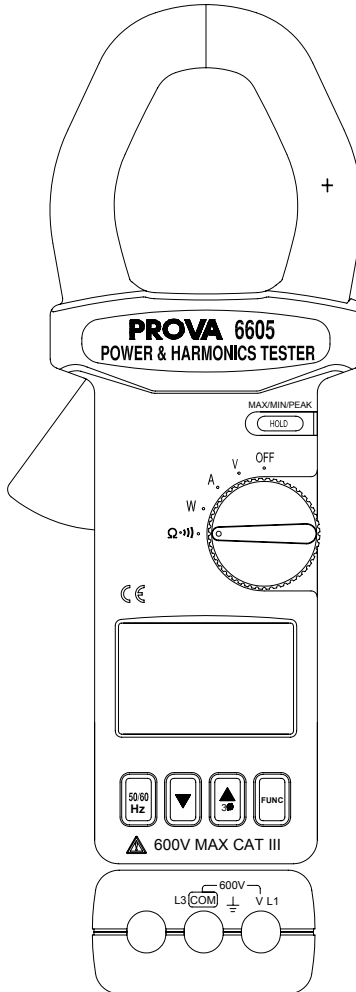


Power and Harmonics Tester

Model 6603/6605

Users Manual



PROVA INSTRUMENTS INC.



EN 61010-2-032
CAT II 600V
CAT III 300V
Pollution Degree 2

Definition of Symbols:



Caution: Refer to Accompanying Documents



Caution: Risk of Electric Shock



Double Insulation

Over-voltage Category I (CAT I):

Equipment for connection to circuits in which measures are taken to limit the transient over-voltages to an appropriate low level.

Over-voltage Category II (CAT II):

Energy-consuming equipment to be supplied from the fixed installation.

Over-voltage Category III (CAT III):

Equipment in fixed installations.

WARNING: If the clamp meter is used in a manner Not specified by the manufacturer, the protection Provided by the clamp meter may be impaired.

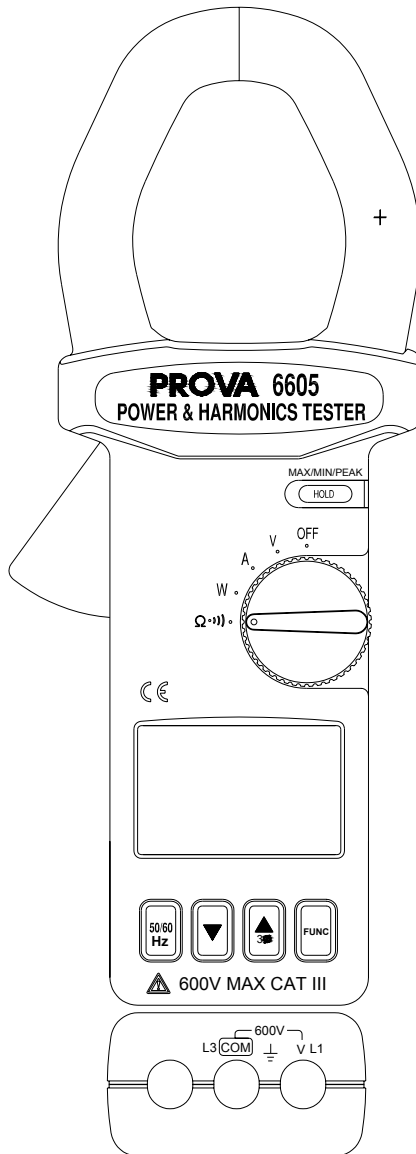
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I. FEATURES

- a. Active (W, KW, HP), reactive (VAR, KVAR) and apparent (VA, KVA) power.
- b. Power factor (PF), phase angle (Φ), and energy (WH, KWH).
- c. Non-interrupted AC current harmonic analysis.
- d. 1 to 99th order of harmonics at 0.5% basic accuracy.
- e. Total harmonic distortion (%THD-F) and crest factor (CF).
- f. True RMS measurement of V and A at 0.5% basic accuracy.
- g. Fast peak function (39 μ s for 50 Hz, 33 μ s for 60Hz).
- h. Resistance and Continuity with Beeper
- i. Measurement of balanced 3 Φ power.
- j. Measurement of balanced 3 Φ sequence.
- k. Programmable CT ratio from 1 to 250.
- l. Max, Min and data hold functions.
- m. Active power in H.P.
- n. Auto power off function in 30 minutes.

II. PANEL DESCRIPTION



1. Transformer Jaw Assembly

This is used to pick up current signal. To measure AC current or Power/Watt, the jaw must enclose conductor completely.

2. Transformer Trigger

Press the trigger to open the jaw.

3. Rotary Switch

This is used to turn the power on and select measurement of current, voltage or power.

4. MAX/MIN/HOLD/PEAK and ▼ Button

In the measurement of A, or V, press this button to perform function of MAXIMUM, MINIMUM, HOLD and PEAK. It is also used to decrement the order of harmonics or CT ratio.

If this button is hold when turning on power, the tester can perform measurement of phase sequence instead of phase angle in the balanced 3Φ power system.

5. ▲ 3Φ Button

This button is used to increment order of harmonics or CT ratio. When the rotary switch is set at W position, press this button to select measurement of balanced 3Φ power instead of single-phase power.

6. FUNC Button

In the measurement of mA, A, or V, press this button to select function of harmonics, THD-F, or CF. In the measurement of W-mA or W-A, press this button to select function of VA, VAR, PF, phase angle, HP, or energy (KWH).

7. LCD

This is a 4+2+2 digit Liquid Crystal Display. Function symbols, units, sign, decimal points, low battery symbols, max, min symbols, peak and harmonic symbols are included.

8, 9, 10, 12

Those are symbols of selected functions such as, Harmonic, PEAK, MAX, MIN or HOLD.

11. Primary Digits

These digits display the value of measurement, such as current, voltage, or power.

