

Hand-held Digital Oscilloscope Meter WENS 800 Series

WENS 820
WENS 840
WENS 860

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Operator's Manual

Digital Oscilloscope Meter

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For the safe and effective operation of unit, please read this manual carefully before using the unit.

1. ⚠ Notes for Safe Operation □



WARNING. USE EXTREME CAUTION IN THE USE OF THIS INSTRUMENT
Improper use of this device can result in injury or death.
Follow all safeguards suggested in this manual . In addition to the normal safety precautions used in working with electrical circuits.
DO NOT service this device, if you are not qualified to do so.

1-1. Prevention of fire or injury

Use a proper AC Power Adapter. or Test Leads

- Only use a Power Adapter or Test Leads supplied with the instrument.

Connect and Disconnect Properly

- Connect the probe or Test Leads output to the measuring device before connecting to the active circuit in testing. Before disconnecting the probe or Test Leads from the measuring device, first disconnect Probe or Test Lead from active circuit in testing.

Observe all terminal ratings

- In order to prevent fire or risk of electrical shock, observe all ratings and markings of the unit. Before connecting to the unit, refer to the operator's manual for detailed information on ratings.

⚠ Max Input Voltages



Scope Input.

- Input CH A and CH B direct(1:1 probe) 300V CAT III

Meter Input

- 600V CAT III

⚠ Max Floating Voltage



- 600V CAT III

- Voltage ratings are "working voltage" Vac-rms(50 - 60Hz) for AC sine wave and Vdc for DC applications

Replace the battery properly

- Replace the battery supplied by manufacturer.
- **Do not connect the ground wire to voltages higher than 42V Peak(30Vrms) from earth ground.**

Do not use exposed metal BNC or Banana plug connectors.

- Use only insulated voltage probes, test leads and adapters supplied with the instrument.
- Do not apply any voltage when measuring OHM(Resistance), or Capacitance of Meter mode.

Do not operate the unit without its cover.

- Do not operate this unit with its cover properly.

Do not expose the circuits.

- Do not touch any exposed connecting parts or components while power is being supplied.

Do not operate the unit if it does not operate properly.

- If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do not operate this unit in wet or damp environments.

Do not operate this unit in any environment in a risk of explosion.

Maintain the surface of the unit in a clean and dry state.

Provide proper air ventilation.

1-2. Safety Terms and Symbols

Technical terms which appear in this manual are listed below.



WARNING. Warning statements identify conditions or practices that could result in injury or loss of life.



CAUTION. Caution statements identify conditions or practices that could result in damage to this product or other property.

Technical terms related to the unit.

- The following terms appear on the unit.
- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.

Symbols related to the unit

- The following symbols appear on the unit.



Danger
High Voltage



Protective
Grounding
(Earth) Terminal



CAUTION
Refer to
Manual



Battery
Information

1-3. Preventing electro-static discharge



CAUTION. Electro-static discharge(ESD) can result in damage to the oscilloscope components and accessories. To prevent ESD, observe the following prevention guidelines when instructed to do so.

Select a proper working location.

- When installing or removing sensitive equipment, do not use devices which can or have the potential to discharge static electricity. Do not handle sensitive equipment on floors or worktables which can discharge static electricity.

Handle components with care.

- Do not slide sensitive components on any surfaces. Do not allow them contact with any exposed connector pins. Handle sensitive components to the minimum extent possible.

Transport and store with caution.

- Transport and store in ESD preventive bag or container which protects sensitive components from static electricity

Recycling the battery

- The battery(optional) must be properly recycled or disposed.

2. Main Product Items and Layout

This instrument was designed to provide analysis of signals through its fast signal acquisition ability through the Fast Data Acquisition Unit. Through a variety of capture methods such as Average, Peak-Detect, along with its long recording length of 125k, it enables the user to quickly and accurately acquire the signal properties. In addition, it offers a more convenient working environment through the use of basic interfaces including, USB storage device and USB PC Communication.

2-1. Main product items and performance features

A. Oscilloscope

- 2 Channel, 20MHz(Model 820) 40MHz(Model 840) or 60MHz(Model 860)
- Maximum 200MS/s Real sampling, 2.5GS/s Equivalent sampling
- Peak Detection for Glitch Acquisition
- Maximum 125K Long Record Length
- Auto-set for quick waveform acquisition
- Improved Trigger Function(Edge)
- Saving of configuration settings and waveforms
- 21 auto measurement features
- Diverse Capture Modes(Sample, Peak-detect, Average)
- Dual Waveform Computation and FFT Spectrum Analysis(model 840, 860 only)
- Support for Portable Flash USB Storage Devices(option)
- Zoom function
- Persistence Intensity Display
- Large 3.9" 320 × 240 LCD
- USB equipped as standard interfaces

B. Digital Multi Meter

- High Precision, Rugged Autoranging True RMS DMM
- 6000 Count with Analog Bargraph Display
- True RMS AC Volts/30kHz wide band
- Complete measurement ranges
DC Volts, AC Volts(RMS), AC+DC Volts(RMS), Ohm, Capacitance, Diode, Continuity(through external adapter), Currents, Temperature, %Relative Humidity, Pressure

2-2. Product configuration

A. Unit with Standard Accessories

- Instrument with Holster case 1set
- Passive Probe CAT III 300V 20Mhz(1:1) : 2PCS or
CAT III 600V 60Mhz(10:1) : 2PCS
- Test Leads(CAT III 1000V) Black + Red 1 set
- PC Software set(USB Database & Flash Memory PC Platform
Data base) 1CD
- AC Power Adapter and Internal Charger 1pc
- Operator's Manual in CD

B. Optional Accessories

- Internal Back Up Battery System & Battery Pack : 2PCS/Unit
- Internal USB FLASH MEMORY System & Port System
(Equipped Internally)
- Deluxe Carrying Bag
- Temp Adapter
- AC Current Adapter
- DC 12V Power Adapter and Cable

3. Initial Setting Operation before use

For more effective operation, the instrument performs quick confirming of functions and provides passive probe installation and adjustment, and setting of time and date. This section explains the methods for quick confirmation on if the instrument is powered on, if it is operating properly, adjusting the probe using the internal adjusting signal, and setting the time and date





- All initialization/configuration steps must be performed when first using the instrument.
- Basic Self Tests shall execute upon power on. Be sure not to connected with any signal to the instrument during testing. The purpose of this test is to flag a major system problem.
- Whenever attaching the passive probe(initially, for the first time) to the input channel, the probe adjustment steps must be performed.

3 - 1. Function Confirmation

Perform the following simple steps to verify that the oscilloscope is operating properly

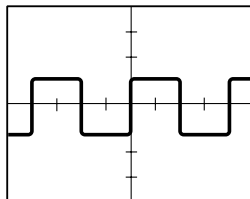
Connect the unit power adapter.

Power ON the unit

- Press  key
- Press  utility key
- Press  more to enter 3/3 page menu
- Press  Self Calibration

Check whether all calibration is done successfully. This test verify poor operation of the instrument. This test requires disconnection of the signals from instrument Inputs. Self calibration performs within operating temperature, calibration, abort, calibration factors, non-volatile factors.

Press the AUTOSCALE button.



A square waveform must appear on the screen.
(Approx 1V at 1kHz)

3 - 2. Probe Adjustment

Perform the adjustment function to match the probe to the input channel. This function must be performed each time the passive probe is first attached to the input channel.

Verify the shape of the wave appearing on the screen



3 - 3. Adjusting the time and date of the oscilloscope

Follow the steps to adjust the time and date of the oscilloscope

- A. Press the **USER** button
- B. Press **F4** MORE to enter 2/3 page
- C. Press the date and time input confirmation menu button **F3** **F4** to set the date and time.

3 - 4. Adjusting Auto power off

“Auto power off” time can be selected by user.

- A. press **USER** key
- B. Press **F4** utility
- C. select 5 min, 10 min, 30 min, 1 hr, 2hr, 4hr or OFF by **F1** key

3 - 5. Adjusting Contrast

LCD brightness can be adjusted by user

- A. press **USER** key
- B. Press **F4** utility
- C. select contrast by **F2** key

3 - 6. Selecting Language

Language can be selected by user

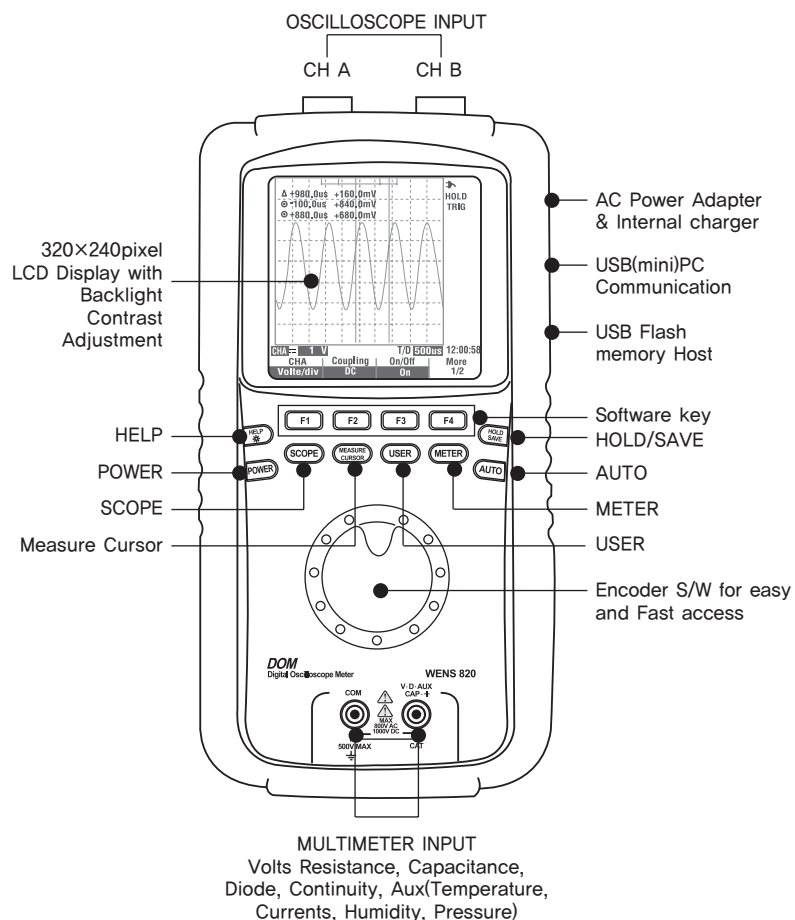
- A. press **USER** key
- B. Press **F4** utility
- C. select Language by **F2** key

3 - 7. Factory set-up

Store setting data when deliver Instrument from Factory. After completion Data is displayed on screen

4. Front Layout Summary

4-1. Front Layout



4-2. Keys

Soft keys are located directly below the Liquid Crystal Display and perform multiple operation as indicated on the Liquid Crystal Display and determined by the function selected by the rotary switch.

Some functions will produce a sub-menu on the display for further selection

Operation of the menus and sub-menus is described in the appropriate operation paragraph.

