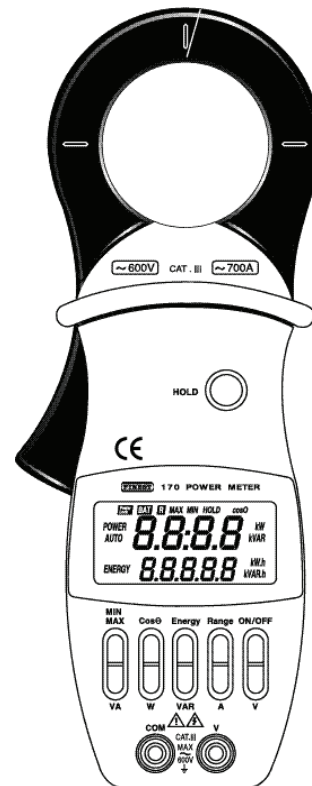


**FINEST**<sup>®</sup>

# INSTRUCTION MANUAL

## MODEL 170 True RMS DIGITAL POWER METER



**FINEST**<sup>®</sup> a world leader in test & measurement

FINE INSTRUMENTS CORPORATION

B11, A-DONG, SMART VALLEY , SONGDOMIRAE-RO 30,  
YEONSU-GU, INCHEON, KOREA

- TEL: (82-32) 837-5777 - FAX: (82-32) 837-5776

- E-mail: fine@finest.co.kr

- Internet: www.finetwon.com (or www.finet. co.kr)

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**FINE INSTRUMENTS CORPORATION**

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### WARNING!

**SOURCES LIKE SMALL HAND-HELD RADIO TRANSCEIVERS, FIXED STATION RADIO AND TELEVISION TRANSMITTERS, VEHICLE RADIO TRANSMITTERS AND CELLULAR PHONES GENERATE ELECTROMAGNETIC RADIATION THAT MAY INDUCE VOLTAGES IN THE TEST LEADS OF THE MULTIMETER. IN SUCH CASES THE ACCURACY OF THE MULTIMETER CANNOT BE GUARANTEED DUE TO PHYSICAL REASONS.**

## 1. Introduction

This Meter is a handheld battery operated True – RMS Clamp-on Power Meter that is designed to measure the majority of parameters associated with electrical powers.

This Meter is designed and tested according to IEC Publication 1010-2-032 (1994-12)(Overvoltage Category III) and the EMC Directive (EN 50081-1 and EN 50082-1) and other safety standards (see “ Technical Specifications”).

This user friendly Meter has many applications including ; appliance testing, checking industrial and commercial power systems, plant maintenance and inspection, and electric utility testing, etc.

### Features

- Current to 1000A Peak (True RMS)
- Voltage to 600V RMS (True RMS)
- True Power, Apparent Power and Reactive Power AC to 750 kW/kVA/kvar (True RMS)
- Power Factor (Cos  $\Theta$ )  
0.3 Cap (or Lead) ... 1 ... 0.3 Ind (or Lag)
- Energy (kWh, kVAh, kvarh) Integrator for maximum 80 hours

- Time Stamp for the Energy Integrator
- Auto Ranging with Manual Ranging Capability
- MAX/MIN Record Mode
- Data Hold
- Low Battery Indicator
- Automatic Power off after 20 minutes inactivity in any measurement function just except the MIN/MAX RECORD mode and the Energy Integrator mode
- Frequency Response Range : 45 Hz to 450 Hz

## 2. Technical Specifications

### 2.1 General Specifications

Display : 4 digit LCD for power  
6 digit LCD for energy

A/D Conversion Rate : approx. 4 times/sec for digital

Max Volts to Ground : 600V RMS

Max Current : 700A RMS

Overflow Indication : LCD will show an "OFL"

Low Battery Indication : The **BAT** is displayed when the battery voltage drops below the operating voltage.

Battery Life : 80hours typical (alkaline)

Battery Type : NEDA 1604A 9V or 6LF22 9V

Maximum Conductor Size :  $\varnothing$ 51mm (2,00")

Maximum Jaw Opening : 52mm (2,04")

Maximum Conductor Voltage : 600V RMS

Adjacent Conductor Effect : 1.5% of current in adjacent conductor (Max.)

