User's Manual

EXTECH INSTRUMENTS

Test Equipment Depot
1-800-517-8431

99 Washington Street
Melrose, MA 02176
Phone 781-665-1400
Toll Free 1-800-517-8431

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Model 382075
3ϕ/1ϕ Power Clamp-on Meter

Introduction

Congratulations on your purchase of the Extech Model 382075 Auto Range Power Clamp-On Meter. Careful use of this device, will provide years of reliable service.

Meter Functional Description

1. Transformer Jaw

Used to sense current signal. To measure current or power, the conductor under test must be fully enclosed by the jaw.

2. Transformer Trigger

Press to open the jaw.

3. Data Hold Button

Press to freeze most recent reading on the LCD. Press again to release.

4. Function Select and On/Off Switch

Select desired function, such as KW, V, A, KVA, or 3ϕ.

5. LCD Display

4-digit (9999 count) display with function symbols, units, decimal point, low battery icon, and zero indication.

6. Units Symbols

Once a function is selected, the corresponding unit (KW, V, A, Phase, KVA, or 3ϕ) will be displayed.

7. 3ϕ3W and 3ϕ4W Select Button

If the 3ϕ system is not a balanced system, users can press this button to select 3ϕ3W, 3ϕ4W or a balanced system. Once the button is pressed, the LCD displays 3ϕ3W or 3ϕ4W depending on the function selected.

Figure 1

8. Read/Next Button

- When the rotary switch is set to the 3ϕ function, the READ/NEXT button is used as a NEXT button. In the 3ϕ balanced mode, pressing the NEXT button will display W+PF, KVA+KVAR, or V+A data.
- In the 3ϕ3W mode, pressing the NEXT button stores the measured values $W_{RS(L1L2)}$ and $W_{TS(L3L2)}$. After two values are measured and stored, the meter adds the two values, displays the result with the symbol W_{RST} to represent $W_{3\phi3W}$. To start another $W_{3\phi3W}$ measurement, press the NEXT button again.
- In the 3ϕ4W system mode, press the NEXT button to store the measured values $W_{R(L1)}$, $W_{S(L2)}$ and $W_{T(L3)}$. After three values are measured and stored, the meter adds the three values, displays the result with the symbol W_{RST} to represent $W_{3\phi4W}$. To start another $W_{3\phi4W}$ measurement, press the NEXT button again.
- If the rotary switch is not set to the 3ϕ function, the READ/NEXT button is used as a READ button. Stored data in memory (saved by pressing the REC button) can be read by pressing READ.

9. & 10. V and COM Input Terminals

Used as positive and negative (common) inputs for voltage measurements.

11. DC A/W ZERO button

Press this button once to zero the Amp or Watt display. While the meter is zeroing, the word ZERO appears the LCD.

12. REC button

Press the REC button to store up to 4 data points in meter memory.

Operating Instructions

NOTE: Ensure that the jaws are clear of any conductors before applying power to the meter. The meter performs an auto zero upon power-up to null any residual magnetism. If this is done with a conductor inside the jaw area, the auto zero function will cause subsequent measurements to be inaccurate.

DC/AC 1ϕ2W Power (W) and Power Factor (PF) measurements

1. Apply power to the meter with the jaws clear of any conductors.
2. Set the rotary switch to the Watts function (KW).
3. If the watt reading is not zero, press the DCA/DCW ZERO button once to zero it.
4. Insert the test leads into the input terminals.
5. Connect the COM (black) terminal to the neutral line.
6. Connect the V (red) terminal to the power line.
7. Clamp on to the line where the V (red) terminal is connected. The power clamp will automatically select the proper measurement range. Read the Watt and PF (Power Factor) values displayed on the LCD.

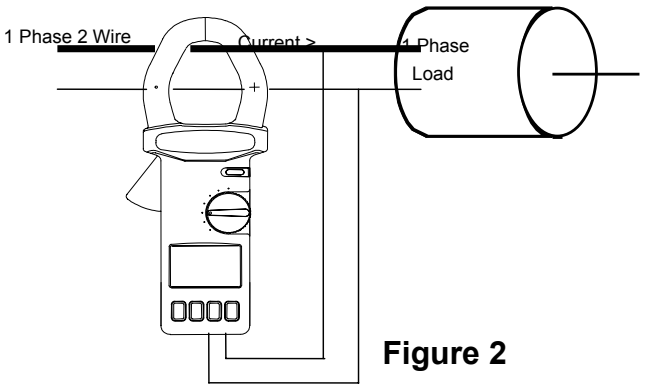


Figure 2

NOTE: The "+" sign printed on jaw must face the power source for accurate measurements.

