



SBS – 600

Graphical Digital Multi-meter User Manual

Read the Users Manual prior to using the Meter

Pay special attention to the “Safety Precautions” section of the manual.

 **Attention**

Attention mark may be displayed while meter is in use. Meter can be damaged or important Data may be lost if the Meter is not properly used.

 **Warning**

Warning mark may be displayed while meter is in use, using the meter on voltages above safety ratings may cause serious personal injury or fatal death.

[Safety Symbol]

Table lists and describes the safety symbols shown on the Meter Display or in the User Manual.

 : DC (Direct Current or Voltage)

 : AC (Alternating Current or Voltage)

 : DC and AC

 : Earth Ground

 : Double Insulation

 : Power Supply OFF

 : Power Supply ON

 : Warning on Electric Shock

 : Warning on Danger

 : Category II 1000V Overload Protection

 : Category III 600V Overload Protection

[Notes for Safe Operation]

WARNING: USE EXTREME CAUTION IN THE OPERATION OF THE METER

Improper use of the Meter can result in injury or death.

Follow all safeguards in this manual, in addition to the normal safety precaution used in working with electrical circuits.

DO NOT SERVICE the Meter if you are not qualified to do so.

[WARNING ]

- Pay attention when testing conditions exceeded 60V DC, 30V AC rms or 42.4V AC Peak that can cause electrical shock. Do not connect the ground wire to a voltage higher than 0V DC, 30V AC rms or 42.4V AC Peak.
- Use only the accessories supplied with the Meter. Rechargeable Battery Pack, AC Power Adapter and Internal Charger, Test Leads, Probes, Logic/Signal Cable set. Warranty will not cover Meter Measurement failure or damage from improper accessories other than those supplied by the manufacturer with the Meter.

- Connect and disconnect properly. Test leads, Probes or Test Cables must always be connected to the meter before connecting into circuits to be measured. Always remove leads from test circuit prior to disconnecting from the meter.
- Meters with rechargeable NiMH battery packs must only use manufacturer supplied replacement batteries. Remove the AC Power Adapter, Test Leads, Probes and Cables from the Meter when replace the Battery.
- When the Battery Warning Symbol is blinking on the display, the measured values may be in error. Replace with new batteries or recharge the unit.
- Observe all input terminal ratings. Observe all ratings and markings on the Meter. Refer to the users manual for detailed information.

[ Max Input Voltage]

- Meter Input: 600V CAT III.

- Do not apply voltage when measuring in the Ohm(resistance) or Capacitance Meter Mode.
- Do not use the meter in or near explosive, flammable, wet or damp environments.
- Do not use Meter if the Case Cover is opened for any reason.
- Fuses must be replaced with only the proper size and rating as the original.
- Do not expose internal circuits.

[ATTENTION]

- Before testing for Resistance, Capacitance, Continuity or Diode, disconnect any power supply at the circuit being tested and discharge High Voltage Rated Capacitors.
- Do not attempt Voltage measurements while measuring Currents.

[ENVIRONMENT]

The Meter is designed Indoor use in the following environmental conditions:

- Operating Temperature: 0°C ~ 50°C
- Guaranteed Accuracy Temperature: 23 0°C +/- 5°C
- Operating Humidity: 80% R.H. or less
- Storage Temperature: 0°C ~ 70°C
- Altitude : 2000m
- Pollution Degree: 2

WEEE (Waste Electrical and Electronic Equipment) (2002/96/EC)

Meter complies to WEEE (2002/96/EC) requirements.

Do not dispose Electrical / Electronic devices with other trash.



Table of Contents

	Page
1. Introduction	
♦ Major Functions	6
♦ Front View	6
♦ Keys and Function Description	6
♦ LCD Display.	8
♦ Measurement Input Terminals.....	11
♦ Rear and Side View.....	12
♦ Voltage Warning, Input Warning, Power, Battery , Auto Power Off, Battery Save, Back Light Display, Auto / Manual Ranging.....	12
♦ Sub Menu	14
♦ Help, Data Hold	15
♦ Auto Hold, Save/ Recall	16
2. How to measure Main Function	
♦ Digital Multi Meter	
♦ AC Volts().....	16
♦ DC Volts ().....	17
♦ mA ().....	19
♦ A ()	21
♦ Frequency Counter	22
♦ Resistance (Ω)	24
♦ Continuity ().....	25
♦ Diode ()	25
♦ Capacitance ().....	26
♦ AUX	27
♦ Power Efficiency	28
♦ Ripple Noise.....	29
♦ Signal Out ().....	29
3. How to measure Secondary Function	31
♦ Data Logger	31
♦ Data Saving	37
♦ Data Hold (Trigger Hold).....	39
♦ Auto Hold	39
♦ dBm (decibel measurement)	39
♦ Rel (Relative measurement)	40
♦ Peak Hold	41
♦ Limit	41
♦ Min/Max.....	42
♦ SOFTWARE COMMUNICATION.....	43

4. Initial Setting before use

◆ User Mode.....	46
◆ Initial set up and useful setting options.....	47
◆ Battery Saver Feature	49

5. Maintenance

◆ General maintenance	50
◆ Battery Replacement	50
◆ Fuse replacement	50

6. Function Test and Calibration

◆ Calibration concept	51
◆ Recommended Test Equipment	51
◆ Basic Performance Test	52
◆ Points to consider.....	52
◆ Calibration Points to review	52
◆ Calibration Procedure	52

7. Specifications

◆ Electrical Specifications.....	53
◆ General Specifications	57

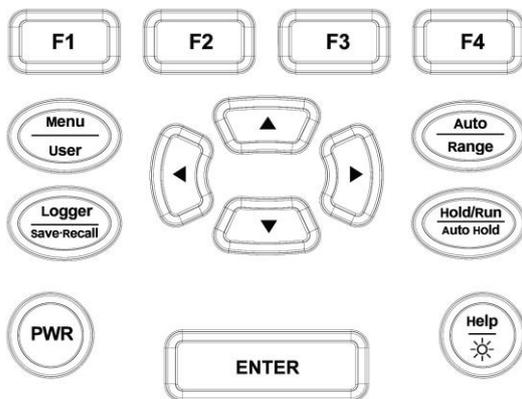
1. Introduction

□ Major Functions

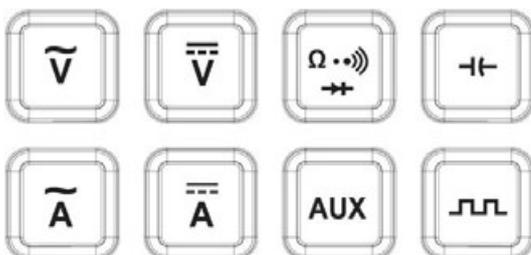
- ◆ 240*160 pixel, 3.5" Graphic display.
- ◆ DC, AC, AC+DC Volt and Current measurements.
- ◆ AC Volts and Current True RMS measurements.
- ◆ DC Volts
- ◆ AC Volts
- ◆ AC+DC Volts
- ◆ Resistance, Continuity, Capacitance, Diode measurements.
- ◆ Frequency Counter
- ◆ Selectable Base Impedance to measure dBm.
- ◆ AUX function : Temperature, Pressure, High Currents, Humidity
- ◆ Frequency, Duty Cycle, Pulse Width
- ◆ MIN (minimum). MAX (maximum), AVE (Average), Present Measuring Value
- ◆ Data Logger
- ◆ Battery Capacity Level Display
- ◆ GUI Application Software (USB)
- ◆ EN/IEC 61010-1:2001 Category III 600V Pollution Degree : 2

□ Front View

[Secondary Function Key]



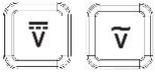
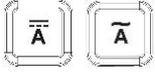
[Main Function Key]



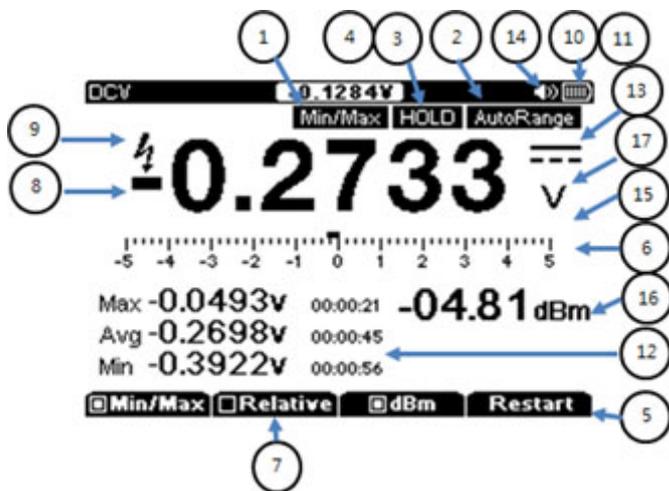
[Key Function Description]

Function key	Function Description
	Selects Sub Menu functions and modes, for each Main Menu Mode.
	Upper Line: (Short Key) One Touch press Enter Menu (Main Menu) functions and modes. Lower Line: (Long key) Hold longer than 2 seconds to enter USER. Press Exit key to return to Main Menu.
	Upper Line : Meter setup Auto Ranging mode Lower Line : (Long key) Hold longer than 2 seconds to enter Manual measurement mode (Range) - In Manual Range, range up/down can be done with Short key (One touch) press. - To return to Auto measurement mode, Hold key longer than 2 seconds
	Upper Line: (Short Key) One Touch press enter Data Logger mode. Lower Line: (Long key) Hold longer than 2 seconds to enter Save (Data) and Recall (Data) mode. Save or Recall mode selection is available in sub-menu. - Press Short Key to change Logger Mode. - Press F4 Exit to leave Logger mode.

	Upper Line (Manual Hold): (Short Key) One touch press to enter Hold/Run mode. Holds the present measurement value on Display and can save the value. Changing from Hold to Run can be done (Short Key) One Touch press. Lower Line (Automatic Hold): (Long key) Hold longer than 2 seconds to enter Auto Hold mode.
	I (Help): (Short Key) One Touch press enter Help mode. Brief Information on present function is displayed. Back Light On/Off: Hold longer than 2 seconds to enter Back Light display mode. Help: shot key(50ms), Backlight: long key(2s)
	Turn the meter power ON/OFF HOLD Longer than 2 seconds to power ON / OFF
	Cursor buttons select an item in Menu. Adjust Display Ratio. Scroll the information and Input the Data

	<p>All functions and menus on the rubber keys will be set automatically after 2 seconds after selection of functions or menu.</p> <p>Press ENTER key to set immediately after select of Functions or Menu to avoid the 2 second wait time.</p>
	<p>Volts measurement keys : AC+DC, DC, AC</p>
	<p>Currents measurement keys : AC+DC, DC, AC</p>
	<p>Resistance, Continuity, Diode key</p>
	<p>Capacitance measurement key</p>
	<p>Auxiliary measurements (Temperature, Relative Humidity, Hi-Currents. Pressure can be measured through external adapter)</p>
	<p>Square wave signal out put</p>

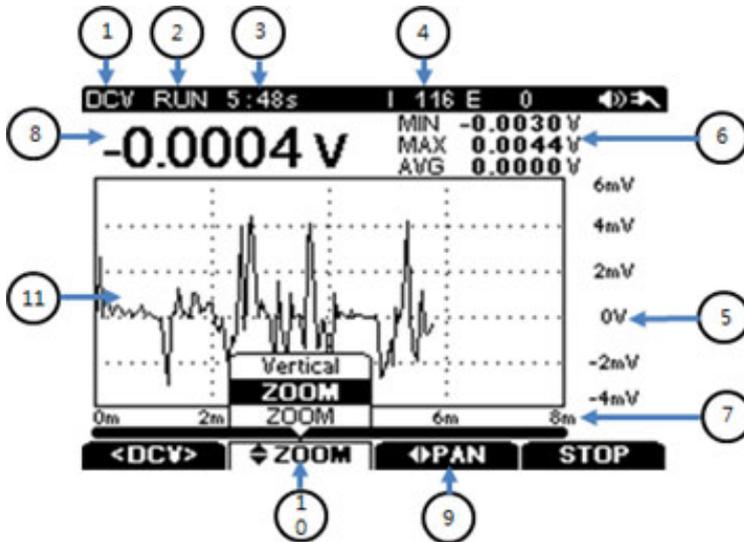
□ LCD Display



No	symbol	Description
1		Minimum. Maximum, Average measurement
2		Can select Measuring Range in Automatic mode or Manual mode
3		Freeze the present reading in display.