Indoor use

Altitude : 2,000m

Operating Temperature and Humidity :  
0 °C to 50 °C (32 °F to 122 °F) at R.H.< 80% non-condensing

Pollution degree : 2

Safety Conformance :

Conforms to the requirements of UL 3111-1, CSA C22.2 No.1010.1-92 and ANSI/ISA-S82.01-94.

Weight : Approx. 545g (1.21 lb)

Size : 4.39 cm (H) x 9.75 cm (W) x 24.5 cm (L)  
( 1.73" H x 3.84" W x 9.65" L)

Standard Accessories : Battery (9V), instruction manual, test leads and clip-on holster

### 2.2 Electrical Specifications

Accuracy is given as  $\pm$ ([% of reading] + [number of least significant digits]) at 18 °C to 28 °C with a relative humidity of up to 80%, for a period of one year after calibration.

(The accuracy is specified from 5% to 100% of the selected range.)

#### ■ True Power Measurement

RANGE	RESOLUTION	ACCURACY	FREQUENCY RANGE	OVERLOAD PROTECTION
400 kW	0.1 kW	1.5% + 2	45 Hz to 450 Hz	750V RMS / 1000A Peak
750 kW	1 kW			

#### ■ Apparent Power Measurement

RANGE	RESOLUTION	ACCURACY	FREQUENCY RANGE	OVERLOAD PROTECTION
400 kVA	0.1 kVA	1.5% + 2	45 Hz to 450 Hz	750V RMS / 1000A Peak
750 kVA	1 kVA			

### ■ Reactive Power Measurement

$$\text{kVAR} = \sqrt{(\text{kVA})^2 - (\text{kW})^2}$$

### ■ Power Factor (cos $\theta$ ) Measurement

RANGE	RESOLUTION	ACCURACY	FREQUENCY RANGE	OVERLOAD PROTECTION
0.3 ~ 1	0.001	2% + 20	10 Hz to 60 Hz	750V RMS / 1000A Peak

※ Voltage Range : 20 V to 750 V RMS  
 Current Range : 20A to 1000 A Peak

### ■ AC Amps Measurement

RANGE	RESOLUTION	ACCURACY	FREQUENCY RANGE	OVERLOAD PROTECTION
400 A	0.1 A	1.5% + 2	45 Hz to 450 Hz	1000A Peak
700 A	1 A			

\* Conversion Type : AC Coupled, True-RMS Measurement  
 \* Crest Factor :  $\leq 5$

Additional Crest Factor Errors (non-sinusoidal)

Crest Factor	Error (% of reading)
1 ~ 3	0.5%
3 ~ 5	3%

For the continuous waveform of 45 Hz to 65 Hz  
 (less than 1000A peak )

### ■ AC Volts Measurement

RANGE	RESOLUTION	ACCURACY	FREQUENCY RANGE	OVERLOAD PROTECTION
400 V	0.1 V	1% + 3	45 Hz to 450 Hz	750V RMS
750 V	1 V			

\* Conversion Type : AC Coupled, True-RMS Measurement  
 \* Crest Factor :  $\leq 5$

Additional Crest Factor Errors (non-sinusoidal)

Crest Factor	Error (% of reading)
1 ~ 3	0.5 %
3 ~ 5	3 %

For the continuous waveform of 45 Hz to 65 Hz  
 (less than 750V RMS )

### ■ True Power Energy Integrator

RANGE	RESOLUTION	ACCURACY	FREQUENCY RANGE	MAXIMUM INTEGRATION PERIOD
40000 kWh	0.1 kWh	1.5% + 2	45 Hz to 450 Hz	80 hrs.
75000 kWh	1 kWh			

### ■ Apparent Power Energy Integrator

RANGE	RESOLUTION	ACCURACY	FREQUENCY RANGE	MAXIMUM INTEGRATION PERIOD
40000kvah	0.1 kvah	1.5% + 2	45 Hz to 450 Hz	80 hrs.
75000kvah	1 kvah			

## Reactive Power Energy Integrator

RANGE	RESOLUTION	ACCURACY	FREQUENCY RANGE	MAXIMUM INTEGRATION PERIOD
40000kvarh	0.1 kvarh	4% + 2	45 Hz to 450 Hz	80 hrs.
75000kvarh	1 kvarh			

### 3. Safety

Read the following safety information carefully before attempting to operate or service the Meter.