13. Symbols of Units

These are symbols of current, voltage, and power. There are two digits used to display the fundamental frequency 50 or 60 Hz.

14. V Input Terminal

This terminal is used as input for voltage and power measurements.

15. COM Terminal

This terminal is used as common reference input.

16. Hand Strap

Put your hand through the hole of hand strap to avoid accidental drop of the clamp meter.

18. Sliding Switch

Users should select the correct fundamental frequency (50/60 Hz) by moving the sliding switch to a correct position.

III. OPERATING INSTRUCTIONS

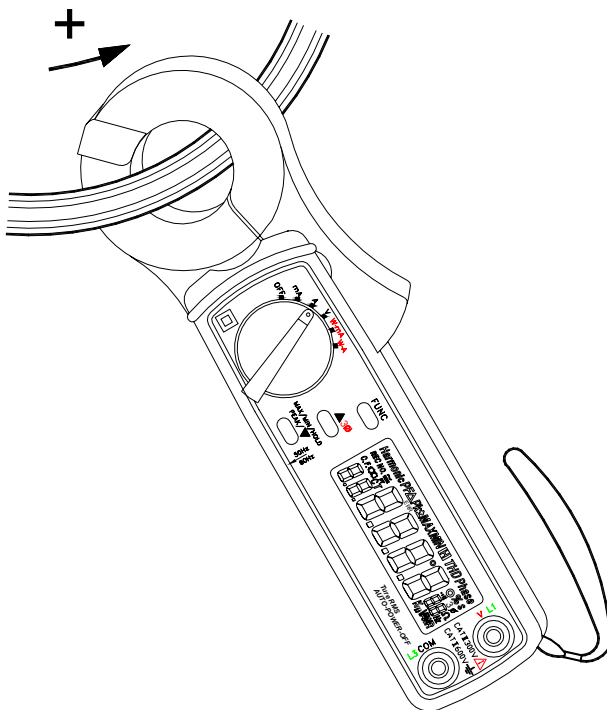
III.1. Measurement of ACA

NOTE:

1. Select the correct fundamental frequency of current by pressing the left most button. The LCD will display the 50 or 60 Hz selected.
2. Set the rotary switch at the A position.
3. If the peak value of the input AC current is greater than the maximum value of the range, then symbol of OL will be displayed.

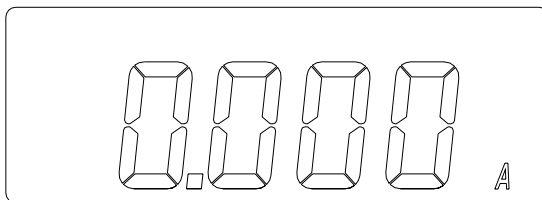
NOTE: Whenever the rotary switch is set at a new position, the CT ratio and fundamental frequency will be displayed first.

NOTE: If the CT ratio is not 1, a symbol of “CT” will be shown in the LCD display for the measurement of A.



WARNING: Make sure that all the test leads are disconnected from the meter's terminals for current measurement.

III.1.1. True RMS value of AC Current

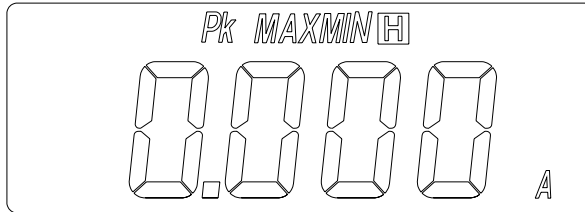


- Set the rotary switch at A. Then select the correct frequency by pressing the left most button at the bottom of the tester.
- Press the trigger to open the jaw and fully enclose the conductor to be

measured.

c. Read the measured value from the LCD display.

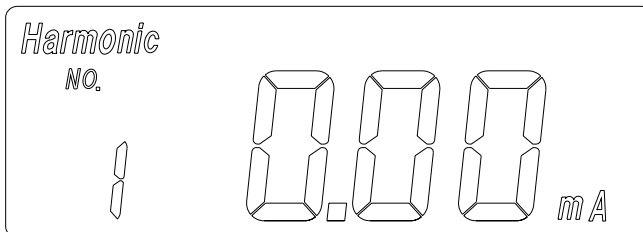
III.1.2. HOLD, MAX, MIN and PEAK of AC Current.



- Set the rotary switch at A. Then select the correct frequency by pressing the left most button at the bottom of the tester.
- Press the trigger to open the jaw and fully enclose the conductor to be measured.
- The measured value from the LCD display. If the ▼ button is pressed, the symbol of "HOLD", "MAX", "MIN" or "PEAK" will be shown in LCD alternatively. And the value of the HOLD, MAX, MIN or PEAK function will be displayed in LCD alternatively.
- To return to the display of current measurement, hold the ▼ button for more than 2 seconds.

NOTE: The PEAK function displays the maximum value of the input waveform. The sampling time for the PEAK function is 39 μ s (50Hz) or 33 μ s (60Hz). The HOLD, MAX, or MIN function displays the true RMS value.

III.1.3. Harmonics of AC Current in Magnitude

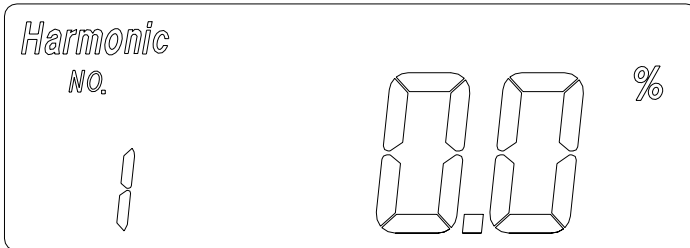


- Set the rotary switch at A. Then select the correct frequency by pressing the left most button at the bottom of the tester.
- Press the trigger to open the jaw and fully enclose the conductor to be

measured.

