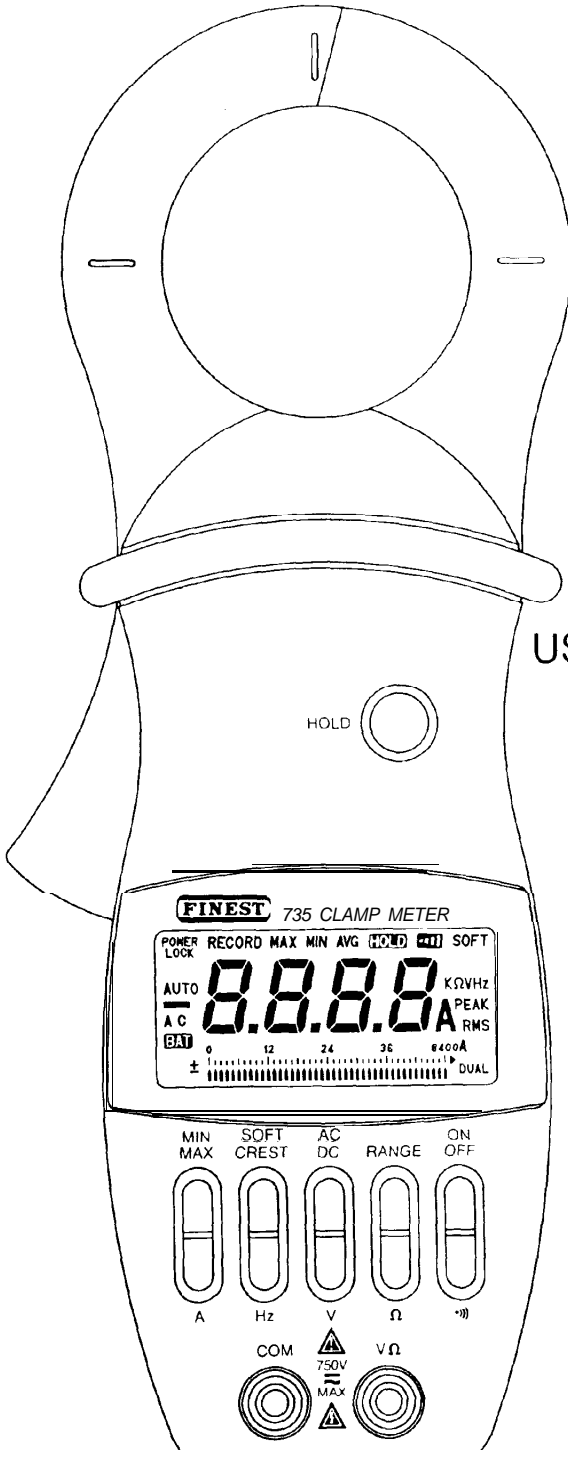


FINEST 135

TRUE RMS CLAMP-ON METER



USER'S MANUAL

This Meter measures the true-rms value of Alternating Current (AC) over from 0.3A to 700A. AC measurements are from 10Hz to 1 KHz and frequency measurements are from 0.5Hz to 10KHz.

Clamp meters that measure average current flow are inaccurate for non-linear currents and their measurements may have some differences from those obtained using this Meter,

This Meter can also measure frequency while measuring current flow simultaneously. AC and DC voltages and resistances can be measured and also continuity check is possible with this Meter.

This Meter also provides:

- Auto Range or Manual Range selection.
- HOLD function to freeze readings.
- 41-segment analog bar graph that displays current while simultaneously measuring frequency on the digital display.
- Low-battery indicator and battery life indicator at power-up using bar graph.
- Automatic power off after 10 minutes of inactivity and power lock to disable the automatic power off function.
- When an ineffective pushbutton is pressed, this Meter beeps twice continuously.
- A SOFT mode to display a 3-second running average.
- A CREST mode that measures half-cycle peak AC amperes.
- A MIN/MAX RECORD mode to record maximum, minimum, and average values of rms current, softened rms, frequency, voltage or ohms. Half-cycle peak maximum may also be recorded in the CREST mode.
- Zero adjustment by the microprocessor when measuring DC amperes.

2. Clamp-on Meter Safety

In this manual, the word "DANGER" identifies a severe or immediately accessible personal hazard that can cause death or injury; the word "WARNING" identifies a personal hazard about a condition or procedure that could cause death or injury; the word "CAUTION" identifies an equipment hazard about a condition or procedure that could cause damage or destruction of this Meter.

Observe the International Electrical Symbols listed below.



Warning!

Risk of electric shock.



Caution!

Refer to this manual before using this Meter.



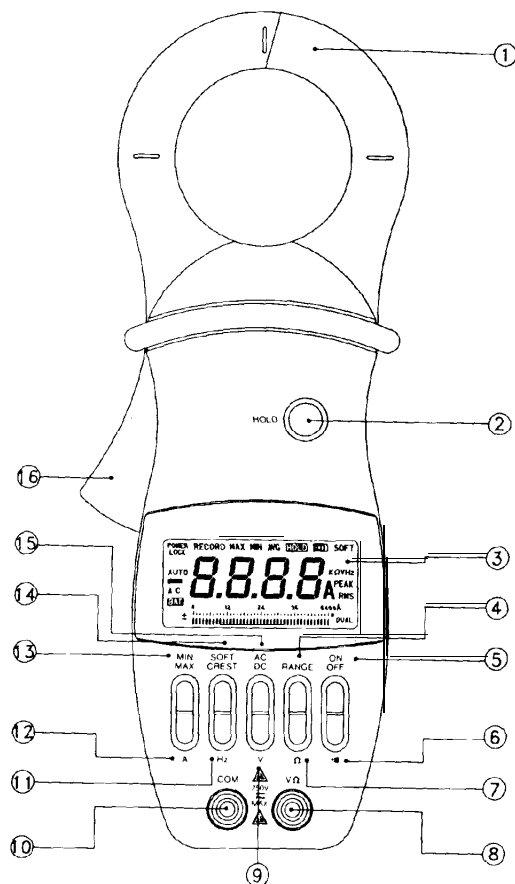
Double Insulation (Protection Class II)

- Never clamp around a conductor at 600V rms or greater or with a frequency of 10KHz or greater.
- Never use a meter whose insulating protection has been impaired.
- Be extremely cautious when clamping around uninsulated conductors or bus bars.
- Use this Meter only as specified in this manual. Otherwise, the protection provided by this Meter may be impaired.
- Observe the safety messages contained in this manual
 - Avoid working alone.
 - Inspect the test leads for damaged insulation or exposed metal. Check test lead continuity. Damaged leads should be replaced.
 - Disconnect the live test lead before disconnecting the common test lead.
- Be sure this Meter is in good operating condition. During a continuity test, a meter reading that goes from overflow (OFL) to 0 generally means this Meter is working properly.