NOTE : Softwarekey F1 F2 F3 F4 **has no EXIT** menu. When SCOPE MEASURE CURSOR USER METER is in measuring, ENTER or EXIT between software key F1 F2 F3 F4 menu should be done by pressing the major key SCOPE MEASURE CURSOR USER METER respectively.


F1 F2 F3 F4 : Keys to select various Software Program.


POWER : Power ON and OFF


HELP * : Display user guide ON Test procedure ON each measuring range
Back light display key - press longer than 2 seconds to turn ON or OFF.




AUTO : Scope mode : Auto scale function
Meter mode : when change to manual Ranging mode. See “table of contents” 10 AUTO for details.

SCOPE : Oscilloscope mode

 : Multimeter mode

 : MEASURE CURSOR(Oscilloscope) measure, cursor key. cursor Key-press longer than 2 seconds to enter or out from cursor function.

 : (Oscilloscope) Acquire, MATH, FFT cursor menu contrast, persistence Intensity, Auto power off, Time, Self-calibration, Factory set-up

 : “freezes” the reading on the display. press  again to resume normal RUN operation. The  HOLD will be shown on the display when hold is selected.

For SAVE mode - press key longer than 2 seconds to enter or exit from the SAVE mode. See “of contents” a. SAVE for details.



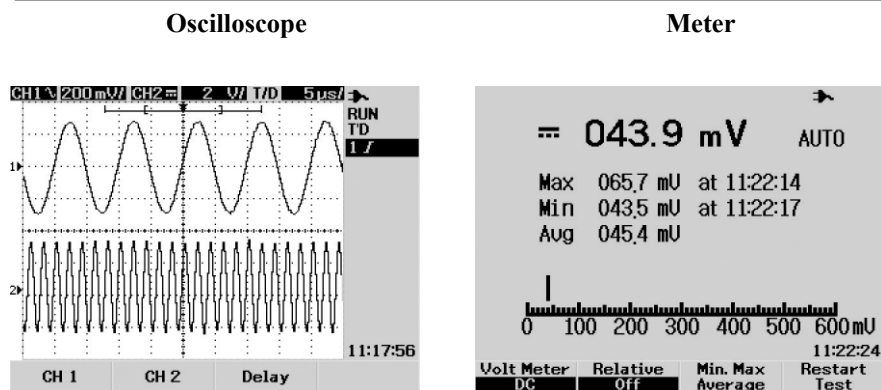
Encoder is activated only in oscilloscope mode for adjustment of.

- Volts/div
- Position(Move A, Move B)
- Trigger Level
- Pulser Trigger Period/ Pattern Trigger Period
- Video Trigger Line
- Time/div
- Horizontal Position
- Zoom Window
- Measure Parameter Select
- Cursor Move
- Contrast
- Average Number Select
- Math Position
- Time Set

For Faster speed, push sown ENCODER to enter or exit from COARSE mode(25 times faster than Normal speed)

5. Display Layout Summary

Display Indicators Explanation



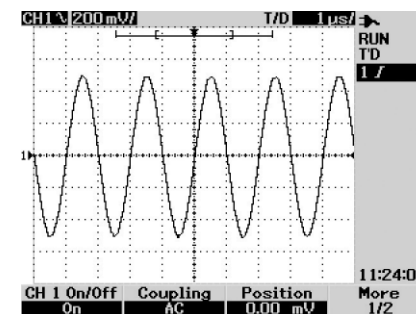
Main Display waveforms and indicators

CH A, CH B, math waveform and trigger A, B level, horizontal position, CH A, CH B offset, volt/division, time/division and so on.

Analogue Bargraph, MIN, MAX, AVG VOLT, DC and so on.

6. Oscilloscope Function

6-1. CH A, CH B

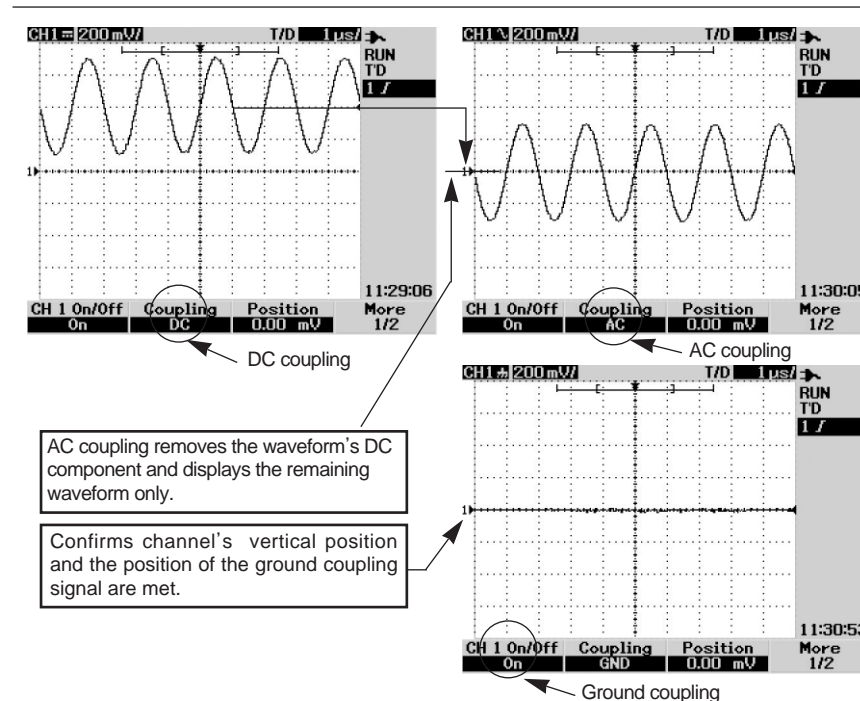
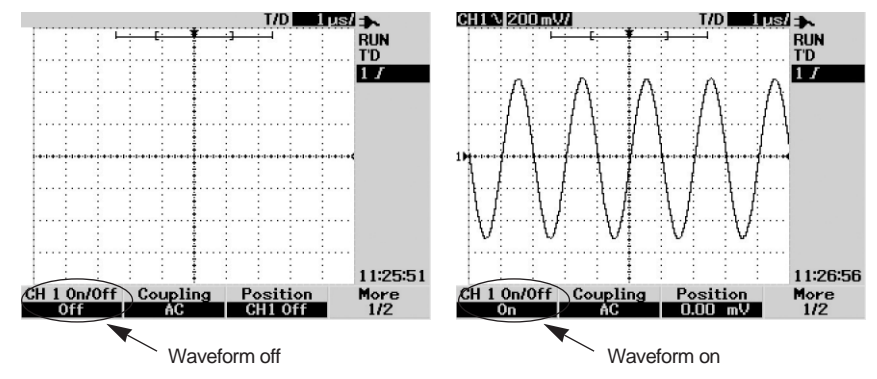


This function allows changes the settings of the CH A(CH B) input signal. Press CH A(CH B) to display the sub menu for configuration setting changes. By using the software key **F1** **F2** **F3** **F4** corresponding to the item in the sub menu, configuration settings can be changed.

Top level menu	Sub menu	Function
CH A(CH B) MORE 1/2(page 1/2)	On/Off	On/Off
	Coupling	DC/AC/Ground
	Position	volts/div, position A
CH A(CH B) MORE 2/2(page 2/2)	Probe	1X, 10X
	Invert	On/Off
	Position to 0	Sets vertical position to 0V

On/Off (page 1/2)

Use this function to turn the CH A(CH B) waveform on or off. In the On state, the vertical sensitivity and vertical position indication will display corresponding to the position of CH A and CH B. In the Off state, these indicators will not display.



Coupling (MORE 1/2 page 1/2)

Use this function to capture a specific area of waveform.

① **DC coupling**

The input signal is directly connected to the amplifier which components can be viewed. The \equiv symbol on the top line of the screen.

② **AC coupling**

The input signal passes through the condenser and is connected to the amplifier. Only the alternating current components of the input signal can be viewed. The \sim symbol on the top line of the screen.

③ **Ground coupling**

The input signal is split and the input signal entering the vertical amplifier is grounded. The \perp symbol will display on the top line of the screen.

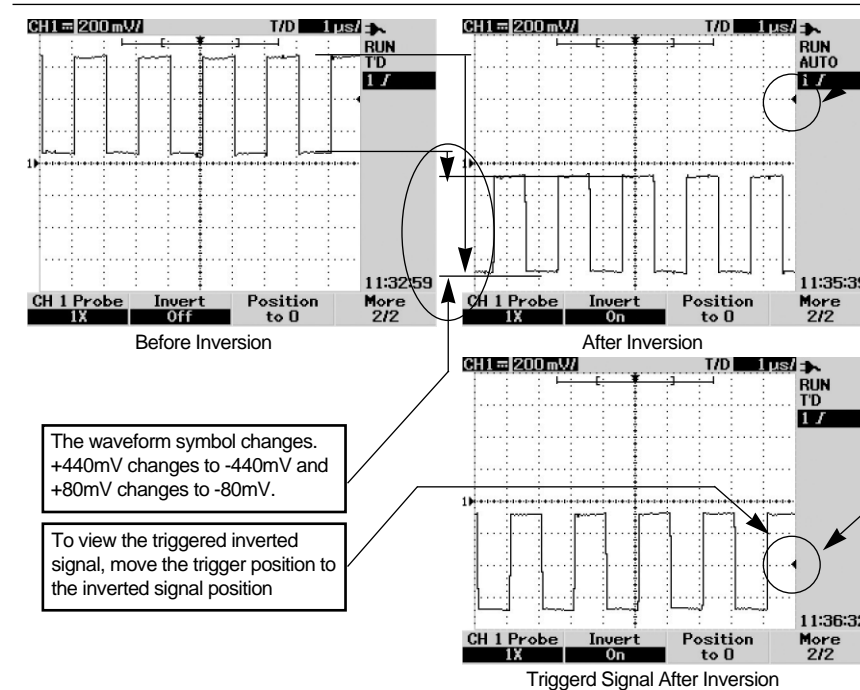
Note. Long time use of the unit or use in an not recommended environment may cause disagree of the channel's vertical position and position of the ground coupling signal. In this event, turn power off and On for automatic 0 setting.

Position (page 1/2)

To set Vertical position by rotating ENCODER.

Invert (page 1/2)

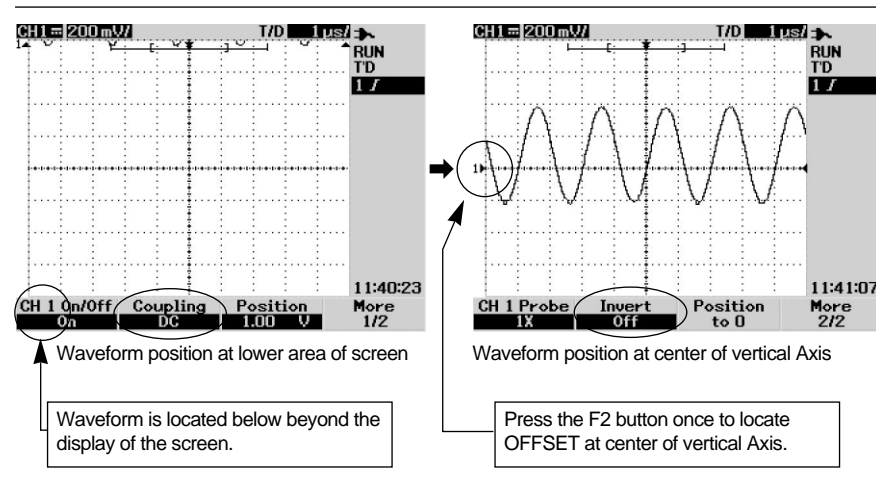
Use this function to display an inverted waveform(change positions of upper waveform and lower waveform) Waveform voltage level will change based on earth grounding level of waveform. For example +5V voltage will appear as -5V. It is used when set INVERT of waveform characteristics of CH A/CH B



Note. Even when inverted, the vertical trigger position remains unchanged. Therefore if the inverted signal is not positioned at the vertical trigger, the signal will not trigger and will shake. To view the triggered signal, move the trigger position to the inverted signal position.

