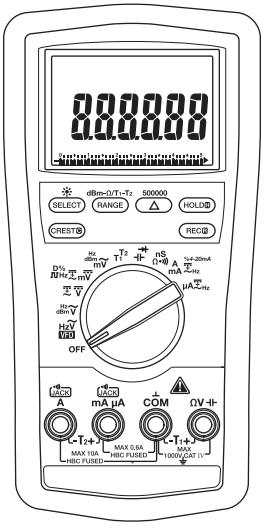
INSTRUCTION MANUAL

GREENLEE®
A Textron Company



DM-860A

Digital Multimeter

Test Equipment Depot
1-800-517-8431

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

Description

The Greenlee DM-860A Digital Multimeter is a hand-held testing device with the following measurement capabilities: AC and DC voltage, AC and DC current, percent of loop current, two channels of temperature (K-type thermocouples), frequency, duty cycle, resistance, conductance, and capacitance. It also checks diodes and verifies continuity.

The DM-860A features a bar graph display that responds more quickly than the numeric display—useful for detecting faulty contacts, potentiometer clicks, and signal spikes. An optional optically isolated computer interface with software facilitates the recording of readings from the meter to a computer.

Other specialized functions and capabilities include:

- Dual display shows two measurements, such as AC voltage and frequency, at the same time.
- Beep-Jack™ audible warning alerts the user with a beep and an error message on the LCD if the test lead is plugged into the **mA µA** or **A** input terminal while the selector switch is not in the **mA µA** or **A** position.
- AC bandwidth to 100 kHz for voltage or 20 kHz for current.
- MAX/MIN function which stores the maximum, minimum, and average.
- Crest capture mode to capture voltage or current signal peaks.
- Selectable between 50,000 or 500,000 counts resolution when measuring DC voltage.
- Relative zero mode.
- Automatic or manual ranging.
- Intelligent automatic power off.
- Backlighted LCD for reading in dim conditions.

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 of This Manual

This instruction manual is intended to familiarize all personnel with the safe operation and maintenance procedures for the Greenlee DM-860A Digital Multimeter.

Keep this manual available to all personnel. Replacement manuals are available upon request at no charge at www.greenlee.com.

Do not discard this product or throw away!
For recycling information, go to www.greenlee.com.

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 could result in an accident causing serious injury or death.

⚠WARNING

Electric shock hazard:

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

KEEP THIS MANUAL

Important Safety Information

⚠WARNING

Electric shock and fire hazard:

- Do not expose this unit to rain or moisture.
- Do not use the unit if it is wet or damaged.
- Use test leads or accessories that are appropriate for the application. Refer to 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.
- Use this unit for the manufacturer's intended purpose only, as described in this manual. Any other use can impair the protection provided by the unit.

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

⚠WARNING

Electric shock hazard:

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

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

⚠WARNING

Electric shock hazard:

The fuses are an integral part of the overvoltage protection. When fuse replacement is necessary, refer to "Specifications" for the correct type, size, and capacity. Using any other type of fuse will void the overvoltage protection rating of the unit.

Failure to observe this warning could result in severe injury or death.

Important Safety Information

⚠WARNING

Electric shock hazard:

- Unless measuring voltage, current, or frequency, shut off and lock out power. Make sure that all capacitors are discharged. Voltage must not be present.
- Set the selector and connect the test leads so that they correspond to the intended measurement. Incorrect settings or connections can result in a blown fuse.
- Using this unit near equipment that generates electromagnetic interference can result in unstable or inaccurate readings.

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

⚠CAUTION

Electric shock hazard:

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

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

⚠CAUTION

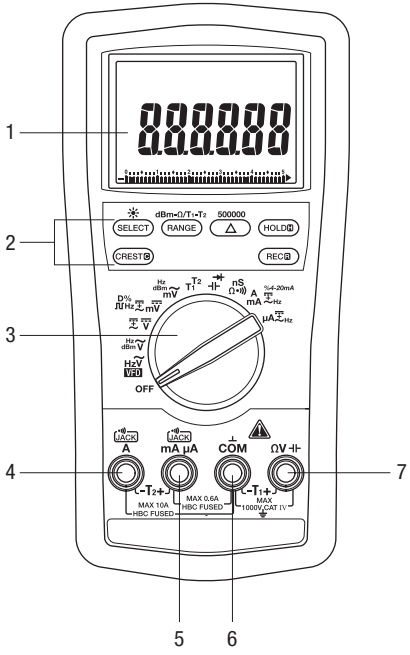
Electric shock hazard:

- 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. Refer to “Specifications.”