4		Freeze the present reading in display.
5	Sub Menu 	The Sub Menu. After main menu selected, sub menu tree shows up to select options.
6	Bar-Graph 	Input Signal is displayed in Bar-Graph. see details on" Bar-Graph page)
7		Compare with the reference value and display the Difference.
8		Negative Reading
9		Over voltage on input warning (Voltage higher than defined safety protection voltage)
10		Remaining Battery Capacity level.
11		AC Power Adapter is connected.
12		Sampling, Run time
13		Measurement mode.(DCV, ACV, Ohm, Capacitance, Diode)
14		Audible signal is active
15	 (Bar Scale)	Range of Meter
16	Secondary measurement	secondary measurement information of Input Signal (Hz. dBm)
17		Unit symbol is displayed at right side of the measurement

[Data Logger Display Symbol]



No	Symbol	Description
1	DCV	Measuring Mode. (DCV, ACV, Ohm, Capacitance, Diode)
2	RUN	RUN or STOP indication of Data Logging function
3	5:48s	Run Time
4	116	Accumulated Sample (Qty in Data Logger).
5	6mV	Maximum Display Range
6	MIN -0.0030 V MAX 0.0044 V AVG 0.0000 V	Minimum, Maximum , Average of the Samples
7	8m	Total Time Scale of Data Logging.
8	-0.0004 v	Present Measurement Value
9	<PAN>	Change the Time Scale (left - right horizontal axis) to review closely on the specific Time Zone.
10	ZOOM	Zoom (at Regular Ration) the specific waveform quickly (up/down Vertical axis).
11	Data Logger	Data Logger Display

[BAR-GRAPH]

- ♦ BAR-GRAPH displays Measurement Data in an Analogue Meter Display type. Refresh rate is 15 times / second. Response Time of Analogue display is faster than Digital display which Bar-Graph display is very efficient to observe display like as PEAK that input change very fast.
- ♦ Pattern Generator, Current Generator, logic Analyzer, and MIN/MAX modes do not activate the BAR-GRAPH display.
- ♦ Direct Voltage, Currents and Relative displays the BAR-GRAPH "0" in the center position. For Direct Voltages and Currents, the BAR-GRAPH total scale displays the Maximum of the selected measurement range.
- ♦ Displayed Segment indicates Measurement Size which is displayed within the Maximum Scale of selected range.
- ♦ When measured value exceeds the maximum scale of the selected range, ► is displayed at RIGHT of BAR-GRAPH. When Direct Voltage or Current, ◀ is displayed at LEFT of BAR-GRAPH at negative MAX and ► is displayed at RIGHT of BAR-GRAPH at positive MAX

[Measurement Status display]

- ♦ Status icon is displayed at top of Display.
 - Battery status, Present Measurement Value, Buzzer (Continuity), Data Hold, Auto Hold, AC Power Adapter Connected.

[Display]

- ♦ Display consist of Main Measurement Display, BAR-GRAPH display, Sub function display (Sub measurement or Data)

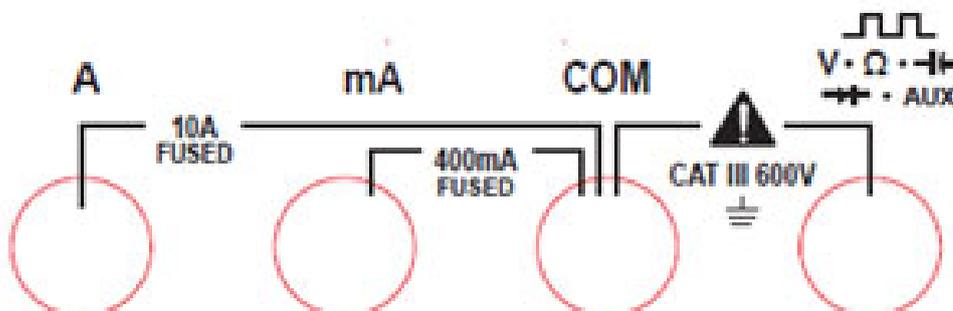
[Sub Menu Key]

- ♦ 4 keys (F1 ~ F4) underneath of Display. Select sub- functions dependent upon measurement mode function or menu

□ Measurement Input Terminals

To prevent Damage, Do not apply signals that exceed the ratings for the input channels.

Input Terminal Connection



Measurement	Input Terminal
10A	0 A ~ 10.00 A currents. (10A overload, 30sec On, 10 sec OFF)
mA	0 A ~ 500 mA Currents measurement.
COM	Negative Terminal to all measurements.
V, Ω , Hz, , AUX . Sig Out	Volts, Continuity, Resistance, Diode, Capacitance, Frequency measurement and AUX (auxiliary function with external adapter : Temperature, High Current, Relative Humidity, Pressure measurement) , Sig Out.

□ Rear View and Side View



□ Voltage Warning

- ◆ User should pay attention to the Voltage Rating and Over Voltage warnings.
- ◆ Immediately remove the Test Leads/Test Probes from the circuit if the VOLTAGE WARNING comes on the screen. Scope function Input (SBS- 700), has a max 300V. Other Multi-meter function Inputs (SBS-600 and SBS-700), max 600V. Milliohm Meter- meter input (SBS-6500). Max 50VDC.
- ◆ Meter will display the VOLTAGE WARNING regardless of AUTO or MANUAL measurement mode. When over the Maximum Measurement limit, the WARNING alert sound starts. In this case, immediately remove Test Leads/Test Probes from the circuit under test
- ◆ When measurement range is set to manual. The display shows “OL” if the range is exceeded.

❑ Power

- ◆ 6 X 1.5V AA Alkaline Battery. (Non-Rechargeable)

❑ Remaining Battery Capacity Level indicator

- ◆ Top right of the display indicates Remaining Battery Capacity Level,

Level	Remaining Battery
	Fully Charged.
	3/4 charged (75 %)
	1/2 charged (50 %)
	1/4 charged (25 %)
	Replace Batteries (0 %)

❑ Auto Power Off

- ◆ While in operation, the meter will automatically power off after 15 minutes with no key press on any key.
- ◆ User can select the Auto Power Off time (min 5 minutes ~ max 2 hours or Auto Power Off mode) in the User Menu.

[NOTE]

- ◆ Auto Power Off mode does not activate in DATA LOGGER mode (MIN MAX, PEAK mode in operation)
- ◆ Auto Power Off mode does not activate when Meter is powered by ADC Power Adaptor.

❑ Battery Saver Mode

- ◆ Auto Power Off mode is not activated when in Data Logger or Auto Hold mode of operation. If no key is pressed on Meter for the set amount of time, the Meter automatically changes to Battery Saver Mode. Mode enable time is equal to Auto Power Off mode timing.
- ◆ All features including Display will power off except for the present active measurement function.
- ◆ Release Battery Saver Mode by:
 - Pressing any key
 - Change the measurement range
 - Start PC Interface communication.Meter function and Operation Mode does not change when exiting battery saver mode.

❑ Back Light Display

- ◆ When measurement environment is dark and or it is hard to see the LCD display, HOLD the Back Light key  longer than 2 seconds,
- ◆ Back Light operation time can be set in the USER MENU (Off Mode, Min 1 minutes ~ Max 1 hours).

□ **Measurement Range selection (Auto/Range)**

- ◆ Selected Measurement Range is shown to the Right of the BAR-GRAPH. The  key, changes between AUTO Range mode or Manual Range mode. Pressing the  key in MANUAL Range mode will automatically shift the meter back to AUTO Range.

[NOTE]

- ◆  Key is not active during Capacitance, Diode, or Frequency modes which are always set automatically Auto Ranging.
- ◆ Manual Range mode can be switched to Auto Range mode by holding the  key longer than 2 sec.
- ◆ Auto Range mode can be switched to Manual Range mode by holding the  key longer than 2 sec.
- ◆ In manual mode, the Up/Down keys will move the decimal point for the range.

[Multi-meter Sub Menu]

<Volts>

DMM (Vdc)	F1	F2	F3	F4
	Min/Max	<input checked="" type="checkbox"/> Relative		Stop
	Peak			

Vac	F1	F2	F3	F4
	Min/Max	<input checked="" type="checkbox"/> Relative	dBm	Stop
	Peak		Filter	

DMM (Vac+dc)	F1	F2	F3	F4
	Min/Max	<input checked="" type="checkbox"/> Relative		Stop
	Peak			

AUX	F1	F2	F3	F4
	Min/Max	<input checked="" type="checkbox"/> Relative	Temp	Stop
	Peak		Ampere Humidity Pressure	

< Resistance, Diode, Capacitance >

DMM (ohm)	F1	F2	F3	F4
	<input checked="" type="checkbox"/> Min/Max	<input checked="" type="checkbox"/> Relative	Limit	

DMM (Continuity)	F1	F2	F3	F4
			Limit	

DMM (Diode)	F1	F2	F3	F4
			Limit	

DMM (Capacitance)	F1	F2	F3	F4
	■Min/Max	■Relative	Limit	

< **Currents** >

DMM (μ A)	F1	F2	F3	F4
	■Min/Max	■Relative	■dBm	AC

DMM (mA)	F1	F2	F3	F4
	■Min/Max	■Relative	■dBm	AC

DMM (10A)	F1	F2	F3	F4
	■Min/Max	■Relative	■dBm	AC

The above Menus shows Initial Set Up status. When a function or mode is selected by pushing the function key on the Sub Menu (Keys F1~F4), the selected function or mode is activated instantly, and then the POP UP window is shut off and the selected menu is displayed on screen.

□ **Help**

- ◆ While the Meter is in operation, pressing the  key longer than 1 second will display brief information or an explanation about the present function or mode.
- ◆ Press the  key longer than 1 second to exit Help mode.
- ◆ Help mode contains brief information from the Users Manual for quick reference.
- ◆ Where Help information is more than 1 page of the screen, you can scroll the contents with Cursor (Up/down) keys.

□ **Data Hold/Auto Hold**

- ◆ In order to momentarily hold the measurement value on the screen, press  HOLD key. The measurement value is displayed in Holding mode, but the meter is actually still acquiring measurement data. Pressing the  key once more will release HOLD mode.
- ◆ Pressing  for more than 1 second will enter **Auto Hold** mode. When in Auto Hold mode, the monitoring and display of the input signal is continuously updated.
- ◆ Whenever a new measurement is acquired during Input the display is updated and the alert signal sounds.
- ◆ Auto Hold can be reset by pressing the  key.
- ◆ Hold the  key for longer than 2 seconds to release Auto Hold.

□ **SAVE / RECALL**

- ◆ Saves the Waveform or the Data on the display. Data is saved to the internal memory of the meter and can be recalled and displayed on meter the meter or in the software.
- ◆ Hold the  key longer than 1 second.
- ◆ Use Sub Menu keys to Save, Recall or Erase

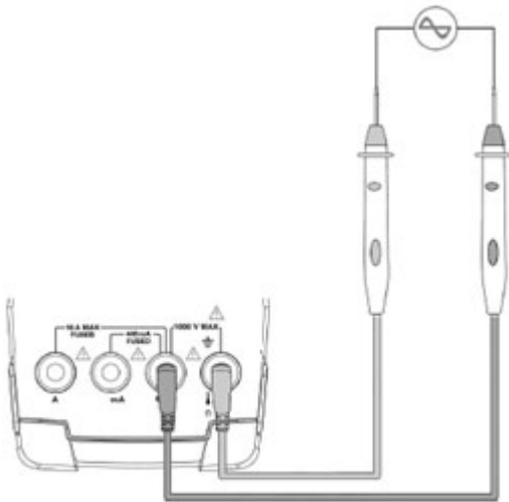
2. How to Measure Main Functions

□ **AC Voltage measurement**

Meter is capable of accurate RMS measurement readings of various AC signals. True RMS measurement is available for Sign, Square, Triangle waveforms, as well as other types of signals.

Voltage	F1	F2	F3	F4
	Min/Max	■ Relative	■ dBm	
	Peak			
	OFF			

- ◆ Press the  main function key.
- ◆ Next press the  Menu key and select “**VAC**” among VAC, VDC, VAC+DC,
- ◆ Insert Black (-)Test Lead to COM input terminal and insert Red (+)Test Lead into “V” input terminal
- ◆ Start measurement



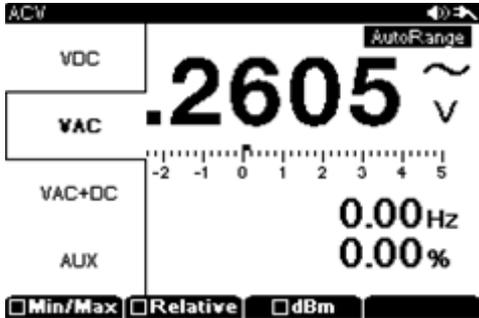
[AC Voltage Measurement]

- Measurement Range can be selected by Auto Range or Manual Range..
 - ☞ Auto Ranging Scales: : 5V, 50V, 500V, 600V (4 ranges)
 - ☞ Manual Ranging Scales: : 50mV, 500mV, 5V, 50V, 500V, 600V (6 ranges)
- The measured **Voltage** value is displayed on the main display and lower the area will display **Frequency** and **Duty** cycle values.

