trigger System

Trigger function confirms the time of collecting data and displaying waveform for the oscilloscope. After correctly setting up the trigger, the oscilloscope can switch unstable displayed result into meaningful waveform.

2-8-1 Trigger Mode

• 2 Kinds of trigger mode for the oscilloscope: raising edge and falling edge. When signal voltage across trigger reaches electrical level, raising and falling edge of input signal is adopted for triggering.
• Raising edge setup: press **"setup"** → **"trigger"** → **"raising edge"** → **"save and quit".**
• Falling edge setup: press **"setup"** → **"trigger"** → **"falling edge"** → **"save and quit".**
• If select **"setup"** → **"trigger"** → **"no trigger"** → **"save and quit"**, the oscilloscope may lose synchronizing signal and any signal measured by fast display.
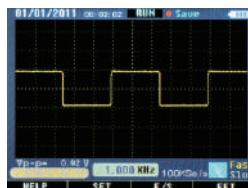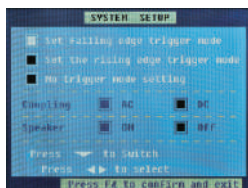
2-9 Channel

• Oscilloscope vertical response should be slightly greater than its bandwidth, so that FFT frequency spectrum can be higher than effective frequency of oscilloscope bandwidth. However, amplitude close to or higher than the bandwidth will not be accurate.
• If channel coupling mode is DC, user can measure DC component of signal by observing the difference between waveform and signal ground.
• If coupling mode is AC, DC component is filtered in the signal. This mode makes user easily display the AC component of signal with higher sensitivity.

Channel Settings

• Channel coupling settings
  Measured signal is sinusoidal signal containing DC bias:
• Press **"setup"**→ **"coupling"**→**"AC",** select AC coupling mode. DC component in measured signal is separated.
• Press **"setup"** → **"coupling"** → **"DC"**, select DC coupling mode. DC and AC component in measured signal can all pass.
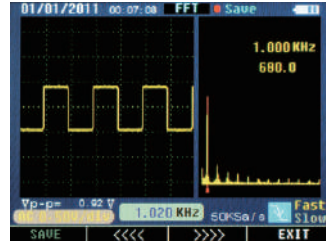
2-10 FFT frequency spectrum analysis

Time signal can be converted into frequency component (frequency spectrum) by using FFT mathematical operation (Fast Fourier Transform). Observe following signals by FFT mathematical mode:

• Analyze harmonic wave in power line
• Measure harmonic wave content and distortion in system
• Measure impulse response of filter and system
• Analyze oscillation

If adopt FFT (Fast Fourier Transform) mode, take the following steps:

1. Set up time domain waveform

- Press **"AUTO"** to display proper waveform.
- If displayed waveform shows unsatisfactory, press "◄ ►" and "▲ ▼" for adjustment.
- Press **F4 (FFT)**, the oscilloscope may adopt the 256 central points of time domain waveform to calculate FFT frequency spectrum.
- According to Nyquist criterion, press "◄ ►", make sampling rate up to at least 2 times of input signal frequency.


Picture 2-10-1(split screen)

2. FFT frequency spectrum display

Press **"F4" FFT** button, display FFT frequency spectrum, in which a channel waveform and FFT waveform are shown in the split screen.

FFT windows instructions

As the oscilloscope takes FFT transform for time records of limited length, FFT calculation mode bases on repeated YT waveform. In this case, if the cycle is integer, frequency values of YT waveform are the same at the beginning and the end, the waveform may not be interrupted. However, if the YT waveform cycle is not integer, frequency values shows different at the beginning and the end, high-frequency transient interrupts occur at connecting part. That is so-called "leakage" in frequency domain. Therefore, in order to avoid leakage, multiply a window function with the original waveform, forcing the values at the beginning and the end to 0.
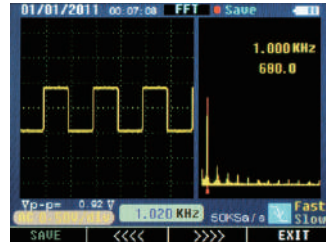
Picture 2-10-2

3. Position FFT frequency spectrum

- "◄ ►" button can still be pressed under FFT interface to change sampling rate, to realize horizontal amplification or minification;
- Adjust "▲ ▼ " to realize vertical amplification or minification.