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

Identification

1.	Display	LCD and bar graph
2.	Feature Buttons	Refer to explanations under “Using the Features”
3.	Selector	Selects a function or turns power OFF
4.	**A**	Positive input terminal for high current measurements; negative input terminal for T2
5.	**mA µA**	Positive input terminal for low current measurements; positive input terminal for T2
6.	**COM**	Negative, common, or ground input terminal for all measurements
7.	**ΩV** ⊣⊢	Positive input terminal for all measurements except current



Symbols on the Unit

Warning—Read the instruction manual

Double insulation

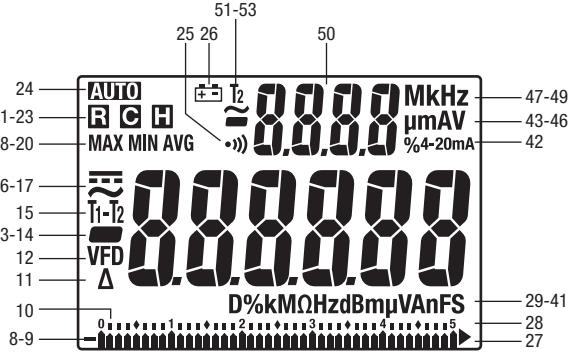
Display Icons

Primary Display

8. ▮ Bar graph element
9. **–** Polarity indicator for bar graph
10. **I** Bar graph scale
11. **Δ** Relative zero function is enabled.
12. **VFD** VFD function is enabled.
13. **–** Polarity indicator
14. **8.8.8.8.8.8** Numeric display
15. **T1-T2** T1, T2, or T1-T2 function is enabled.
16. ~ AC measurement is selected.
17. ⎓ DC measurement is selected.
18. **MAX** Maximum value being recorded or displayed.
19. **MIN** Minimum value being recorded or displayed.
20. **AVG** Average value being recorded or displayed.
21. **R** Record function is enabled.
22. **C** Crest capture function is enabled.
23. **H** Hold function is selected.
24. **AUTO** Automatic ranging is enabled.
25. •)) Continuity
26. Low battery
27. ▶ Overload symbol (bar graph display)
28. **5** Bar graph maximum range indicator
29. **D%** Duty cycle function is enabled.
30. **k** Kilo (10^3)
31. **M** Mega (10^6)
32. **Ω** Ohm
33. **Hz** Hertz (frequency in cycles per second)
34. **dBm** Decibel
35. **m** Milli (10^{-3})
36. **µ** Micro (10^{-6})
37. **V** Volt
38. **A** Ampere
39. **n** Nano (10^{-9})
40. **F** Farad
41. **S** Siemen

Secondary Display

42. **%4-20mA** Industrial process control loop current function is enabled.
43. **µ** Micro (10^{-6})
44. **m** Milli (10^{-3})
45. **A** Ampere
46. **V** Volt
47. **M** Mega (10^6)
48. **k** Kilo (10^3)
49. **Hz** Hertz (frequency in cycles per second)
50. **8.8.8.8** Numeric display
51. **T2** T2 function is enabled.
52. ~ AC measurement is selected.
53. **–** Polarity indicator



Using the Features

- **Dual Digital Display:** This meter can display two measurements, such as AC voltage and frequency, at the same time. Display combinations are shown using large symbols to indicate the measurement on the primary display and small, raised symbols to indicate the measurement on the secondary display. For example, "VAC^{Hz}" means the primary display contains the AC voltage measurement, and the secondary display contains the frequency measurement.
- **VFD ~V and VFD Hz:** These functions use filtering and noise-rejection algorithms to make accurate voltage and frequency measurements on most variable frequency drives. The voltage measurement automatically selects the 500 volt range. Use the **RANGE** button to select other ranges only when needed. The sensitivity for VFD frequency measurements depends on voltage range and input frequency. Refer to "Frequency – Line Level" in the "Accuracy" section of this manual.
- **SELECT:** Press momentarily to toggle between functions, measurement modes, or display modes. The last used setting becomes the default when that function is selected again. To change the default, select a new setting. The setting will be stored in nonvolatile memory.
- **RANGE:** Press once to enter the manual ranging mode. The **AUTO** icon will disappear from the display. Press repeatedly to step through the ranges. Press and hold to return to the automatic ranging mode.

  Note: When using CREST, REC, HOLD, or Δ mode, pressing **RANGE** *will cause the meter to exit that mode.*
- **Δ:** Finds the difference between two measurements. While taking a measurement, press **Δ** to set the display to zero. The **Δ** icon will appear on the display. Take the second measurement. The value on the display will be the difference between the two measurements. Press again to exit this mode.