Although the Meter is designed to be as safe as possible, safety in use is the responsibility of the operator who must be suitably qualified and/or authorized.



#### WARNING

Maximum voltage between current carrying conductors, which are uninsulated, and ground must not exceed 750V RMS. Always choose an insulated conductor if available.

- Do not attempt to measure any current or voltage higher than the maximum limits of the input values shown in the electrical specifications.
- Never measure any current while the test leads are inserted into the input jacks.
- Never use the Meter or test leads whose insulating protection has been impaired. Be extremely cautious when clamping around uninsulated conductors or bus bars.

#### ONLY USE THE TEST LEADS SUPPLIED BY FINE INSTRUMENTS CORPORATION

- Disconnect the live test lead before disconnecting the common test lead.
- Never leave the Meter to contact with any surface water. Ingress of water could damage the electronics as well as cause a potential shock hazard.
- Accidental contact with the conductor could result in electric shock.
- Frequently inspect the Meter and the test leads for damage. If the Meter is physically damaged or does not function correctly, don't use it.
- Avoid working alone with high voltage circuits.
- Use the meter only as specified in this manual. Otherwise, the protection provided by this Meter may be impaired.
- When taking measurements in high voltage circuits, connections should be made to the circuits while the power is off.

#### Safety Symbols



**Warning!** – There is a risk of electrical shock.



**Caution** – Refer to this manual before using this meter.



**Double Insulation** – The meter is protected throughout by double insulation or reinforced insulation. When servicing, use only specified replacement parts.



Alternating Current (AC)

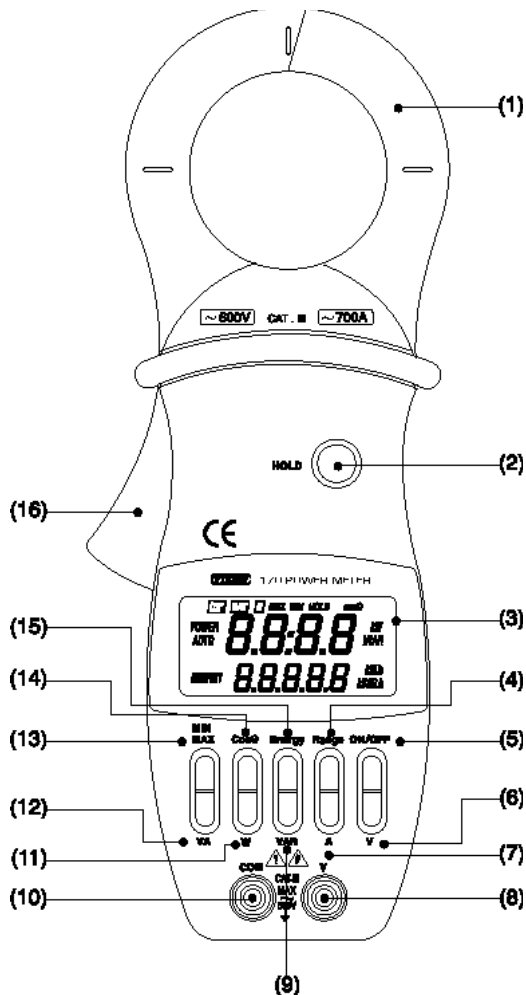


Earth Ground

CAT. III Installation category (overvoltage category) III according to EN61010-1 and EN61010-2-032.