Position to 0 (page 2/2)

Use this function to set the CH A(CH B) waveform offset to 0. This is a convenient function to return to the original state after changing the offset(via the ENCODER) to view the top and bottom of the waveform.

**Position to 0** (page 2/2)

It is used when position is set at 0. Move ICON of CH A/CH B position to center.

Probe

The probe must be set according the probe setting in order to adjust the scope voltage unit to match the probe scale

- 1x : Select when using 1:1 probe or when directly inputting the signal to the input terminal.
- 10x : Select when using a 10:1 probe.

6-2. TRIGGER

Use this function to configure settings for the trigger and trigger type.

Edge

Use to acquire the waveform from the rising and falling edge of the signal for the trigger level. Setting value of Trigger source and Trigger slope is displayed on screen.

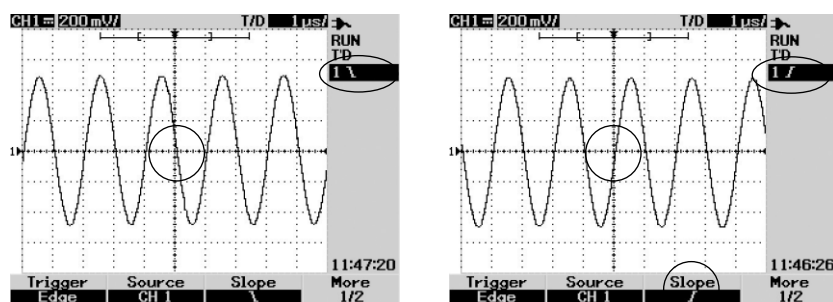
Type	Sub menu		Setting
Edge Trigger	More 1/2(page)	Source	CH A / CH B
		Slope	Rising / Falling
	More 2/2(page)	Coupling	DC / AC / HF Rej. / LF Rej. / Noise Rej.
		Level	Level Value / TTL / ECL / 50%

① Source

Use to select the signal to use as the trigger source.

② Rising/Falling

Use to select the slope.



The Trigger occurs and the waveform is captured on each slope according to the Falling/Rising Setting

③ Coupling (DC/AC/HF Rej./LF Rej./Noise Rej.)

As this sets the trigger source coupling, it must be selected to match the situation to observe.

- DC Coupling

The selected trigger source is applied to the trigger input unchanged. This is identical to using the actual displayed waveform as the trigger source.

- AC Coupling

Passes the selected trigger source through the capacitor and a signal without the AC component applied to the trigger input.

- High Frequency Rejection

A signal with the high frequency component removed from the selected trigger source is applied to the trigger input. This is used to observe low frequency signals with a high amount of high frequency noise.

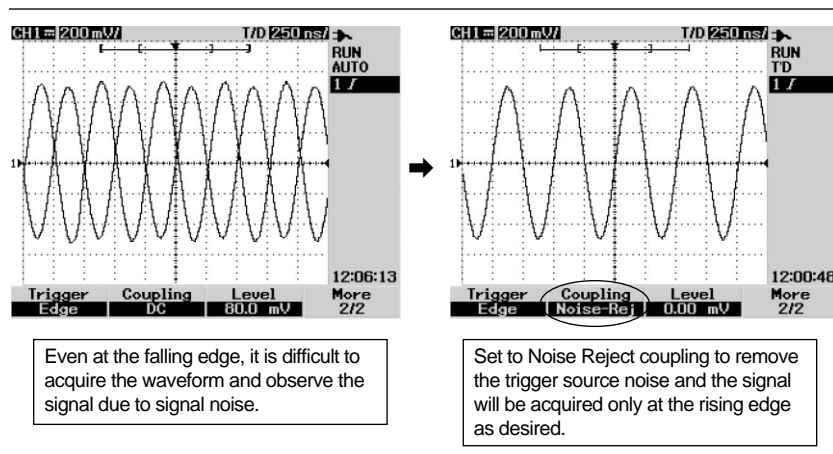
- Low Frequency Rejection

A signal with the low frequency component rejected/removed from the selected trigger source is applied to the trigger input.

- Noise Rejection

A signal with noise removed from the selected trigger source is applied to the trigger input.

When comparing the trigger source and level, this adds hysteresis and disregards the noise within the source near the trigger level, and recognizes the overall slope as the trigger point. When the noise is excessive and when simultaneously observing the Rising/Falling edge while acquiring the waveform, set the noise reject coupling to acquire the waveform only on the desired slope.



④ **Trigger Level** (Manual/TTL/ECL/50%)

Sets the trigger level for the signal to acquire by comparing with the trigger source. Set the trigger level, adjust trigger level by rotating ENCODER. Present level voltage value is displayed with position with ICON.

- Manual setting


Manually change the trigger level by rotating the TRIGGER LEVEL knob or VARIABLE knob. The value of the changed trigger level will display.

- TTL

Sets the trigger level to to automatically recognize High/Low when the observed signal is a TTL signal.

- ECL

Sets the trigger level to to automatically determine High/Low when the observed signal is an ECL signal.

- SET TO 50% 

This automatically sets the trigger level to the center of the high-low value of the waveform currently displayed. This function is convenient when the trigger level is beyond the display.

Pattern Trigger

Use this function to set each of the two trigger source High/Lows and to observe the wavelength according to the area length matching the setting.

Type	Sub menu	Setting
More 1/3	Input 1 Logic	CH A High, CH A Low, CH B High, CH B Low
	Input 1 Level	Trigger Source1, Trigger Level
More 2/3	Input 2 Logic	CH A High, CH A Low, CH B High, CH B Low
	Input 2 Level	Trigger Source2, Trigger Level
More 3/3	Gate	AND/OR/NAND/NOR
	Condition / Period	Shorter / Longer / Between / Non-Between

- Set the Source1,2 level and condition with the VARIABLE knob.

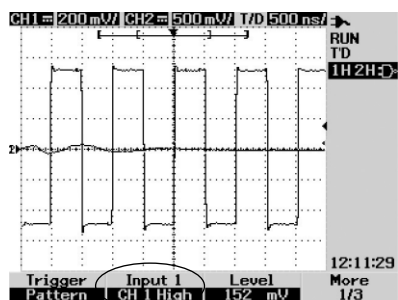
- In condition, Between refers to time within $\pm 7\%$ of the set value of the Period. Non-Between refers to time beyond this percentage range.

For example, if the CH A signal is 150mV higher or CH B is 100mV lower in a Period which is less than 400us, configure the settings as shown below.

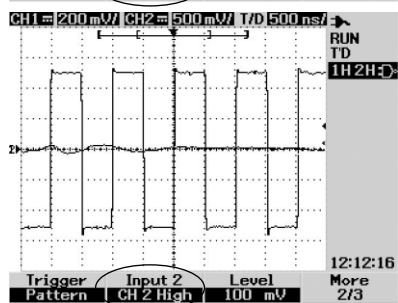
Source1 : CH A High Level1 : 150mV

Source2 : CH B High Level2 : 100mV

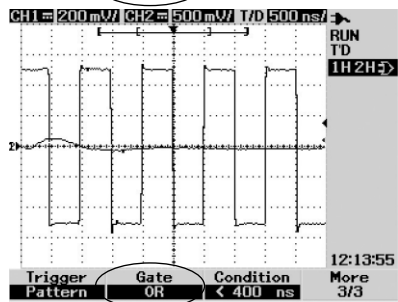
Gate : OR Condition : Shorter Period : 400us



Set input1 to 'CH A', logic to 'High' and rotate the variable knob to set the level to 150mV.



Set inputB to 'CH B', logic to 'High' and rotate the variable knob to set the level to 100mV.



Set gate to 'OR', condition to 'Shorter' and rotate the variable knob to set the period to 400us

Pulse Trigger

Use this function to acquire the instantaneous waveform which is satisfied by the trigger source2 level and trigger source1 edge.

Pulse Trigger Type	Sub menu	Setting
Pulse Trigger 1/2	Source	CH A / CH B
	Level	Trigger source1 trigger level Manual Setting/TTL/ECL/Set to 50%
Pulse Trigger 2/2	Polarity	Positive, Negative
	Condition	Longer/Shorter/Equal/Not Equal Condition with Pulse width set by Encoder

- Use the Encoder to set the Source1,2 levels.

Video Trigger

Use this function to observe the video signal. Select NTSC/PAL/SECAM according to the video signal type, set Odd/Even of the line to observe and rotate the ENCODER knob to move to the desired line.

Sub menu		Mode
More 1/2(page)	Standard	NTSC / PAL / SECAM
	Source	CH A / CH B
More 2/2(page)	Trigger	Odd / Even
	Line	Desired line number to observe

6-3. TIME / ZOOM

Use this function to magnify a waveform for better observation. The observed waveform can be magnified to the desired level of horizontal(time) SCALE FACTOR to view the desired waveform area.

The area may be selected through either the ENCODER Refer to the following illustration.

Upper level menu	Sub menu	Function
TIME More 1/2 (Page 1/2)	Time	Display the horizontal Position Changed by rotating Encoder
	Time Ref	Left, Conter, Right
	XY	XY, YT
TIME More 2/2 (Page 2/2)	Main	Cancel zoom
	zoom	Perform zoom
	Window on/off	Display/Remove the zoom rarge bar

Time (Page 1/2)

When adjust Position, Position ICON should indicate to adjusted point. If Cursor measurement is on Vertical axis its value is displayed.

Time Ref (Page 1/2)

Time Position value is set Left(10%) Center(50%), Right(90%) Value. Waveform Position ICON is displayed accordingly, If cursor measurement is Performing on Vertical axis, its value is displayed.

Main/Zoom (Page 2/2)

Main: Use this function to return to the previous state before magnification. The horizontal factor returns to its original level.

If press Main Key while in ZOOM mode, return back to previous Time/Div. This activates only when Window is OFF or ZOOM mode.

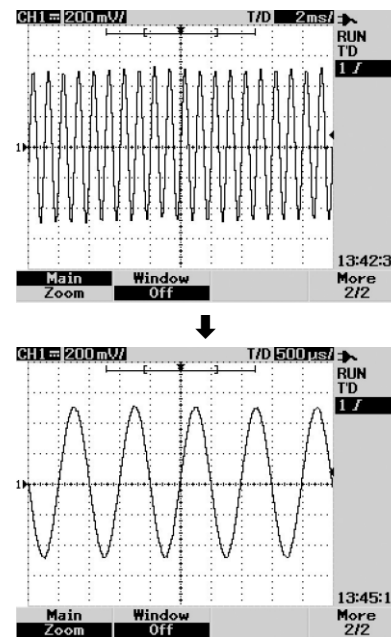
If the menu is set while Window is ON, Vertical axis is magnified according to selected Window and Time/div is magnified according to Magnifying ratio. There is no activation if Window is OFF.