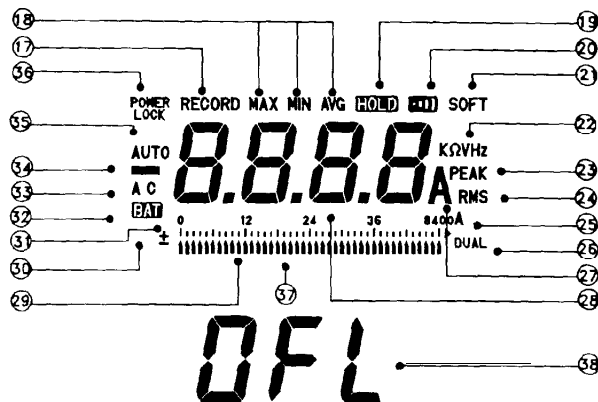
- Select the proper function and range for your measurement.

3. Explanation of Controls and Indicators

- ① **CLAMP.** Opens 2.04 inches (52mm) to enclose conductors.
- ② **HOLD.** Freezes reading in digital display.
- ③ **DISPLAY.** Liquid crystal display.



- ④ **RANGE.** Selects 0 to 40A, 0 to 400A, or AUTO.
- ⑤ **ON OFF.** Selects meters power ON or power OFF.
- ⑥ **•**. Selects continuity testing mode.
- ⑦ **Ω.** Selects ohms measurement mode.
- ⑧ **VΩ.** Volt, Ohms, Continuity Test Input Terminal.
- ⑨ **V.** Selects volts measurement mode.
- ⑩ **COM.** Common Terminal.
- ⑪ **Hz.** Selects frequency measurement mode.
- ⑫ **A.** Selects amperes measurement mode.
- ⑬ **MIN MAX.** Selects RECORD mode and displays recorded MAX, MIN, and AVG.



- ⑭ **SOFT CREST.** Select SOFT for a running 3-second average, or CREST for half cycle peak amperes.
- ⑮ **AC DC.** Selects AC or DC mode.
- ⑯ **LEVER.** Opens and closes clamp jaws.
- ⑰ **RECORD.** Displayed (blinking) when MAX, MIN, and AVG values are being recorded. Duration of RECORD is limited by battery life.
- ⑱ **MAX MIN AVG.** Displayed in RECORD mode by pressing MIN MAX pushbuttons.
- ⑲ **HOLD** . Displayed when HOLD pushbutton has been pressed.

- ⑳ **OFF** . Displayed when **OFF** pushbutton has been pressed.
- ㉑ **SOFT**. Displayed when current flow readings or Hz or V readings are softened out over 3-second intervals.
- ㉒ **KΩVHz**. Displayed when measuring ohms or voltage or frequency.
- ㉓ **PEAK**. Displayed when current flow readings are in half-cycle peak amperes (Crest mode).
- ㉔ **RMS**. Displayed when current reading is in amperes rms.
- ㉕ **OFF-SCALE ARROW**. Displayed when bar graph pointer is off scale.
- ㉖ **DUAL**. Displayed when measuring frequency in digital and amperes in bar graph simultaneously.
- ㉗ **A**. Displayed when meter is measuring amperes.
- ㉘ **DIGITAL DISPLAY**. Displays 3999 counts, with two decimal points relative to the two ranges. But, displays 9999 counts in frequency mode. Display is updated 4 times each second.
- ㉙ **POINTERS**. Displayed to indicate position on bar graph scale. Positions are updated 20 times each second.
- ㉚ **ANALOG DISPLAY POLARITY**. Displays + or – when the pointers are displayed.
- ㉛ **0 to 400A**. (or 0 to 800A.) Numeric reference for the bar graph.
- ㉜ **BAT** . Displayed when internal battery needs replacing.
- ㉝ **AC**. Alternating Current or Voltage.
- ㉞ **—** . Automatically indicate negative digital displays.
- ㉟ **AUTO**. Displayed when autoranging controls bar graph scale (0 to 40A scale, or 0 to 400A scale) and controls position of decimal point on digital display.
- ㊱ **POWER LOCK**. Displayed when the Auto Power off mode of the meter has been disabled.
- ㊲ **BEEPER**. Beeps for pushbutton Operation or current overload.
- ㊳ **OFL**. Overflow Indication

4. Alignment Marks

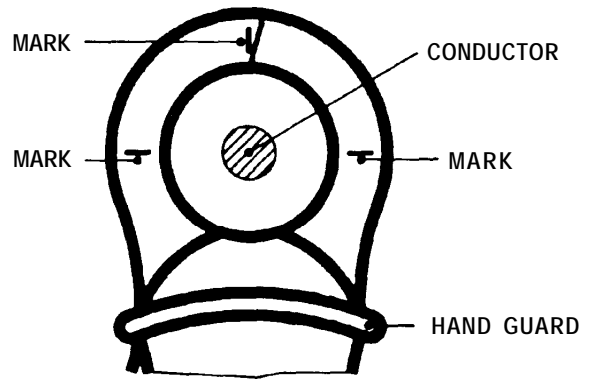


Figure 1. Alignment Marks

Position the conductor within the jaws at the intersection of the indicated marks as much as possible (Figure 1) in order to meet this Meter's accuracy specifications.