AC/DC Voltage Measurements

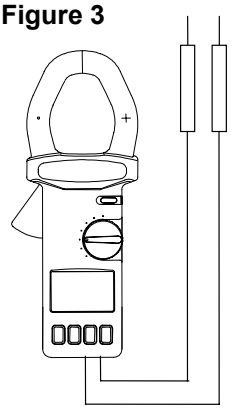
Voltage (V) and Frequency (Hz) Dual Display

WARNING: Maximum input voltages: 1000VDC and 750VAC. Do not attempt to measure voltage that exceeds these limits.

1. Set the rotary switch to the Voltage position (V).
2. Insert the test leads into the input terminals.
3. Connect the test leads in PARALLEL with the circuit to be measured.
4. The power clamp will automatically select the proper range.
5. Read the voltage and Frequency values displayed on the LCD.

NOTE: The sensitivity for voltage/frequency measurements is 1V, and the frequency range is 10 - 400Hz. If the frequency is < 10 Hz, the LCD will indicate 0 Hz. If the frequency is > 400 Hz, LCD will show OL.

Figure 3



Voltage(V) / Current (A) Dual Display

Follow the instructions in the section entitled "3ϕ Balanced Power Measurements" to monitor V and A simultaneously.

AC/DC Current Measurements

Current (A) + Frequency (Hz) Dual Display

WARNING:
1. When applying power to the meter, make sure the clamp jaws are not near a conductor.
2. Make sure that test leads are disconnected from the meter during current measurements.

1. Set the rotary switch to the Amps position (A).
2. Push and hold the DCA/DCW ZERO button to zero the reading.
3. Press the trigger to open the jaw and fully enclose the conductor to be measured. The Jaws must be completely closed to make a measurement (see Fig.4).
4. Read the current/frequency values on the LCD.

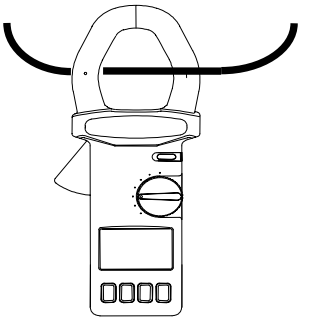


Figure 4

NOTE: The sensitivity for current/frequency measurement is 5A, and the frequency range is 10 - 400Hz. If the frequency is < 10 Hz, the LCD will display 0 Hz. If the frequency is > 400 Hz, LCD will display "OL".

Voltage (V) and Current (A) Dual Display

Follow the instructions in the section entitled "3ϕ Balanced Power Measurements" to monitor Voltage and Current simultaneously.

DC/AC 1ϕ2W Apparent/Reactive Power Measurements (KVA+KVAR)

NOTE: Before taking any measurements, zero the current (A) reading and set the rotary switch to the KVA position.

Follow the steps listed in section entitled DC+AC 1ϕ2W Power (W) and Power Factor (PF) measurement for these measurements. KVAR is a calculated value, and its accuracy greatly depends on the accuracy of the V, A, and KW readings. To obtain a more accurate KVAR value when PF is greater than 0.91 ($\phi < 25°$), measure the phase angle and obtain the KVAR from the following equation for a pure sine wave:

$$\mathbf{KVAR = KVA * \sin \phi}$$

Phase Angle Measurements

1. Set the rotary switch to the A position. If the current reading is not zero, press the DCA ZERO button.
2. Set the rotary switch to the Phase position.
3. Insert the test leads into the input jacks.
4. Connect the test lead inserted in the COM (black) terminal to the reference line.
5. Connect the test lead connected to the V (red) terminal to the voltage signal under test.
6. Clamp on to the wire where the V (red) terminal is connected (see Fig.5).
7. If current signal is detected from the jaws, the phase angle will be displayed in degrees on the LCD together with the frequency of the voltage.
8. If current is not detected, only the frequency of the voltage will be displayed while the phase angle display will be left blank.