## 4. Operating Instructions

### 4.1 Controls and Indicators



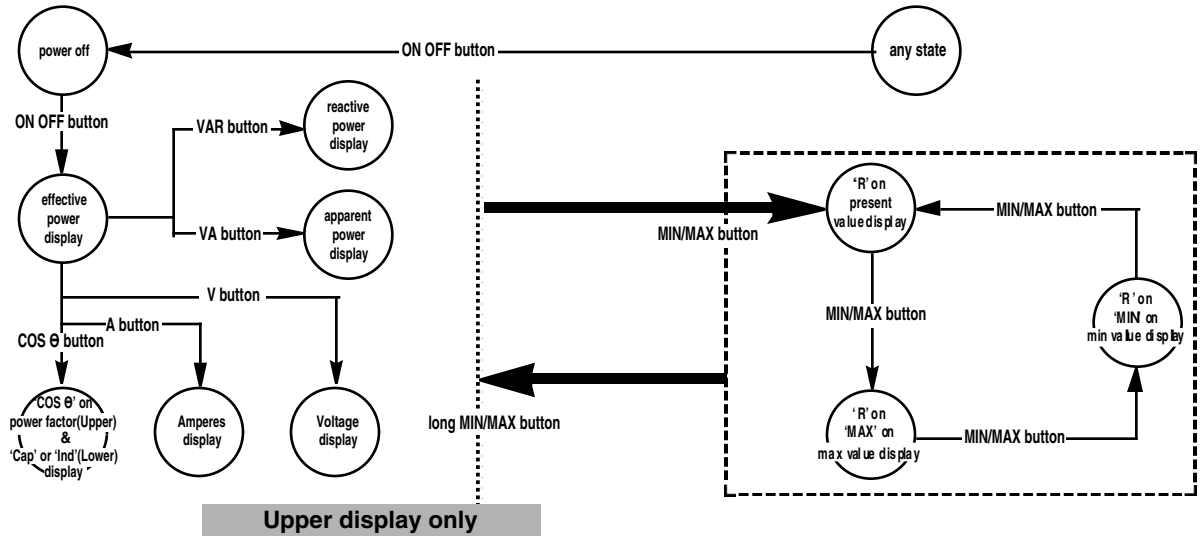
- (1) **CLAMP** . Opens 52mm (2.04 inches) to enclose conductors.
- (2) **HOLD** . Freezes reading in digital display.
- (3) **DISPLAY** . Liquid crystal display.
- (4) **RANGE**. Selects ranges or AUTO.
- (5) **ON OFF** . Selects meter's power ON or power off.
- (6) **V** . Selects volts measurement mode.
- (7) **A** . Selects amperes measurement mode.
- (8) **V** . Volts Input Terminal.
- (9) **VAR** . Selects reactive power measurement mode.
- (10) **COM** . Common Terminal.
- (11) **W** . Selects true power measurement mode.
- (12) **VA** . Selects apparent power measurement mode.
- (13) **MINMAX** . Selects MAX/MIN recording mode and displays recorded MAX and MIN.
- (14) **COS θ** . Selects power factor measurement mode. The Lower part of the LCD indicates "Cap" or "Ind".
- (15) **ENERGY** . Selects energy integrator mode.
- (16) **LEVER** . Open and closes clamp jaws.