**4. Measure FFT frequency spectrum by cursor**

- Two kinds of measurement can be taken for FFT spectrum by using cursor: amplitude (relative value) and frequency (unit: Hz).
- Under FFT interface, press **F2** (◄ ◄ ◄) or **F3** (► ► ►) according to prompt bar to move red cursor, corresponding frequency and relative amplitude can be measured.

Note:

• DC component or deviation existed in signal may cause error or deviation in FFT waveform component part. Select DC coupling mode to reduce AC component.
• Nyquist frequency: for waveform, of which highest value ups to F, sampling rate of 2F must be adopted to rebuild the waveform, that is also called Nyquist criteria, "F" means Nyquist frequency, "2F" means Nyquist rate.

2-11 Signal Capture System

• Real-time sampling: the memory space should be full for every sampling. Real-time sampling rate ups to 50MSa/s.
• The system is under default continuous sampling state after startup, press **"HOLD"** if user wants to take static measurement, press the same button again to turn back to continuous sampling state.
• "REC" button: if the user needs the oscilloscope to take sample of enough data to analyze a series of numbers, press **"REC"**, the oscilloscope may continuously take data sample of 10 pages for measurement analysis.
• Time base: the oscilloscope takes sample of input signal values at discontinuous points to digitalize the waveform. Frequency of value digitalization can be controlled by adopting time base. Press "◄►", adjust the time base to a horizontal level to satisfy user's needs,
• False wave phenomenon: if the speed of sampling is not fast enough, causing inaccurate waveform records, "false wave phenomenon" occur. In this case, the oscilloscope displays the waveform by a frequency which is below actual input waveform's frequency, or triggers and displays unstable waveform. Therefore, press **"AUTO"** to auto search for the first measurement of new signal, to confirm the basic frequency of this signal.

actual high frequency waveform

low frequency waveform caused by false wave phenomenon

sampling point
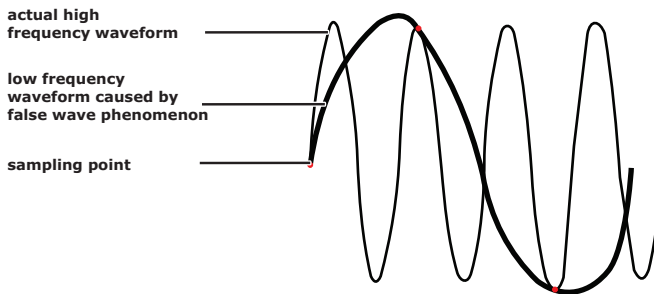
False wave phenomenon
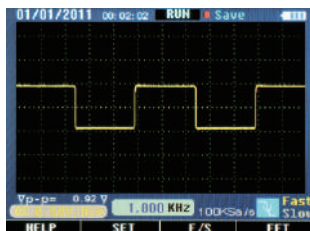
2-12 Display System

2-12-1 Time and Date

• After startup, actual time and date display at the top
  left corner on the interface, format: mm/dd/yy,
  hh/mm/ss **(picture 2-10-1)**.
• Function of the clock is supplied by the back-up battery
  inside of the device, which can work for 5 to 10 years
  and irrelevant to the Li-ion rechargeable battery.
• Take "Operating Instructions For Oscilloscope" for
  reference for the adjustment of clock.
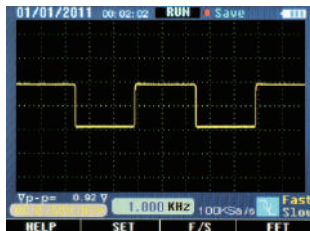
Picture 2-10-1

2-12-2 Battery Electric Power Display

• After startup, at the top right corner, display the working
  Li-ion rechargeable battery electric power **(picture 2-10-2)**.
• The battery fully charged, 4 cells.
• When 1 cell left, blue color turn to red, warning to
  recharge, 30 to 45 minutes may be used by this left power.
• All cells disappear, please recharge promptly, 15 to 20
  minutes may be used by this left power.