If the conductor is positioned elsewhere within the jaws, the maximum additional error resulted is 1.5 percent.

5. How to Use this Meter

5.1 Battery Replacement

This Meter is powered by a single 9V battery (NEDA Type 1604A, 6LF22, or 006p). To guarantee the specified battery life, 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 procedure referring to Figure 2.

1. Unclamp this Meter from any conductor, and turn it off by pressing the ON OFF pushbutton.
2. Place this Meter face down on a nonabrasive 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 insert the battery into Position. Dress the battery leads so that they will not be pinched between the case bottom and the case top.
6. Replace the rear cover, ensuring it slips beneath the hold-down lip (next to the jaws) and fits securely into Position.
7. Reinstall the three securing screws.

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

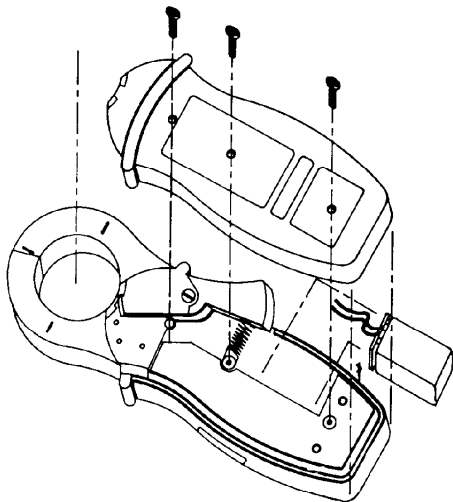


Figure 2. Battery Replacement



5.2 Notes

For taking full advantage of this Meter's capabilities, read completely, in sequence, each of the following pages. It is

not necessary to make a measurement to learn how to use this meter. Take the time to read this section completely before attempting any meter applications because this meter has many features and operating sequences that are not readily apparent.



WARNING!

MOST OF THE TYPICAL APPLICATIONS ARE EXPOSED TO LETHAL VOLTAGES. BE CAUTIOUS WHEN TAKING MEASUREMENTS. BEFORE THE METER IS CONNECTED TO ANY CIRCUIT, REVIEW THE SAFETY INFORMATION. ALWAYS KEEP YOUR HANDS BEHIND THE METER'S HAND GUARD.

5.3 Power Up/Self Test



Press and hold the ON OFF pushbutton in order to power up and initiate self test. This meter beeps and all LCD segments will turn on (some segments have nothing to do with this Meter.) as part of a self-test routine. Observe a bar graph pointer blinks to indicate the battery condition while still pressing the ON OFF pushbutton. The "Off-Scale" arrow blinks for a battery life in excess of 40 hours and a corresponding bar graph pointer blinks for a battery life of less than 40 hours. Read the scale as 0 to 40 hours for this battery test. A pointer under the 3 (6 is not displayed) on the scale, for example, represents approximately 30 hours of remaining battery life.

Release the ON OFF pushbutton to initialize this Meter.

Replace the battery before using this Meter when the battery test gives a reading of only a few hours or when the low-battery indicator is displayed on the digital display.

If the Meter does not turn ON, the battery is missing or worn out. To replace the battery, see 5.1 Battery Replacement.

This Meter shuts OFF after 10 minutes if no pushbutton is pressed, even if it is making a measurement. To disable the auto power off, press the ON OFF pushbutton (**POWER LOCK** is displayed), when if you press the ON OFF pushbutton again, the Meter turns OFF.

When you want to use this Meter in manual range, press the RANGE pushbutton, then this Meter is in manual range. Press RANGE pushbutton for 2 seconds to return to Autoranging mode.

This Meter's auto power off feature is disabled when you are using the RECORD mode.

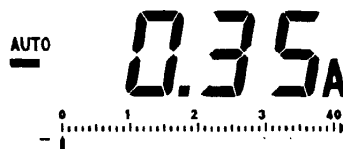
5.4 Measuring AC Amperes



When this meter has been powered up, it defaults in the AC amperes mode with 250-ms measurement intervals (AC displayed) and autoranging mode (AUTO displayed), which automatically selects the proper range for both the bar scale and the digital display. Press the RANGE pushbutton to select a fixed scale instead of autoranging. Observe that each press alternates between the 40A and 400A scales and AUTO is no longer displayed. When the reading is beyond the limits of the digital display, for example, 40A on a 40A scale, OFL appears on the digital display.

Press the RANGE pushbutton for 2 seconds and then release in order to return to autoranging mode. This Meter acknowledges with a beep sound and displays AUTO.

5.5 Measuring DC Amperes



Press the AC DC pushbutton to select the DC amperes measurement mode (AC disappeared on the LCD), but the meter is still in the autoranging mode (AUTO displayed), unless you press the RANGE pushbutton to enter into the manual ranging mode.

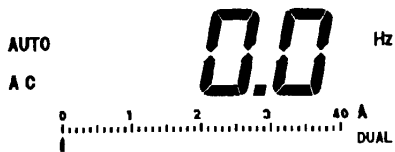
When the DC amperes measurement mode is entered, the display reads a non-Zero DC amperes (positive or negative) value due to the presence of the Earth's Magnetism. This value is variable according to the location measuring DC amperes.

Zero Adjustment by the Microprocessor

To initiate the Zero Adjustment procedure, press the HOLD pushbutton for 2 second. Then, the meter beeps and the display reads Zero just after the microprocessor memorized the right preceding display value that is used for calculating the exact DC amperes measurement value when measuring the DC amperes of a current-carrying conductor.

When measuring the DC amperes of a current-carrying conductor, the DC amperes value has a positive or negative polarity according to the direction of current-carrying. This value is positive when the current flows through the conductor in the forward-moving direction of a right-hand threaded screw. And it is negative when the current flows through the conductor in the backward-moving direction of a right-hand threaded screw.