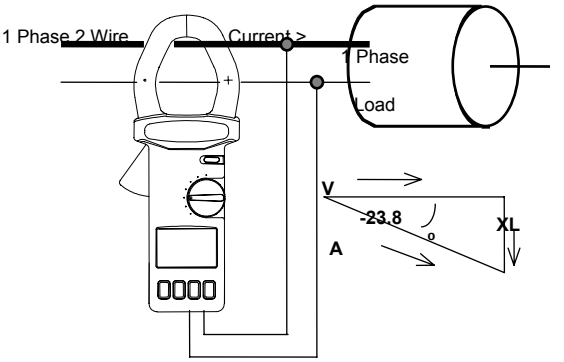


Figure 5

NOTE: Zero the current (A) reading before measuring to avoid incorrect Phase Angle readings.

INDUCTIVE LOAD: A negative phase angle indicates that the current signal lags the voltage signal. A negative phase angle also indicates an inductive load.
CAPACITIVE LOAD: A positive phase angle indicates that the current signal leads the voltage signal. A positive phase angle also indicates a capacitive load.

NOTE: The "+" sign printed on the clamp jaw must face the power source for correct readings.

3ϕ Balanced Power Measurements

Power (W) and Power Factor (PF) Dual Display

1. Apply power to the meter with the jaw clear of any conductors.
2. Set the rotary switch to the 3ϕ position.
3. The LCD will show 3ϕ3W, 3ϕ4W, and BAL symbols to indicate balanced mode.
4. If the watt reading is not zero, press the DCA/DCW ZERO button once to zero reading
5. Insert the test leads into the input terminals.
6. Select one phase (R or L1) as COM and Connect the COM (black) terminal to the same phase just selected (R or L1).

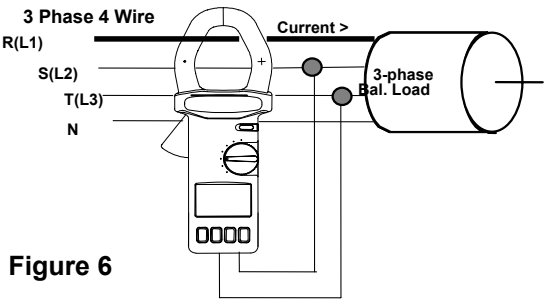


Figure 6

7. Connect another test lead to the second phase (S or L2). See Fig. 6.
8. Clamp on to the third phase (T or L3).
9. The power clamp will automatically select proper range.
10. Read the Watt and PF values displayed on the LCD.
11. To view the KVA and KVAR data, press the NEXT button.
12. To view V and A, press the NEXT button again.
13. To return to the W and PF display, press the NEXT button again.

KVA/KVAR Dual Display

Follow steps 1 through 10. in the above section and press the NEXT button. Wait approx. 2 seconds for the LCD to display the KVA and KVAR.

Voltage (V) and Current (A) Dual Display

Follow steps 1 through 10 in the above section and press the NEXT button twice. Wait approx. 2 seconds for the LCD to display Voltage (V) and Current (A).

NOTE: Specific selection of each phase is not required in 3ϕ balanced power measurement mode. As long as each test lead and the jaws are connected to different phases, the reading is always correct. The "+" sign printed on jaw must face the power source for accurate measurement.

NOTE: To find out if a load is capacitive or inductive, refer to the section entitled "Phase Angle Measurements".

3ϕ3W Unbalanced Power Measurements

Two measurements W_{RS} (or W_{L1L2}) and W_{TS} (or W_{L3L2}) are required. Refer to Fig. 7.

1. First measure W_{RS} (or W_{L1L2})
   a. Apply power to the meter with the jaw clear of any conductors.
   b. Set the rotary switch to the 3ϕ position.
   c. Press the 3ϕ button once, the 3ϕ3W symbol will display on the LCD. At this moment, the W_{RS} symbol flashes prompting the user to begin measurement of $W_{RS.}$
   d. If the watt reading is not zero, press the DCA/DCW ZERO button once to zero reading
   e. Insert the test leads into the input terminals.

f. Select one phase (S or L2, for example) as COM and connect the COM (black) terminal to that phase (S or L2).
g. Connect V (red) terminal to the second phase (R or L1).
h. Clamp on to the same phase as in step g. (R or L1).
The power clamp will automatically select the proper range.
i. Wait until the reading stabilizes, then press the NEXT button. The W_{RS} (W_{L1L2}) symbol will disappear. At this moment, W_{RS} is stored in memory, and the W_T (W_{L3L2}) symbol appears flashing to prompt the user to take the W_{TS} (W_{L3L2}) measurement.

