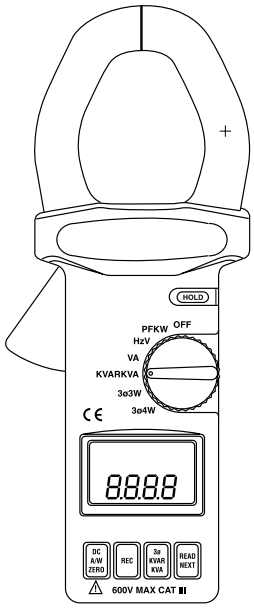
INSTRUCTION MANUAL

GREENLEE®



CMP-200

DIGITAL CLAMP-ON METER

Read and **understand** all of the instructions and safety information in this manual before operating or servicing this tool.

999 3282.2

IM 1417 REV 1 3/00

Description

The Greenlee CMP-200 is a Digital Clamp-on Meter intended to measure true power (watts), apparent power (volt-amps), reactive power (volt-amps reactive) and power factor in single-phase and three-phase circuits. It also measures voltage, current and frequency.

Safety

Safety is essential in the use and maintenance of Greenlee tools and equipment. This instruction manual and any markings on the tool provide information for avoiding hazards and unsafe practices related to the use of this tool. Observe all of the safety information provided.

Purpose

This instruction manual is intended to familiarize all personnel with the safe operation and maintenance procedures for the Greenlee CMP-200.

Keep this manual available to all personnel.

Replacement manuals are available upon request at no charge.

KEEP THIS MANUAL

Important Safety Information

SAFETY ALERT SYMBOL

This symbol is used to call your attention to hazards or unsafe practices which could result in an injury or property damage. The signal word, defined below, indicates the severity of the hazard. The message after the signal word provides information for preventing or avoiding the hazard.

⚠DANGER

Immediate hazards which, if not avoided, WILL result in severe injury or death.

⚠WARNING

Hazards which, if not avoided, COULD result in severe injury or death.

⚠CAUTION

Hazards or unsafe practices which, if not avoided, MAY result in injury or property damage.

⚠WARNING

Read and **understand** this material before operating or servicing this equipment. Failure to understand how to safely operate this tool can result in an accident causing serious injury or death.

Important Safety Information

⚠WARNING

Electric shock hazard:

Contact with live circuits can result in severe injury or death.

⚠WARNING

Electric shock hazard:

- Do not use the unit if it is wet or damaged.
- Use test leads or accessories that are appropriate for the application. See the category and voltage rating of the test lead or accessory.
- Inspect the test leads or accessory before use. They must be clean and dry, and the insulation must be in good condition.

Failure to observe these warnings can result in severe injury or death.

⚠WARNING

Electric shock hazard:

- Do not apply more than the rated voltage between any two input terminals, or between any input terminal and earth ground.
- Do not contact the test lead tips or any uninsulated portion of the accessory.

Failure to observe these warnings can result in severe injury or death.

Important Safety Information

⚠WARNING

- Do not operate with the case open.
- Before opening the case, remove the test leads (or jaw) from the circuit and shut off the unit.

Failure to observe these warnings can result in severe injury or death.

⚠CAUTION

Do not change the measurement function while the test leads are connected to a component or circuit.

Failure to observe this precaution can result in injury and can damage the unit.

⚠CAUTION

- Do not attempt to repair this unit. It contains no user-serviceable parts.
- Do not expose the unit to extremes in temperature or high humidity. See Specifications.

Failure to observe these precautions can result in injury and can damage the unit.

IMPORTANT

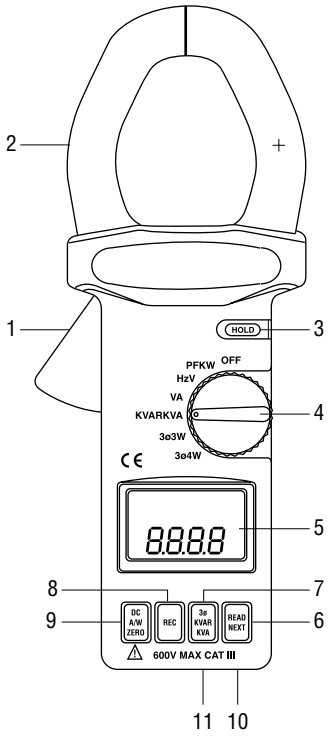
Using this unit near equipment that generates electromagnetic interference can result in unstable or inaccurate readings.