- Bar-Graph changes depending on the level of the value from the “0” point.
- The Sub Menu allows for: **Min/Max, Relative, dBm** measurements.

[Safety Note]

Before measurement, ensure the Test Leads/Probes are correctly inserted into the correct Input terminals. For safety, do not test circuits that exceed the Voltage Ratings marked on the meter.

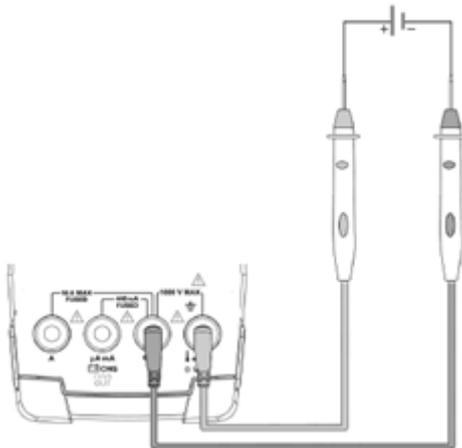


DC Voltage Measurement

The Bar-Graph of the Display starts from the “0” point. Negative (-) voltage is displayed to the left of Center “0”. Positive (+) voltage is displayed to the right of Center “0”.

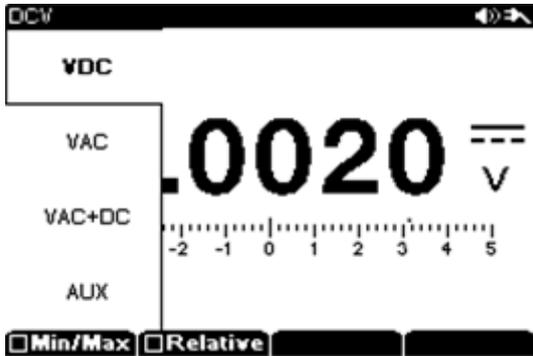
Voltage	F1	F2	F3	F4
	Min/Max	<input checked="" type="checkbox"/> Relative	<input checked="" type="checkbox"/> dBm	
	Peak			
	OFF			

- Press the  main function key.
- Next press the  Menu key and select “**VDC**” among VAC, VDC, VAC+DC
- Insert Black (-)Test Lead to COM input terminal and insert Red (+)Test Lead into “V” input terminal
- Start measurement



[DC Voltage Measurement]

- Measurement Range can be selected by Auto Range or Manual Range..
 - ☞ Auto Ranging Scales: : 5V, 50V, 500V, 600V (4 ranges)
 - ☞ Manual Ranging Scales: : 50mV, 500mV, 5V, 50V, 500V, 600V (6 ranges)
- The measured **Voltage** value is displayed on the main display with polarity indication.
- Bar-Graph changes depending on the level of the value from the “0” point.
- The Sub Menu allows for: **Min/Max, Relative**, measurements.

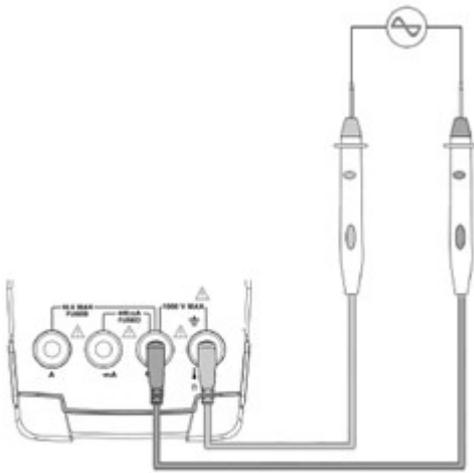


AC+DC Voltage Measurement

The Meter measures the combined value AC+DC Voltage measurement, Measurement value displayed is the (Absolute Value). Bar-Graph will display in the Positive (+) direction only.

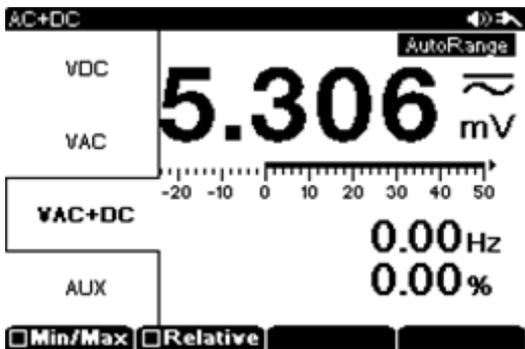
Voltage (AC+DC)	F1	F2	F3	F4
	Min/Max	<input checked="" type="checkbox"/> Relative		
	Peak			
	OFF			

- Press the  main function key.
- Next press the  Menu key and select “**VAC+DC**” among VAC, VDC, VAC+DC
- Insert Black (-)Test Lead to COM input terminal and insert Red (+)Test Lead into “V” input terminal
- Start measurement



[AC+DC Voltage]

- Measurement Range can be selected for Auto Range or Manual Range.
 - ☞ Auto Ranging Scales: : 5V, 50V, 500V, 600V (4 ranges)
 - ☞ Manual Ranging Scales: : 50mV, 500mV, 5V, 50V, 500V, 600V (6 ranges)
- The measured **Voltage** value is displayed on the main display with polarity indication.
- Bar-Graph changes depending on the level of the value from the “0” point.
- The Sub Menu allows for: **Min/Max, Relative**, measurements.

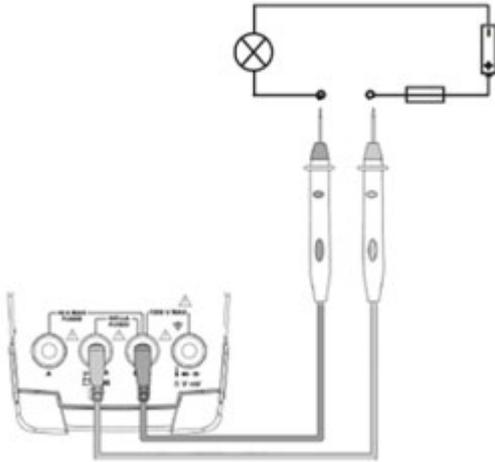


□ Current Measurement (mA, μ A) (500 milli-AMP MAXIMUM inline current measurement)

Current measurements must be done with the circuit open and the meter connected in series as part of the circuit.

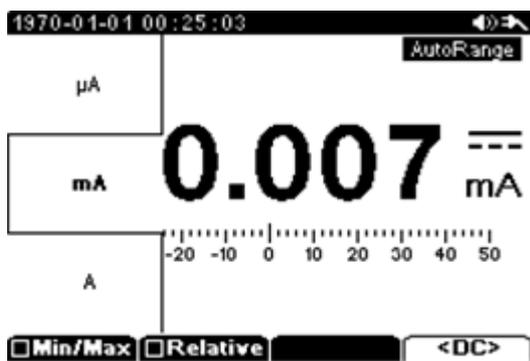
	F1	F2	F3	F4
mA, μ A	Min/Max	<input checked="" type="checkbox"/> Relative	<input checked="" type="checkbox"/> dBm	DC
	Peak			
	OFF			

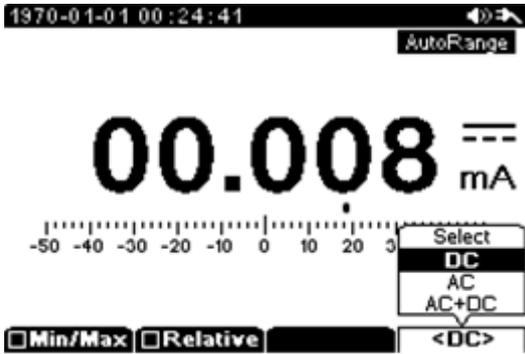
- Press the  main function key.
- Next press the  Menu key and select m-Amp or μ -Amp range
- Insert Black (-) Test Lead to COM input terminal and insert Red (+) Test Lead into mA input terminal.
- Start measurement



[mA, μ A measurement]

- Measurement Range can be selected for Auto Range or Manual Range.
 - μ A: 500 μ A, 5mA(auto ranging)
 - mA: 50mA, 500mA(auto ranging)
- The measured Current value is displayed on the main display and the lower portion of the display will show Frequency and Duty (in AC Only)
- Protection: 500mA/250V Fuse
- The Sub Menu allows for: : Min/Max, Relative, dBm, DC, AC, DC+AC





[Warning]

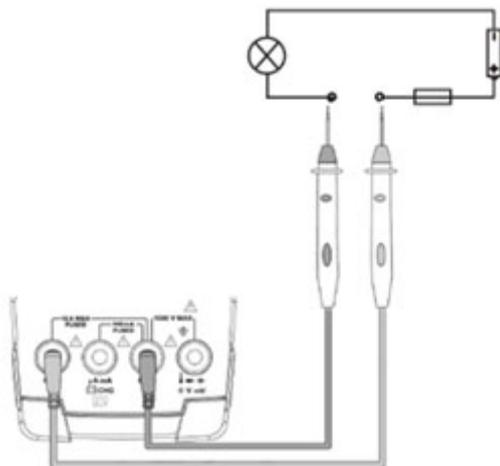
- To prevent damage to the meter or equipment being measured, check the FUSE before current measurements are made.
- Verify the correct Input Terminals and Measurement Range is set.
- When Leads are connected for Current Input Terminals, do not connect other Circuits or Components in Parallel.

□ 10A measurement (10 AMP MAXIMUM inline current measurement)

Current measurements must be done with the circuit open and the meter connected in series as part of the circuit.

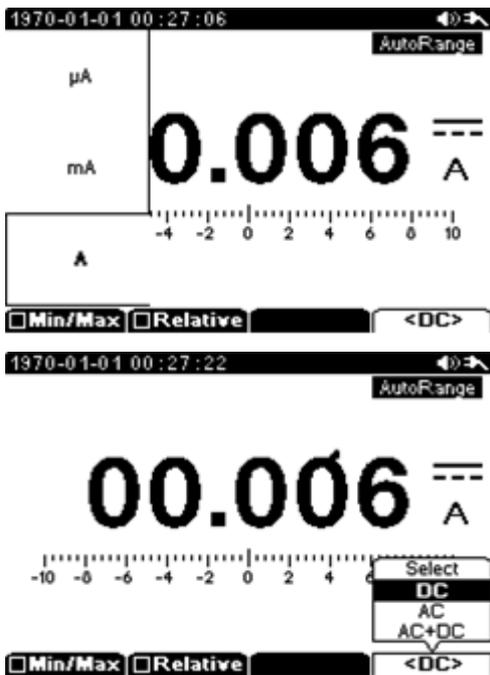
10A	F1	F2	F3	F4
	Min/Max	<input checked="" type="checkbox"/> Relative	<input checked="" type="checkbox"/> dBm	DC
	Peak			
	OFF			

- Press the main function key.
- Next press the Menu key and select A
- Press F4 key to select “DC, AC, AC+DC”
- Insert Black (-) Test Lead to COM input terminal and insert Red (+) Test Lead into 10A input terminal
- Start measurement



[10A measurement]

- Measurement Range
 - A : 10A max (1 range)
- The measured current value is displayed on the Main display, and Frequency, Duty value is displayed in sub display (AC current measurement only).
- Selectable sub menu: Min/Max, Relative, dBm, DC, AC, DC+AC
- Circuit Protection : 10A/250V Fuse
- Input current can not exceed 10 Amps. Measurement time must not exceed 30 Seconds.
- Allow a 1 minute cool down period before the next full current measurement to prevent overheating / damage to the meter.



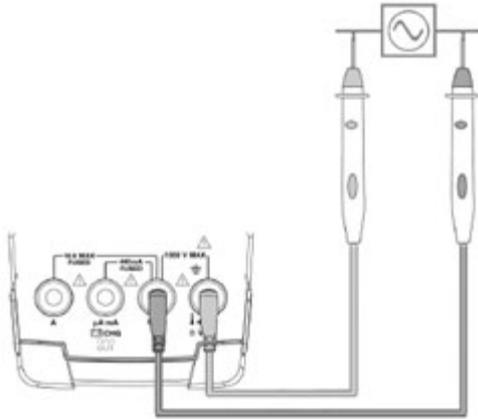
[WARNING]

- To prevent damage to the meter or equipment being measured, check the FUSE before current measurements are made.
- Verify the correct Input Terminals and Measurement Range is set.
- When Leads are connected for Current Input Terminals, do not connect other Circuits or Components in Parallel.