Picture 2-10-2

2-13 Measuring System

The oscilloscope displays forms of voltage relative to time, and helps user measure and display waveforms.
Two ways of measurements can be adopted: Scale measurement or cursor measurement.

2-13-1 Scale Measurement

Fast and direct evaluation can be done by this way, for example, waveform amplitude can be observed to
judge whether it's 0.8V or not. By calculating relevant primary and secondary scale division, then
multiplying by proportion factor, simple measurement can be taken. For example, if four main vertical scale
divisions between the waveform peak and base are figured out, proportion factor is 200 mV/division, peak
value voltage can be calculated by the following method: 4 divisions * 200mV/div= 0.8V

2-13-2 Movement of Cursor

As the following picture shows, press **"HOLD"** or **"REC"**, **"V/F cursor"** appear in prompt bar, indicates
function switch button for cursor measurement.

1. Blue vertical cursor appears on the displayed screen, press "◄►" to move the cursor, once for one
   space, press this key for more than 1 second for fast moves, the cursor moves continuously in the same
   direction.
2. Press **"MODE"** to switch left/right cursor, lighter cursor indicates state of activation.
3. Display mode of frequency and cycle is also switched at the time of left/right cursor switch. Activate left
   cursor displays frequency, right cursor for cycle. See **picture 2-11-1.**

4. Press **F1 (V/F cursor)**, cursor measurement turns to voltage amplitude from frequency (cycle). Up and down cursor appears on the screen at the moment.
5. If use needs to move the cursor, press "▲▼", one time for one space, press this key for more than 1 second for fast moves, the cursor moves continuously in the same direction.
6. Press **"MODE"** to switch up/down cursor, lighter one indicates state of activation.
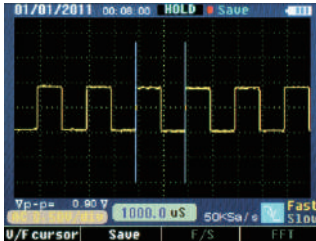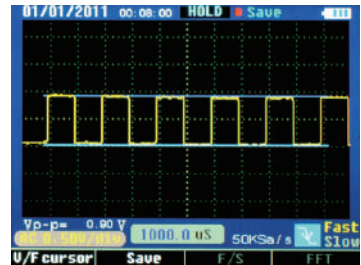

Picture 2-11-1
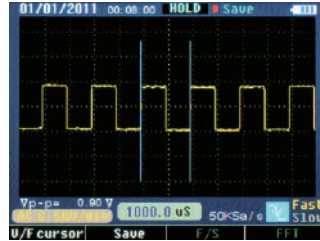
Picture 2-11-2

2-13- Cursor Data Measurement

Manual cursor measurement- increment for horizontal or vertical coordinate figure and increment between two cursors
• **Time cursor:** time cursor displays as vertical line on the screen, which can measure vertical parameter, result appears on the bottom of screen, see **picture 2-11-2.**
• **Voltage cursor:** voltage cursor displays as horizontal line on the screen, which can measure vertical parameter, result appears on the bottom, see **picture 2-11-3.**

Picture 2-11-3

2-14 Waveform Records

In order to clearly observe some serial signals, as UART, IIC, record mode can be used. Press **"REC"**, the device captures and records signals, after the records, result displays on the screen by page order.
• Press **"NEXT",** turn to next page, 10 pages can be continuously turned.
• Press **"PREVIOUS"**, turn back to the previous page.
• State of movement and measurement of cursor is same as "HOLD".

2-15 Memory System

Digital Oscilloscope memorizes 10 series waveforms to its internal memorizer. The memorized date can be stored for 10 years, memorizer space can be repeatedly used one million times. The waveform data stored can be recalled back to current oscilloscope, or be sent to upper computer via internal Bluetooth, with portable computer or PC, then be opened by relevant software in computer. Measurement in the computer may also be taken.