Window - Off, On (Page 2/2)

In order to enter Zoom mode, decide whether Window set is displayed on screen or not. If selec "On" screen display Window Set status. Rotate ENCOEDER to change to Zoom Window. If select "Of", delete Window Set Status on display.

Main

Use this function to return to the previous state before magnification. The horizontal scale factor returns to its original level.



Waveform magnified by the waveform function. Press the F1 button to return to the previous horizontal scale.

Return to the previous horizontal scale before magnification.

Zoom

The zoom function rapidly displays the target phenomenon contained in large amounts of waveform data.

Window ON/OFF

Use this function to view or remove the zoom area selection bar. Press F2 to open the window and set the zoom area through the use of the ENCODER knob

Using the VARIABLE knob

Open the window. Rotate the ENCODER knob to expand the center of the window as shown in the illustration below. Press F3(Zoom) to magnify the desired area.

When the zoom window opens, the selection area bar will appear. Select the range using the ENCODER.

The selected range will cover the entire horizontal area and the horizontal scale factor will change.

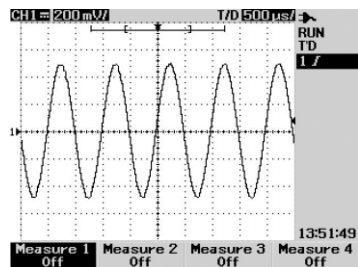
6-4. MEASURE MEASURE CURSOR

Top level menu	Sub menu
Measure	Frequency, Period, Average, RMS, Pk - Pk, Max, Min, Amplitude, Top, Base, +(pulse) width, -(pulse) width, Risetime, full time, +duty, -duty, phase, delay, +Overshot, -Overshot, preshoot

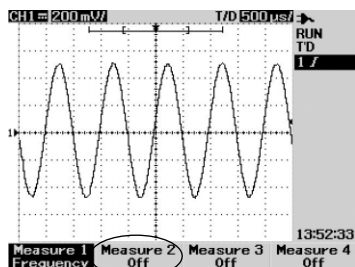
Use this function to utilize the various information regarding the currently observed waveform. Values for the items listed above can be viewed. To display on screen, press F1 F2 F3 F4 key and rotate ENCODER to select measuring Function. Then, press F1 F2 F3 F4 key or push down ENCODER to finish selection.

- Use the method below to delete the measured value.

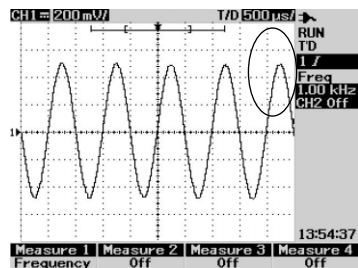
More to page 7 of 7 in the MEASURE menu



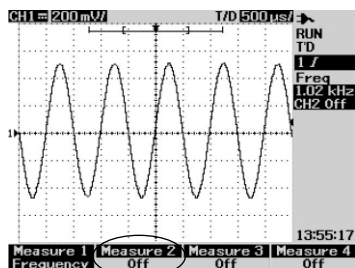
Press the Function 1 button to turn on the remove measured value function.



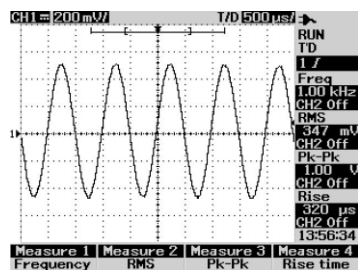
To delete the measured value, press the FUNCTION button corresponding to the position of the measured value to be deleted.



Press EXT button to turn off the Delete measured value.



Press EXT button again to remove the menu located on the right and move the position of the measured value.



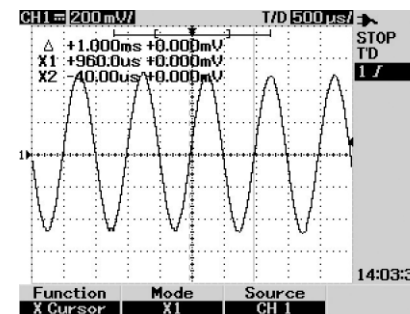
6-5. CURSOR MEASURE CURSOR

Classification	Sub menu	Function
Off	-	Removes cursor from the display
X-Cursor	Mode	X1 / X2 / X1, X2
	Source	CH A / CH B
Y-Cursor	Mode	Y1 / Y2 / Y1, Y2
	Source	CH A / CH B

Use this function to control the cursor to measure the waveform's voltage(vertical) and time(horizontal) at the desired point. The cursor is moved using the ENCODER knob or SELECT key according to track mode.

A. X-Cursor

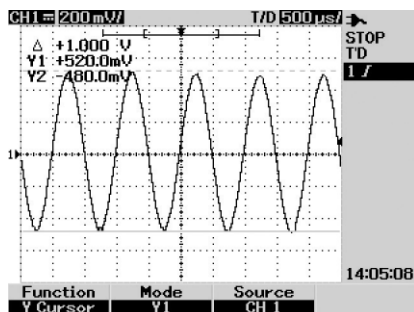
A cursor parallel to the vertical Axis will appear to measure the voltage.



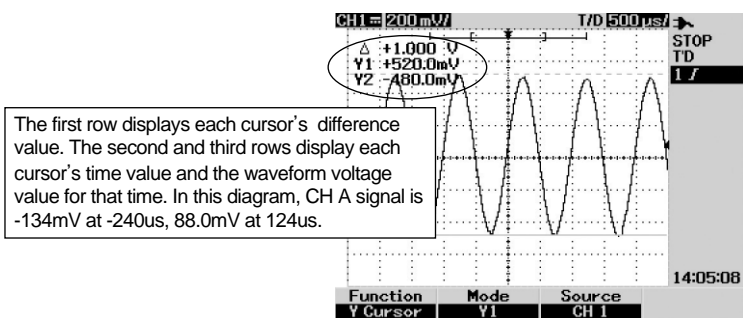
The position of each cursor and difference values between cursors will display on the upper left portion on the screen.

B. Y-Cursor

A cursor parallel with the horizontal axis will appear on the display to measure the voltage value at the desired point. Select the desired signal to measure between CH A/CH B from the source menu.



The measurement value appearing on the upper left of the screen is explained below.



C. X1, X2, Y1, Y2

This sets the method for moving the cursor. Set the mode to match the measuring situation.

① X1, Y1

Use this mode to move the two cursors separately. Change the selected cursor with the SELECT key and position at the desired location using the VARIABLE knob.


② X2, Y2

Use this mode to move the two cursors and simultaneously by using the ENCODER knob while maintaining distance between two cursors. When examining characteristics of an area in signals repeating in a fixed space, match the width of the cursor to the area width. Set the cursor mode to track mode and move the cursor to examine.

D. Source CH A, CH B

Select CURSOR measure value CH A or CH B

7. Multimeter


Note. All multimeter measurement works in AUTO RANGING Mode. To change to MANUAL RANGING, press  key to enter or exit.

7-1. AC and DC VOLTAGE(mV, V) measurements

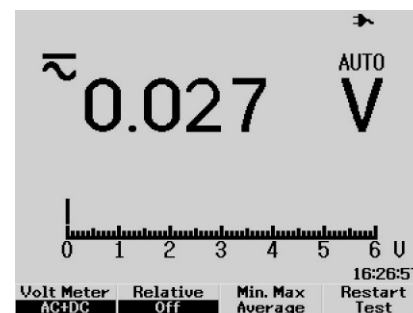
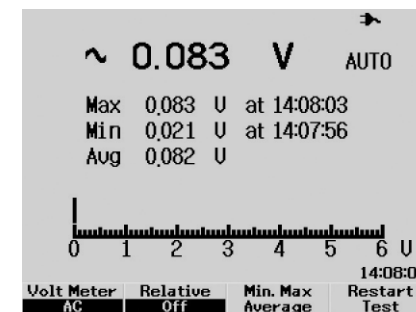
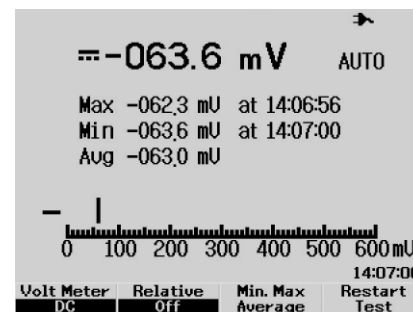
Enter  volt


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 contacting the metal contacts inside the outlet before assuming that no voltage is present.


CAUTION. Do not measure AC or DC voltages if a motor on the circuit is being switched ON or OFF, large voltage surges may occur during the ON or OFF operations that can damage the meter.

- ① Insert the black test lead into the negative jack(COM) and the red test lead into the positive V jack.
- ② Initial setting of the meter is always : “DC”. Press  button to change th “AC”.
- ③ Touch the test probe tips to the circuit under test.
- ④ Read the voltage in the display. The display will indicate the proper decimal point, value and symbols.

METER Display



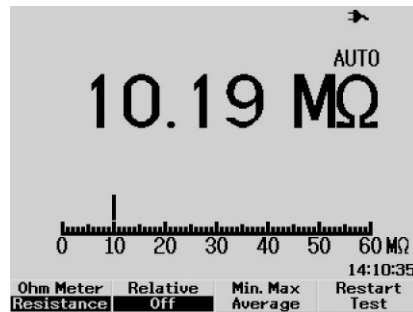
To continue Relative Mode ON/OFF, press  key.

To continue MIN/MAX/AVERAGE, press  key.

7-2. RESISTANCE measurements Ω

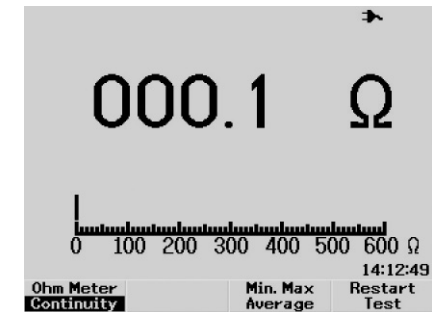
WARNING. To avoid electric shock while taking any resistance measurements, disconnect power to the unit under test and discharge all capacitors, remove the batteries and unplug the line cords.

- ① Insert the black test lead into the negative jack(COM) and the red test lead into the positive **F1** jack.
- ② Press **F1** OHMMETER key. Select " RESISTANCE" with **F1** key.
- ③ Touch the test probe tips across the circuit or part under test.
It is bets to disconnect one side of the part under test so the rest of the circuit will not interfere with the resistance reading.
- ④ Read the resistance in the display. The display will indicate the proper decimal point, value and symbols.