Frequency Measurement

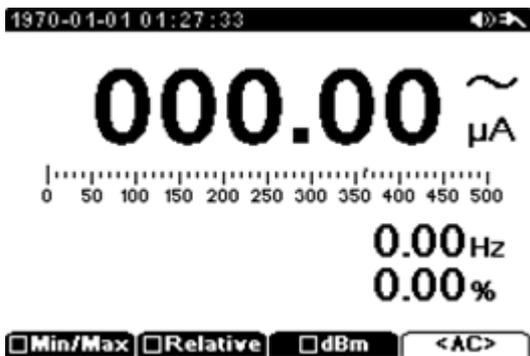
Frequency measurements are displayed any time you are measuring AC Voltage or Current

- ① Press the  or  main function key.
- ② Next press the  Menu key and select VAC or A
- ③ Insert Black (-) Test Lead to COM input terminal and insert Red (+) Test Lead into Volts or Current(mA, 10A) input terminal
- ④ Start measurement



[Frequency measurement]

- Measurement Range
 - Frequency: 0.5Hz ~ 3MHz
 - Duty : 5% ~ 95%
- Measurement Value (AC Voltage, AC Current) is displayed on the Main Display and Frequency, Duty is displayed in the sub display.
- Hz Sensitivity is dependent upon Frequency Range

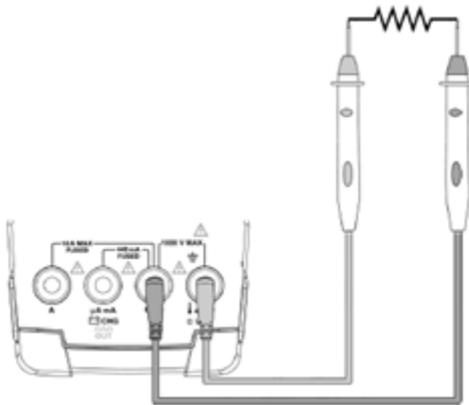


□ Resistance (Ω) measurement

Resistance measurements should be made with all power removed from the circuit and all high power capacitors discharged prior to measurements being made.

Ohm	F1	F2	F3	F4
Min/Max		<input checked="" type="checkbox"/> Relative	Limit	
Peak				
OFF				

- Press the , , or  main function key.
- Next press the  Menu key and select “ Ω , Continuity, Diode, Capacitance”
- Insert Black (-) Test Lead to COM input terminal and insert Red (+) Test Lead into “ Ω /cap/Buzzer/Diode” input terminals
- Start measurement

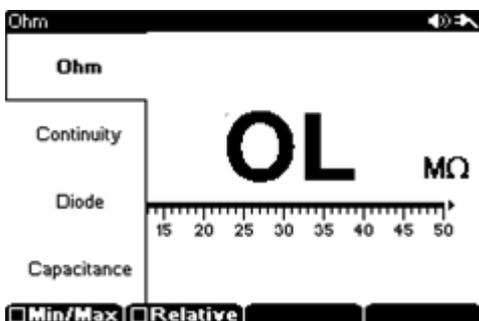


[Resistance measurement]

- Measurement Range can be selected for Auto Range or Manual Range.
- Measurement Range: 50 Ω , 500 Ω , 5000 Ω , 50k Ω , 500k Ω , 5M Ω , 50M Ω , 500M Ω (8 ranges)
- Measured Value is displayed on main display with Bar-Graph display.
- Selectable Sub menu : **Min/Max, Relative, Limit**

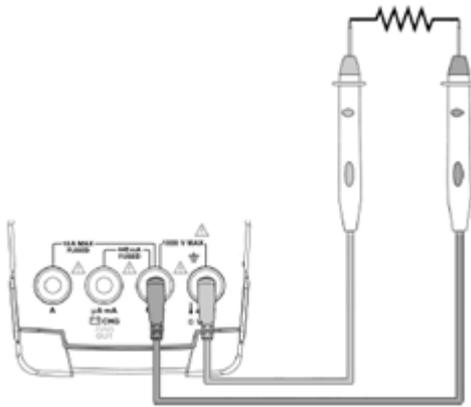
[NOTE]

- Before measuring devices less than 50 ohms , Remove any residual resistance on Test Leads – by momentarily shorting the Test Leads, use F2 “Relative”



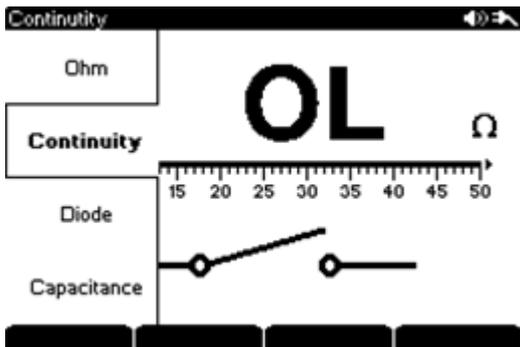
□ Continuity Test (🔊)

Continuity check for open/short circuits. The meter will display the Resistance value and an Open / Short picture on the display. An audible Buzzer will sound for values less than 50Ω.



[Continuity Test]

- Measurement range set automatically
 - Range: 500Ω (1 range)
- Buzzer: sounds less than 50Ω
- Measured value is displayed in main display and on the Bar-Graph display.

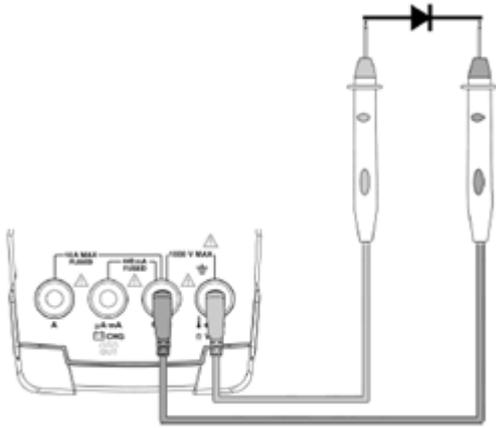


□ Diode (→|←) measurement

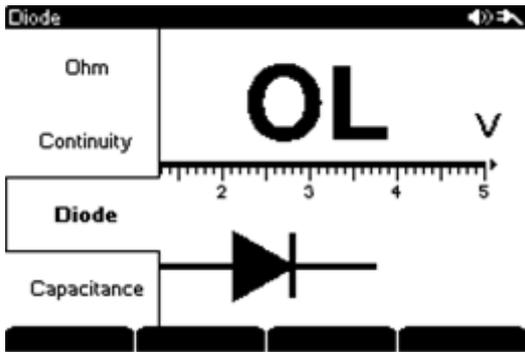
Checks Diodes, Transistors, Silicon Control Rectifier (SCR) and Semiconductor devices.

Diode	F1	F2	F3	F4
			Limit	

- Generally, the negative (-) terminal of the Diode is marked..
- Can display a Maximum 3.0V forward bias voltage.
- General Forward Bias Voltage is 0.3V~0.8V
- If "OL" is displayed in reverse bias mode, diode is good.
- If both Forward and Reverse bias are 0V, diode is SHORT
- If both Forward and Reverse bias are "OL ", diode is OPEN



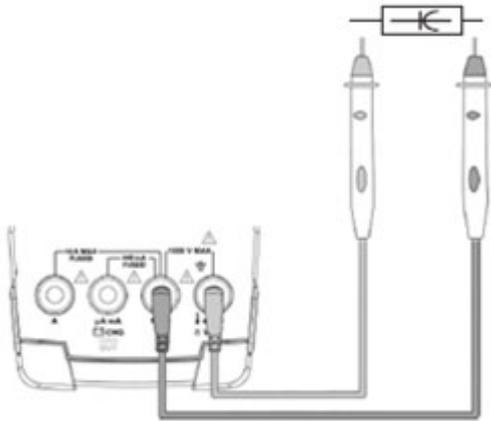
[Diode measurement]



□ **Capacitance Measurement (-|+)**

Ensure power is removed from the circuit before checking capacitance. Discharge all high powered capacitors prior to measurement.

Voltage	F1	F2	F3	F4
	Min/Max	<input checked="" type="checkbox"/> Relative	Limit	
	Peak			
	OFF			

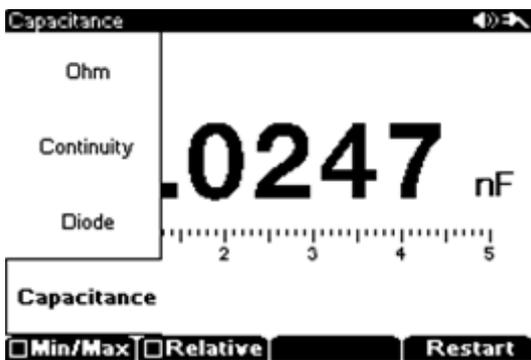


[Capacitance measurement]

- Measurement Range can be selected for Auto Range or Manual Range.
- Range: 5nF, 50nF, 500nF, 5µF, 50µF, 500µF (6 ranges)
- Count : 5,000 counts
- Measured value is displayed on the main display along with Bar-Graph display.
- Sub Menu selectable : **Min/Max, Relative, Limit**

[NOTE]

- When measuring high capacity capacitance values, discharge the capacitors and select an appropriate measurement range to save measurement time and to get accurate measurement values.
- When measuring low capacity capacitance values, short the test leads and press “Relative” to remove any residue Capacitance on Test Lead/Probes.



□ AUX Measurements

Meter can measure Temperature, Currents, Relative Humidity and Pressure by connecting external Probes. Bar-Graph can be Bi-Directional or Single Directional depending on Mode.

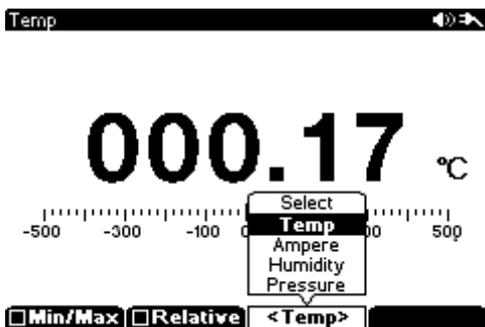
- Temperature, & DC Amps are Bi- Directional with negative scale left of “0” point.
- Humidity, Pressure, & AC Amps are single directions with scale to right of “0” point.

AUX	F1	F2	F3	F4
	Min/Max	<input checked="" type="checkbox"/> Relative	Temp	
	Peak		Ampere	
	OFF		Humidity	

- Press the  main function key.
- Next press the  Menu key and select “**AUX**” among VAC, VDC, VAC+DC, AUX
- Press the Sub-Menu “F3” key to select “Temp, Ampere, Humidity, or Pressure
- Insert (-) Plug of Adapter to COM input terminal and insert (+) plug of Adapter into AUX input terminal.
- Start measurement
- Measurement Display rate: **1mV = 1°C, 1%, 1A, 1Pa.**
- Temperature: **Main display °C and Sub display °F displayed simultaneously.**
- The Accessories Output Value Unit should be checked before using the Device.

[For example]

If 10mV = 1°C or 0.1mV = 1°C, should apply ÷10, ×10 on the displayed value.

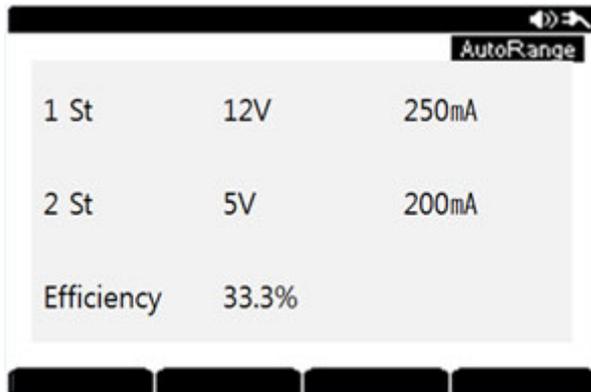


Power Efficiency Measurement

Convenient DC to DC converter efficiency can be measured and displayed without any manual calculations. Power Efficiency is most important on DC to DC Converter,

Set measurement function and measure. Simply Input Primary and Secondary measurements in order. You can use the Directional Keys to shift measurement locations.