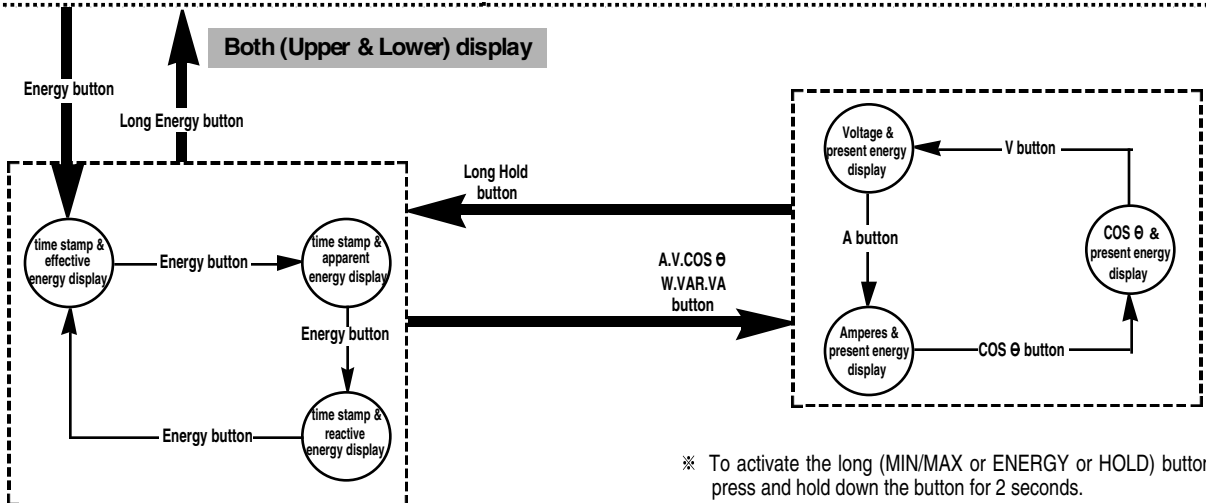
- (17)  . Displayed when the Auto Power off mode has been disabled. Automatically displayed when the meter enters into either the MIN/MAX recording mode or the Energy Integrator mode.
- (18) **BAT** . Displayed when internal battery needs replacing.
- (19) **R** . Selects volts measurement mode.
- (20) **MAX MIN** . Displayed in MIN/MAX RECORD mode by pressing the MIN/MAX pushbutton.
- (21) **HOLD** . Displayed when HOLD pushbutton has been pressed.
- (22) **COS  $\theta$**  . Displayed when COS  $\theta$  pushbutton has been pressed.
- (23) . Displayed when time stamp function is activating in the Energy Integrator mode.
- (24) **Units of Measure Annunciators** .  
These symbols indicate the units of measure of each reading in any function.
- (25) **ENERGY**. Displayed when ENERGY pushbutton has been pressed.
- (26)  . Automatically indicate negative digital displays in the power factor (COS  $\theta$ ) measurement mode.
- (27) **AUTO** . Displayed when the auto-ranging mode is active.
- (28) **POWER** . Displayed when the **W** pushbutton, **VA** pushbutton or **VAR** pushbutton has been pressed in the power measurement mode.
- (29) **OFL** . Over-Range Indication. This is the display when the input exceeds the display capability of the Meter. If measuring voltage or current, remove the input immediately.
- (30) **Inef.** Displayed when a power factor is beyond 1.099 or apparent power is zero.

## 4.2 Operating State Diagram

### Operating State Diagram



### Both (Upper & Lower) display



※ To activate the long (MIN/MAX or ENERGY or HOLD) button, press and hold down the button for 2 seconds.



## 5. How to Measure

**5.1** Before using the Meter, familiarize yourself with the instrument and this manual. **READ AND REVIEW THIS MANUAL FREQUENTLY.**

**5.2 Visual Inspection of the Meter** – Before use, inspect the Meter for any conditions which would make it unsafe. Check for missing or loose parts. Check also for damage. Make certain that the Meter is free from oils, grease, dirt and excessive moisture. **IF ANY OF THESE CONDITIONS ARE FOUND, DO NOT USE THE METER.**

**5.3 Visual Inspection of the Test Leads** – Before use, check the test leads for deterioration of the insulation.



**IF THE TEST LEADS ARE IN ANY WAY DAMAGED OR DEGRADED, DO NOT USE THEM. THEY MUST BE REPLACED.**

### 5.4 Power Up / Self Test

Press and hold the ON OFF pushbutton in order to power up and initiate self test. The Meter beeps and all LCD segments will turn on as part of a self-test routine.

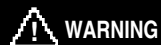
Release the ON OFF pushbutton to initialize the Meter.

Replace the battery before using the Meter when the low battery indicator is displayed on the LCD. If the Meter does not turn ON, the battery is missing or worn out. To replace the battery, see **6.1 Battery Replacement.**

The Meter shuts OFF after 20 minutes if no pushbutton is pressed, even though it is making a measurement in any measurement function just except the MIN/MAX RECORD mode and the Energy Integrator mode.