1. Store the current displayed waveform into the device.

• Press **"HOLD"**→**"F2(Save)"**→ enter into **"Save Operations"** state→"▲▼" (select position) →**"F1 (Memory)"**, when no store exists in the position(No store), store directly, the color may turn to purple red from green if storage succeeds.
• If previous store exists, system presents "Into the new?" if answer "yes", original content is covered, current content is stored; if "no", quit the operation.
• Press "**F4 (EXIT)"** to quit.

2. Store the record state waveform into the device.

• Press **"REC"** → **"F2 (Save)"**→ "▲▼ "(select position) → **"F1 (Memory)"**, rest steps same as 1.
• Press **"F4 (back)"** to turn back to flip operation interface of record state, press "REC"to quit.

3. Store FFT displayed waveform into device.

• Press **"F4 (FFT)"**→ **"HOLD"**→ **"F1 (Save)"**→ "▲▼ " (select position) **"F1 (Memory)"**, rest steps same as 1.

2-15-2 Deletion

Under "Save Operations" state, press " ▲▼ ""◄► "(select position), then press "F2(Delete)", system presents "Are you sure?" if answer "yes", the content is deleted; if "no", quit the operation.

2-15-3 Callout

• Under "Save Operations" state, press " ▲▼ "" ◄► "(select position), then press "F3 (Recall)",the selected content displays on the screen.
• The waveform data is sent to upper computer by Bluetooth or wireless USB while waveform callout.

Picture 2-13-1
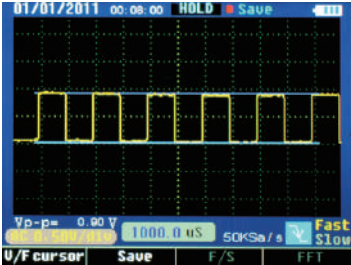
Picture 2-13-2

• Press **F2 (return)** under waveform displaying state, turn back to "Save Operations" state.
• Press **"F4 (EXIT)"** in waveform displaying state, turn back to waveform displaying state.

3. Examples

This chapter mainly introduces several application examples, these simplified examples focus on some main functions of the oscilloscope, and user may take it for reference to solve some actual testing problems.
• Simple measurement
• Cursor measurement
• Analyze detailed information of signal
• Analyze communication signal difference by mathematical computing function

3-1 Simple Measurement

Observe unknown signal in circuit, fast display the frequency and peak value of the measured signal.

1. Auto search function
   In order to fast display the signal, take following steps:
(1) Connect correctly the probe and connector.
(2) Press **"AUTO"**, wait a moment, the oscilloscope auto searches most of the displayed signals. User can take manual adjustment on this basis, until the displayed waveform satisfies user's needs.

Note: *the oscilloscope displays corresponding auto search result in waveform area on the screen according to detected signal type.*

3-2 Cursor measurement

The oscilloscope can auto measure most displayed signals. If needs to accurately measure the frequency and peak value of signal, take following steps:

(1) Measure signal frequency
• Press **"HOLD"**, freeze the waveform.
• Press "◀ " or " ▶", to move left cursor.
• Press **"MODE"**, to switch cursor, press "◀ " or "▶", to move right cursor.
• Read the time (cycle) between the two cursor press **"MODE"**, read corresponding frequency.

(2) Measure signal peak value
• Press **"F1 (V/F cursor)"** after step 1, switch to horizontal cursors, press "▲"or" ▼" to move up cursor.
• Press **"MODE"**, to switch cursor, press "▲ "or"▼" to move down cursor.
• Read the voltage value between two cursors.

3-3 Serial Signal Measurement

To measure serial signals, as UART, IIC, SPI and etc, please take following steps:
1. Take 3.1 operations as reference, preliminary observe the measured signal.
2. Press **"REC"** while signal transmission.
3. Press **"NEXT"** or **"Previous"** according to prompt bar on the screen to check corresponding page.
4. Take 3.2 (1) operations as reference, press " ▶", "◀" and **"MODE"** to move the cursor, signal
   frequency can be measured.