2. Secondly, measure W_{TS} (or W_{L3L2}). Refer to Fig. 8.
a. Disconnect the test leads and jaws from the lines in the previous measurement.
b. Connect the test leads to the third phase (T or L3).
c. Open and close the jaws, be sure that no conductor is in the jaws.
d. If the watt reading is not zero, press the DCA/DCW ZERO button once to zero the reading.
e. Clamp on to the third phase where the test lead is connected (T or L3)
f. The power clamp will automatically select proper range.
g. Wait until the reading stabilizes, then press the NEXT button. The W_T (or W_{L3L2}) symbol will disappear. At this moment, W_{TS} (or W_{L3L2}) data are stored in memory,

Once the NEXT button is pressed (after measurements of W_{RS} (or W_{L1L2}) and W_{TS} (or W_{L3L2})), the power clamp will add the two values and display the result on the LCD. The W_{RST} symbol appears indicating that the reading shown is the wattage of the 3ϕ3W unbalanced Power. PF is not shown in the 3ϕ3W unbalanced power mode.

$$W_{3\phi W} = W_{RST} = W_{RS(L1L2)} + W_{TS(L3L2)}$$

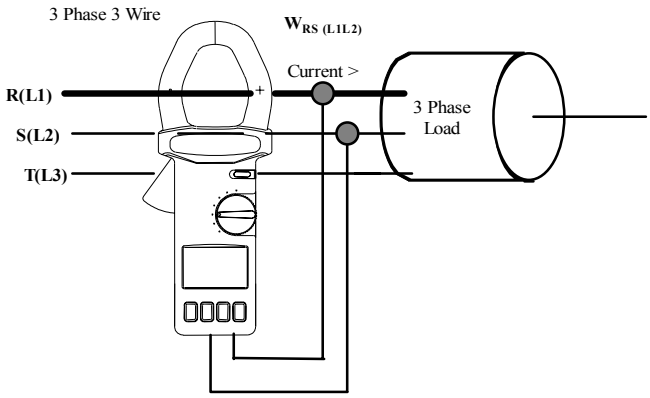


FIGURE 7

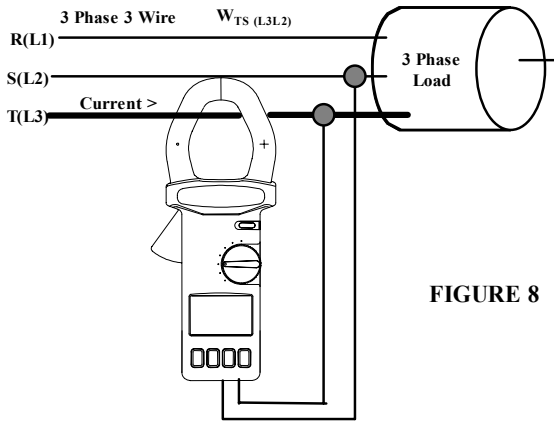


FIGURE 8

NOTE: Once a phase is selected as the COMMON connection, users cannot change this selection in the subsequent measurements. For example, if S (or L2) phase is selected, S (or L2) phase is always connected to the COM of the power clamp during measurements of W_{RS} (or W_{L1L2}) and W_{TS} (or W_{L3L2}) in 3ϕ 3W unbalanced power mode.

NOTE: The "+" sign printed on the jaw must face the power source.

NOTE: In the 3ϕ3W unbalanced power measurement mode, W_{RS} or W_{TS} could be a negative value. Users must make sure all the connections are correct to obtain correct power readings.

3ϕ4W Unbalanced Power Measurements

The measurements of W_R(or W_{L1}), W_S(or W_{L2}), and W_T(or W_{L3}) are required for these measurements.

1. First, measure W_R (or W_{L1}) (Fig. 9).
   a. Apply power to the meter with the jaw clear of any conductors.
   b. Set the rotary switch to the 3ϕ position.
   c. Press the 3ϕ button twice, and the 3ϕ4W symbol appears singularly on the left side of the LCD. The W_R symbol will flash prompting the user to take the W_R measurement

   Note: If the watt reading is not zero, press the DCA/DCW ZERO button once to zero reading

   d. Insert the test leads into the input terminals
   e. Connect the neutral line to the COM (black) terminal.
   f. Connect the V (red) terminal test lead to the first phase (R or L1).
   g. Clamp on to the same phase (R or L1).
   h. The power clamp meter will automatically select the proper range.
   i. Wait until the reading is stable, then press the NEXT button. The W_R symbol will disappear. Now, W_R is stored in the memory, and the W_S symbol flashes prompting the user to take the W_S measurement.