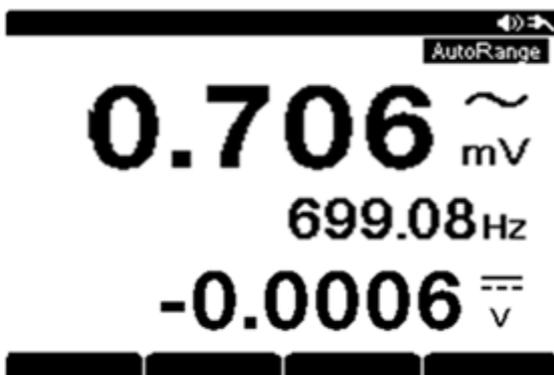
- DC Voltage: 50mV ~ 1000V
- DC Current: 500 μ A~10A



□ Ripple Noise(Dual Mode) Measurement

Useful for measuring AC Noise on DC Power Circuits.
 Will measure Ripple Noise values below 100 kHz.
 Easy to accomplish measurement without the need of an O-scope..

- DC Voltage, AC Voltage measurements both display on the LCD screen.
 This unique function is different from AC+DC Measurement function of the Meter.
- Measure DC Voltage and AC voltage in Order in display.
- DC/V Range: 5V~1000V.
- AC/V Range: 50mV~500mV.
- ripple Noise Frequency is displayed simultaneously.
- Measured Values Auto Hold on the display. Reset to take next measurement values.

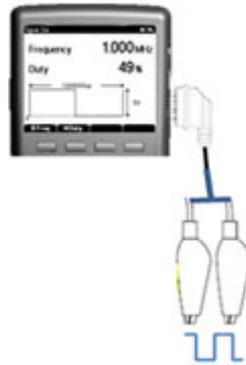


Signal Out (⌚)

The meter can output a Square wave which can generate PWM (Pulse Width Modulation) generation or supply a Synchronous clock signal (Transmission Speed generator). This function allows for checking and calibration of Water Flow Meter display, Counter, Tachometer, Oscilloscope, Frequency converter, Frequency Transmitter and other Frequency Input Devices.

Signal Output	F1	F2	F3	F4
	▲▼ Freq	◀▶ Duty		

[Signal Output]



- Select main function “” key .
- Press sub menu F1 frequency to change Frequency Output
- Press F2 Duty to change Duty of Frequency Output

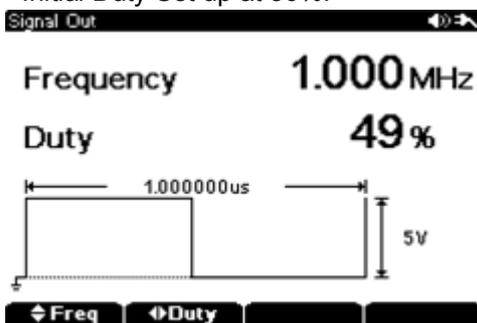
- Output Frequency: 5Hz ~ 1000kHz
- Duty : 5% ~ 95%
- Output level : 3.3V

1) To Adjust the Frequency Output

- Press the sub menu “F1” key to set Output Frequency
- Use the UP/DOWN directions keys to adjust the value.
- Frequency is displayed on main display.
- Minimum Changeable Resolution is 1Hz.
- Default Frequency Output set up at 1kHz.

2) Output Duty Cycle Change

- Press the Sub menu “F2” key to set Duty Cycle (%).
- Use the UP/DOWN directions keys to adjust the value.
- Duty Adjustable Range 5% ~ 95% by 1% step.
- Initial Duty Set up at 50%.



3. MEASUREMENT SECONDARY FUNCTIONS

- ◆ Data Logger
 - Data Logger Set Up
 - Start Recording Start
 - Recording Stop
 - Recall
 - Zoom
- ◆ Data Save, Recall, Erase
- ◆ Hold(Data Hold, Auto Hold)
- ◆ dBm Display
- ◆ USB PC Communication
- ◆ Relative measurement
- ◆ Peak Detect
- ◆ Limit
- ◆ Max/Min

□ Data Logger

The meters data logging function can collect measured data and save the results for diagnosing trends and events over long periods of time. The logging feature works on Voltages, Currents, Resistance, Capacitance and AUX measurements (Temperature, High Currents, Relative Humidity and Pressure)

Measured data is saved in the internal memory of meter which is stored even if the Data Logger is power off or the battery is replaced. While Data logging, the data includes Min, Max, Average data and the logged data records can be recalled on the meter display through the Recall function or on the PC through PC interface software program.

Logged Data includes Logging Time information which consists of Sampling Time, Min/Max value detection time, logged data is accumulated from Start to Stop.

The Data Logging function has a 3 step menu, Logging Setup Menu, Active Logging Menu, and Logging Review Menu.

Main Menu	F1	F2	F3	F4
	▲▼ Sampling	RUN Time	Start	Exit

[Menu – Logging Setup]

Logging	F1	F2	F3	F4
---------	----	----	----	----

				Stop
--	--	--	--	------

[Menu - Active Logging]

Stop	F1	F2	F3	F4
	▲▼Zoom	Pan	Save	Start
		Cursor		

[Menu - Logging Review]

[How to Operate]

- ◆ First: Select "Voltage", Current, Resistance, Capacitance or AUX" from the Main Menu.
- ◆ Second: press "Logger"  key to enter Data Logging function.
- ◆ Set "F1" Sampling rate and "F2" RUN time in sub menu.
- ◆ After set up, press "F3" (Start) key to start Data Logging.
- ◆ Data Logging is to achieve measured data for the desired time period. To minimize error during Data Logging, all keys (except Power On/Off key, Data Logger Sub Menu keys) are disabled during Data logging.
- ◆ While the Data Logger is running after set up, Automatic Power Off function is also de-activated.
- ◆ To stop Data Logger function when Data Logger in running, press the "F4" (Stop) key in the Sub Menu.

[Note]

Data Logging stops when

- Data Logging (Running) preset time is over.
- Data Logging data exceeds the Internal Memory Capacity.
- Battery Drains completely when Battery is the only power supply.

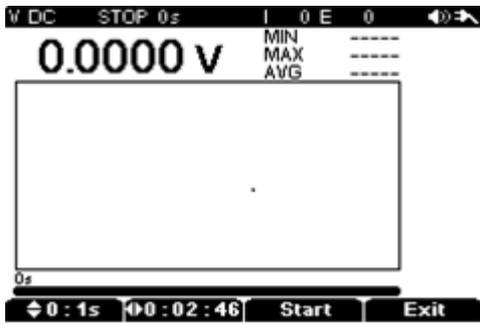
1) Data Logger Set Up

Factory defaults below will be used if not changed during logging setup.

- Sampling Time : 1s
- RUN Time : 10,000s
- Max Sample Data : 10,000 records

Main Menu	F1	F2	F3	F4
	▲▼ Sampling	RUN Time	Start	Exit

[Menu Logging Setup]



- **Sampling Time (Logging Interval Time) :**

The Sub Menu to set up data Logging consists of “F1”(sampling), “F2”(Run Time), “F3”(start), “F4”(Exit) as above.

- ◆ Press the “F1” (sampling) key and adjust the value with the up with Up/Down directional keys.
- ◆ The Internal Memory size is fixed. Adjustment of the (Sampling) and (Run Time) settings will determine the maximum number or recorded data’s that will fit in the memory. Priority for Sampling or Run Time is determined by which setting is programmed first.
- ◆ Sampling Time (Logging Interval Time) : can be variable 1s ~ 60s
- ◆ Sampling Quantity : Interval (Max 10,000), Event(Max5,000)

- **Run Time :**

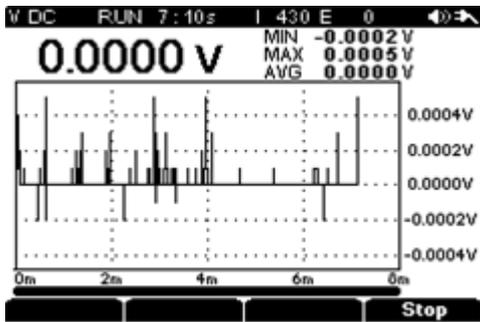
Data Logging Total Running Time can be set up to a maximum of 10,000 data sampling points due to the limit of the internal memory capacity.

- ◆ Press “F1” Key to set SAMPLING TIME, then Maximum Sampling time can automatically be calculated.
- ◆ Press “F2” key to reduce Maximum Sampling Time with Up/Down keys. Maximum Sampling Reduction is available but Maximum Sampling Increase is not available.

2) Logging Start

After parameters are set, press the “F3” (Start) key to begin data logging. While Data Logging is active, all sub menus disappeared except “F4” (Stop) and All sub Menu keys are inactive except the “F4” (Stop) key.

	F1	F2	F3	F4
Logging				Stop



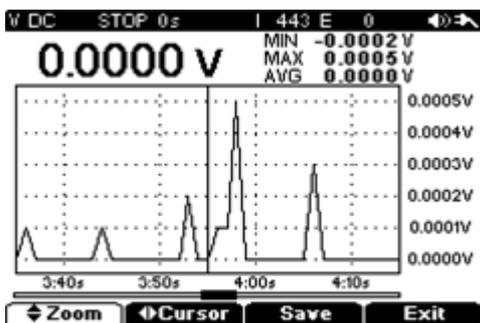
3) Logging Stop

Data Logging ends when the Sampling Time setting is reached, the battery is completely discharged, or when the “F4” (STOP) key is pressed.

- ◆ After Logging is completed, the data can be reviewed or saved. Or Logging can be exited.
- ◆ During Data Logging, if the “F4” (Stop) key is pressed, Sub-menu ZOOM or SAVE is displayed.
- ◆ To save Data Logging Data, press “F3” (Save). The meter then switches to the save menu and results can be saved in order in a separate Memory Area.
- ◆ If any key is pressed without saving the Data, A warning message appears to prompt whether to SAVE or NOT. If the user still does not press “F3” (Save), the data will be lost.
- ◆ To restart Data Logging after the Save function, press “F4” (Start) key again.

Stop	F1	F2	F3	F4
	▲▼Zoom	Pan	Save	Start
		Cursor		

[Stop Menu]



4) Recalling Saved Data

Saved Data is saved in regular intervals which displays as a Strip Chart Recorder.

To recall Data when Data Logging is stopped or from any other function in progress, Hold the

 key longer than 2 seconds. Recall is not available while actively Data Logging.

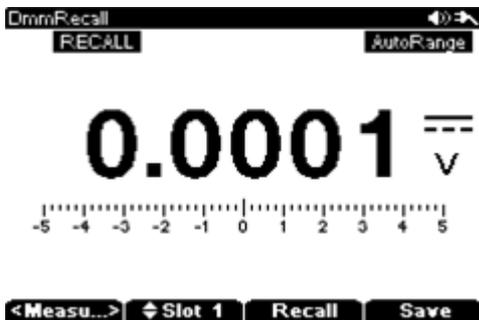
Save/Recall/Erase	F1	F2	F3	F4
	Mode	▲▼Slot	Recall	Save
				Erase

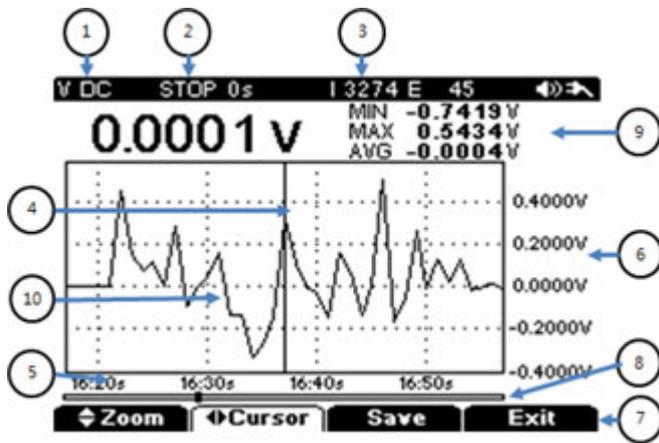
[Save, Recall Initial Menu]

Recall	F1	F2	F3	F4
Recall	▲▼Zoom	Pan		Exit
		Cursor		

[Save, Recall Review Menu]

- ◆ Hold the  key longer than 2 seconds to see “F1” (Mode), “F2” (Slot) initial recall menu.
- ◆ Press “F3” (Recall) key, to open the Data Log (Recall) mode, and show Saved Location slots.
- ◆ Select the data to recall using the Up/Down keys.
- ◆ When the data is selected, press the “F3” Recall Key. The selected data is shown on the Display.
- ◆ Pressing “F3” Recall Key again will change the menu to the Zoom menu





No	Description
1	Data Logging Function
2	Logging Mode(RUN or STOP)
3	Data Sampling Number
4	Cursor
5	Time Scale(Horizontal)
6	Voltage Scale(Vertical)
7	Sub-Menu
8	Time Bar
9	Measure Value(Min/Max/Avg)
10	Trend Line

5) ZOOM

Logged Data is accumulated continuously and saved during Data Logging. To review data in a specific period, the user can zoom the Data in “STOP” mode.