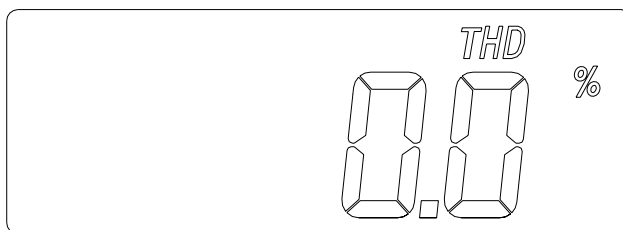
- c. Press the FUNC button once. The symbols of “Harmonic” and “NO” will be shown in LCD. The n-th order (1 to 99) will be shown in front of the reading of the magnitude (mA or A) of the current.
- d. Press the ▲ or ▼ button to increment or decrement the order of harmonics in front of the reading. The number will roll over when the maximum (99) or minimum (1) is reached.

III.1.4. Harmonics of AC Current in Percentage (%)



- a. Set the rotary switch at A position. Then select the correct frequency by pressing the left most button at the bottom of the tester.
- b. Press the trigger to open the jaw and fully enclose the conductor to be measured.
- c. Press the FUNC button twice. The symbols of “Harmonic” and “NO” will be shown in LCD. The n-th order (1 to 99) will be shown in front of the reading of the percentage (%) of the current.
- d. Press the ▲ or ▼ button to increment or decrement the order of harmonics in front of the reading. The number will roll over when the maximum (99) or minimum (1) is reached.

III.1.5. Total Harmonic Distortion (% THD-F)



- Set the rotary switch at A. Then select the correct frequency by pressing the left most button at the bottom of the tester.
- Press the trigger to open the jaw and fully enclose the conductor to be measured.
- Press the FUNC button three times. The symbols of “THD” and “%” will be shown in LCD. The total harmonic distortion in percentage with respect to the fundamental frequency (50 or 60 Hz) will be measured and displayed.

$$\%THD-F = (\sqrt{V2^2 + V3^2 + \dots + V98^2 + V99^2} / V1) * 100$$

Where,

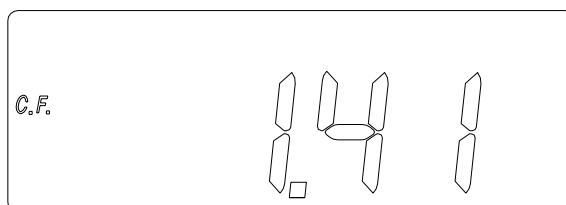
V1: magnitude at the fundamental frequency

V2: magnitude at the second harmonics

...

V99: magnitude at the 99-th harmonics.

III.1.6. Crest Factor (C.F.)



- Set the rotary switch at A. Then select the correct frequency by pressing the left most button at the bottom of the tester.
- Press the trigger to open the jaw and fully enclose the conductor to be measured.

- c. Press the FUNC button four times. The symbols of C.F. will be shown in LCD. The crest factor (C.F.) will be measured and displayed. The crest factor (CF) is defined as following:

$$\text{C.F.} = (\text{peak value}) / (\text{RMS value})$$

III.2 Measurement of AC Voltage

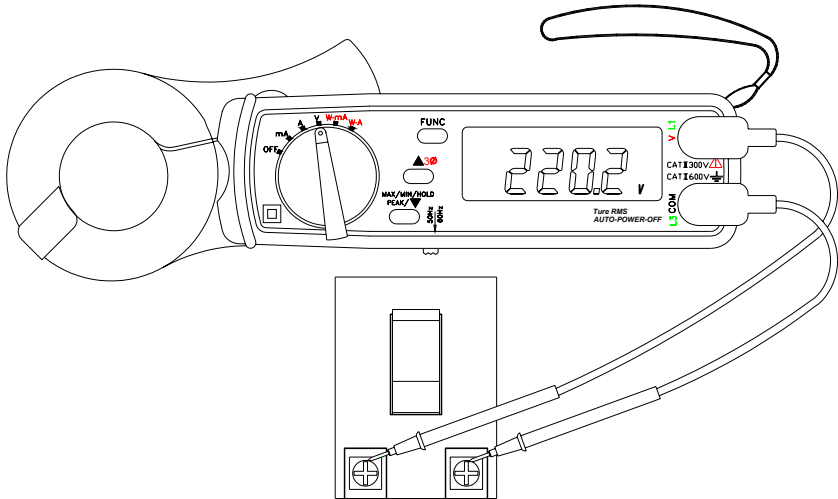
NOTE:

1. Select the correct fundamental frequency of voltage by moving the sliding switch at the side of the tester.
2. If the peak value of the input AC voltage is greater than the maximum value of the range, then symbol of OL will be displayed.

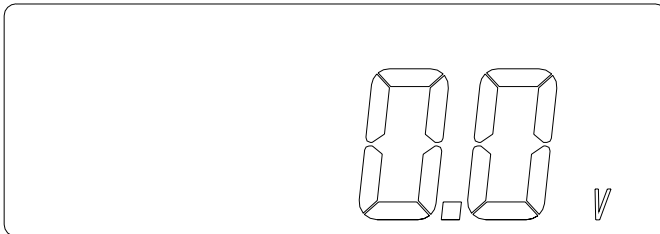
NOTE: Whenever the rotary switch is set at a new position, the CT ratio and fundamental frequency will be displayed first.

NOTE: If the CT ratio is not 1, a symbol of “CT” will be shown in the LCD display.

WARNING: Maximum input for ACV is 600. Do not attempt to take any voltage measurement that exceeds the limits. Exceeding the limits could cause electrical shock and damage to the clamp meter.

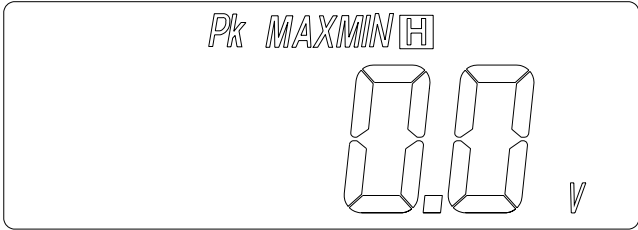


III.2.1. True RMS value of AC Voltage



- Set the rotary switch at position V. Then select the correct fundamental frequency by moving the sliding switch at the side of the tester.
- Insert the test leads into the input jack. Connect the test prods of the test leads in PARALLEL to the circuit to be measured.
- Read the measured RMS value from the LCD display.