5.6 Measuring Frequency



To enable the frequency measurement mode, press the Hz pushbutton. This Meter displays Hz, DUAL, and AUTO. The frequency of the current flow is displayed. AUTO (auto-ranging) is applied to the bar graph, which represents rms value of the current flow. When in AUTO, frequency measurement uses an auto trigger threshold based on one-half of the peak current measurement. This provides the best sensitivity and noise immunity.

To select a fixed 40A or 400A bar graph display (AUTO is no longer displayed), press the RANGE pushbutton. With a fixed 40A or 400A scale, fixed trigger thresholds are imposed for frequency readings. The thresholds are 6A (40A scale) or 40A (400A scale). The frequency display is 0.0Hz when a trigger threshold is not reached.

Press the RANGE pushbutton for 2 seconds and then release in order to return to autoranging mode. This Meter acknowledges with a beep sound and displays AUTO on the digital display. Press the other function (A or V or Ω or \bullet II) pushbutton to exit the frequency mode.

5.7 Using Data Hold



To freeze the digital display reading (HOLD is not applied to the bar graph.), press the HOLD pushbutton. **HOLD** is displayed when HOLD is enabled.

When HOLD is used while measuring frequency, RANGE can be changed only for imposing trigger thresholds of 6A on the 40A scale, and 40A on the 400A scale. The frequency reading will be 0.0Hz when HOLD is released, if the trigger threshold is not reached.

When in the HOLD mode, this Meter function can be changed from the held function to one of the other functions, when HOLD is automatically released.

Press the HOLD pushbutton again (**HOLD** is no longer displayed) in order to exit HOLD.

Press the RANGE pushbutton for 2 seconds and then release in order to autoranging mode. This Meter acknowledges with a beep sound and displays AUTO on the digital display.

5.8 Measuring AC/DC Voltage



Press the V pushbutton to enable the voltage measurement mode and then select AC or DC by toggling the AC DC pushbutton. This Meter defaults in the autoranging mode and displays V, AC and AUTO. AUTO (autoranging) is applied to the bar graph.

To measure voltage, connect this Meter in parallel with the load or circuit under test. Each of the three AC/DC voltage ranges presents an input impedance of approximately 10M Ω in parallel with less than 100 pF.

Measurement errors due to circuit loading can result when making either AC or DC voltage measurement on circuits with high source impedance. In most cases, the error is negligible (0.1% or less) if the measurement circuit source impedance is 10 Kiloohms or less.

5.9 Measuring Resistance



Press the Ω pushbutton to enable the resistance measurement mode. This Meter defaults in the autoranging mode and displays KR and AUTO. And also the off-scale arrow of the bar graph blinks and the digital display reads OFL.

AUTO (autoranging) is applied to the bar graph.

This Meter measures resistance by comparing the internal reference resistance given by a resistor array with the unknown resistance to be measured. Remember, the resistance displayed by this Meter is the total resistance through all possible paths between the probes. This explains why in-circuit measurement of resistors does not often yield the ohms value indicated by the resistor's color code.



CAUTION!

TURN OFF POWER ON THE TEST CIRCUIT AND DISCHARGE ALL CAPACITORS BEFORE ATTEMPTING IN-CIRCUIT RESISTANCE MEASUREMENTS. IF AN EXTERNAL VOLTAGE IS PRESENT ACROSS A COMPONENT, IT WILL BE IMPOSSIBLE TO TAKE AN ACCURATE MEASUREMENT OF THE RESISTANCE OF THAT COMPONENT.

The resistance in the test leads can diminish accuracy on the lowest (400-ohm) range. The error is usually 0.1 to 0.2 ohms for a Standard pair of test leads.

When measuring resistance, be sure that the contact between the probes and the circuit under test is good. Dirt, Oil, Solderflux, or other foreign matter seriously affect resistance.

5.10 Continuity Testing



Press the Ω pushbutton to enable the continuity testing mode. This Meter defaults in the 400-ohm range and then highest bar graph scale shows 400. The digital display reads OFL.

Continuity testing verifies that circuit connections are intact. Test resistances below 35Ω cause the Meter to emit a continuous tone.

Table 1. Beeper Response in Continuity Test

Input Range	Beeper On If
400 Ω	Approx. < 35 Ω

The continuity mode is extremely fast and can be used to detect either shorts or opens that last for as little as 100 milliseconds. When a change is detected, the beeper tone is "stretched" to last at least 1/4 second, so you can hear it and detect both shorts and opens.

This can be a valuable troubleshooting aid when looking for intermittents associated with cables connections, switches, relays, etc. If the test value is very close to the threshold, erratic beeps can also occur due to environmental electrical noise (EMI).

5.11 Using Soft



Observe that SOFT is displayed after pressing the SOFT CREST pushbutton once. This SOFT mode digitally displays a running average of readings over 3-second interval to reduce the fluctuation of the readings. The bar graph is unaffected by this SOFT function and updates 20 times each second.

SOFT function can be used for ampere readings or voltage readings.

Press the SOFT CREST pushbutton twice when in the **AC** or DC amperes mode, or once when in the voltage mode, in order to exit SOFT.

5.12 Using Crest



Observe that PEAK is displayed after pressing the SOFT CREST pushbutton twice. PEAK is available for AC ampere readings only and can not be selected when in the other modes.

Both the digital display and bar graph measure the half-cycle peak AC amperes when PEAK is displayed.

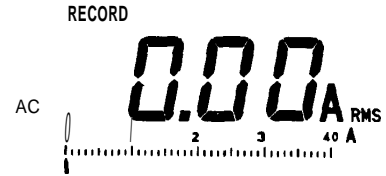
The crest factor of a waveform is the ratio of its half-cycle peak amperes to its rms amperes.

$$\text{Crest Factor} = \frac{\text{Half-Cycle Peak Amperes}}{\text{RMS Amperes}}$$

The Crest Factor is a nominal 1.414 for linear current flow without current wave distortion. Crest Factors other than 1.414 indicate the presence of harmonic current flow. (See 6.1 Non-Linear Loads.)