Glossary

PF	Power Factor
Ø	Phase
W	Wire
W	Watts (True Power)
VA	Volt-Amps (Apparent Power)
VAR	Volt-Amps Reactive (Reactive Power)

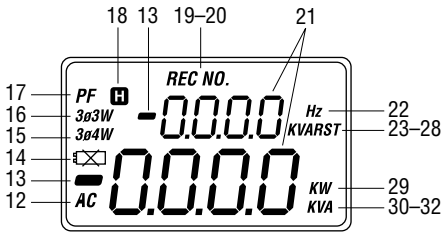
Identification

1. Lever
2. Jaw
3. Hold Button
4. Selector
5. Display
6. READ NEXT Button
7. 3Ø KVAR KVA Button
8. REC Button
9. DC A/W ZERO Button
10. + Terminal
11. COM Terminal



Display Icons

12.	AC	Alternating Current
13.	–	Polarity Indicator
14.		Low Battery
15.	3Ø4W	Three-Phase Four-Wire Circuits
16.	3Ø3W	Three-Phase Three-Wire Circuits
17.	PF	Power Factor
18.	H	Hold
19.	REC	Indicates that data is stored in memory
20.	REC NO. (1, 2, 3 or 4)	Indicates that stored data is on the display
21.	0.0.0.0	Numeric Display
22.	Hz	Frequency (in Hertz or cycles per second)
23.	K	Kilo (10^3)
24.	V	Volts
25.	A	Amps
26.	R	First Phase
27.	S	Second Phase
28.	T	Third Phase
29.	KW	Kilowatt
30.	K	Kilo (10^3)
31.	V	Volts
32.	A	Amps
	OL	Overload (not shown)



Symbols on the Unit

	Read the instruction manual.
	Double Insulation
	Battery

Using the Features

- **H HOLD** Press momentarily to hold the present value on the display and store it in the memory. Press again to exit this mode.
- **DC A/W ZERO Button** Sets the meter to zero to eliminate the effects of residual magnetism when measuring DC current, power and power factor.
- **REC Button** Press to store data in memory; the CMP-200 has four memory locations. FULL indicates that all memory locations are in use. Shut the meter off to clear all of the memories.
- **3Ø KVAR KVA** After the 3ø3W or 3ø4W function has finished calculations, press this button to toggle between power factor (PF)/true power (W) display and reactive power (VAR)/ apparent power (VA) display.
- **READ NEXT Button** When taking current and voltage measurements from 3Ø3W or 3Ø4W circuits, use this button for storing data and performing calculations.

  When measuring any other value, use this button to recall data stored in the four memory locations. REC NO. 1 will appear momentarily on the display, followed by the value stored in the first memory. Change the selector to any position to exit the READ mode.

AC Measurement

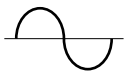
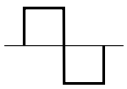
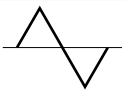
AC measurements are usually displayed as RMS *(root mean squared)* values. Two methods of AC measurement are *average-responding RMS calibrated* and *true RMS-reading.*

The average-responding RMS calibrated method takes the average value of the input signal, multiplies it by 1.11, and displays the result. This method is accurate if the input signal is a pure sine wave.

The true RMS-reading method uses internal circuitry to read the true RMS value. This method is accurate, within the specified crest factor limitations, whether the input signal is a pure sine wave, a square wave, sawtooth, half wave or signal with harmonics. The ability to read true RMS provides much more measurement versatility. The Greenlee CMP-200 is a true RMS meter.

The Waveforms and Crest Factors table shows some typical AC signals and their RMS values.