3-4 Analyze AC signal by FFT

Observe amplifying circuit in device, analyze output harmonic component and observe its distortion by FFT.
To adopt FFT function, following steps can be taken.
1. Connect the input end of the amplifying circuit to sine wave signal.
2. Connect the oscilloscope probe to output end of amplifying circuit.
3. Take 3.1 operations as reference, proper signal can be observed.
4. Press ''**F4 (FFT)''**, observe frequency spectrum of output waveform for amplifying circuit after Fast
   Fourier Transform.
5. Adjust the input signal source of amplifying circuit, observe FFT.
6. Press **"F2 (◀◀◀)"** or **"F3 (▶▶▶)"** to adjust position of red cursor, read corresponding frequency and
amplitude ratio of dominant wave and harmonic wave.

3-5 Waveform Save

Waveform data save should be operated under static state, three ways lead to "static" state.
1. Press **"HOLD"** + **"F2 (SAVE)"**;
2. Press **"REC"** + **"F2(SAVE)''**;
3. Press **"FFT"** + **"HOLD"** + **"F1 (SAVE)"**;
Then operate according to screen prompts.

4.Fault Processing

4.1 General fault processing

1. If turn the oscilloscope switch to any gear, still black screen, no any display, please operates by following
steps:
   (1) The Li-ion battery may be used out, please recharge it.
   (2) Recharge the battery by matched charger for 5 to 10 minutes, try again.
   (3) If still no display, Li-ion battery may be damaged, need to change.

2. Press **"AUTO"**, if waveform of signal doesn't display on the screen, please take following steps:
   (1) Verify if the probe is correctly connected to signal cable.
   (2) Verify if the signal cable is correctly connected to connector.
   (3) Verify if the probe is correctly connected to measured object.
   (4) Verify if the measured object emits signals.

(5) Press "AUTO" to try again.

4.2 Waveform displays, but cannot stabilize.

(1) Check the trigger option is correct or not. Waveform stabilizes only proper trigger mode is operated.
(2) Try to change "trigger mode" to falling edge or raising edge, waveform can not stabilize in "no trigger" state.
(3) Try to change "▲" button, weak signal is vulnerable to be interfered, and emits unstable waveform.

4.3 Waveform appears ladder shape:

Normal phenomenon. Level time-base gear may not be proper, adjust horizontal time-base to raise the level resolution, display improved.

Appendix 1:Daily maintenance

While store or place the device, please don't make LCD display surface exposed to direct sunlight for long time.

Note: *To avoid device or probe damage, please don't place it in fog condition, liquid or dissolvent.*

Cleaning:

Verify the device and probe frequently according to operation times. Please clean outside surface of the device by following steps:

1. Wipe dust of external part of the device and probe with soft cloth. While cleaning the LCD screen, pay attention not to scratch the transparent plastic protection screen.
2. Clean the device with a water soaked cloth, note to disconnect the power. If a more thorough clean is needed, 75% isopropanol water dissolvent can be used.

Note:

• *To avoid device or probe damage, any abradant reagent or chemical cleaning reagent can not be adopted.*
• *Before cleaning the device, please make sure to disconnect all lines.*

Appendix 2:Specifications

Function	Main specification	Format or note
LCD display	3.5" color TFT-LCD; 320 X 240 pixels	
Refresh rate	15~50 V/S	Fast / Slow
Bandwidth	10MHz	0 - 10 MHz
Input	Coupling, AC, DC	AC , DC
Input impedance	1000C/CA:1MΩ +/-2% // 15pF +/-2pF	
Max input voltage	1000V/600V (DC+AC peak value, 1MΩ input impedance)	CAT I, CAT II , CAT III
Probe attenuation	1X	
Sampling mode	Real time sampling, random sampling	Single channel 3K,
Real time sample rate	50MSa/s~ 500pts	
Sampling resolution	8 bits	
Record length	3K / 10pages	SRAM
Storage length	10 charts	EEPROM
Time error	±5 s / 24hours	
FFT collect	4-256 points	
Bluetooth transmission rage	9600 baud rate	
Li-ion battery	7.4V 2400mAH	

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