Press the SOFT CREST pushbutton once to exit CREST. Then, PEAK is no longer displayed.

5.13 Enabling Record



To enable RECORD, press the MIN MAX pushbutton. The blinking RECORD is displayed. The recording of a new maximum or minimum is indicated by beep sounds. We can use RECORD in all modes of this Meter, but we can not change Meter modes while in RECORD, for example, from voltage to amperes.

In the AC amperes mode, the bar graph displays the rms value of current flow and also blinking pointers at the recorded MAX and MIN. But, in the frequency mode, the bar graph displays the rms value of current flow only. No blinking Pointers.

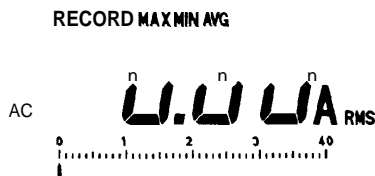
In SOFT, the softened values of rms current flow, frequency or voltage is recorded for MAX, MIN, and AVG. The bar graph displays instantaneous values of rms current with blinking pointers for MAX and MIN.

In CREST (that is, PEAK) mode, the half-cycle peak amperes are recorded for MAX. In CREST mode, MIN and AVG are not available. The bar graph displays a single blinking pointer for MAX. The CREST (that is, PEAK) function is not available in the other (V or Hz or Ω) modes.

To stop recording, use the HOLD pushbutton. Then, RECORD no longer blinks, and the values of MAX, MIN, and AVG are frozen. Press the HOLD pushbutton again to restart recording, when the values of **MAX**, **MIN**, and **AVG** are not reset. The recording simply starts again from where it left off.

Press and hold the MIN MAX pushbutton for 2 seconds and then release in order to exit RECORD. This Meter acknowledges with a beep sound and RECORD is no longer displayed.

5.14 Using Record



After enabling RECORD, press the MIN MAX pushbutton to cycle through the MAX, MIN, and AVG readings held in memory. If this Meter is in CREST (that is, PEAK) function, only MAX is held in memory. Battery life limits the duration of RECORD. The MAX reading is the maximum value detected since RECORD started. The MIN reading is the minimum value detected since RECORD started. The AVG reading is calculated continuously from the start of RECORD.

To stop recording and to freeze the values of MAX, MIN, and AVG in memory, press the HOLD pushbutton. Press the MIN MAX pushbutton to cycle through the readings, including a position where the **HOLD** blinks. In this mode, readings may be taken without disturbing the values held in memory. To restart recording, press the HOLD pushbutton. Then, RECORD blinks.

When using HOLD and RECORD, note that when RECORD is blinking, this Meter is recording values; when RECORD is not blinking, this Meter is not recording values. When **HOLD** is blinking, the digital display is showing a real measurement; when **HOLD** is not blinking, the digital display is showing a recorded measurement. HOLD and RECORD apply to the digital display only. The bar graph shows a real measurement only at all times.

If you press the MIN MAX pushbutton to start recording while in the HOLD mode, RECORD is not blinking because this Meter is not recording values. And if you cycle through the MAX, MIN, and AVG readings, this Meter displays just

Press the MIN MAX pushbutton for 2 seconds and then release in order to exit RECORD (or HOLD and RECORD if selected). This Meter acknowledges with a beep sound and RECORD is no longer displayed.

6. Applications of Measurement

6.1 Non-Linear Loads

True-RMS current flow is very important because it directly relates to the amount of heat dissipated in wiring, transformers, and system connections. Most ammeters in the market measure average current flow, not true rms current flow, even if this average current flow is displayed on a scale calibrated in rms. These average-sensing ammeters are accurate only for a pure sine-wave current.

All current waveforms are virtually distorted in some way. The most common is harmonic distortion caused by non-linear loads such as household electrical appliances, personal Computers or speed controls for motor drives. Harmonic distortion caused significant current flow at frequencies that are at odd multiples of the power line frequency. Harmonic current flow gives a substantial impact on the neutral wires of star (wye)-connected power distribution Systems.

In most countries a power distribution system uses commercial 3-phase 50Hz/60Hz power applied to a transformer with a delta-connected primary, and a star (wye)-connected secondary. The secondary generally provides 120V AC from phase to neutral, and 208V AC from phase to phase. To balance the loads for each phase was a big headache for the electrical system designer, historically.

The vector addition of the currents in the transformer's neutral wire was zero or quite low (because perfect-balance was rarely achieved) in a well-balanced system, devices connected to which were incandescent lighting, small motors, and other devices that presented linear loading. The result was an essentially sine-wave current flow in each phase and a low neutral current flow at a frequency of 50Hz/60Hz.

But, devices such as TV sets, fluorescent lighting, video machines, and microwave ovens are commonly drawing

power line current for only a fraction of each cycle so that they cause non-linear loading and subsequent non-linear current flow. This generates odd harmonics of the 50Hz/60Hz line frequency. Therefore, the current in the transformer of today contains not only a 50Hz (or 60Hz) component, but a 150Hz (or 180Hz) component, a 250Hz (or 300Hz) component, and the other significant harmonic components up to a 750Hz (or 900Hz) component and beyond.

The vector addition in a properly-balanced power distribution system feeding non-linear loads may still be quite low. But, the addition does not cancel all the harmonic currents. The odd multiples of the 3rd harmonic (called the "TRIPLENS") are, particularly, added together in the neutral. These harmonics can form a total rms current in the transformer's neutral wire that is normally 130% of the total rms current measured in any individual phase, whose theoretical maximum is 173%. For example, phase currents of 80 amperes may cause harmonic current flow in the neutral of 104 amperes. The dominant current flow in the neutral is most commonly the 3rd harmonic.

The electrical system designer must consider the following 3 issues when he designs a power distribution system containing harmonic current flow.