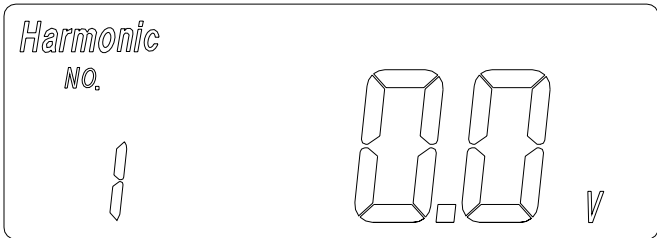
III.2.2. HOLD, MAX, MIN and PEAK value of AC Voltage



- Set the rotary switch at position V. Then select the correct fundamental frequency by moving the sliding switch at the side of the tester.
- Insert the test leads into the input jack. Connect the test prods of the test leads in PARALLEL to the circuit to be measured.
- The measured value is displayed in the LCD display. If the ▼ button is pressed, the symbol of "HOLD", "MAX", "MIN" or "PEAK" will be shown in LCD alternatively. And the value of the HOLD, MAX, MIN or PEAK function will be displayed in LCD alternatively.
- To return to the display of current measurement, hold the ▼ button for more than 2 seconds.

NOTE: The PEAK function displays the maximum value of the input waveform. The sampling time for the PEAK function is 0.5 ms. The HOLD, MAX, or MIN function displays the true RMS value.

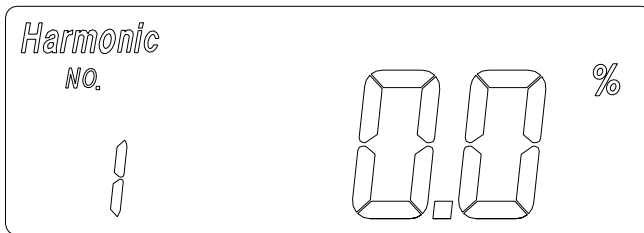
III.2.3. Harmonics of AC Voltage in Magnitude (V)



- Set the rotary switch at position V. Then select the correct fundamental frequency by moving the sliding switch at the side of the tester.
- Insert the test leads into the input jack. Connect the test prods of the test leads in PARALLEL to the circuit to be measured.

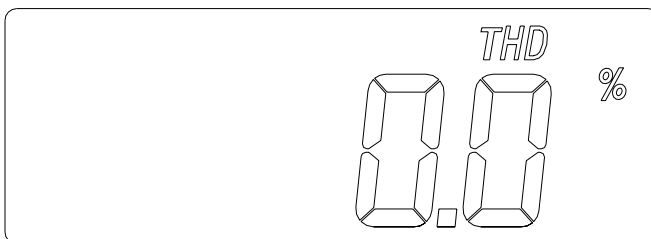
- c. Press the FUNC button once. The symbols of “Harmonic” and “NO” will be shown in LCD. The n-th order (1 to 99) will be shown in front of the reading of the magnitude (V) of the voltage.
- d. Press the ▲ or ▼ button to increment or decrement the order of harmonics in front of the reading. The number will roll over when the maximum (99) or minimum (1) is reached.

III.2.4. Harmonics of AC Voltage in Percentage (%)



- a. Set the rotary switch at position V. Then select the correct fundamental frequency by moving the sliding switch at the side of the tester.
- b. Insert the test leads into the input jack. Connect the test prods of the test leads in PARALLEL to the circuit to be measured.
- c. Press the FUNC button twice. The symbols of “Harmonic” and “NO” will be shown in LCD. The n-th order (1 to 99) will be shown in front of the reading of the percentage (%) of the voltage.
- d. Press the ▲ or ▼ button to increment or decrement the order of harmonics in front of the reading. The number will roll over when the maximum (99) or minimum (1) is reached.

III.2.5. Total Harmonic Distortion (% THD-F)



- Set the rotary switch at position V. Then select the correct fundamental frequency by moving the sliding switch at the side of the tester.
- Insert the test leads into the input jack. Connect the test prods of the test leads in PARALLEL to the circuit to be measured.
- Press the FUNC button three times. The symbols of “THD” and “%” will be shown in LCD. The total harmonic distortion in percentage with respect to the fundamental frequency (50 or 60 Hz) will be measured and displayed.

$$\%THD-F = (\sqrt{V2^2 + V3^2 + \dots + V98^2 + V99^2} / V1) * 100$$

Where,

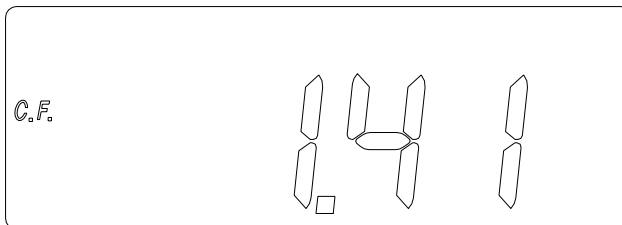
V1: magnitude at the fundamental frequency

V2: magnitude at the second harmonics

...

V99: magnitude at the 99-th harmonics.

III.2.6. Crest Factor (C.F.)