Waveforms and Crest Factors

Waveform				
RMS Value	100	100	100	100
Average Value	90	100	87	64
Crest Factor* (ξ)	1.414	1	1.73	2

* The crest factor is the ratio of the peak value to the RMS value; it is represented by the Greek letter ξ.

Operation

⚠WARNING

Electric shock hazard:

Contact with live circuits can result in severe injury or death.

1. See the Settings Tables. Set the selector to the proper setting and connect the test leads to the meter.
2. See the appropriate section for specific measurement instructions and illustrations.
3. Test the unit on a known functioning circuit or component.
   - If the unit does not function as expected on a known functioning circuit, replace the battery and/or fuse.
   - If the unit still does not function as expected, send the unit to Greenlee for repair.
4. Take the reading from the circuit or component to be tested.

Measurements on Single-Phase Circuits

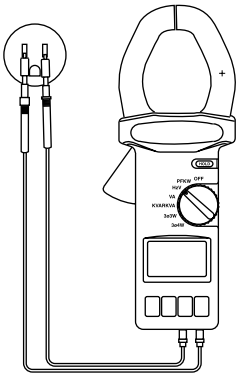
Single-Phase Two-Wire Circuits: Settings Table

Measurement	Selector Setting	Icons Displayed	Red Lead Connection	Black Lead Connection	Clamp Location
Voltage or Frequency	**Hz V**	Hz and V	hot or neutral	hot or neutral	N/A
Watts and Power Factor* (W and PF)	**PF KW** and press **DCA/W ZERO**	PF and KW	hot	neutral	hot
Apparent and Reactive Power (KVA and KVAR)	**KVAR KVA** and press **DCA/W ZERO**	KVAR and KVA	hot	neutral	hot
Current or Voltage	**VA**	V and A	hot	neutral	hot

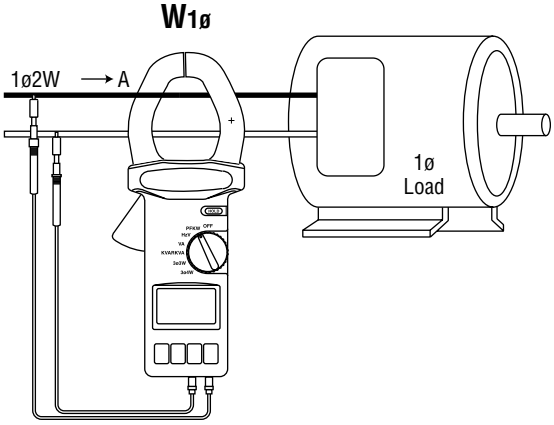
* A positive (+) PF indicates an inductive load. A negative (–) PF indicates a capacitive load. If the PF is greater than 0.91 (a phase shift of less than 25°), set the selector to 3Ø3W for a more accurate reading of KVA and KVAR.

Measurements on Single-Phase Circuits (cont'd)

Single-Phase Two-Wire Circuits: Voltage or Frequency Measurement



Single-Phase Two-Wire Circuits: True Power, Power Factor, Apparent Power and Reactive Power Measurement or Current and Voltage Measurement



Measurements on Single-Phase Circuits (cont'd)

Single-Phase Three-Wire Circuits: Settings Table

Measurement: True Power, Power Factor*, Apparent Power and Reactive Power (W, PF, KVA, KVAR)
Type of Circuit: 1ø3W
Selector Setting: 3ø3W

Instructions	Red Lead Connection	Black Lead Connection	Clamp Location
"R" will flash on the display. Press **DCA/W ZERO****. Connect the leads and position the clamp as shown to take the first measurement (W_{RS} / $KVAR_{RS}$).	L1	Neutral	L1
After the measurement stabilizes, press **READ NEXT**. "T" will flash on the display. Remove clamp from wire. Press **DCA/W ZERO**** and connect the leads and position the clamp as shown to take the final measurement (W_{TS} / $KVAR_{TS}$).	L2	Neutral	L2
After the final measurement stabilizes, press **READ NEXT**. The CMP-200 will calculate and display the power factor (PF) and true power (W). Press **3ø KVAR KVA** to display the reactive power (KVAR) and apparent power (KVA).			