7-3. CONTINUITY check Ω




WARNING. To avoid electric shock, never measure continuity on circuits or wires that have voltage on them

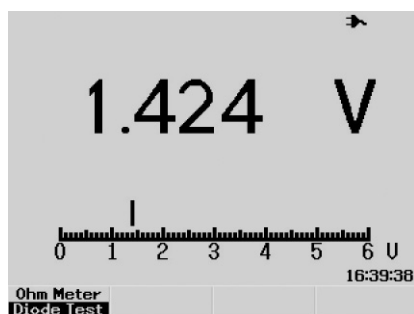
- ① Insert the black test lead banana plug into the negative jack and the red test lead banana plug into the positive Ω jack.
- ② Press **F1** OHMMETER key. Select "CONTINUITY" by **F1** key.
- ③ Touch the test probe tips to the circuit or wire you wish to check.
If the resistance is less than 60 Ω , the audible signal will sound.



7-4. DIODE test 

WARNING. To avoid electric shock, do not test any diode that has voltage on it.


- ① Insert the black test lead into the negative jack(COM) and the red test lead into the positive diode symbol  jack.
- ② Press  OHMMETER key. Select “Diode Test” by  key.
- ③ Touch the test probe tips to the diode or semiconductor junction you wish to test, note the meter reading
- ④ Reverse the probes polarity by switching probe position. Note this reading.
- ⑤ The diode or junction can be evaluated as follows:
 - If one reading shows a voltage value(approximately 0.25V for germanium and 0.7V for silicon) and the other reading shows “OVER” the diode is good.
 - If both reading show “OVER”, the device is open.
 - If both reading are very small or 0, the device is shorted.









NOTE. The value indicated in the display during the diode check is the forward voltage.

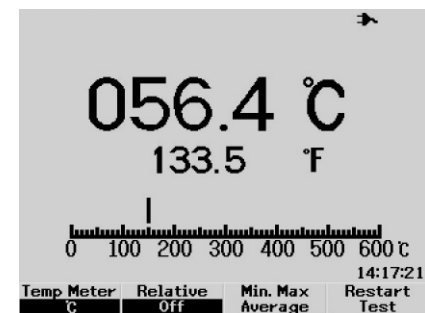
7-5. CAPACITANCE measurements 

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 Insert the black test lead into the negative jack(COM) and the red test lead into the positive CAP jack.
- ② Press  key to enter capacitance.
- ③ The meter will turn on in the capacitance autoranging mode.
- ④ Touch the test lead to the capacitor to be tested. The display will indicate proper decimal point, value and symbol.

7-6. CURRENT/TEMPERATURE(AUX) with exterior probe 

- ① Insert the(-) probe into the negative(COM) jack and the red test lead into the AUX input jack on the instrument.
- ② Press  key or  key to enter currents or temperature respectively.
- ③ Select menu by using     keys.



8. USER USER

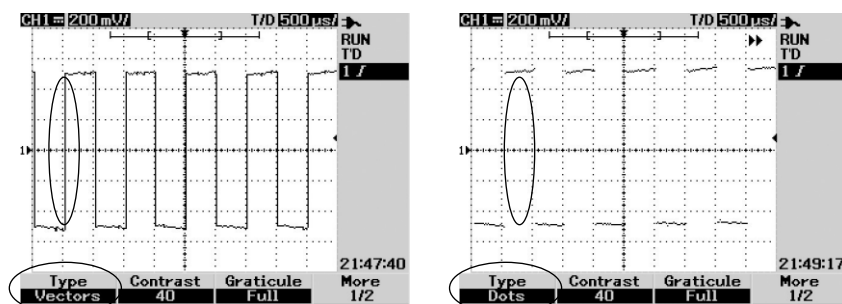
8-1. DISPLAY

Top level menu	Sub menu	Mode
DISPLAY	Waveform	vectors, Dot
	Contrast	0~100
	Graticule	Full, Cross hair, Grid, Frame
	Persistence	Infinite, OFF

Clear Displaying reset the persistence display
 Configures the display environment and method of display for acquired waveform.

A. Waveform

Selects whether to display waveform points connected with a line or to display dots only. In case dot, only 250 waveform data displayed.



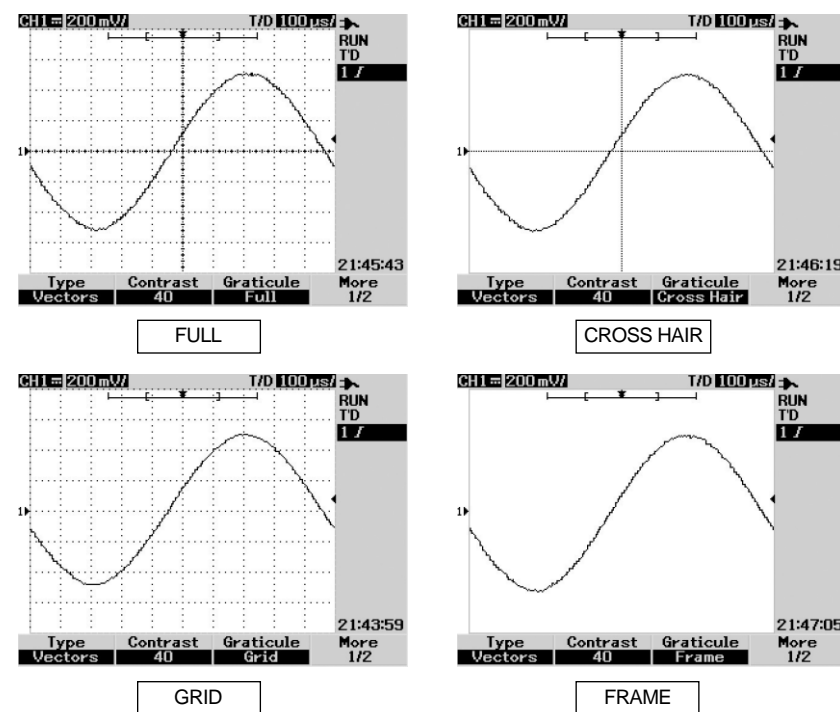
Displaying in linear mode, the high-low of square waves will appear connected. In dot mode, the high-low of square waves will appear separate.

B. Contrast

Adjust the screen contrast using ENCODER.

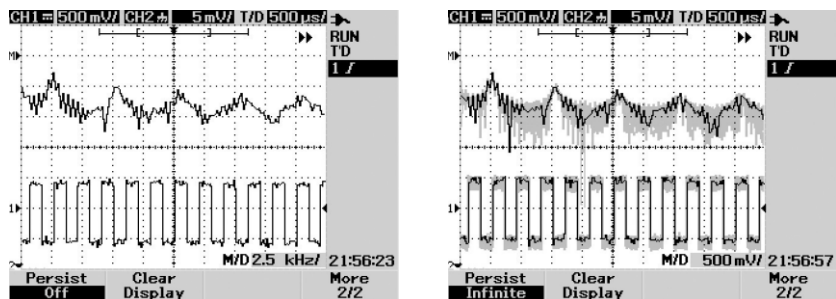
C. Graticule

Adjusts the grid shape of the waveform display section
 Select type of lines, Full(10×8 lines including grid), cross Hair(cross + sharp lines) Grid(10×8 lines) or Frames(Outer Frame lines)



D. Persistence

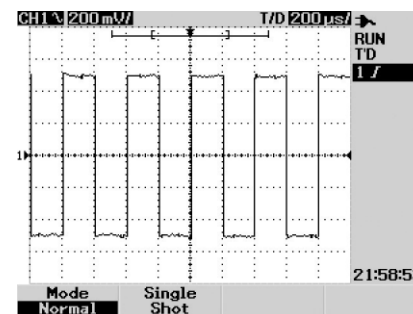
In persistence mode, Channel and Math function are displayed Dimmer for previous acquisition.



8-2. ACQUIRE Press enter Acquire mode. Acquire mode.

Upper Level Menu	Sub menu	Explanation
Acquire	Mode	Normal, Average, Peak
	Single shot	

Use this function to configure the signal acquisition mode. By changing the waveform acquisition, the desired characteristics among the signal characteristics can be easily achieved.



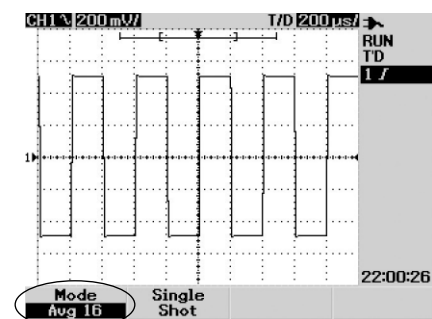
A. Normal

Use this function to observe the signal from the ADC unchanged.

B. Average

Averages and displays the waveforms collected from the oscilloscope high speed data collection terminal. The number of waveforms to average can be adjusted between 2 and 256 using the ENCODER knob. A higher number of waveforms to average displays a clearer waveform and decreases the sensitivity to signal changes.

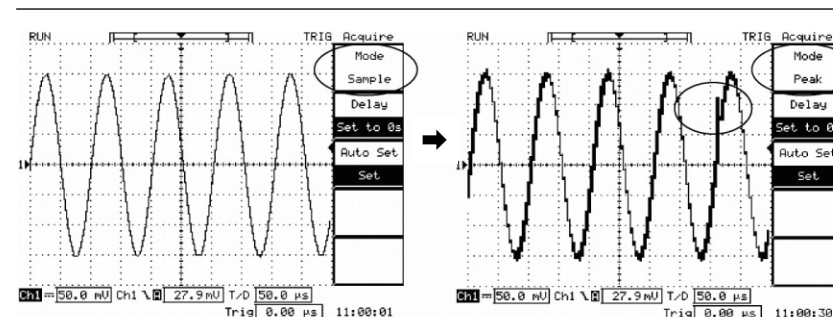
If the signal cannot be observed properly due to noise or other unexpected signals, by selecting an appropriate number of waveforms in the average mode, the overall flow of the signal can be verified with the noise removed through averaging.



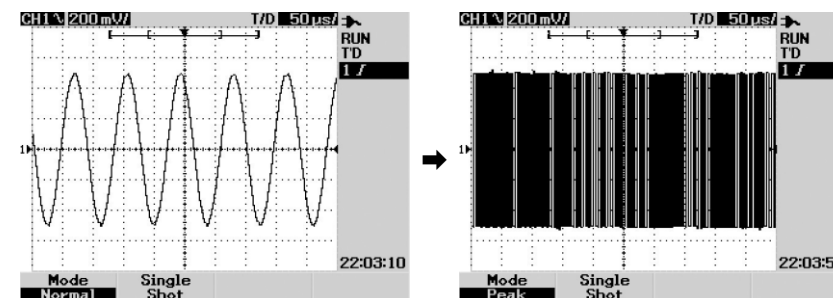
Rotate the ENCODER knob to select the number of waveforms to average. Increasing the number of waveforms increases the clarity of the waveform and decreases its sensitivity level.

C. Peak Detect

Use this function to display the minimum and maximum of the sampling signal in 10ns units for each horizontal scale level without missing glitches. It also allows verification of aliasing in the currently observed waveform.



As shown in the illustration, peak detection mode can detect glitch not observed in SAMPLE mode.



The actual applied signal to the oscilloscope is a 10KHz sine wave. However, through aliasing at 5ms/div, the wave display as about 130Hz sine wave.