### 5.5 Measuring Power

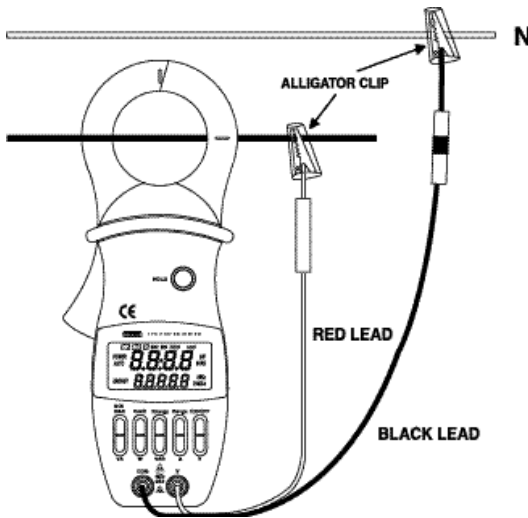
When the Meter has been powered up, it defaults in the true power measurement mode and auto-ranging mode (POWER, kW and AUTO displayed).



**MAXIMUM INPUT VOLTAGE OF AC VOLT RANGE IS 750V RMS. DO NOT ATTEMPT TO MEASURE ANY VOLTAGE THAT EXCEEDS 750V RMS TO AVOID ELECTRICAL SHOCK HAZARD OR DAMAGE TO THE INSTRUMENT.**

1. Put the Meter in the **W** (or **VA** or **VAR**) range.
2. Connect the black and red test leads to the COM and V terminals respectively.
3. Clamp the jaws around the current carrying conductor under test, ensuring a good contact between the dosing faces of the jaws.
4. Apply the test leads to the circuit under test and read the displayed value.

## 5.6 Measuring Power Factor



### NOTE

The Meter is designed for measurement in single - phase systems. It is possible to measure in a three - phase system by creating an artificial neutral point by using a three phase adapter.

### WARNING

MAXIMUM INPUT VOLTAGE OF AC VOLT RANGE IS 750V RMS. DO NOT ATTEMPT TO MEASURE ANY VOLTAGE THAT EXCEEDS 750V RMS TO AVOID ELECTRICAL SHOCK HAZARD OR DAMAGE TO THE INSTRUMENT.

1. Put the Meter in the **COS  $\theta$**  range.
2. Connect the black and red test leads to the COM and V terminals respectively.
3. Clamp the jaws around the current carrying conductor ensuring a good contact between the dosing faces of the jaws.
4. Apply the test leads to the circuit under test. ( See the figure of 5.5 . )
5. Read the displayed value.

A time lag / lead power factor is indicated on the display by – and + signs (of the upper part ) as well as by “Ind” and “Cap” letters (of the lower part).

## 5.7 Measuring AC Voltage



**MAXIMUM INPUT VOLTAGE OF AC VOLT RANGE IS 750V RMS. DO NOT ATTEMPT TO MEASURE ANY VOLTAGE THAT EXCEEDS 750V RMS TO AVOID ELECTRICAL SHOCK HAZARD OR DAMAGE TO THE INSTRUMENT.**

1. Put the Meter in the **V** range.
2. Connect the black and red test leads to the COM and V terminals respectively.
3. Apply the test leads to the circuit under test.
4. Read the displayed voltage.

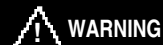
## 5.8 Measuring AC Current



**MAXIMUM INPUT CURRENT IS 700A RMS. BEFORE SELECTING THE CURRENT MEASUREMENT FUNCTION ENSURE THAT THE TEST LEADS ARE DISCONNECTED FROM THE INSTRUMENT.**

1. Put the Meter in the **A** range.
2. Clamp the jaws around the current carrying conductor, ensuring a good contact between the dosing faces of the jaws.
3. Read the measured current.