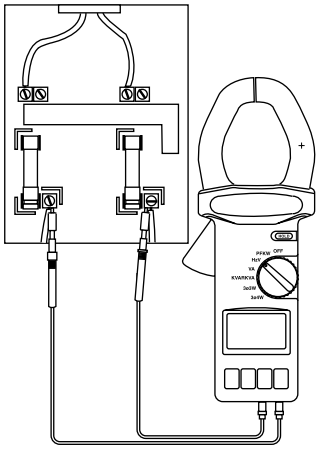
* A positive (+) PF indicates an inductive load. A negative (–) PF indicates a capacitive load. Power factor value is correct for balanced loads only.

** Jaw should be closed and removed from circuit whenever DCA/W ZERO is pressed.

Note: The + sign on the jaw must face the power source.

Measurements on Single-Phase Circuits (cont'd)

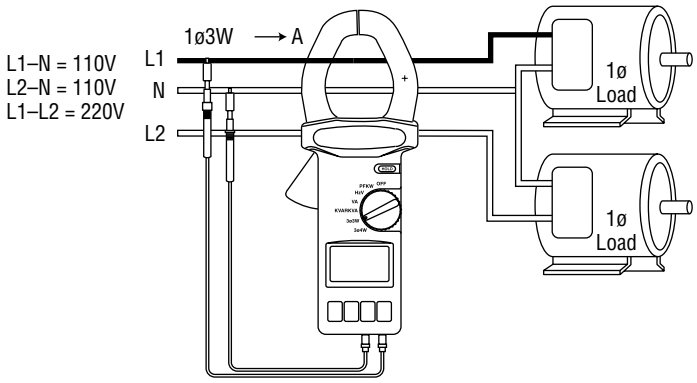
Single-Phase Three-Wire Circuits: Voltage or Frequency Measurement



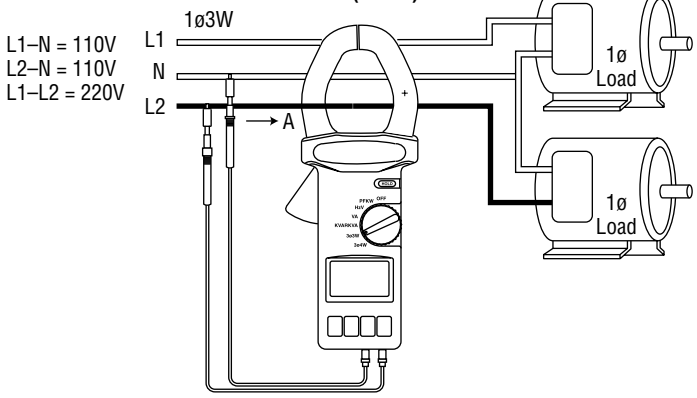
Measurements on Single-Phase Circuits (cont'd)

Single-Phase Three-Wire Circuits:
True Power, Power Factor, Apparent Power and Reactive Power Measurement

W_{L1} (W_{RS})



W_{L2} (W_{TS})



Measurements on Three-Phase Circuits

The branches or legs of three phase electrical circuits are typically labeled in any of the following conventions:

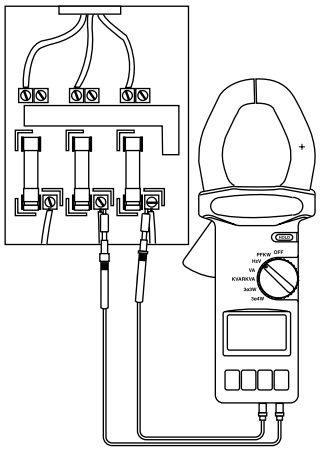
- A, B and C
- L1, L2 and L3
- R, S, and T

They are referred to as R, S and T in this manual and on the meter.