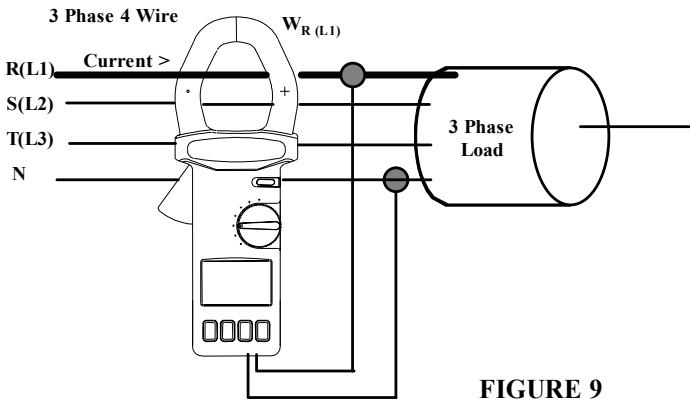


FIGURE 9

2. Measure W_S (or W_{L2}) (Fig. 10).
   a. Disconnect the test leads from the phase where the jaw was clamped onto as described in the section entitled "3ϕ 3W unbalanced power measurements".
   b. Connect V (red) terminal to the second phase (S or L2).
   d. If the watt reading is not zero, press the DCA/DCW ZERO button once to zero reading
   e. Clamp onto the phase where the test lead is connected to (S or L2 phase)
   f. The power clamp will automatically select the proper range.
   g. Wait until the reading stabilizes, then press the NEXT button. The W_S symbol will disappear. W_S is now stored in memory.

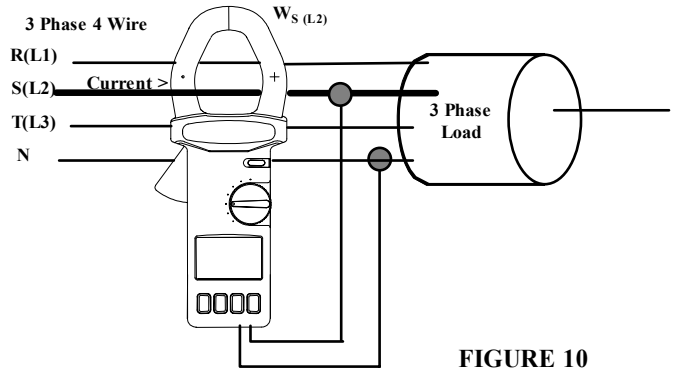


FIGURE 10

3.Thirdly, measure W_T (or W_{L3}). See Fig. 11.

a. Disconnect the test lead from the phase where the Jaw was connected in the section entitled "3ϕ3W Unbalanced Power Measurements".
b. Connect the test lead inserted in the V (red) terminal to the third phase (T or L3 phase).
d. If the watt reading is not zero, press the DCA/DCW ZERO button once to zero reading
e. Clamp onto the phase where test lead is connected to (T or L3).
f. The power clamp will automatically select the proper range.
g. Wait until the reading stabilizes, then press the NEXT button. The W_T symbol will disappear and W_T will be stored in memory,

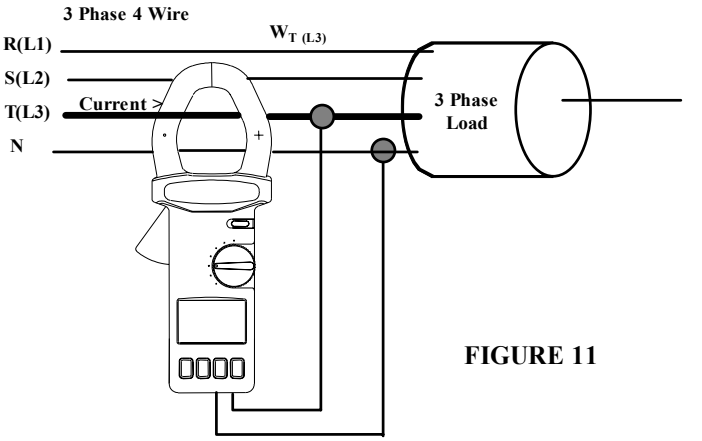


FIGURE 11

4. Once the NEXT button is pressed (after measurements of W_R W_S, and W_T), the power clamp will add the three values W_R, W_S, and W_T together and display the result on the LCD. The W_{RST} symbol will appear indicating that the reading shown is the wattage of the 3ϕ4W unbalanced circuit. PF is not shown in the 3ϕ4W unbalanced power measurement mode.

$$W_{3\phi W} = W_{RST} = W_{R(L1)} + W_{S(L2)} + W_{T(L3)}$$

NOTE: The "+" sign printed on jaw must face the power source.