Peak detect mode display higher frequency waveforms observed in single mode. Accordingly, reduce T/D to observe the waveform.

D. Single shot

The SINGLE Will be shown on the display at the upper right side of screen when Single SHOT key is pressed. Set single Trigger status, Single Trigger status is Normal Trigger status and stop if there is any more waveform gain.

8-3. MATH USER

Enter USER and press F3 key.

OFF : erase all data or math

DWM : indicates Dual Waveform computation

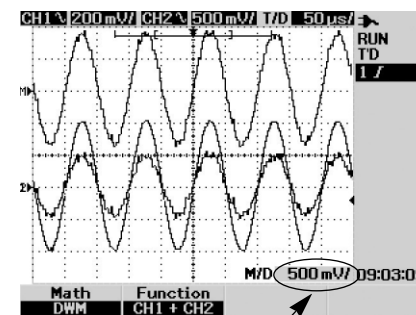
FFT : indicates Fast Fourier Transform of CH A, CH B

CH A / CH B waveforms viewed on the screen can be calculated to produce a new waveform through the math operations and displayed on the screen in real time.

Note. When CH A/CH B waveform and MATH waveform overlap making observation difficult, the MATH waveform vertical position(OFFSET) can be adjusted by rotating the ENCODER knob when the MATH menu open.

Dual waveform computation

Displays a waveform with CH A and CH B. CH A+CH B, CH A-CH B, CH B-CH A added or subtracted.



MATH waveform vertical scale factor

Note. The source for dual waveform computation are CH A and CH B respectively. When the vertical scale differ, the MATH waveform vertical scale will automatically be set to the higher sensitivity vertical scale.

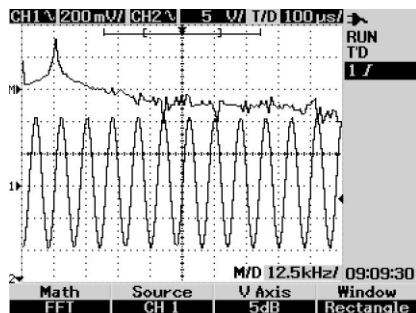
FFT (Fast Fourier Transform)(model 840, 860 only)

Calculates and updates the FFT to determine the properties of the signal frequency on the screen in real time.

- Source : CH A/CH B
FFT waveform Horizontal Unit
- Vertical axis : 1dB/2dB/5dB/10dB when perform FFT, set div of voltage(Y-axis) FFT waveform is displayed depend on dB setting.
- Window : Rectangular/Hamming/Hanning/Blackman-harris. Select type of Window to perform FFT. Each Window has different Frequency, AMP characteristics.

Math

Dual waveform math(+, -) and FFT support. Math function supports Dual wave form math such as(+), (-) and 4 windows in FFT such as Rectangular, Hamming, Hanning and Blackman-Harris.



8-4. UTILITY

Top level menu	Sub menu	Mode
UTILITY	Auto Power	Off
	Language	English, Deutsch, Korean
	Factory Setup	
	Format	YY / MM / DD, HH / DD / YY
	Time Set	Year, Howth, Day Hour, Hinute, Second
	Self Cal	
	Probe Cal	The Probe Compensation

Please see “Initial Setting Operation before use”
3-4, 3-5, 3-6, 3-7

9. HOLD/SAVE

HOLD key operation

If press HOLD key, In case Scope mode, waveform in holding status is displayed. In case METER mode, no more dat updated and display as Holding Text.

SAVE key operation

Press longer than 2 second of the Key to enter SAVE mode.

Upper Level Menu	Sub menu	Explanation
USB flash memory not connected	Save/Load setup	Saves/recalls configuration settings
	Save/Load waveform	Saves/recalls waveform.
	Erase setup	Deletes saved configuration settings.
	Erase	Deletes saved waveform
USB flash memory connected	Save	Saves waveform/configuration settings
	Recall	Downloads waveform/configuration settings
	Erase	Deletes saved file
	Clear waveform	Erase the recalled waveform and setting in the screen

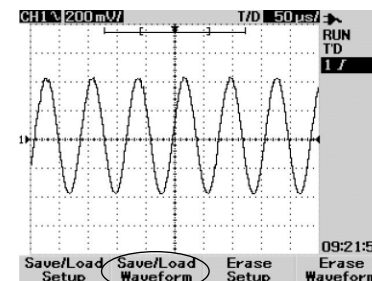
This function downloads or saves waveform and configuration settings. The information stored in the unit's internal memory can be saved to the external USB flash memory device.

When USB flash memory is connected, select the menu item for automatically saving and loading information onto the flash memory. If not, select the menu item for saving and loading information into the unit's internal memory. When saving internally, up to 5 waveforms and 7 configuration settings may be saved. When using USB flash memory, waveform and configuration settings are saved simultaneously, and the saved file size is approximately 1 kilobyte. (USB flash memory port is optional.)

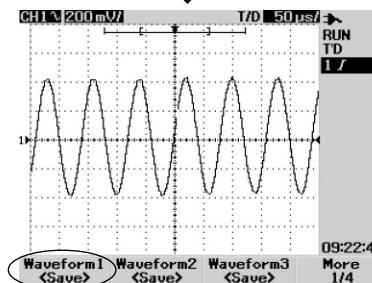
A. When USB memory is not connected

Use this function to save or load the desired waveform or settings to the unit's internal memory. Up to 5 waveforms and 7 settings can be saved.

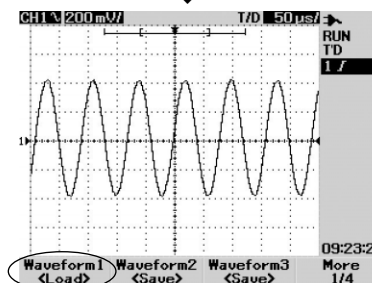
SAVE



Press the SAVE/RECALL button to stop the waveform and display the menu screen. Execute Save/Load Waveform to save the waveform.

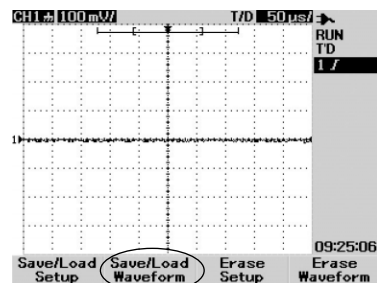


Execute the item displayed as <Save>. In the example, the waveform is being saved to Waveform1. If <Load> is displayed, it indicates that the waveform has already been saved.

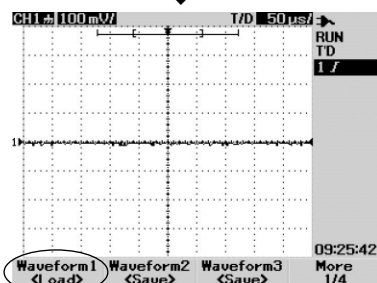


If saved to Waveform1, the waveform will be saved to the space in Waveform1 and the display will change to <Load> as shown in the diagram.

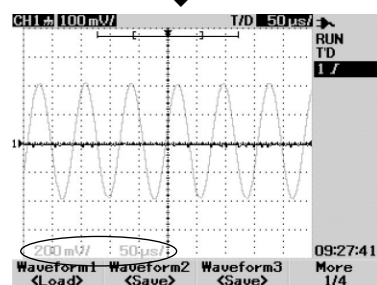
RECALL



Press the SAVE/RECALL button to stop the waveform and display the menu screen. Execute Save/Load Waveform to load the waveform.

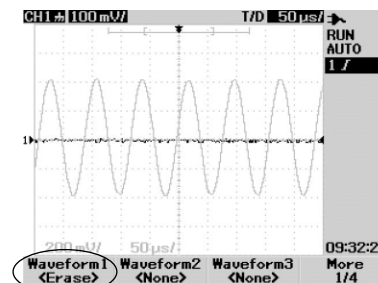


Execute the waveform to recall. In the example, Waveform1 is being recalled.

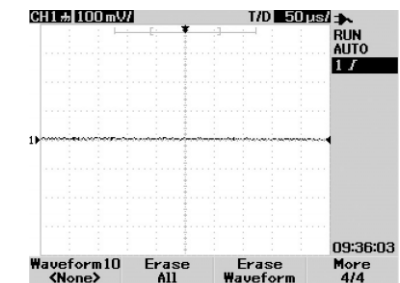
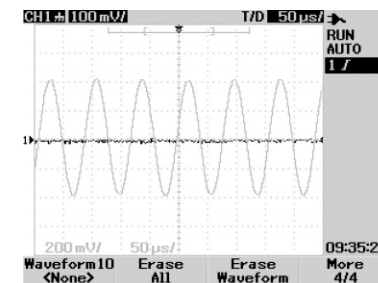
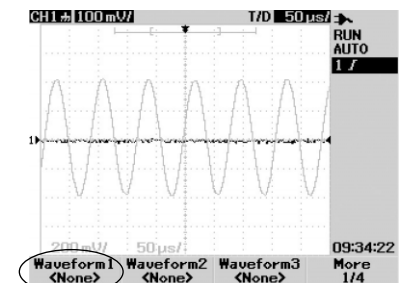


The recalled waveform will display on the screen and the waveform's VOLT/DIV, TIME/DIV will display at the bottom of the screen. Pressing the EXIT button will remove the loaded waveform from the screen.

DELETE



Press the SAVE/RECALL button and execute Erase Waveform. and the display is appeared as shown on the left. If <Erase> is displayed, the saved waveform can be deleted. If <None> is displayed, no saved waveform exists.




Select the desired waveform to delete. In the example, Waveform1 has been deleted through performing <Erase> and the indicator has changed to <None>

Note. For configuration settings, the save/recall/delete functions are identical to that of the corresponding waveform functions.

Recall factory setup

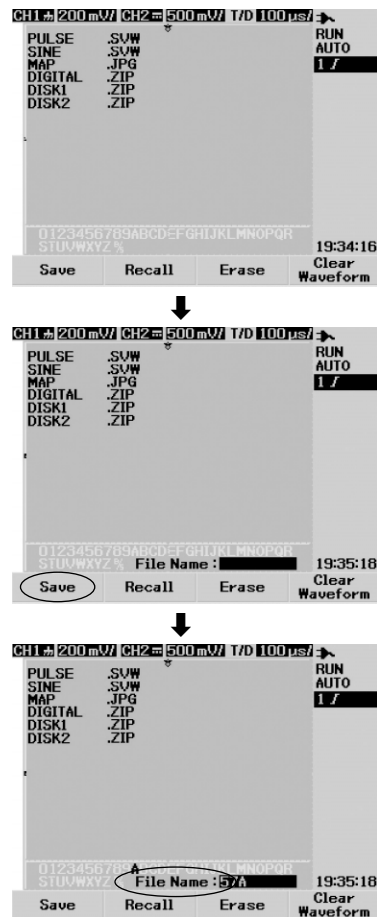
Use this function to return all settings of the unit to the original factory configuration, press the F5 button from the SAVE/RECALL menu to execute the Recall Factory Setup function.

 **Caution.** Resetting the unit to its original factory setup will delete all saved waveform and configuration setting information.

B. When Flash memory Port is connected (optional feature)

Use this function to directly store or load data from USB flash memory.