Three-Phase Circuits: Settings Table for Voltage and Frequency

Measurement	Type of Circuit	Selector Setting	Icons Displayed	Red Lead Connection	Black Lead Connection	Clamp Location
Voltage or Frequency	3ø3W or 3ø4W	**Hz V**	Hz and V	R, S or T	any other phase (or neutral on 3ø4W only)	N/A

Three-Phase Circuits: Voltage or Frequency Measurement



Measurements on Three-Phase Circuits (cont'd)

Three-Phase Three-Wire Circuits: Settings Table for Power Measurements

Measurement: True Power, Power Factor*, Apparent Power and Reactive Power (W, PF, KVA and KVAR)
Type of Circuit: 3ø3W
Selector Setting: 3ø3W

Instructions	Red Lead Connection	Black Lead Connection	Clamp Location
"R" will flash on the display. Press **DCA/W ZERO****. Connect the leads and position the clamp as shown to take the first measurement (W_{RS} / $KVAR_{RS}$).	R	S	R
After the measurement stabilizes, press **READ NEXT**. "T" will flash on the display. Remove clamp from wire. Press **DCA/W ZERO**** and connect the leads and position the clamp as shown to take the final measurement (W_{TS} / $KVAR_{TS}$).	T	S	T
After the final measurement stabilizes, press **READ NEXT**. The CMP-200 will calculate and display the power factor (PF) and true power (W). Press **3ø KVAR KVA** to display the reactive power (KVAR) and apparent power (KVA).			

* A positive (+) PF indicates an inductive load. A negative (–) PF indicates a capacitive load. Power factor value is correct for balanced loads only.

** Jaw should be closed and removed from circuit whenever DCA/W ZERO is pressed.

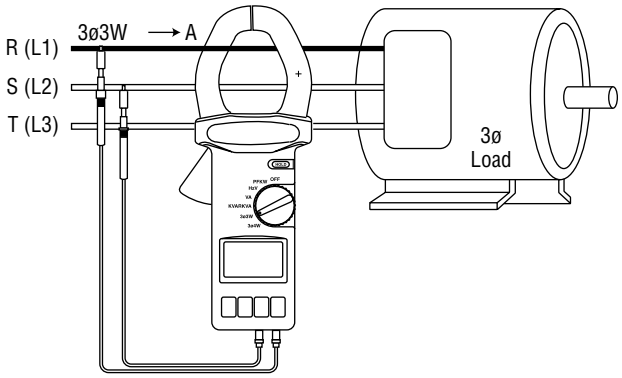
Notes:

- *The + sign on the jaw must face the power source.*
- *COM connection (black lead) should remain connected to the same phase during both measurements.*
- *Both power measurements may be positive, or one may be negative. Make sure all connections are correct to obtain proper measurements.*

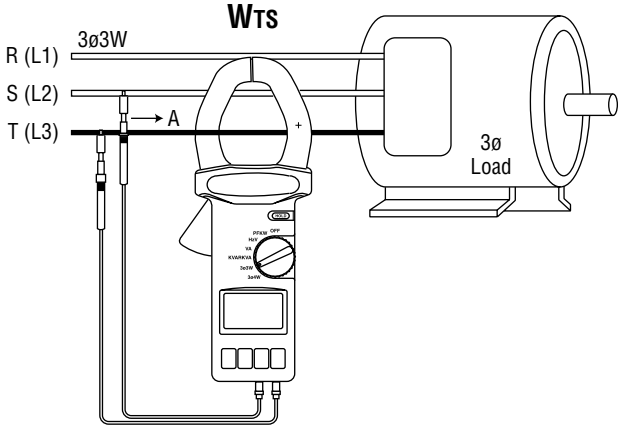
Measurements on Three-Phase Circuits (cont'd)

Three-Phase Three-Wire Measurements:
True Power, Power Factor, Apparent Power and Reactive Power Measurement

WRS



WTS



Measurements on Three-Phase Circuits (cont'd)

Three-Phase Four-Wire Circuits: Settings Table

Measurement: True Power, Power Factor*, Apparent Power and Reactive Power (W, PF, KVA and KVAR)
Type of Circuit: 3ø4W
Selector Setting: 3ø4W