1. The AC neutral wires must be of sufficient gauge to allow for harmonic current flow.
2. The distribution transformer must have additional cooling to continue operation at its rated capacity, if it is not harmonic-rated. This is because the harmonic current flow in the secondary neutral wire is circulating in the delta-connected primary winding, after it is reflected to the primary winding. The circulating harmonic current heats up the transformer.
3. Phase current harmonics are reflected to the primary winding and they continue back towards the power source. This can cause distortion of the voltage wave so that any power factor correction capacitors on the line can be easily overloaded.

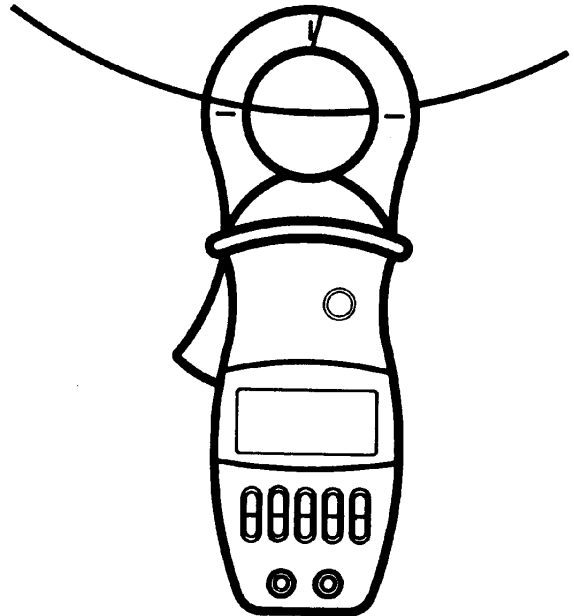
We can use this Meter to analyze components such as power distribution transformers and power factor correction capacitors.

6.2 General Applications



You can measure any conductor carrying AC unless this conductor is at a potential above 600V AC or at a frequency above 10KHz. True rms measurement yields the effective current value.

1. Press the ON OFF pushbutton to turn on this Meter.
2. Clamp around the conductor to be measured. Be sure the clamp jaws are securely closed, or measurements will not be accurate.
3. Observe the display for true rms current flow.
4. Press the Hz pushbutton to measure frequency.
5. Press the HOLD pushbutton to freeze the digital display, if necessary.



6. To soften readings, press the SOFT CREST pushbutton once (SOFT displayed) or to measure half-cycle peak amperes, press this pushbutton twice (PEAK displayed). A crest factor (see 5.11 Using Crest) other than 1.414 is an indication of non-linear current flow.

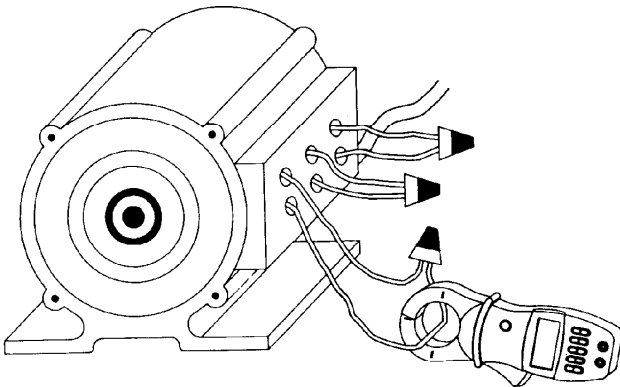
7. To record readings and to view readings, press the MIN MAX pushbutton.

8. To clear RECORD, press the MIN MAX pushbutton for 2 seconds.

6.3 Motors

You can measure starting (inrush) current, running current, and current imbalance. Inrush current is typically 6 times the value of running current, depending on the motor type.

1. Press the ON OFF pushbutton to turn on this Meter.
2. Clamp around a motor phase conductor. Be sure the clamp jaws are securely closed, or measurements will not be accurate.
3. While watching the bar graph, turn on the motor and observe the level of inrush current. In this case, the bar graph is better than the digital display because the bar graph response is faster than the digital display.



4. When the motor reaches the desired speed, observe the running current.

5. Repeat your measurement for each motor phase. Unbalanced current may be caused by a voltage imbalance, or a shorted motor winding.

6. Repeat steps 1 thru 3, then press the MIN MAX pushbutton to enable RECORD.

7. Turn on the motor. When the motor gets to the desired speed, note the blinking upper bar on the bar graph (inrush rms current), and the displayed level (running rms current).

8. To view the maximum inrush current, press the MIN MAX pushbutton once.

9. Repeat step 6, if necessary.

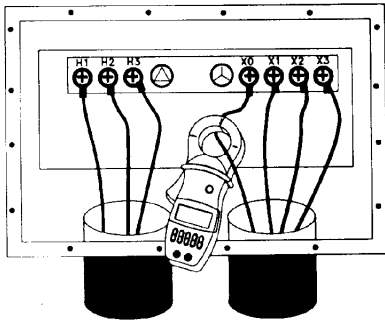
10. To clear RECORD, press the MIN MAX pushbutton for 2 seconds.

6.4 Distribution Transformers

You can measure excessive current, load balance between phases, true rms and frequency of neutral current. True rms measurement yields the effective value.

1. Press the ON OFF pushbutton to turn on this Meter.
2. Clamp around a phase wire of the transformer. Be sure the clamp jaws are securely closed, or measurements will not be accurate.
3. Observe the display for true rms current flow.
4. Repeat your measurement for each phase to observe balance. Unbalanced phases cause large neutral currents flow.
5. Clamp around the neutral wire.

6. Observe the display for true rms current flow. Any significant flow, with balanced phases, indicates the presence of harmonic currents.
7. Press the Hz pushbutton to measure the frequency of neutral wire. **Reading** indicates the frequency of the dominant current flow (in case of harmonic current flow, 180Hz reading in a 60Hz System).
8. To freeze the digital display, press the HOLD pushbutton.
9. To measure half-cycle peak amperes, press the SOFT CREST pushbutton twice (PEAK displayed). A crest factor other than 1.414 is an indication of harmonic current flow.
10. To record readings and to view maximum, minimum, and average values, press the MIN MAX pushbutton.
11. To clear RECORD, press the MIN MAX pushbutton for 2 seconds.