- Set the rotary switch at position V. Then select the correct fundamental frequency by moving the sliding switch at the side of the tester.
- Insert the test leads into the input jack. Connect the test prods of the test leads in PARALLEL to the circuit to be measured.
- Press the FUNC button four times. The symbols of C.F. will be shown in LCD. The crest factor (C.F.) will be measured and displayed. The crest factor (CF) is defined as following:

$$\text{C.F. (Crest Factor)} = (\text{Peak Value}) / (\text{RMS Value})$$

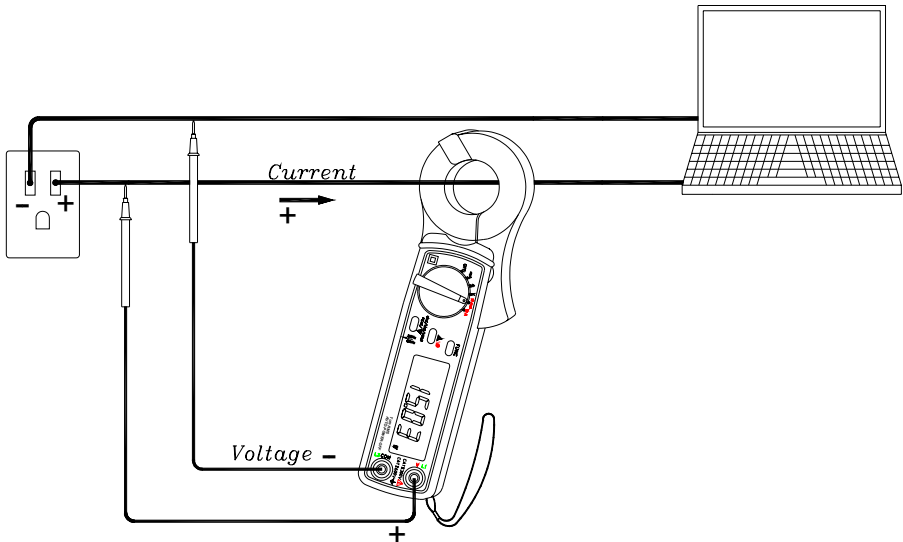
III.3 Measurement of Single Phase AC Power Quality (21, 23)

NOTE:

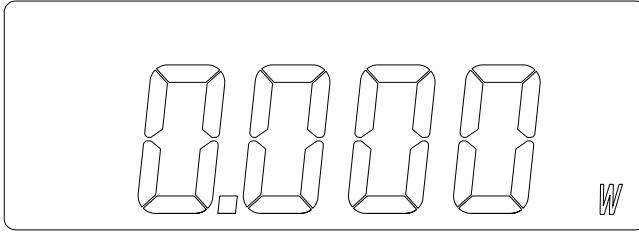
1. Select the correct fundamental frequency of current and voltage by moving the sliding switch at the side of the tester.
2. Set the rotary switch at the W position.
3. If the peak value of the input AC current is greater than the maximum value of the range, then symbol of OL will be displayed.

NOTE: Whenever the rotary switch is set at a new position, the CT ratio and fundamental frequency will be displayed first.

NOTE: If the CT ratio is not 1, a symbol of “CT” will be shown in the LCD display for the measurement of W.

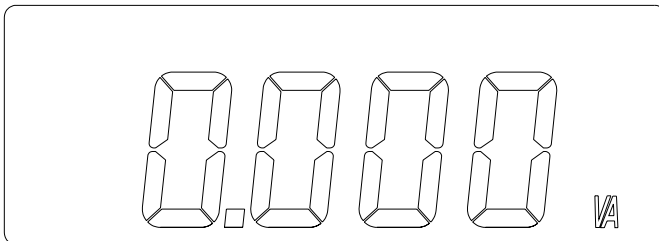


III.3.1 Single Phase AC Watt



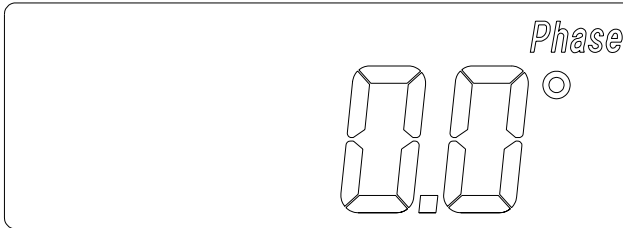
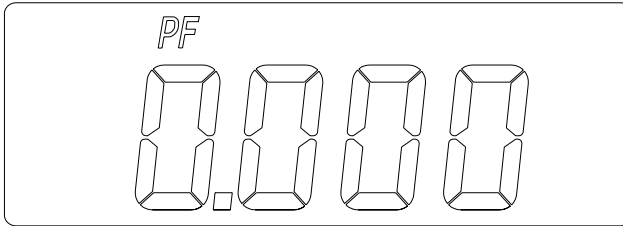
- Connect the test leads to the voltage source in parallel with the load.
- Clamp on one of the wire to the load. The current should flow from the front of the tester to the side of the battery cover.
- Set the rotary switch at the W position.
- Read the value shown on LCD in W, or KW. The unit of watt is automatically scaled.

III.3.2. Apparent Power (VA, KVA) and Reactive Power (VAR, KVAR)



- Connect the test leads to the voltage source in parallel with the load.
- Clamp on one of the wire to the load. The current should flow from the front of the tester to the side of the battery cover.
- Set the rotary switch at the W position.
- The value of mW, W, or KW will be displayed in LCD. The unit of watt is automatically scaled.
- Press the FUNC button once to display VA or KVA. The unit is automatically scaled.
- Press the FUNC button twice to display VAR or KVAR. The unit is automatically scaled.

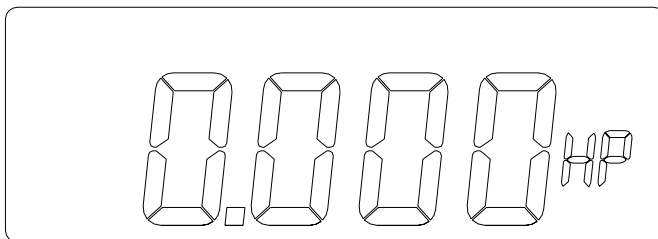
III.3.3. Power Factor (PF), and Phase Angle (Φ)



- Connect the test leads to the voltage source in parallel with the load.
- Clamp on one of the wire to the load. The current should flow from the front of the tester to the side of the battery cover.
- Set the rotary switch at the W position.
- The value of mW, W, or KW will be displayed in LCD. The unit of watt is automatically scaled.
- Press the FUNC button three times to display PF from 0.000 to 1.000.
- Press the FUNC button four times to display phase angle (Φ) from -180° to $+180^\circ$.