Stop	F1	F2	F3	F4
Stop	▲▼Zoom	Pan	Save	Start
		Cursor		

[Data Logging Stop menu]

[How to operate]- While in STOP mode.

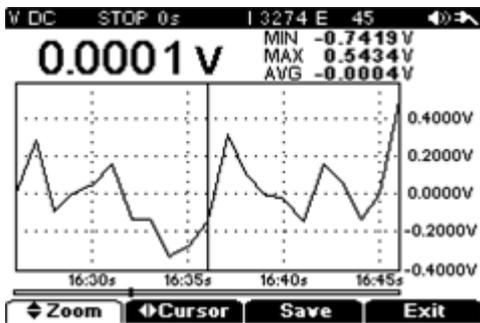
- When Data Logging is active, press “F4” (Stop) key to pause the data logging. Press Sub Menu “F1” key to Zoom the Data.
- Use “F2” Cursor key (Left/Right) to expand the area to observe.
- Press “F1” Zoom key and set Zoom with up/down keys (Expansion ▲(up) up to the minimum Time Ratio. Decrease with ▼(down) key.
- To review the specific area again, press “F2” PAN key and select the area to review again with Left/Right direction key and check Trend Data.

Recall	F1	F2	F3	F4
	▲▼Zoom	Pan		Exit
		Cursor		

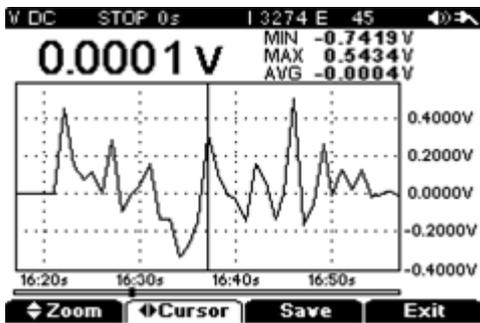
[Recall Menu]

[How to operate]- From the Recall mode

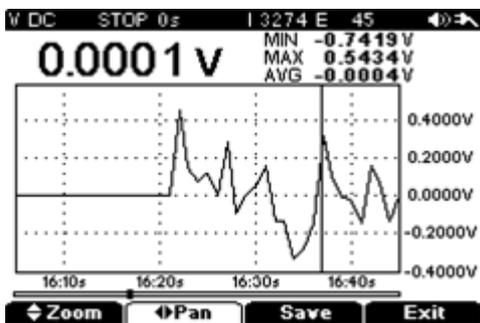
- At Initial Save/Recall screen, select the address to Recall and press the “F3” (Recall) key.
- Press Recall key to see the Recall sub- menu as in above.
- Press “F2” (Cursor) key and select zoom area to observe with Left/Right key.
- Press “F1” (Zoom) key to set Zoom Ratio with Up/Down keys.
- To review the specific area again, press “F2” (PAN) key and select the area to review again with Left/Right directional keys.



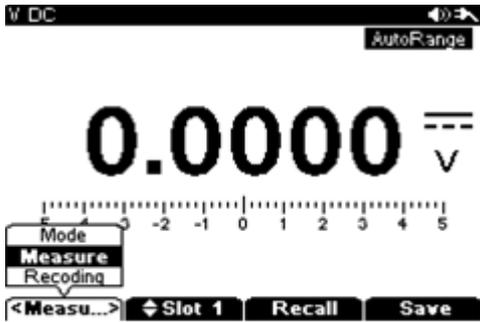
[ZOOM]



[Cursor]



[PAN]



[Save/Recall Initial Screen]

□ Saving Data

All measurement data from meter functions can be saved by pressing the Data Hold key. Data is saved as a Snap Shot taken in Hold mode.

- Press  key longer than 2 seconds. The Save/ Recall initial menu (Save, Recall) comes up.
- Press “F1” (Mode) key then convert to data (Save) mode. Press “F1” (Mode) key to save “snap shot” or recording (Logging).
- Press “F2” key in Save mode and select Saved Area Location Address with Up/Down key. When a Save with Address is not selected, Data will be saved in the next open slot in file.
- If address is selected, press “F4” (Save) Key to save the data at the assigned address.
- Press “Menu” key to return to previous Measurement mode.
- Measuring (snap shot) or Recording (Logger Data) are available in 10 separate locations .
- When all addresses are full, the meter will start over to Save in slot number 1. At this time, the meter will display a warning whether the user will erase the old data in slot number 1.

	F1	F2	F3	F4
Save/Recall/Eraser	Mode	▲▼Slot	Recall	Save
				Eraser

[Save, Recall Initial Menu]

[Recall-Snap Shot]

Snap Shot saved in Internal Memory of Meter can be recalled for viewing.

- Press  key for longer than 2 seconds, initial menu (Save, Recall) will appear.
- Press “F3” (Recall) key to enter RECALL mode.
- Press “F2” (Slot) key and select Recall Data address with Up/Down keys
- After the address is selected, press “F3” (Recall) key to recall the Data
- Press (Menu) key to return to original measurement mode.

Save/Recall/Eraser	F1	F2	F3	F4

	Mode	▲▼Slot	Recall	Save
				Erase

[Save, Recall Initial menu]

Recall (Review)	F1	F2	F3	F4
	▲▼Zoom	Pan		Exit
		Cursor		

[Recall menu]

[Erase]

Erase Saved Data from the Internal Memory.

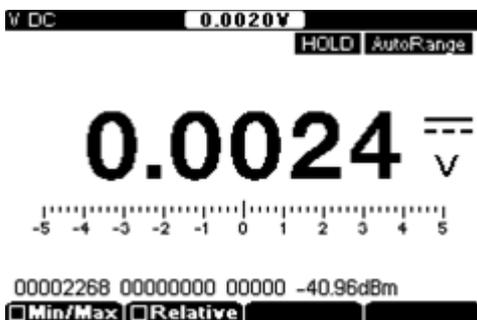
- Hold  key longer than 2 seconds. The menu (Save/Erase/Recall) will appear.
 - Press “F2” (Slot) key and select Erase Data address with Up/Down key
 - After Erase data address is selected, press Erase key to erase the data.
- Press Menu key to return to original measurement mode.

Save/Recall/Erase	F1	F2	F3	F4
	Mode	▲▼Slot	Recall	Save
				Erase

[Save, Recall initial menu]

□ Data Hold

- Press the  key to hold the Measurement data, “HOLD” is displayed in upper corner of the screen.
- Press  key again to release the “HOLD” mode.
- During “Hold” mode, present real time measurement values are displayed in upper screen portion of the display.



□ Auto Hold

Auto Hold function is displays and updates values based on changes in value.

- Hold the  key more than 2 seconds to enter “Auto HOLD” mode.
- Hold the  key more than 2 seconds to release “Auto HOLD” mode.
- Auto Hold displayed values change when the Measurement Value deviates by more than ±5% change from 1st Measurement Value displayed in auto hold mode.
- Auto Hold function is very useful to check measurement value shifts and levels during measurements.



□ dB (decibel)

- Voltage can be displayed as dBm, relative to a value of 1mW.
- To change the Measurement Value to dBm, select dBm in Voltage measurement mode of (VDC, VAC, or VAC+DC).
- dBm measurement is differentiated with a Reference Impedance. Therefore, you must set the reference impedance value depending on the application.
- Impedance value can be set up between 1Ω ~ 1000Ω range in User mode. Default value is 600Ω
- dBm unit means Wattage to deliver to Reference Resistance based on 1mW unit. Voltage measurement value can be converted using the following formula.

$$\text{dBm} = 10\log \frac{1000 \times (\text{measured voltage})^2}{\text{reference impedance}}$$

- Press “F3” key to activate the dBm function while measuring Voltages and press “F3” key again to release the dBm function.
- dBm value is displayed in the sub display area: lower right area of screen.
- When dBm function is activated it will display the value where duty is normally displayed.
- The dBV calculates the voltage with respect to 1V, as in the formula shown below.
- $\text{dBV} = 20\log(\text{measured voltage})$



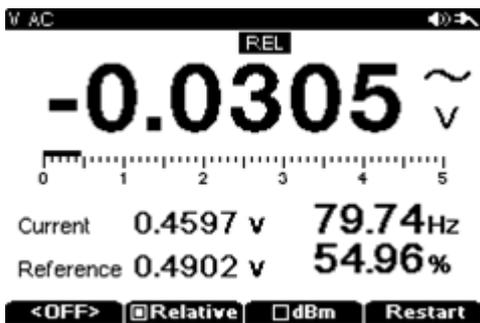
□ Relative measurement.

Relative measurements display the difference in value between the present measurement value versus the initial set up base value when entering into the relative mode.

Relative measurement is available when measuring Voltage, Current, Resistance, or Capacitance.

“Relative” is in the Sub Menu for those main functions.

- Relative function is activated by pressing the “F2” (Relative) key during Voltage, Current, Resistance, or Capacitance measurements.
- “REL” is displayed in the upper center of the screen when this feature is active.
- Main Display shows Relative measurement value and the Sub display below shows the present value and initial set up reference value. All values are displayed simultaneously.
- Exiting the relative mode will revert back to the Main Menu Function.
- To restart the relative reference value, press “F4” (Restart) to refresh the reference value.



□ Peak Detect

Peak Detect is a similar function to the MIN/ MAX functions explained earlier. The difference between Peak and MIN/MAX is response time.

Response Time of Peak function is (250µs), much faster than the MIN/MAX responds.

Because of this quick response time, the meter can measure the true peak value of Sine Waveform, Peak function can also be used to measure transient currents accurately.

- To activate Peak mode, press Sub Menu “F1” key and select (Peak)
- Main Display will show the present measurement value and the sub display shows the peak captured value with time stamp of when the peak occurred.
- If Peak Value of Input signal drops lower than MIN value recorded or higher than MAX value recorded, an audible alert sounds and a new value is recorded. After a new peak session is started, all measurement values are recorded with measurement time stamping.
- Pressing the  key, will exit the Peak Detect mode.

Voltage	F1	F2	F3	F4
	Min/Max	<input checked="" type="checkbox"/> Relative	<input checked="" type="checkbox"/> dBm	
	Peak			
	OFF			



[NOTE]

- If you change the measurement function without saving the data, all collected data will be lost.
- To store peak value, press the  (HOLD) key.

Limit

This meter function is useful for setting upper and lower limit ranges for measurements for comparisons within a range.

Voltage (AC)	F1	F2	F3	F4
	Min/Max	<input checked="" type="checkbox"/> Relative	Limit	
	Peak			
	OFF			

[How to operate]

- 1 Press the  main function key.
 - Press the Menu key and select “Ohm, Continuity, Diode, or Capacitance”
 - select “F3” (Limit)
 - After measuring the component, the measured value is compared with the preset Low-High limits, display shows “Pass” or “Fail”.
 - Limit function is automatically released when any other Sub function key or main function key is selected.

Min/Max

Min/Max mode records the Minimum, Average, and Maximum Input Values when checking Voltages, Currents, Resistance, or Capacitance. Min/Max mode is in a Sub Menu for each main function.

If Input value is lower or higher than preset values, an alert beep sounds and new

measurement value is updated and recorded with a time stamp. This mode is useful when checking values generated intermittently or to record Minimum, Maximum values while user is not at the meter.

- Pressing the  (Hold) key exits the Min/Max mode.

Voltage (AC)	F1	F2	F3	F4
	Min/Max	<input checked="" type="checkbox"/> Relative	<input checked="" type="checkbox"/> dBm	
	Peak			
	OFF			

DMM (ohm)	F1	F2	F3	F4
	Min/Max	<input checked="" type="checkbox"/> Relative	Limit	
	Peak			
	OFF			

[How to Operate]

- Select the Main Function Key.
- Then press “F1” Min/Max in the Sub Menu.
- Pressing “F1” will cause the upper Screen to show “Min/Max” icon and the measurement screen is changed.
- Main display shows present measurement value.
- Sub display will show Max/Min values displayed with time stamp.
- To exit the Min/Max mod, press the  (Hold) key.

[Note]

- While in MIN/MAX recoding mode, the meter converts to Battery Save mode to extend battery time.
- MIN/MAX is displayed in the lower portion of the Main Display with time.



SOFTWARE COMMUNICATION

USB Communication Link

- The meter features a bi-directional communication function and allows for all stored data in memory to be transmitted to a PC.
- USB Cable (standard) is supplied with the Software interface program file included in the packaging.
- Select USB in “**User**” setup Mode.
- A USB Mini Type connection socket is located on the top right side of the meter.
- Install the software and device drivers prior to connecting the USB to the PC.
- A USB communication cable is supplied as an original accessory with the meter. If using another USB cable, make sure it is of the “A-B” type.
- After installation of the PC program, pressing the HELP key button on meter will display the details about the PC Program execution.