NOTE: In the 3ϕ4W unbalanced power measurement mode, all three W_R or W_S and W_T readings must be positive. If one is negative, check the connection of the test leads and the clamping of jaw. Make sure test lead and clamp connections are correct to obtain useful power readings.

1ϕ3W Power Measurement

1ϕ3W power measurements are similar to 3ϕ3W unbalanced power measurements except that the nomenclature is different. Two measurements of W_{RS} (or W_{L1G}) and W_{TS} (or W_{L2G}) are required

1. First, measure W_{RS} (or W_{L1G}). See Fig.12.
   a. Apply power to the meter with the jaw clear of any conductors
   b. Set the rotary switch to the 3ϕ position.
   c. Press the 3ϕ button once, and the 3ϕ3W symbol will singularly appear on the left side of the LCD. The W_{RS} symbol will flash prompting the user to measure $W_{RS(L1G)}$.
   d. If the watt reading is not zero, press the DCA/DCW ZERO button once to zero it.

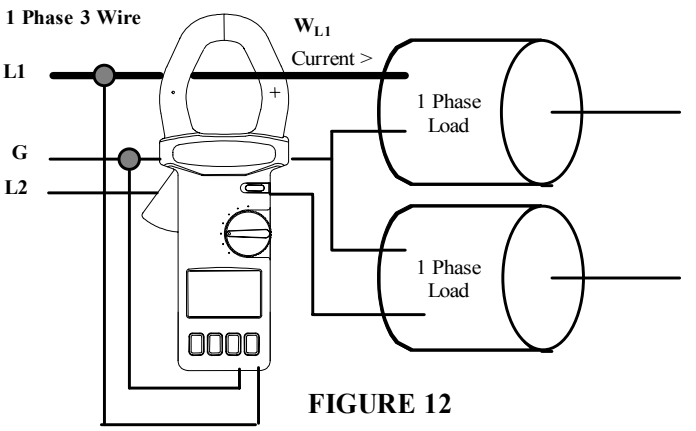


FIGURE 12

   e. Insert the test leads into the input terminals.
   f. Connect the COM (black) terminal to ground.
   g. Connect the V (red) terminal to the second phase (L1).
   h. Clamp on to the same phase as connected in step g. (L1).
   i. The power clamp will automatically select the proper range.
   j. Wait until the reading stabilizes, then press the NEXT button. The W_{RS} (W_{L1G}) symbol will disappear and the $W_{RS(L1G)}$ reading will be stored in memory. The W_T (W_{L2G}) symbol will flash prompting the user to take W_{TS} (W_{L2G}) measurements.

2. Secondly, measure W_{TS} (or W_{L2G}). Fig. 13.
   a. Disconnect the test leads from the phase where the jaws were clamped onto in the previous measurement.
   b. Connect the test lead to the L2 line.
   d. If the watt reading is not zero, press the DCA/DCW ZERO button once to zero reading
   e. Clamp on to the L2 line where the test lead is connected.
   f. The power clamp will automatically select the proper range.
   g. Wait until the reading is stable, then press the NEXT button. The W_T (or W_{L2G}) symbol will disappear. At this moment, W_{TS} (or W_{L2G}) is stored in the memory,