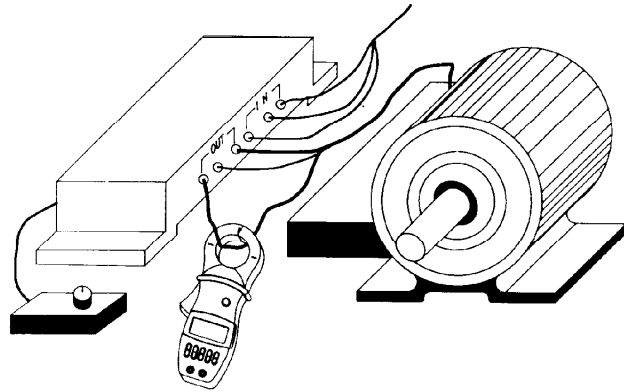


6.5 Adjustable Speed Motor Controllers



You can measure input current, output current and frequency of the adjustable speed motor controllers. The output current frequency is used to calculate the rotating speed of the motor, while input current frequency is used to measure the frequency of the power line. The frequency of the output current is important because the voltage frequency is often meaningless for the calculations of motor controller speed.

1. Press the ON OFF pushbutton to turn on this Meter.
2. Clamp around an input or output phase (**as** required), and run motor at desired speed. Be sure the clamp jaws are securely closed, or measurements will not be accurate.
3. Observe the display for true rms current flow.
4. Measure an output phase of the motor controller and use Hz mode to measure frequency. Nominal motor speed is calculated from $RPM = 120 F/P$, where **F** is the frequency measured, and **P** is the number of motor poles.
5. To record readings and to view readings, press the MIN MAX pushbutton.
6. To clear RECORD, press the MIN MAX pushbutton for 2 seconds.



7. Maintenance and Calibration

7.1 Maintenance

Repairs or servicing should only be performed by qualified personnel.



WARNING!

TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING PROCEDURE UNLESS YOU ARE QUALIFIED TO DO SO. READ “CLAMP-ON METER SAFETY” AT THE BEGINNING OF THIS MANUAL BEFORE PROCEEDING.

To assure continued safety of this Meter, inspect this Meter before use for cracks or missing portions of the insulating cover, or for loose or weakened components. Pay particular attention to the insulation surrounding the clamp jaws and clamp lever. Any Meter that fails this inspection should be made inoperative by taping the clamp shut.

Periodically wipe the case with a damp cloth and detergent; do not use abrasives or solvents. Open the clamp jaws and wipe the magnetic pole pieces with a lightly oiled cloth. Do not allow rust or corrosion to form on the pole pieces.

The serial number is stamped on the back of the unit. The serial number should be used when ordering parts or requesting service/calibration information.

7.2 Replaceable Parts



WHEN SERVICING THIS METER, USE ONLY THE REPLACEMENT PARTS SPECIFIED.

Replaceable parts are shown in Figure 3 and listed in Table 2.

7.3 Calibration

This Meter should be calibrated annually. Regarding the service/calibration information on this Meter, contact the nearest distributor of this Meter.

Table 2. Replaceable Parts

ITEM	DESCRIPTION	PART NUMBER
①	Lens, LCD	CL2 LENS
②	Cover, Rear	CL2 CASE
③	Screw, Case (metric)	CL2 SCRWB
④	Battery, 9V	CL1 BT09
⑤	User's Manual	CL3 MAN
⑥	Clip-on Holster	C130
⑦	Test Lead Set	TL34

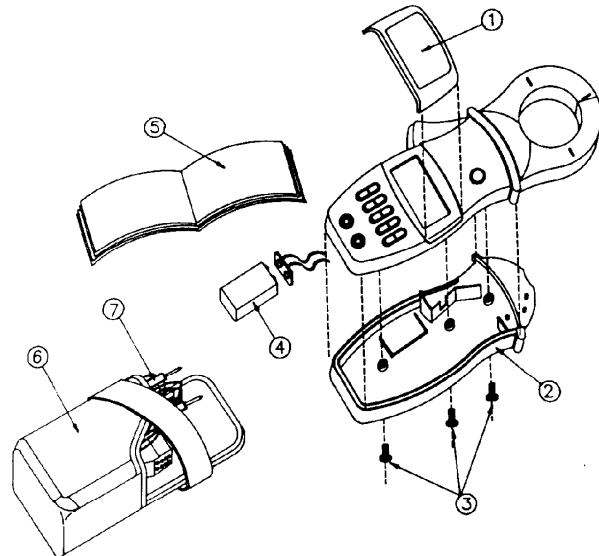


Figure 3. Replaceable Parts

8 Technical Data and Specifications

8.1 Technical Data

Display: Digital – 4000 counts (3¾ digits)
 [Hz: 9999 counts], updates 4 times/sec.
 Analog – Updates 20 times/sec, 41 segment bar graph.

Maximum Conductor Size: ϕ 51mm (2.00")
 Maximum Jaw Opening: 52mm (2.04")
 Max. Conductor Voltage: 600V rms
 Frequency Range: Current Measurement – 10Hz to 2KHz
 Frequency Measurement – 0.5Hz to 10KHz

Crest Factor, Continuous Waveform: (45Hz to 65Hz, less than 1000A peak)
 1.4 to 2.0 add 20. digits to accuracy below 100A
 2.0 to 3.0 add 1% to accuracy (+ 20 digits below 100A)
 3.0 to 5.0 add 2% to accuracy (+ 20 digits below 100A)

Adjacent Conductor Effect: 1% of current in adjacent conductor max.