[NOTE]

The SBS-600 is capable of performing bi-directional communication and control of the meter via the PC on a real time basis, user can review or download the data that is stored inside of internal memory of meter as well as use the software for recording and screen capture.

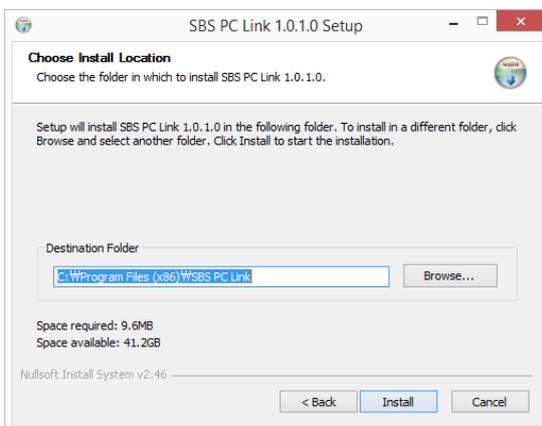
[How to install USB]

Driver and PC Software

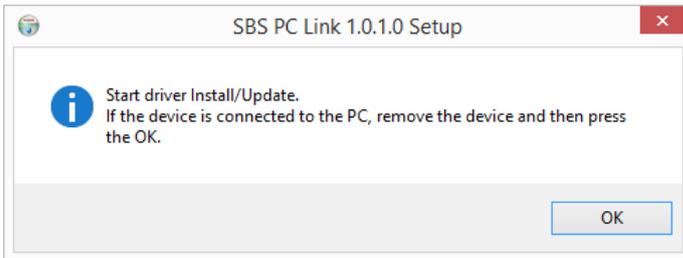
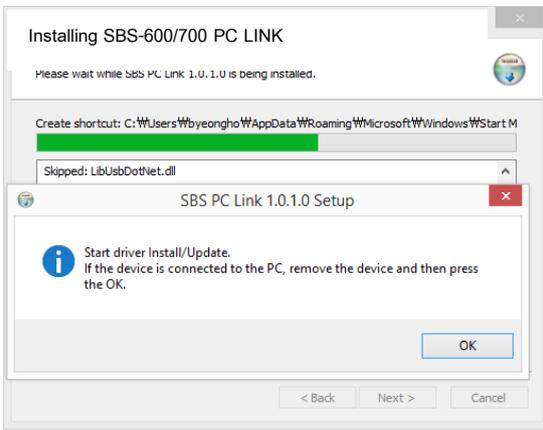
- Insert the supplied CD disc into the PC
- Open the Disk Directory and Run the “SETUP” by double clicking on the icon.



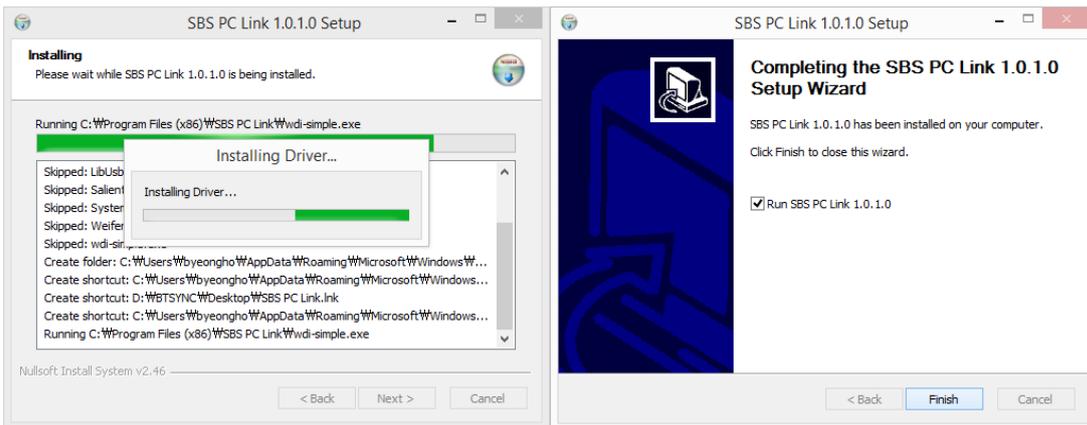
- Click “NEXT” to continue.



- Click “Install” to continue.



- Appear driver Install/Update message.
If the device is connected to the PC, remove the device and then press the OK.



- Click "Finish" to complete the installation.
Software and Driver installation is completed.
Remove the installation CD from the PC.

A Desktop ICON for the SBS600/SBS700 will appear on the desktop.



[How to RUN the PC Program]

- Power "On" Meter. .
- USB Interface connected to meter and PC USB port.
- Click the desktop ICON to launch the SBS-600/SBS-700 PC Link.

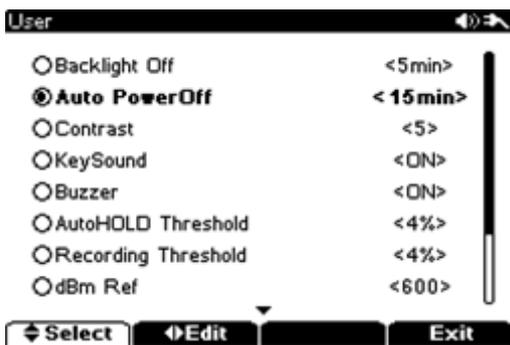
4. Initial Settings before use

This chapter explains the Meter's Initial Set Up and useful Option Set Up procedures.

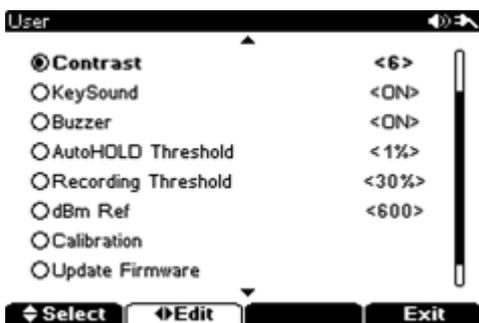
- User Mode
- Initial Impedance Set Up to measure dBm measurement
- Beep(Buzzer) Sound Set Up
- Key Sound(MUTE)
- Auto Power Off
- Back Light OFF Time
- PC Interface ON/OFF

□ User Mode

- ♦ To enter the User Menu, hold the  (User)key longer than 2 seconds.
- ♦ In the User Menu, the following procedure can be used to Set Up meter defaults.
- Click Menu to set up or change.
- Change the menu with “▼▲, ►◀” keys.
- Press  key to complete Set Up or Change.



[Select Menu]



[Edit Menu]

□ Factory Default settings / Options

Function	Initial Set Up	Setup Options
Back Light	ON	ON(10minute), OFF
Auto Power	OFF	ONOFF, 5m ~ 240minute
LCD Contrast	50	30 ~ 70 Adjust
Key Sound	ON	ON, OFF
Beep Sound	ON	ON, OFF
Auto hold Threshold	4%	1%~30%
Recording Threshold	4%	1%~30%
dB Reference	600Ω	2, 4, 6,1200
Calibration	OFF	ON, OFF
Update Firmware		
Device Information		
USB Interface	OFF	ON, OFF
Help Language	English	English

□ Initial Impedance Set Up for dBm measurement

Impedance to measure dBm can be set up within the range of 1 ~ 1200Ω.

Factory preset value is 600 Ω.

□ Beep(Buzzer) Sound Set Up

- ◆ This mode controls the sound during Continuity Test.
- ◆ This mode can be set to ON or OFF in the User Menu.

[The WARNING sounds for input Over Voltage or battery power low warnings are set up with the "TONE" setting which is a different set up procedure than the above Continuity sound.]

□ Key Sound(MUTE)

- ◆ This mode toggles the Function key sound when Pressing "Function" keys.
- ◆ This mode can be set to ON or OFF in the User Menu.

□ Auto Power Off

- ◆ User can select the APO(Auto Power Off) time in the range from 10minute~60 minutes
- ◆ User can select 10, 15, 20, 30, 45, 60min, or OFF.
- ◆ With the APO timer active, the Meter will be automatically Powered off after the set amount of time unless any of following events occur.
 - Pressing any function key or menu key.
 - Change of measurement function.
 - Data Logging is Active
 - Peak Hold is Active
 - APO is disabled in the User Menu.
- ◆ To turn the meter on from APO after Power is Off, press any key on the meter.
- ◆ To disable APO function, select OFF in the User Menu.

Back Light OFF Time

Back Light on timing can be set up in the range from 1minute ~ 60minutes by minute unit steps with the "F2" (Edit) Key or UP/DOWN keys. Default setting time is 10 minutes.

PC Interface ON / OFF

- ◆ PC Interface can be set to ON / OFF in the User's Menu.
- ◆ Default Mode is ON.

LCD Contrast

- ◆ Adjusts the LCD display brightness to the measuring environment conditions.
- ◆ Adjust Level range from 1~10. Lower number makes screen brighter, higher number becomes darker.
- ◆ Factory Default setting is at "5".

Auto Hold Threshold

- ◆ Auto Hold is the feature that data is automatically held on the display when it exceeds the preset level compare to the Initial value.
- ◆ Factory default setting level is 5%. The adjustable range is between 1 % ~ 30 % in the User Menu.

Recording Threshold

- ◆ In Data Logging modes, it records the difference in value from the Threshold compared with previous data stored.
- ◆ Factory default setting level is 5%. The adjustable range is between 1 % ~ 30 % in the User Menu.

Calibration

Calibration Mode of Meter is available in the User Menu.

Firmware Update

Future Firmware Updates can be completed using the following Procedure:

- ◆ Select (Update Firmware) in the User Menu.
- ◆ Download the Updated Firmware to the PC
- ◆ Connect the USB Cable between PC and the Meter
- ◆ Press "Enter" key on the Meter.
- ◆ When the Update is finished, the message "Finish" will be displayed on the screen.

System Information

- ◆ Meter System Information is listed in the User Menu.
- ◆ System information includes Model, Firmware version, Results of last Self calibration.

Language

Display Text is written in English.

□ Help

- ◆ Press the  (Help) key will bring up brief Information about the active Function on the display.
- ◆ Help Information pages can be scrolled up/down with ▼▲ keys.
- ◆ Select the Help Language after pressing the  key.

□ Battery Save

- ◆ This mode minimizes Battery power consumption during long duration use of meter in Data Logging mode. When Battery Save mode is activated, all functions including Display and any features not related to Data Logging are shut off. Battery save function starts 10 minutes after Data Logging begins, to see the Display, press the  key.
- ◆ When Battery Save mode is active, Auto Power Off function is disabled.

5. Maintenance

This chapter explains the basic maintenance of the meter.

- ◆ General Maintenance
- ◆ Battery Replacement
- ◆ Battery Charging
- ◆ Fuse Replacement

[Note]

Troubleshooting beyond that specified in this manual is only to be completed by an authorized repair center.

□ General Maintenance

Wet or Dusty Input Terminals could cause incorrect measurement readings. Cleaning procedure is as follows.

- ① Power off the Meter and remove the Test Leads/Probes from the Meter.
- ② Turn the meter face down and remove any dust in the terminals by gently shaking the meter.
- ③ Clean the Exterior Cases with soft detergent or wet cloth. Do not use Solvents or any abrasive cleaning agents.
- ④ Clean cotton swab wet with Alcohol may be used to clean out the surface of the Input Terminals.

□ Battery Replacement

[Note]

- When Battery low signal is blinking, replace the batteries as soon as possible.
- ◆ If Battery is completely drained replace the Batteries using the following procedure.
- ① Remove the Protective Holster Case from the Meter.
 - ② Remove the Battery Cover from the Rear Case of the meter.
 - ③ Replace Batteries and ensure to connect the correct polarity inside the battery compartment.
 - ④ Close the Battery Cover and re-assemble in the reverse order as above.

□ Fuse Replacement

If the Fuses clear due to fault or overload, the fuses can be replaced as follows;

- ① Power off the Meter. Disconnect Test Leads from the Meter.
- ② Separate the Battery Cover from the meter.
- ③ Pull out one end of defect Fuse from Fuse Clip.
- ④ Replace with same size and ratings as the original fuse.. Fuse should be placed in center of Fuse Clip and pressed into place.
- ⑤ Do not touch any other components besides the fuse.
- ⑥ Re-assemble the Battery Cover on the meter
- ⑦ Fuse Ratings and Dimensions are as below ;

[Fuse Rating and Dimensions]

- ◆ 500mA/250V 5mm × 20mm (FF)
- ◆ 10A/250V 6.3mm × 32mm (FF)

□ Open Fuse Test

Select main menu "Resistance" key. Insert Test Leads into Resistance Input Terminals. Test Lead Tips Connected to 10A Input or mA Input to check the Fuse Open status.