## 5.9 Integrating Energy



**MAXIMUM INPUT VOLTAGE OF AC VOLT RANGE IS 750V RMS. DO NOT ATTEMPT TO MEASURE ANY VOLTAGE THAT EXCEEDS 750V RMS TO AVOID ELECTRICAL SHOCK HAZARD OR DAMAGE TO THE INSTRUMENT.**

1. When the ENERGY pushbutton has been pressed, the Meter defaults in the true energy integrating mode and time stamping mode (ENERGY, KW.h, : , and AUTO displayed).
2. Connect the black and red test leads to the COM and V terminals respectively.
3. Clamp the jaws around the current carrying conductor under test, ensuring a good contact between the closing faces of the jaws.
4. Apply the test leads to the circuit under test and press the ENERGY button to scroll through the true, apparent, and reactive energy value. The elapsed time between the last value and the start of the integration shows in the upper display.
5. Press and hold the ENERGY button for two seconds to exit Energy Integrating mode. See 4.2 Operating State Diagram for more information.

## 6. Maintenance and Calibration

### 6.1 Battery Replacement

The Meter is powered by a single 9V battery (NEDA Type 1604, 6 LF 22 or 006 p). To guarantee the specified battery alkaline or other long-life batteries are recommended.

If the low-battery indicator on the digital display will be displayed, replace the battery by using the following procedures.

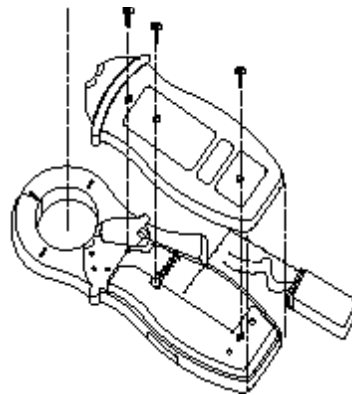


**WARNING**

**TO PREVENT ELECTRICAL HAZARD OR SHOCK, TURN THE METER OFF AND DISCONNECT TEST LEADS BEFORE REMOVING THE BACK COVER.**

1. Undamp the Meter from any conductor, and turn it off by pressing the ON OFF pushbutton.
2. Place the Meter face down on a non-abrasive surface and completely loosen the three rear panel screws with a phillips-head screwdriver.
3. Grasp the bottom of the rear cover and lift it free of the case.
4. Lift the battery from the case, and carefully disconnect the battery connector leads.
5. Snap the battery connector leads to the terminals of a new battery and reinstall the battery cover. Then insert the battery into position. Dress the battery leads so that they will not be pinched between the case bottom and the case top. Do not discard battery cover.
6. Replace the rear cover, ensuring it slips beneath the holddown lip (next to the jaws) and fits securely into position.
7. Reinstall the three securing screws.

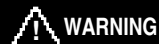
If the Meter is not be used for periods of longer than 60 days, remove the battery and store it separately.



**Battery Replacement**

### 6.2 Maintenance

Repairs or servicing should be performed by qualified personnel only.



**WARNING**

**TO AVOID ELECTRICAL SHOCK OR DAMAGE TO THE METER, DO NOT GET WATER INSIDE THE CASE. REMOVE THE TEST LEADS AND ANY INPUT SIGNALS BEFORE OPENING THE CASE.**

Periodically wipe the case with a damp cloth and detergent; do not use abrasives or solvents.

### 6.3 Calibration

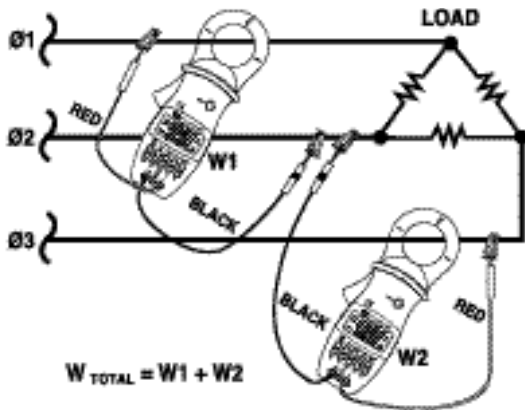
The Meter should be calibrated annually.