Operating Temperature: – 10°C to 55°C
 Operating Humidity: 0% to 80% @ 40°C, 70% @ 50°C
 Storage Temperature: – 20°C to 60°C

Standard Equipment: Clamp-on Meter, Clip-on Holster, Test-leads, User's manual, and 9V battery (installed)

Battery Type: NEDA 1604A 9V or 6LF22 9V
 Battery Life: 80 hours typical (alkaline)

Safety Standards: UL 1244, IEC 348/1010, IEC 664
 (Appropriate Parts) Installation Category III, CSA C22.2 No. 231, ANSI/ISA S82, VDE 0411

Weight: Approx. 1.21 lb (545g)

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

8.2 Specifications

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

AC Current

RMS AMPERES¹

RANGE	RESOLUTION	ACCURACY ²	
0.30 to 39.99A (40A Scale)	0.01A	\pm (3% + 20 dgts) \pm (4% + 30 dgts) \pm (4% + 30 dgts) \pm (8% + 30 dgts)	45Hz – 65Hz 30Hz – 45Hz ³ 65Hz – 1KHz 20Hz – 30Hz ⁴
0.3 to 399.9A (400A Scale)	0.1A	\pm (3% + 2 dgts) \pm (4% + 3 dgts) \pm (4% + 3 dgts) \pm (8% + 3 dgts)	45Hz – 65Hz 30Hz – 45Hz ³ 65Hz – 1KHz 20Hz – 30Hz ⁴
400 to 700A (400A Scale)	1A	\pm 5% \pm 7% \pm 7% Not Specified	45Hz – 65Hz 30Hz – 45Hz ³ 65Hz – 1KHz 20Hz – 30Hz ⁴

¹ Sine Wave, measured with conductor centered at alignment marks and battery life indication greater than 40 hours on meter power up

² RMS Min/Max ADD 10 counts

³ 1A and above, 30Hz – 45Hz

⁴ AVG only, 2 SA and above
 RMS Min/Max Add 2% of reading

INSTANTANEOUS AMPERES (CREST MODE)¹

RANGE	RESOLUTION	ACCURACY	
0.4 to 39.99A (40A Scale)	0.2A	\pm (3% + 30 dgts) \pm (4% + 30 dgt.s) \pm (4% + 30 dgts) \pm (4% + 40 dgt.s)	45Hz–65Hz 30Hz – 45Hz ² 65Hz – 1KHz 20Hz – 30Hz ³
0.4 to 399.9A (400A Scale)	2A	\pm (3% + 3 dgt.s) \pm (4% + 3 dgts) \pm (4% + 3 dgts) \pm (4% + 4 dgt.s)	45Hz – 65Hz 30Hz – 45Hz ² 30Hz – 45KHz 20Hz – 30Hz ³
400 to 599A (400A Scale)	4A	\pm 3% \pm 4% \pm 4% \pm 4%	45Hz – 65Hz 30Hz – 45Hz ² 65Hz – 1KHz 20Hz – 30Hz ³
600 to 999A (400A Scale)	4A	\pm 7% \pm 7% \pm 7% \pm 7%	45Hz – 65Hz 30Hz – 45Hz ² 65Hz – 1KHz 20Hz – 30Hz ³

¹ Same as ¹ ² Same as ³ ³ 2.5A and above

FREQUENCY ***1

RANGE	RESOLUTION	ACCURACY
0.5 to 999.9 Hz	0.1 Hz	$\pm(0.2\% + 3 \text{ dgts})$
1000 to 9999 Hz	1 Hz	$\pm(0.2\% + 3 \text{ dgts})$

***1 Same as **1

With current autorange: Trigger Level, 5 Hz to 1500 Hz,
0.7A RMS or more, 1/2 peak
current

With manual ranging: Trigger Threshold, 10 Hz to 1000Hz
40A Range – 6A RMS or more
will trigger,
400A Range – 40A RMS or more
will trigger.

DC Current

RANGE	RESOLUTION	ACCURACY
0.30 to 39.99A	0.01A	$\pm(2\% + 30 \text{ dgts})$
0.3 to 399.9A	0.1A	$\pm(2\% + 10 \text{ dgts})$
400 to 700 A	1A	

AC Voltage (True-RMS)/DC Voltage

RANGE	RESOLUTION	ACCURACY		
		AC VOLTAGE		DC VOLTAGE
		45 Hz to 65 Hz	45 Hz to 1 KHz	
0 to 39.99V	0.01V	$\pm(1.0\% + 3)$	$\pm(2.5\% + 5)$	$\pm(1.0\% + 3)$
0 to 399.9V	0.1V			$\pm(1.5\% + 5\%)$
0 to 750V	1V	$\pm(1.5\% + 5)$		

AC Voltage

Common Mode Rejection Ratio: >80dB, dc to 60Hz.

DC Voltage

Normal Mode Rejection Ratio: >11dB at 50Hz or 60Hz

Common Mode Rejection Ratio: >84dB at dc,
50Hz or 60Hz

Resistance

RANGE	RESOLUTION	ACCURACY
0 to 399.9 Ω	0.1 Ω	$\pm(1.0\% + 10)$
0 to 3.999K Ω	1 Ω	$\pm(1.0\% + 3)$

Continuity Check

RANGE	CONTINUITY BEEPER
400 Ω	Approx. <35 Ω

Measurement Limits:

AC Amperes	: True-rms 0.3 to 700A
DC Amperes	: 0.3 to 700A
AC Voltage	: True-rms 0 to 750V
DC Voltage	: 0 to 750v
Frequency	: 0.5 to 9999Hz
Resistance	: 0 to 4K Ω
Continuity Check	: Beep at Approx. < 35 Ω in the 400 Ω range



WARNING!

READ "CLAMP-ON METER SAFETY" BEFORE USING THIS METER.

Contents

1. Introduction
2. Clamp-on Meter Safety
3. Explanation of Controls and Indicators
4. Alignment Marks
5. How to Use this Meter
6. Applications of Measurement
7. Maintenance and Calibration
8. Technical Data and Specifications

1. Introduction

This Meter is a handheld and battery operated True-RMS Clamp-on Meter that is designed and tested according to IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus (Protection Class II) and other safety Standards (see "Technical Data").

This Meter combines the speed and versatility of a high resolution analog display with the precision of a digital meter.