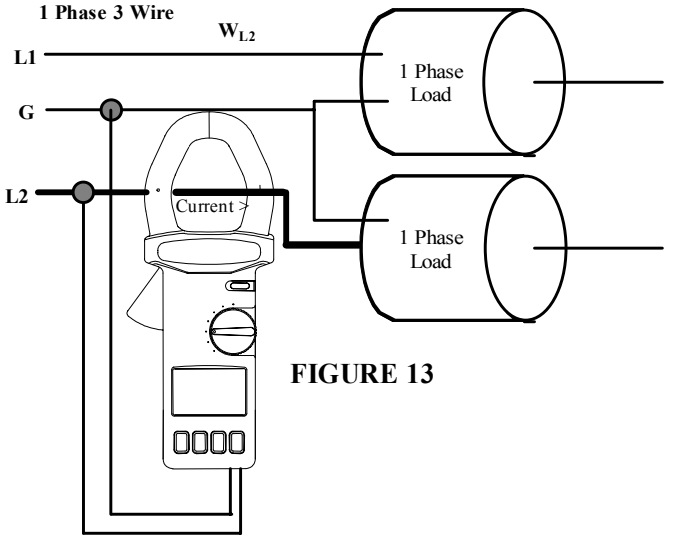


FIGURE 13

3. Once the NEXT button is pressed after measurements of W_{RS} (or W_{L1G}) and W_{TS} (or W_{L2G}) are taken, the power clamp will add the two values together and show the result on the LCD. The W_{RST} symbol will display along with the wattage of the 1ϕ3W unbalanced Power. PF is not shown in 1ϕ3W unbalanced power mode. See equation below.

$$W_{1\phi W} = W_{RST} = W_{RS(L1G)} + W_{TS(L2G)}$$

Calculation of 3ϕ4W Power Factor (PF)

When measuring 3ϕ4W unbalanced power, use the REC button to record the individual power factors ($KW_{R(L1)}$, $PF_{R(L1)}$, $KW_{S(L2)}$, $PF_{S(L2)}$, $KW_{T(L3)}$, and $PF_{T(L3)}$) of each phase in memory. 3ϕ4W power factor can be calculated using the following equation:

$$KVA_{R(L1)}=\frac{KW_{R(L1)}}{PF_{R(L1)}};KVA_{S(L2)}=\frac{KW_{S(L2)}}{PF_{S(L2)}};KVA_{T(L3)}=\frac{KW_{S(L3)}}{PF_{T(L3)}}$$

$$KVA_{3\phi W} = KVA_{R(L1)} + KVA_{S(L2)} + KVA_{T(L3)}$$

$$PF_{3\phi W} = \frac{KW_{3\phi W}}{KVA_{3\phi W}}$$

Improving the Power Factor of a 3ϕ4W Power System

Measure the $KVAR_R$ (or $KVAR_{L1}$), $KVAR_S$ (or $KVAR_{L2}$), and $KVAR_T$ (or $KVAR_{L3}$) values of each phase. Based upon the measured values, a 3ϕ or 1ϕ capacitor at the rated voltage and frequency can be used to improve the power factor. To find the value of capacitance, refer to the following equation.

$$Capacitance(Farad) = \frac{KVAR*1000}{2\pi fV^2}$$

Where:
f: frequency in Hz
V: phase voltage

It is recommended that the KVAR value of the capacitor a somewhat less than the value measured.

Improving the Power Factor of a 3ϕ Balanced Power System

1. Measure the KVAR 3ϕ value of a balanced system.
2. Based upon the measured value, a 3ϕ capacitor at the rated voltage and frequency can be used to improve power factor.
3. To find the value of capacitance, refer to the equation in the section above.
4. It is recommended that the KVAR value of the capacitor be somewhat less than the value measured.

Improving Power Factor of a 1ϕ2W Power System

1. Measure KVAR value of a 1ϕ2W power system.
2. Based upon the measured value, users can purchase required capacitor at rated voltage and frequency to improve power factor.
3. If value of capacitance is needed, obtain the value via the equation in the section entitled "Improving Power Factor of 3-phase 4-wire System".
4. It is recommended that the KVAR value of the capacitor should be a little less than the value measured.

NOTE: The indication of phase sequence is not limited to 3ϕ balanced power. It can be used in general as long as the Power Factor is greater than 0.1.

Phase Sequence Indication (for Power Factor > 0.1)

In the 3ϕ balanced power mode the meter will automatically detect the phase relationship between three individual phases.

1. Set the rotary switch to the 3ϕ position.
2. Connect the voltage input (red terminal) to the 'R' (or L1) phase, connect the COM input (black terminal) to the 'S' (or L2) phase, and clamp on the T (or L3) phase. When clamping onto the T (or L3) phase, the power clamp must face the power source.
3. If the phase sequence is clockwise, R, S, T sequence will flash on the display.
4. If the phase sequence is counterclockwise, T, S, R sequence will flash.