Regarding the service / calibration information on the Meter, contact the nearest distributor of the Meter.

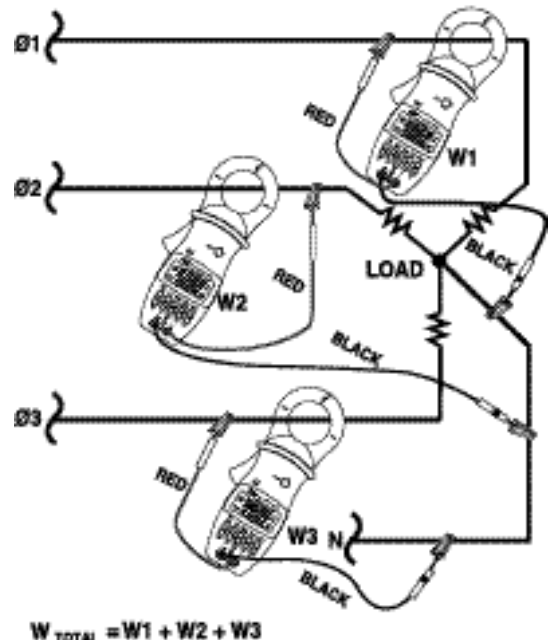
## 7. Three – Phase Power Measurements

Refer to the following figures for suggested ways to measure total power in a three phase system.

Measurement Connections (3 $\phi$ , 3 wire)



Measurement Connections (3 $\phi$ , 4 wire)



## 8. Three – Phase Adaptor (Optional)



**NOTE**

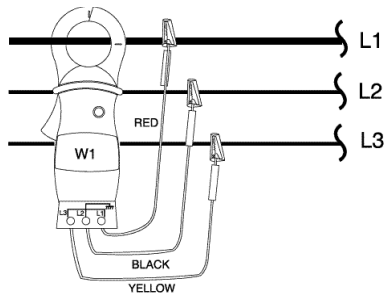
The three-phase adaptor should be used with the Model 170 only.

The three-phase adaptor generates an artificial neutral point when the Model 170 measures;

- The true power (kW)
- The apparent power (kVA)
- The power factor (cos  $\Theta$ )

in a either Balanced or Unbalanced 3 phase / 3 wire system.

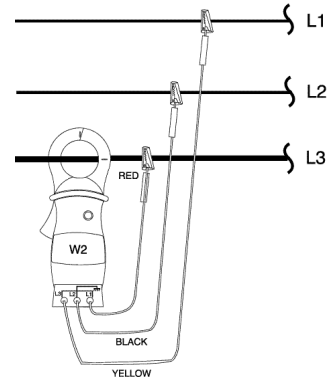
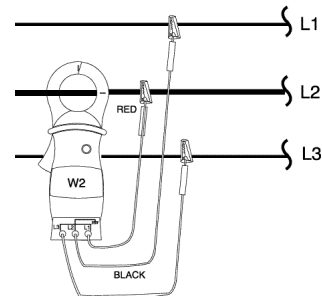
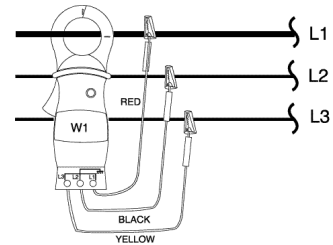
**Measurement Connections in a Balanced 3 phase / 3 wire system.**



$$W_{TOTAL} = 3 X W1$$

1. Set the Model 170 at kW (or kVA or Cos  $\Theta$ ) range position.
2. Hook-on the 3 phase adaptor to the input jacks of the Model 170.
3. Clamp the jaws around One phase wire and apply the Red test leads to the same wire and the two Black test leads to the other two wires respectively.
4. Read the displayed value. In order to get the total value, multiply the displayed value by 3.

**Measurement Connections in a Unbalanced 3 phase / 3 wire system**



$$W_{TOTAL} = W1 + W2 + W3$$

Repeat the above item 3 for each phase wire and accumulate the displayed values for the total 3 phase power measurement.