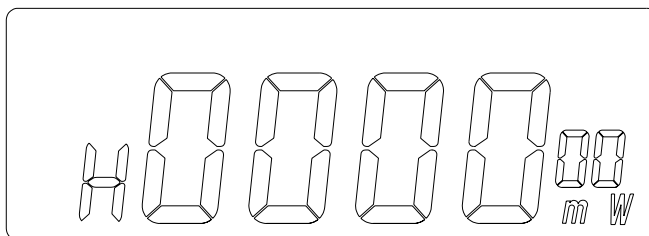
NOTE: To display phase angle (Φ) from 0 to 360, hold the ▼ button, then turn the power on. Once the tester is turned on in this way, the tester will display phase angle from 0 to 360° (when phase angle function is selected).

III.3.4. Horse Power (H.P.)



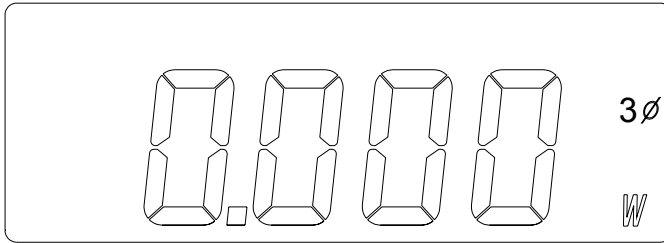
- Connect the test leads to the voltage source in parallel with the load.
- Clamp on one of the wire to the load. The current should flow from the front of the tester to the side of the battery cover.
- Set the rotary switch at the W position.
- The value of mW, W, or KW will be displayed in LCD. The unit of watt is automatically scaled.
- Press the FUNC button five times to display power in the unit of HP.

III.3.5. Energy (WH, or KWH)



- Connect the test leads to the voltage source in parallel with the load.
- Clamp on one of the wire to the load. The current should flow from the front of the tester to the side of the battery cover.
- Set the rotary switch at the W position.
- The value of W, or KW will be displayed in LCD. The unit of watt is automatically scaled.
- Press the FUNC button six times. A character of H is displayed in front of reading to indicate energy (WH, or KWH). The energy is displayed in 6 digits (Four large digits and two small digits). The energy will be reset to zero at the beginning when this function is selected.

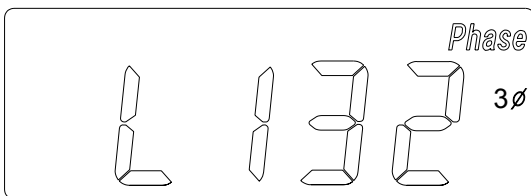
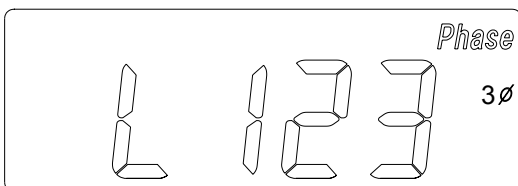
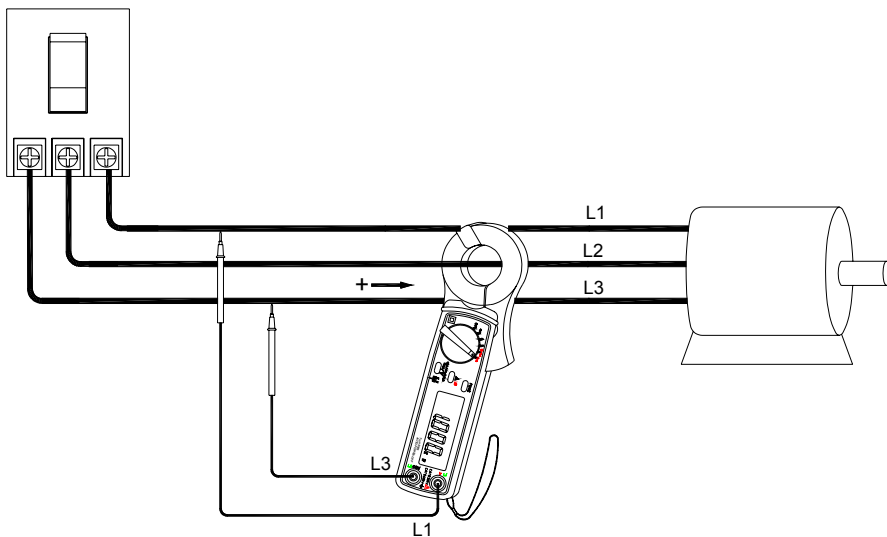
III.4 Measurement of the Balanced 3 Phase AC Power Quality



- Connect the black test lead to the voltage L3, and connect the red test lead to L1.
- Clamp on one of the wire to L2. The current should flow from the front of the tester to the side of the battery cover.
- Set the rotary switch at the W position.
- Press the ▲ button to select balanced 3Φ. Symbols of “3Φ3W, 3Φ4W, and BAL” will be shown in LCD.
- The value of W, or KW will be displayed in LCD. The unit of watt is automatically scaled.

NOTE: Users can also obtain the measurements of VA, VAR, PF, Phase Angle, HP, and energy (WH) for balanced 3Φ power system. The operations are the same as the measurements for the single-phase power system.

III.5 Measurement of the Balanced 3 Phase Sequence



- Hold the ▼ button, and then turn the power on. Set the rotary switch at the W position.
- Connect the black test lead to the voltage L3, and connect the red test lead to L1.
- Clamp on one of the wire to L2. The current should flow from the front of the tester to the side of the battery cover.
- Press the ▲ button to select 3 phase power system. A symbol of 3Φ will be

shown in LCD.

- e. Press the FUNC button to select phase angle function. The LCD will show L123 to indicate the clockwise sequence. Or the LCD will show L132 to indicate counter clockwise sequence.