- ◆ 10A: 0.00Ω ~ 0.50Ω measurement
- ◆ mA: 100Ω ± 1Ω measurement.

6. Function Test and Calibration.

This chapter introduces Performance Testing and Calibration procedures. Performance Test Procedure verifies the meter performs in accordance with the specifications of the meter. Calibration procedure ensures that the meter performs correctly according to specifications until next calibration time.

- ◆ Description of Calibration
- ◆ Recommended Calibration Test Equipment.
- ◆ Basic Performance Test
- ◆ Test points
- ◆ Calibration points.

□ Calibration Description

This manual contains the procedure to check the performance of meter to determine if calibration is needed.

Calibration of the meter does not require the case be opened and does not need calibration on passive components. Meter calculates calibration coefficient parameters based on input base signal. Calibration Coefficient values are kept in the internal memory until next calibration time.

[Calibration Cycle]

Calibration is generally recommended once per year. Product accuracy is guaranteed only when calibration is regularly conducted. If 1 year Calibration cycle is not kept, the meters accuracy can't be guaranteed.

[Suggestion on Calibration]

Meter specifications are guaranteed within the period from the last calibration until next calibration time. Calibration needs to be completed for all functions to meet the specifications

of meter.

❑ Recommended Test Equipment

The following is the recommended Test Equipment for Performance Test and Calibration procedure. If below Equipment is not available, use alternative equivalent test equipment.

Area	Recommended Test Equipment	Accuracy
DC Voltages	Fluke 5520A	under 20 % of Accuracy of meter
DC Currents	Fluke 5520A	
Resistance	Fluke 5520A	
AC Voltages	Fluke 5520A	
AC Currents	Fluke 5520A	
Capacitance	Fluke 5520A	
Diode	Fluke 5520A	

❑ Basic Performance Test

Basic Performance Test checks the basic functionality of the meter. Failure of the Basic Performance Test indicates the need for a complete calibration of the unit.

❑ Consideration Points

Long Test Leads can act as an Antenna and capture AC Signal noises.

Best results are achieved when the following conditions are met.

- ◆ Check whether measurement is stable within Adequate Environmental Temperature 18°C~28°C range. Calibration is recommended at 23°C ± 1°C.
- ◆ Environment Relative Humidity below 80%.
- ◆ When connect V and COM input terminals with Plugs, allow a minimum of 5 minutes warm up time.

The Meter can perform very accurate measurements which require special care and attention to errors during standard calibration procedures and performance test procedure. Please be sure that the Calibrator units output is correctly at "0" when calibration for DC Voltage, DC Currents, and Resistance.

❑ Input Connection

Connection between the Calibrator and the Meter is recommended using minimum length shielded Coaxial Cables. Cable screening strands must be grounded.

This is recommended to ensure minimum noise and stabilized performance during the calibration procedure.

❑ Calibration Precautions

To accurately calibrate the Equipment, the following points are to be compared to output reference signals in their best conditions.

- ① Before calibration, Allow the Equipment a minimum 5 minute warm up time to stabilize.
- ② During Calibration, a low battery warning could cause a calibration error. The calibration procedure should only be conducted with a fully charged or new battery in the meter.
- ③ Allow the meter and the Calibration unit to adjust to the same ambient temperature.

□ Calibration procedure

Meter Calibration procedure is as follows;

- ① Hold  "USER" Mode key longer than 2 seconds to enter the User Menu.
- ② Select "Calibration" in Menu.
- ③ Select Calibration function to calibrate (DC/V, AC/V, DC/A, AC/A, Resistance, etc.)
- ④ Connect reference Signal from the Calibrator to the Meter and observe the display.
- ⑤ Press "Start" key on the Meter.
- ⑥ While adjustment is in progress, the right upper screen shows the symbol "CAL". If the value is within the allowable range, "PASS" will come up momentarily and Calibrator advances to the next calibration item. If the value is out of the allowable range, Error Code is display for 3 seconds and the unit remains at the present calibration step. In this case, check the input value was correctly applied.
- ⑦ To continue calibration of the other functions, select other calibration item and repeat the above steps of the procedure.
- ⑧ When all of the functions are calibrated, press "Enter" key to complete Calibration process.
- ⑨ Power the meter first "Off" and then "On". Then return to normal measurement mode.

7. Specifications

□ Electrical Specifications

□ DC Voltage

- Start measurement after minimum 1 minute warm up time.
- DC Accuracy \pm (Reading % + LSD)

Function	Range	Resolution	Accuracy
DC Voltage	50.000mV	0.001mV	0.05+50
	500.00mV	0.01mV	0.025+10
	5.0000V	0.0001V	0.025+10
	50.000V	0.001V	0.025+10
	500.00V	0.01V	0.030+10
	1000.0V	0.1V	0.030+10

□ DC Currents

Function	Range	Resolution	Accuracy
DC Current	500.00 μ A	0.01 μ A	0.05+10
	5.0000mA	0.0001mA	0.05+10
	50.000mA	0.001mA	0.15+10
	500.00mA	0.01mA	0.15+10
	10.000A	0.001A	0.30+10

□ AC

- Start measurement after minimum 1 minute warm up time.
- True RMS AC Voltage, Accuracy \pm (reading % + LSD)

Range	Resolution	Accuracy				
		20Hz~45Hz	45Hz~1kHz	1kHz~5kHz	5kHz~10kHz	10kHz~30kHz
50.000mV	0.001mV	2.5+60	1.0+50	1.0+50	1.5+50	5+50
500.00mV	0.01mV	1.5+60	0.4+50	0.4+50	0.75+50	3+50
5.0000V	0.0001V	1.5+60	0.4+50	0.4+50	0.75+50	3+50
50.000V	0.001V	1.5+60	0.4+50	0.4+50	1.5+50	No spec
500.00V	0.01V	1.5+60	0.4+50	0.4+50	No spec	No spec
700.0V	0.1V	1.5+60	0.4+50	0.4+50	No spec	No spec

- True RMS AC Current, Accuracy \pm (Reading % + LSD)

Range	Resolution	Accuracy			
		20Hz~45Hz	45Hz~1kHz	1kHz~10kHz	10kHz~30kHz
500.00 μ A	0.01 μ A	1.0+20	0.7+20	0.75+20	3.5+100
5.0000mA	0.0001mA	1.0+20	0.7+20	0.75+20	3.5+100
50.000mA	0.001mA	1.0+20	0.7+20	0.75+20	3.5+100
500.00mA	0.01mA	1.5+20	0.7+20	1.5+20	3.5+100
10.000A	0.001A	1.5+20	0.7+20	3+50	No spec

- Current measurement max 10 A within 30 second continuous measurement.

□ AC+DC

- Start measurement after minimum 1 minute warm up time.
- AC+DC Voltages Accuracy \pm (reading % + LSD)

Range	Resolution	Accuracy				
		20Hz~45Hz	45Hz~1kHz	1kHz~5kHz	5kHz~10kHz	10kHz~30kHz
50.000mV	0.001mV	2.5+60	1.0+50	1.0+50	1.5+50	5+50
500.00mV	0.01mV	1.5+60	0.4+50	0.4+50	0.75+50	3+50
5.0000V	0.0001V	1.5+60	0.4+50	0.4+50	0.75+50	3+50
50.000V	0.001V	1.5+60	0.4+50	0.4+50	1.5+50	No spec
500.00V	0.01V	1.5+60	0.4+50	0.4+50	No spec	No spec
700.0V	0.1V	1.5+60	0.4+50	0.4+50	No spec	No spec

- AC+DC Currents Accuracy \pm (reading % + LSD)

Range	Resolution	Accuracy			
		20Hz~45Hz	45Hz~1kHz	1kHz~10kHz	10kHz~30kHz
500.00 μ A	0.01 μ A	1.0+20	0.7+20	0.75+20	3.5+100
5.0000mA	0.0001mA	1.0+20	0.7+20	0.75+20	3.5+100
50.000mA	0.001mA	1.0+20	0.7+20	0.75+20	3.5+100

500.00mA	0.01mA	1.5+20	0.7+20	1.5+20	3.5+100
10.000A	0.001A	1.5+20	0.7+20	3+50	No spec

- Current measurement max 10 A within 30 second continuous measurement.

Frequency Accuracy ± (reading % + LSD)

Function	Range	Accuracy
Frequency	99.999Hz	0.02+5
	999.99Hz	0.02+5
	9.9999kHz	0.02+5
	99.999kHz	0.02+5
	999.99kHz	0.02+5
	3.00MHz	0.05+5

Resistance Accuracy ± (reading % + LSD)

Function	Range	Resolution	Accuracy
Resistance	50.000Ω	0.001Ω	0.05+30
	500.00Ω	0.01Ω	0.05+10
	5.0000kΩ	0.0001kΩ	0.05+10
	50.000kΩ	0.001kΩ	0.05+10
	500.00kΩ	0.01kΩ	0.05+10
	5.0000MΩ	0.0001MΩ	0.15+10
	50.000MΩ	0.001MΩ	1.00+10

When measure low resistance, use “Relative” function to make accurate measurement

Diode, Continuity

Function	Range	Resolution	Accuracy
Continuity	50.000Ω	0.001Ω	0.05+20
Diode Test	5.0000V	0.0001V	0.05+10

- Buzzer function (Continuity): Buzzer sounds at below 50.0Ω.

Capacitance

Range	Resolution	Accuracy	Measurement Rate
5.000 nF	0.001 nF	1+10	4/s
50.00 nF	0.01 nF	1+10	4/s
500.0 nF	0.1 nF	1+10	1/s
5.000 μF	0.001 μF	1+10	1/s
50.00 μF	0.01 μF	2+10	1/s
500.0 μF	0.1 μF	3+10	0.1/s
5.00mF	1 μF	5+10	0.1/s

- When Capacitance value is below 5nF, use “Relative” function to make accurate measurement.

□ Square Waveform Signal Out

Output	Range	Resolution	Accuracy
Frequency	10Hz	0.001Hz	0.005%
	100Hz	0.01Hz0.005%	
	1kHz	0.1Hz0.005%	
	10kHz	<2Hz0.005%	
	100kHz	<170Hz0.005%	
	1000kHz	<16kHz0.005%	
Duty Cycle	5~95%	0.1% <60kHz 1% <600kHz	±0.5%
Amplitude	Fixed(5.0V)	0.1V	±0.2V

- Out Put Impedance: Max 3.5kΩ.
- Out Put Frequency accuracy is different from Signal Frequency
- Duty Cycle and Pulse Width Accuracy is based on 5V Square wave without Signal divide.

□ Measurement Rate per function

Function	Measurement Rate
AC V	7/s
DC V	7/s
AC+DC V	2/s
Ω	14/s
Diode	14/s
Capacitance	4 (< 10μF)/s
DC A	7/s
AC A	7/s
AC+DC A	2/s

[Input Impedance]

Function	Range	Input Impedance
DC Voltage	50.000mV	10.00MΩ
	500.00mV	10.00MΩ
	5.0000V	11.10MΩ
	50.000V	10.10MΩ
	500.00V	10.01MΩ
	1000.0V	10.001MΩ
AC Voltage	50.000mV	10.00MΩ
	500.00mV	10.00MΩ
	5.0000V	11.10MΩ
	50.000V	10.10MΩ
	500.00V	10.01MΩ
	1000.0V	10.001MΩ

AC + DC Voltage	50.000mV	10.00MΩ
	500.00mV	10.00MΩ
	5.0000V	11.10MΩ
	50.000V	10.10MΩ
	500.00V	10.01MΩ
	1000.0V	10.001MΩ

- ① 5V ~ 1000V range, Dual Display. 10MΩ in parallel
- ② Below 100pF in Parallel.

□ General Specifications

[Display]

- ◆ Max 50,000counts, 240*160pixel FSTN Display.

[Power Consumption]

(without B/L) 80 Hours Continuous

[Environment]

- ◆ Temperature: 0°C ~ 50C(Operation Temperature).
- ◆ Humidity: 80% RH or less(non-condensing)

[Storage Temperature]

- ◆ -0°C ~ 70°C

[Safety]

- ◆ DMM: Category III 600V, Pollution Degree 2.

[Temp Coefficient]

- ◆ $0.15 \times (\text{Accuracy}) / ^\circ\text{C}$ (0°C ~ 18°C or 28°C ~ 55°C).

[Dimensions (L×W×H)]

- ◆ 203.5 × 94.4 × 59.0mm (8.01" × 3.71" × 2.32")

[Weight]

- ◆ 527 ± 5g (1.2 lbs) Meter only

[Battery Type]

- ◆ 1.5V x 6 AA Alkaline Battery