Instructions	Red Lead Connection	Black Lead Connection	Clamp Location
"R" will flash on the display. Press **DCA/W ZERO****. Connect the leads and position the clamp as shown to take the first measurement (W_R / PF_R).	R	N	R
After the measurement stabilizes, press **READ NEXT**. "S" will flash on the display. Remove clamp from wire. Press **DCA/W ZERO**** and connect the leads and position the clamp as shown to take the final measurement (W_S / PF_S).	S	N	S
After the measurement stabilizes, press **READ NEXT**. "T" will flash on the display. Remove clamp from wire. Press **DCA/W ZERO**** and connect the leads and position the clamp as shown to take the final measurement (W_T / PF_T).	T	N	T
After the final measurement stabilizes, press **READ NEXT**. The CMP-200 will calculate and display the power factor (PF) and true power (W). Press **3ø KVAR KVA** to display the reactive power (KVAR) and apparent power (KVA).			

* A positive (+) PF indicates an inductive load. A negative (–) PF indicates a capacitive load. Power factor value is correct for balanced loads only.

** Jaw should be closed and removed from circuit whenever DCA/W ZERO is pressed.

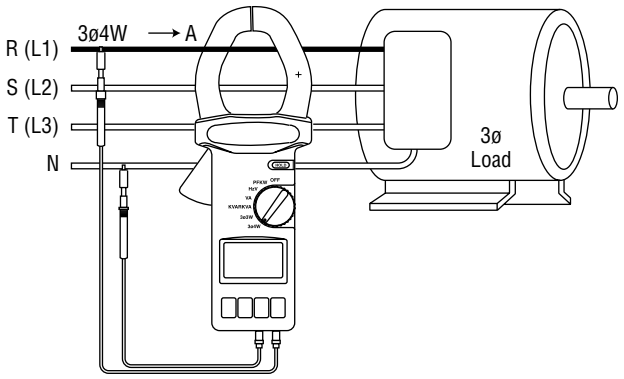
Notes:

- *The + sign on the jaw must face the power source.*
- *All three power measurements (W_R, W_S and W_T) should be positive. Check test lead connection and clamping of jaw if any power measurement is negative.*

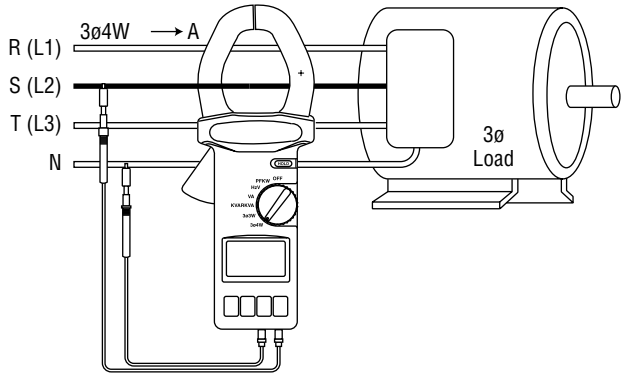
Measurements on Three-Phase Circuits (cont'd)

Three-Phase Four-Wire Measurements: True Power, Power Factor, Apparent Power and Reactive Power Measurement

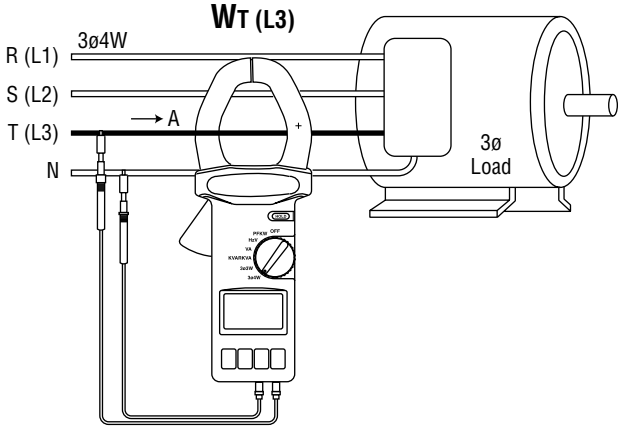
WR (L1)



WS (L2)



Measurements on Three-Phase Circuits (cont'd)



Calculations

When using the 3ø3W and 3ø4W functions of the CMP-200, the unit automatically performs the following calculations:

Single-Phase

$$W_{1Ø3W} = W_{L1L2N} = W_{L1N} + W_{L2N}$$

Three-Phase Three-Wire

$$W_{3Ø3W} = W_{RS} + W_{TS}$$

$$KVAR_{3Ø3W} = KVAR_{RS} + KVAR_{TS}$$

$$KVA_{3Ø3W} = \sqrt{[KW_{3Ø3W}]^2 + [KVAR_{3Ø3W}]^2}$$

$$PF_{3Ø3W} = \frac{KW_{3Ø3W}}{KVA_{3Ø3W}}$$

Three-Phase Four-Wire

$$W_{3Ø4W} = W_R + W_S + W_T$$

$$KVAR_{3Ø4W} = KVAR_R + KVAR_S + KVAR_T$$

$$KVA_{3Ø4W} = \sqrt{[KW_{3Ø4W}]^2 + [KVAR_{3Ø4W}]^2}$$

$$PF_{3Ø4W} = \frac{KW_{3Ø4W}}{KVA_{3Ø4W}}$$

Accuracy

Accuracy is specified as follows: ± (a percentage of the reading + a fixed amount) at 18 °C to 28 °C (64.4 °F to 82.4 °F).

Accuracy Table

Value	Measurement Range	Accuracy	
****Frequency**	50/60 Hz	± (2 d)*	
	10 Hz to 1000 Hz	± (1.5% + 2 d)*	
†True Power (AC or DC)	0 to 99.99 KW	± (2% + 0.05 KW)	
	100 to 999.9 KW	± (2% + 0.5 KW)	
	1000 to 1200 KW	± (2% + 5 KW)	
†KVAR (AC or DC)	0 to 99.99 KW	± (2% + 0.05 KW)	
	100 to 999.9 KW	± (2% + 0.5 KW)	
	1000 to 1200 KW	± (2% + 5 KW)	
		at O Hz and 50/60 Hz	**at 40 Hz to 400 Hz**
††Voltage (AC or DC) at 10 mΩ Input Impedance	0 to 499.9 V	± (1.5% + 0.5 V)	± (2.0% + 0.5 V)
	500 to 600 V	± (1.5% + 5 V)	± (2.0% + 5 V)
††Current (AC or DC)	0 to 199.9 A	± (1.5% + 0.5 A)	± (2.0% + 0.5 A)
	200 to 499.9 A	± (2.0% + 0.5 A)	± (2.5% + 0.5 A)
	500 to 2000 A	± (2.0% + 5 A)	± (2.5% + 5 A)

* d refers to the least significant digit (the number in the right-most position)

** Sensitivity: Volts > 1 V; Amps > 5 A
Minimum Input Frequency: 10 Hz

† Maximums: 600 V, 2000 Amps
Power Factor: 0.2 to 1.0

†† Accuracy specified for crest factor less than 4

Specifications

Display: Dual 4-digit LCD (9999 maximum count)

Polarity: Automatic

Sampling Rate:
Volts and Amps: 2 per second
Watts: 0.6 per second

Jaw Opening: 55 mm (2.17")

Operating Conditions: 4 °C to 50 °C (39.2 °F to 122 °F) , 0 to 85% relative humidity
Elevation: 2000 m (6500') maximum

Storage Conditions: –20 °C to 60 °C (–4 °F to 140 °F), 0 to 75% relative humidity
Remove battery.

Battery: 9-Volt battery (NEDA 1604, JIS 006P or IEC 6F22)

Overvoltage Protection: Category III, 600 Volts

Cleaning

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

Lifetime Limited Warranty

Greenlee warrants to the original purchaser of these goods for use that these products will be free from defects in workmanship and material for their useful life, excepting normal wear and abuse. This warranty is subject to the same terms and conditions contained in Greenlee's standard one-year limited warranty.

Mark all packages: Attention TEST INSTRUMENT REPAIR. For items not covered under warranty (such as dropped, abused, etc.), repair cost quote available upon request.

Note: Prior to returning any test instrument, please check replaceable batteries or make sure the battery is at full charge.