III.6 Measurement of Resistance and Continuity with Beeper

- a. Set the rotary switch at Ω
- b. Insert the test leads into the input jack.
- c. Connect the test prods of the test leads to the two ends of the resistor or circuit to be measured.
- d. Read the measured value from the LCD display.
- e. If the resistance is lower than 50 Ω , a beeping sound shall be heard.

IV. SET THE CT RATIO

To set the CT ratio, hold the FUNC button, and then turn the power on. A symbol of "CT" will be shown in LCD. The default value of CT is 1. To change the CT ratio, users can press the ▲ or ▼ button to increment or decrement the value by 1. Holding the ▲ or ▼ button will speed up the process of incrementing or decrementing.

To exit the setting of CT ratio, press the FUNC button.

V. DISABLE AUTO-POWER-OFF

The tester has an auto-power-off function. The tester will turn the power off after power is turned on for 30 minutes. To disable the auto power off function, hold the FUNC button for more than 2 seconds. A beep sound will be heard to indicate that the auto power off function is disabled.

VI. SPECIFICATIONS(23°C±5°C)

AC Watt (50 or 60 Hz, PF 0.5 to 1. CT = 1, Voltage > AC 3V, Current > AC 0.3A for A range, and continuous waveform)

Model 21

Range (0 to 30A)	Resolution	Accuracy of Readings ¹
0.000 – 9.999 W	0.001W	±1% ± 0.02W
10.00 – 99.99 W	0.01W	±1% ± 0.2W
100.0 999.9 W	0.1W	±1% ± 0.2W
1.000 – 9.999 KW	0.001 KW	±1% ± 0.02KW
10.00 – 99.99 KW	0.01 KW	±1% ± 0.2KW
100.0 – 999.9 KW	0.1 KW	±1% ± 0.2KW
1000 – 9999 KW	1 KW	±1% ± 2KW

Model 23

Range (0 to 60A)	Resolution	Accuracy of Readings ¹
0.000 – 9.999 W	0.001W	±1% ± 0.02W
10.00 – 99.99 W	0.01W	±1% ± 0.2W
100.0 999.9 W	0.1W	±1% ± 0.2W
1.000 – 9.999 KW	0.001 KW	±1% ± 0.02KW
10.00 – 99.99 KW	0.01 KW	±1% ± 0.2KW
100.0 – 999.9 KW	0.1 KW	±1% ± 0.2KW
1000 – 9999 KW	1 KW	±1% ± 2KW

¹For CT ≠1, the accuracy in percentage is the same (±1%). But the additional wattage should be multiplied by the CT ratio.

For example, ±0.02W becomes ±0.02W * CT ratio

Model 21 Range (30 – 50A) Model 23 Range (60 – 100A)	Resolution	Accuracy ²
0.000 – 9.999 W	0.001W	±2% of VA ± 5dgts
10.00 – 99.99 W	0.01W	±2% of VA ± 5dgts
100.0 999.9 W	0.1W	±2% of VA ± 5dgts
1.000 – 9.999 KW	0.001 KW	±2% of VA ± 5dgts
10.00 – 99.99 KW	0.01 KW	±2% of VA ± 5dgts
100.0 – 999.9 KW	0.1 KW	±2% of VA ± 5dgts
1000 – 9999 KW	1 KW	±2% of VA ± 5dgts

²For CT ≠1, the accuracy in percentage is the same (±2%). But the additional digits should be multiplied by the CT ratio.

For example, ±5 digits becomes ±5 digits * CT ratio

Range of CT Ratio: 1 to 250

H.P. (Horse Power)

$$\text{H.P.} = W / 746$$

AC Apparent Power (VA, from 0.000VA to 9999 KVA)

$$\text{VA} = V \text{ r.m.s.} \times A \text{ r.m.s}$$

AC Reactive Power (VAR, from 0.000 VAR to 9999 KVAR)

$$\text{VAR} = \sqrt{(\text{VA}^2 - W^2)}$$

AC Active Energy (mWH, WH, or KWH, from 0 mWH to 999,999 KWH)

$$\text{WH} = W * \text{Time (in hours)}$$

AC Current (50 or 60 Hz, Auto Range, True RMS, Crest Factor < 4, CT=1, Overload Protection AC 600A)

Model 19,21

Range	Resolution	Accuracy of Readings ³
0.30 – 60.00 mA	0.01 mA	±0.5% ± 5dgts
60.0 – 600.0 mA	0.1 mA	±0.5% ± 5dgts
0.030 – 3.000 A	0.001 A	±0.5% ± 5dgts
3.00 – 30.00 A	0.01 A	±0.5% ± 5dgts
30.00 – 50.00 A	0.01 A	±1.0% ± 5dgts

³For CT ≠ 1, the accuracy in percentage is the same (±0.5%). But the additional digits should be multiplied by the CT ratio.

For example, ±5 dgts becomes ±5 dgts * CT ratio

Model 23

Range	Resolution	Accuracy of Readings ⁴
0.30 – 60.00 mA	0.01 mA	±0.5% ± 5dgts
60.0 – 600.0 mA	0.1 mA	±0.5% ± 5dgts
0.030 – 9.999 A	0.001 A	±0.5% ± 5dgts
10.00 – 60.00 A	0.01 A	±0.5% ± 5dgts
60.00 – 99.99 A	0.01 A	±1.0% ± 5dgts

⁴For CT ≠ 1, the accuracy in percentage is the same (±0.5%). But the additional digits should be multiplied by the CT ratio.