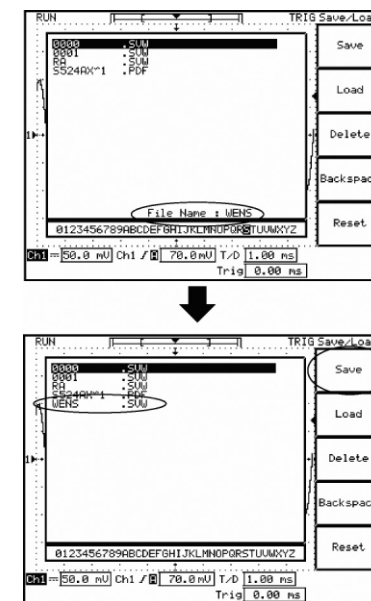
SAVE



Attach the USB Flash memory device to the oscilloscope. Press the SAVE/RECALL button to produce the list of the flash memory's internal file as shown.

Perform the SAVE by pressing F1 button. The filename input area will appear and cursor will move to the list of characters located at the bottom of screen.

Rotate the VARIABLE Knob to position the cursor on the desired letter and press the SELECT button to input the letter in the Filename area.



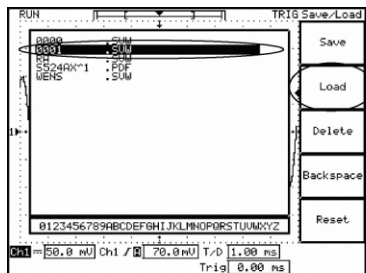
Enter Filename with same method by pressing VARIABLE Knob and SELECT button.

When Filename input is complete. Press F1 key to save the flash memory device. The filename with a file extension of SVW will appear in the file list.

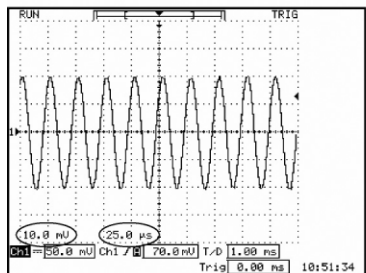
- Backspace : Deletes the previous character when entering the filename.
- Clear : Clears all inputted characters when entering the filename.

Note. Filename in Flash memory may configured with English Capital letter, Numbers which will be saved approx 1KByte SVW file extension.

RECALL



Rotate the VARIABLE Knob to position the cursor on the file to load. Press the F2 button to load the file.



The saved file will appear on the display. The volt/div and time/div of the recalled file will display on the bottom of the screen. To remove recalled file, press the EXT button.

10. AUTO AUTO

AUTO AUTO function in SCOPE mode

Automatically adjust Volts/div, Time/div, Trigger Configure at best condition. Set Time/div by counting Trigger Pulse and find Volts/div and select which channel is base of Time/div.

AUTO AUTO function in METER mode

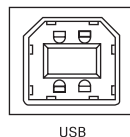
Autoranging function. If press, Autoranging mode changed to Manual ranging mode. Default value of AUTO in SCOPE mode is as under.

	Auto set	Remark
CH A Coupling	AC	-
CH I Probe	x1	-
CH A Invert	Off	-
CH A Position	0 div	-
CH B Coupling	AC	-
CH B Probe	x1	-
CH B Invert	Off	-
CH B Position	0 div	-
Time position	Center	-
Trigger Type	Edge	-
Trigger Edge	CH A	-
Trigger Edge Coupling	DC	-
Trigger Edge Slope	Rising	-
Trigger Edge Level	Set 50%	-
Cursor Type	Off	-
Math Type	Off	-
Display Type	Linear	-
Acquisition Mode	Sample	-

Initial Set in AUTO

11. External Layout Summary

11 - 1. USB COMMUNICATIONS



This instrument is equipped with a USB B type socket located on the rear to communicate with the computer via USB.

A. Items to verify for the setting up of USB communication

- A driver for this instrument must be installed before performing USB communications.
- When using a cable, a USB A-B type cable must be used.

B. Installing the USB driver

- With the unit off, connect the USB cable to the PC and the unit.
- After connecting, power on the unit and check the connection status through the PC and the driver installation wizard appearance.
- Choose “Find Driver” option and locate the driver folder in the CD or disk included with the unit. Click on the folder to automatically install the driver. When installation is complete, “Oscilloscope driver has been successfully installed” message will appear.

C. Installing USB

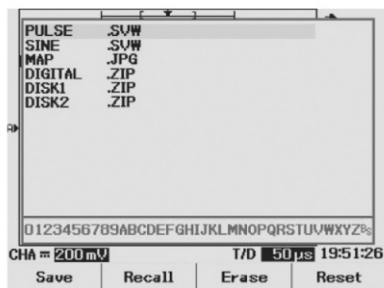
- Connect the USB cable to the PC and the unit.
- Power on the unit.
- If a driver has been installed, no message will appear on the PC screen. If a driver has not been installed, the driver installation wizard will appear. (Driver installation is explained in ‘11-3-B’.)
- When the driver is installed, install the USB communication software.
- When software installation is complete, run the PC software application and verify the port settings for USB communication. (The port setting must be set to ‘USB’.)
- Start communications by clicking the “Power” button in the PC application.



CAUTION. Do not use the USB port for any use with any product other than for communication with the PC.

11 - 2. USB Flash Memory port

optional USB Flash Memory port th store data at present. This makes a large data transfer between instrument and PC conveniently without communication cable.



See “table of Contents” 9. HOLD/SAVE for details.

11 - 3. AC Power

- Input : 100V ~ 240VAC free voltage
 - Output : DC12V/2A 50/60Hz
- AC power Adapter and Internal charger is supplied as standard accessory. No other AC power adapter is used to this instrument.

DC Power

Ni-MH Battery pack can be charged by AC power adapter and internal charger or car cigarette cable. Battery is charged while using or not in use of Instrument.

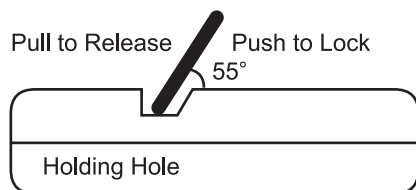
Car Cigarette Cable and Socket

A fused car cigarette cable and socket enable the instrument used or battery charged in the car by connecting car cigarette DC Jack conveniently.

11 - 4. Tilt Stand

The Tilt Stand can be placed either in the locked stand position for flat surface use or in the hinged position for hanging use.

- ① For use on a flat surface, lift the Stand to approximately a 55 degree angle and push in until the Stand locks in the holding hole.
- ② To hang the meter, squeeze the legs of the Stand and remove it from the meter. Turn the stand 180 degree and replace in the holder. The Stand will now swing free over the top of the meter.



11 - 5. Battery Replacement

- ① Disconnect the test leads from any circuit being measured.
- ② Lift Tilt Stand and remove the two screws at each ends of two Battery Cover using Philips Screw driver. (Screws are to be kept securely. Do not loose any of them)
- ③ Lift the two battery covers up to remove them.
- ④ Remove the Tilt Stand.
- ⑤ Replace the batteries, making sure the new batteries are located with the correct polarity and the Metal Contacts and Springs in the Battery Compartments are in proper contacts with the batteries.
- ⑥ Snap the two battery covers back into the original place and put the Tilt Stand in the place.
- ⑦ Put the two screws in the place using Screw Driver.

WARNING. To avoid electric shock, do not operate your meter until the battery covers are in place and fastened securely.

Note. If your meter does not work properly, check the fuses and battery to make sure that they are still good and that they are properly inserted.

CAUTION. Do not use non-rechargeable batteries(alkaline, carbon-zinc, etc.) with meter's AC Power adapter. The AC Power adaptor maybe used whether or not the rechargeable Ni-MH batteries ar installed.

Note. When the Battery becomes exhausted or drops below operating voltage will dimmer or brighter warning.
 The alkaline battery should be replaced if alkaline batteries are installed. In case rechargeable batteries are installed, The battery will be automatically recharged while connected with AC Adapter.
 Rechargeable Battery is charged while using AC Adapter. Recharging time will be shorten if the battery is charged at Rotary Switch "OFF" position.
 When installed Ni-MH Battery is totally drain out, very rare case, Meter may not properly operate with AC Adapter. In this case, recharge the drained out Ni-MH battery (being installed inside meter) with AC Adapter for about 5 minutes - Meter Rotary Switch at "OFF" position.

12. Product Standards and Specifications

OSCILLOSCOPE

MODEL	820	840	860
	20MHZ	40MHZ	60MHZ
BANDWIDTH/ SAMPLE RATE	Real Sampling 100MS/s Per Channel 200MS/s Single Channel	Real Sampling 100MS/s per Channel, 200 MS/s Single Channl with 2.5 GS/s Repetive Samling	

INPUT

Input Channels	2 Channels
Input Coupling	DC, AC, GND
Input Impedance	1M Ω \pm 1%, 20pF \pm 3pF
Probe Attenuation	x1 or x10
Max Input	300V(direct input) 600V(through 10:1 Probe)

VERTICAL

Vertical Resolution	8-Bit
VOLTS/DIV Range	5 mV/div~100 V/div(1,2,5 Step)
Offset(Position)	\pm 5 div from center
Vertical Accuracy	\pm 3%

HORIZONTAL

MODEL	820	840	860
SEC/DIV Range	50 ns/div~50 s/div	10ns/div~50 s/div	
Time Base Accuracy	\pm 0.01%		
Position Range	pre-Trigger : 20div max. Post-Trigger : 1000div		
Delay Resolution	1/250 of screen diameter		
Delay Accuracy	0.04 divisions		
Delta Time Measurement Accuracy	\pm 3%		
Modes	Main, XY		
XY	Yes		
Horizontal Pan and Zoom	Yes		

TRIGGER	
Sources	ChannlA and B
Modes	Normal, Single, Roll, Auto Trigger
Advanced Selections	Edge, Pulsewidth, Pattern Video
Edge	Trigger on arising or Falling edge of any source
Pulsewidth	Trigger on apositive or negative pulsewidth of any source larger than, less than, equal to or not equal th duration width 200 nS ~ 10S
TV	NTSC, PAL, SECAM, Normal Video, Even field, Odd field, Line #select
TV Sensitivity	0.7 div trigger Level
Auto Scale	Yes
Range	± 10 div from center of screen
Level Accuracy	± 0.4 divisions
Level Resolutions	500 pixels
Sensitivity	DC 5MHz - 0.5div 1.5 divisions
Noise Rejections	Yes
Coupling Modes	DC: DC Coupled trigger AC:AC Coupled trigger cutoff frequency < 1HZ HF-Reject:>50KHz LF-Reject:>30KHz Noise Reject:3times the DC coupled limits

ACQUISITION			
MODEL	820	840	860
Real-Time	200MS/s single channel,		
Sample Rate	100MS/s per channel		
Waveform Interpolation	Dot, Linear, Sine, Pulse		
Record Length	125 Kbytes/channel		
Acquisition Mode	Sample, Peak Detect, Envelope, Average		
Peak Detection	10ns		
Average	2-256		
Vertical Resolution	8bit		
Same Rate Accuracy	100ppm		
Minimum Sample Rate	100MS/s(250 ns to 50S/div)		