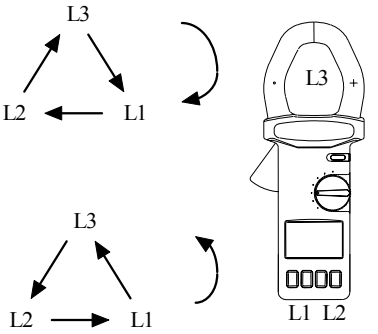


FIGURE 14

5. If current is not detected, only one of the R, S or T phases will be represented on the LCD. See Fig. 14.

NOTE: The "+" sign printed on jaw must face the power source for correct measurement.

Recording Data

The power clamp can store 4 data points in memory. To store data displayed on the LCD, press the REC button. If the power clamp already has 4 data points memorized, the LCD will display FULL. The REC symbol will be displayed on the LCD if any data is currently stored in memory. To clear the meter memory, power the meter down.

Recalling Data from Memory

To retrieve data from memory, press the READ button. **NOTE:** The rotary switch must not be set to the 3ϕ function when reading memory data. Once the READ button is pressed, the reference number of the data will be displayed first; the stored measurement data will then be displayed. While in the READ mode, the REC. and No. symbols will be displayed on the LCD. To exit the READ function, select another function using the rotary switch.

NOTE: If both the **REC** and the **No.** symbols are shown on LCD, the reading shown on the LCD is the data stored in memory, not actual measurement data.

Specifications

General Specifications

Conductor Size	Cable Φ55mm. (approx.) Bus Bar 65mm (D) x 24mm (W)
Display	Dual 4-digit 9999 count LCD
Sampling time	0.5 seconds for Voltage and Current; 1.6 seconds for Watts
Overload Indication	'OL' displayed on LCD
Power	9V Battery (Heavy Duty Type)
Power consumption	Approx. 28mA
Operating conditions	4°C to 50°C <85% RH
Dimensions	10.7" (L) x 4.4" (W) x 1.8" (H)271mm (L) x 112mm (W) x 46mm (H)
Weight	22.8 oz. / 647g (with battery)

AC/DC KW True Power (PF 0.2 - 1.0, 3φ3W, 3φ4W, 1φ2W, and 1φ 3W) Balanced

Range	Resolution	Accuracy (of reading)	Maximum Input Current	Maximum Input Voltage
0 - 99.99KW	0.01KW	±2.0% ±0.5KW	200A	500V AC/DC
0 - 999.9KW	0.1KW	±2.0% ±0.5KW	2000A	
1000-2000KW	1KW	±2.0% ±5KW		600VAC 800VDC

AC/DC Voltage (True RMS, Crest Factor < 4, Autorange, Overload Protection 800VAC)

		Accuracy (of reading)		
Range	Resolution	DC, 50 / 60 Hz	40 - 400Hz	Input Impedance
0-200V	0.1V	±1.5% ±5dgts	±2.0% ±5dgts	10MΩ
200-500V	0.1V	±1.5% ±5dgts	±2.0% ±5dgts	
500 - 600VAC 500 - 800VDC	1V	±1.5% ±5dgts	±2.0% ±5dgts	

AC/DC Current (True RMS, Crest Factor < 4):

		Accuracy (of rdg)		
Range	Resolution	DC, 50 / 60 Hz	40 - 400Hz	Overload Protection
0 - 200A	0.1A	±1.5% ±5dgts	±2.0% ±5dgts	AC 3000A
200 - 500A	0.1A	±2.0% ±5dgts	±2.5% ±5dgts	
500-2000A	1A	±2.5% ±5dgts	±3.0% ±5dgts	

AC/DC KVA (Apparent Power)

KVA = V*A / 1000

AC KVAR (Reactive Power, PF < 0.91)

Range	Resolution	Accuracy	Remark
0 – 1200KVAR	0.1 / 0.01	1 KVAR or +/-3%rdg+9d (whichever is greater)	For more information, refer to the section entitled "DC/AC 1φ2W Apparent/Reactive Power measurements"

Phase Angle (User must zero the current reading before taking measurements)

Range	Accuracy	Sensitivity	Remark
50/60 Hz	± 2.0°	V > 100V, A > 10A	Zero Crossing Detection

Note: If current signal is not detected, the phase angle will be left blank in LCD.

Frequency (if < 10 Hz, then the Hz Display = 0)

Range	Accuracy	Sensitivity
50/60 Hz	±2 dgts	V > 1V, A > 5A
10 - 400 Hz	0.5% ± 2dgts	