For example, ±5 dgts becomes ±5 dgts * CT ratio

AC Voltage (50 or 60 Hz, Auto Range, True RMS, Crest Factor < 4, Input Impedance 10 MΩ, Overload Protection AC 800V)

Model 19, 21, 23

Range	Resolution	Accuracy of Readings
3 V – 250 V	0.1 V	±0.5% ± 5dgts
250 V – 600 V	0.1 V	±0.5% ± 5dgts

Harmonics of AC Voltage in Percentage (1 to 99th order, minimum voltage at the fundamental frequency > AC 50V)

Model 19, 21, 23

Range	Resolution	Accuracy
50V – 600V	0.1 %	±0.5%

Harmonics of AC Voltage in Magnitude (1 to 99th order, minimum voltage at the fundamental frequency > AC 50V)

Model 19, 21, 23

Range	Resolution	Accuracy
50V – 600V	0.1 V	±0.5% ±0.5V

Harmonics of AC Current in Percentage (1 to 99th order, minimum current at the fundamental frequency > 10mA for mA range, and > 0.5A for A range)

Model 19, 21

Range	Resolution	Accuracy
10.00 – 60.00mA	0.1 %	±0.5%
60.0 – 600.0mA	0.1 %	±0.5%
0.5 – 3.000 A	0.1 %	±0.5%
3.00 – 30.00 A	0.1 %	±0.5%
30.00 – 50.00A	0.1%	±1.0%

Model 23

Range	Resolution	Accuracy
10.00 – 60.00mA	0.1 %	±0.5%
60.0 – 600.0mA	0.1 %	±0.5%
0.5 – 9.999 A	0.1 %	±0.5%
10.00 – 60.00 A	0.1 %	±0.5%
60.00 – 99.99 A	0.1 %	±1.0%

Harmonics of AC Current in Magnitude (1 to 99th order, minimum current at the fundamental frequency > 0.5A for A range)

Model 19, 21

Range	Resolution	Accuracy of Readings
10.00 – 60.00mA	0.01mA	±0.5% ± 0.1mA
60.0 – 600.0mA	0.1mA	±0.5% ± 1mA
0.5 – 3.000 A	0.001A	±0.5% ± 0.01A
3.00 – 30.00 A	0.01A	±0.5% ± 0.1A
30.00 – 50.00 A	0.01A	±1.0% ± 0.1A

Model 23

Range	Resolution	Accuracy of Readings
10.00 – 60.00mA	0.01mA	±0.5% ± 0.1mA
60.0 – 600.0mA	0.1mA	±0.5% ± 1mA
0.5 – 9.999 A	0.001A	±0.5% ± 0.01A
10.00 – 60.00 A	0.01A	±0.5% ± 0.1A
60.00 – 99.99 A	0.01A	±1.0% ± 0.1A

Power Factor (PF)

Model 21, 23

Range	Resolution	Accuracy (in degree)
0.000 – 1.000	0.001	± 1°

Phase Angle (Φ)

Model 21, 23

Range	Resolution	Accuracy
-180° to 180°	0.1°	± 1°
0° to 360°	0.1°	± 1°

Total Harmonic Distortion (THD-F with respect to the fundamental frequency, min. value at the fundamental frequency > 50V, > 10mA for mA range, > 0.5A for A range, 1 to 99th Harmonics)

Model 19, 21, 23

Range	Resolution	Accuracy of Readings
0.0 – 999.9 %	0.1%	± 0.5% ± 5 digits

Peak Value of AC Voltage (peak value > 5V) or AC Current (peak value > 10mA for mA range and peak value > 0.5A for A range)

Model 19, 21, 23

Range	Sampling Time	Accuracy of Reading
50 Hz	39 μ s	$\pm 5\% \pm 30$ digits
60 Hz	33 μ s	$\pm 5\% \pm 30$ digits

Crest Factor (C.F.) of AC Voltage (peak value > 5V) or AC Current (peak value > 10mA for mA range and peak value > 0.5A for A range)

Model 19, 21, 23

Range	Resolution	Accuracy of Readings
1.00 – 99.99	0.01	$\pm 5\% \pm 30$ digits

Indoor Use

Conductor Size: 55mm (approx.), 64 x 24mm (bus bar)
Battery Type: two 1.5V SUM-3
Display: 4+2+2 digits LCD
Range Selection: Auto
Overload Indication: OL
Power Consumption: 10mA (approx.)
Low battery Indication:



Auto-Power-Off: 30 minutes after power-on
Update Time: 2 times/sec. (display)
No. Of Samples per Period 512 (voltage or current)

256 (power)

Operating Temperature: -10°C to 50°C
Operating Humidity: less than 85% relative
Altitude: up to 2000M

Storage Temperature: -20°C to 60°C

Storage Humidity: less than 75% relative

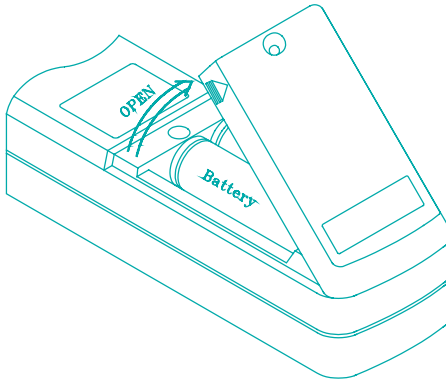
Dimension: 210mm (L) x 62mm (W) x 35.6mm (H)
8.3" (L) x 2.5" (W) x 1.4" (H)

Weight: 640g (battery included)

Accessories: test leads
Carrying bag x 1
Users manual x 1
Batteries 1.5V x 2

Option: Alligator clips

VII. BATTERY REPLACEMENT



When the low battery symbol is displayed on the LCD, replace the old batteries with two new batteries.

- A. Turn the power off and remove the test leads from the clamp meter.
- B. Remove the screw of the battery compartment.
- C. Lift and remove the battery compartment.
- D. Remove the old batteries.
- E. Insert two new 1.5V SUM-3 batteries.
- F. Replace the battery compartment and secure the screw.

VIII. MAINTENANCE & CLEANING

Servicing not covered in this manual should only be performed by qualified personnel. Repairs should only be performed by qualified personnel. Periodically wipe the case with a damp cloth and detergent; do not use abrasives or solvents.

Address of Agent, Distributor, Importer, or Manufacturer