MEASUREMENT

Automatic Measurement	Peak-to-peak, Maximum, Amplitude, Top, Base, Positive/Negative Overshoot, Preshoot, RMS Mean, One Cycle Mean, Frequency Period, + Width, -Width, + - Duty Cycle, Rise time, Fall Time, Delay, Phase shift.
Waveform Math	CH A+CH B, CH A-CH B, CH B -CH A
Cursors	Delta V Voltage
Delta V	Voltage diff Between cursors
Delta T	Time difference between cursors
FFT	Model 840/860/800X only
Windows	Rectangular, Hamming, Hanning, Blackman- Harris
Amplitude Display	Variable dB(1/2/5/10 dB)
Maximum Frequency	1.25 GHz

FUNCTIONS	
Save/Recall	10Waveforms, 10 Settings
Zoom	Direct Time/Volt conversion
XY Mode	X Axis Channel Input - Y Axis Channel Input

MULTIMETER

COUNTS	Autoranging 6000 Count, 35/6 digit with analog Bargraph display
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DC VOLTAGE

Range	600mV-1000V
Accuracy	$\pm(0.3\%+10\text{digit})$
Input Impedance	10Mohm
Overload Protection	1,000v DC or AC Peak within 10 Seconds

AC VOLTAGE(True RMS)

Range	6V-600Vat 30KHz, True RMS
Accuracy	$\pm(0.75\%+10\text{digit})$ at 50-1KHz $\pm(2.0\%+10\text{digit})$ at 1-30KHz
Overload Protection	1,000V DC or AC Peak within 10 Seconds

RESISTANCE

Range	600 ohm - 60M ohm
Accuracy	600 ohm-6M ohm $\pm(0.5\%+10\text{digit})$ 60 Mohm $\pm(1.0\%+10\text{digit})$
Overload Protection	250V DC or AC Peak within 10 Seconds.

CAPACITANCE

Range	60nF - 300uF
Accuracy	$\pm(2.0\%+10\text{digits})$

OTHER MEASUREMENTS

Diode Check	Accuracy:2%
Continuity	less than 60 ohm, Buzzer Sound
MIN/MAX/AVG	Records Minimum, Average and Maximum readings with Time Stamping
Temperature, % Relative Humidity, High-Current, Pressure	Through external adapter

DISPLAY

Display Device	3.9", 320 × 240 MONO LCD with Backlight
Display Contrast	Adjustable
Persistence Mode	Channel and Math function are displayed dimmer for previous Acquisition

OPERATION

Rotary Encoder, 12Keys

USABILITY & SUPPORTABILITY	
USB Flash memory host	Option
USB for PC Interface	USB2.0 Client
Self Test	Power on Test, Diagnostic Test
Self Calibration	Failure message, Calibration Abort, Calibration Factor, Non-Volatile Factors
Help system User Interface	

DIMENSIONS & WEIGHT
107mm(W) × 220mm(H) × 55mm(D) / 4.2" × 8.3" × 2.2", 1.5kg / 3.3lbs Net meter

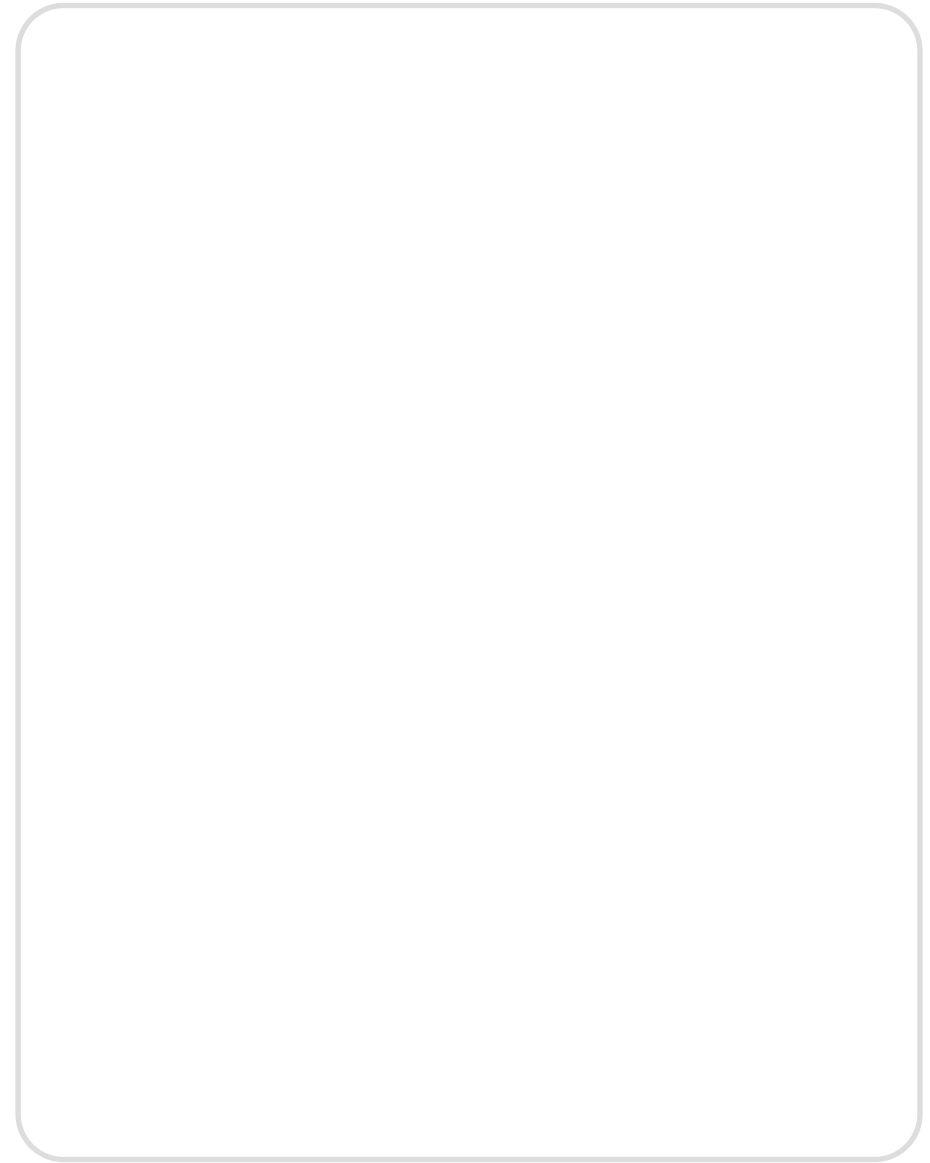
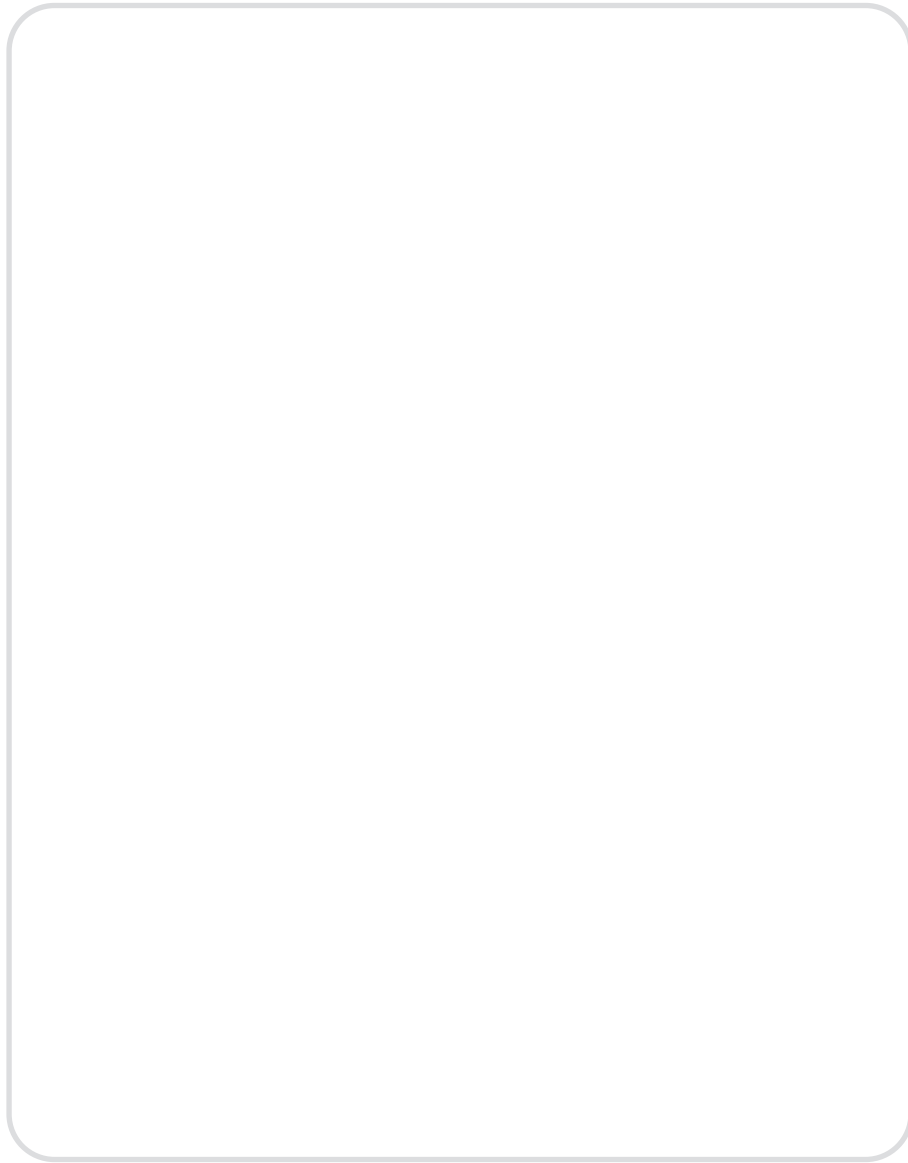
POWER
Power Adapter(DC 12V/2A) With Internal charger
NIMH Rechargeable Battery Pack 2 × 3.6V / 2800mAh

STANDARD ACCESSORIES	
DESCRIPTION	QUANTITY
Power adapter and charger	1
User's Manual in CD or Printed Manual	1
Passive Probe : 20Mhz/40Mhz CAT III 300V(1:1) 2PCS or 60Mhz CAT III 600V(10:1) 2PCS	2
Test Lead(Red, Black) 1000V DC CAT III	1
Holster case	1
USB Interface Package in CD	1

OPTIONAL ACCESSORIES		
PRODUCT	NUMBER	DESCRIPTION
Battery Pack	8B	NIMH Rechargeable Battery Pack
Temp Adapter	9050	Temp Adapter(°C °F)
Current Adapter	8CA	AC 1000A Current Adapter
Current Adapter	8ADC	AC/DC 1,000A Current Adapter
Carrying Bag	8CB	Carrying Bag with schoulder
USB Flash Memory (Host)	8F	USB Flash Memory Internal System & Port(USB Host)
Car Cigarette Cable	8CC	Car Cigarette Cable

13. REVISIONS & REMARK

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13. REVISIONS & REMARK