  This feature applies to the main display only.
- **HOLD H:** Press momentarily to hold the present value on the display. Press again to exit this mode.

  This feature does not affect the bar graph.
- **CREST C:** Press momentarily to activate the crest recording mode.The input value is measured every 1 ms in this mode. **C** and "MAX" will appear on the display. The LCD will display the maximum crest value. The meter will beep whenever the maximum or minimum is updated. Press repeatedly to select the desired display: maximum or minimum crest value. Press and hold to exit this mode.

  The automatic power off feature is disabled when using this function.

  Note: When using the CREST function, pressing **RANGE** *will cause the meter to exit this mode.*
- **REC R:** Press momentarily to activate the MAX/MIN/AVG recording mode. The input value is measured every 50 ms in this mode. "MAX MIN" and "AVG" will appear on the display. The LCD will display the actual input value. The meter will beep whenever the maximum or minimum is updated. Press repeatedly to select the desired display: maximum, minimum, average, or actual input. Press and hold to exit this mode.

  The automatic power off feature is disabled when using this function.

  Note: When using the REC function, pressing **RANGE** *will cause the meter to exit this mode.*
- **☼:** Press and hold until backlight illuminates. Press and hold again to turn off. The backlight automatically turns off after approximately 30 seconds to extend battery life.

Using the Features (cont'd)

- **dBm-Ω:** The reference impedance is displayed for 1 second after selecting the dBm function. Momentarily press **dBm-Ω** to change the reference impedance. Refer to the "Specifications" section for the available values.

  Note: This is an AC voltage measurement calculated according to the formula

  dBm = 20 x log (measured voltage / reference voltage

  The reference voltage is the voltage that causes 1 mW of power to be dissipated in the selected reference impedance.

- **T1-T2:** Press momentarily to select the desired temperature display: T_1, T_2, T_1^{T2}, or $T_1\text{-}T_2^{T2}$.
- **500000:** Press and hold to toggle between 50,000 counts fast mode and the 500,000 counts high resolution mode for DC voltage measurements.
- **Intelligent Automatic Power Off (APO):** To extend battery life, the meter shuts itself off after approximately 17 minutes of inactivity. Inactivity occurs when buttons are not pressed or the selector is not turned. The meter will not enter APO when there are significant readings of over 10% of the range or non-OL readings for resistance and continuity. To restore power, press **SELECT**, **RANGE**, Δ, or **HOLD** or turn the selector to **OFF** and back on again. To disable this feature, press **SELECT** while turning the meter on.
- **Disabling the Beeper:** Hold down the **RANGE** button while turning the meter on to temporarily disable the beeper feature. Turn the selector to **OFF** and then back on to enable the beeper.
- **Hz:** Frequency can be measured in most voltage and current settings of the selector. Press **SELECT** until "Hz" appears in the primary or secondary display, as desired. The sensitivity of the Line Level Frequency function varies with measurement range. Refer to "Specifications." Auto-ranging measurements usually set the best trigger level. If the frequency reading becomes unstable or is blank, press the **RANGE** button to select another trigger level.
- **%4-20mA:** This calculated value is one of three available options for the secondary display when measuring DC milliamps. It is useful for 4-20 mA industrial process control loop applications. A reading of 4 mA on the primary display gives a 0% reading on the secondary display, 12 mA gives 50%, 20 mA gives 100%, etc.

AC Measurement

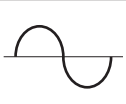
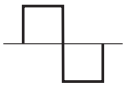
AC measurements are usually displayed as RMS (root mean square) values. The RMS value is equal to the value of a DC waveform, which would deliver the same power if it replaced the time-varying waveform. Two AC measurement methods are average-responding RMS calibrated and true RMS-reading.

The average-responding RMS calibrated method takes the average value of the input signal after full wave rectification, 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, square wave, triangle wave, half wave, or signal with harmonics. The ability to read true RMS provides much more measurement versatility. The Greenlee DM-860A 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.

AC + DC True RMS

AC + DC true RMS calculates both of the AC and DC components given by the expression

$$\sqrt{(AC\ rms)^2 + DC^2}$$

when making measurements and responds accurately to the total effective RMS value regardless of the waveform. Distorted waveforms with the presence of DC components and harmonics may cause:

- Transformers, generators, and motors to overheat
- Circuit breakers to trip prematurely
- Fuses to blow
- Neutrals to overheat due to the triplen harmonics present on the neutral
- Bus bars and electrical panels to vibrate

AC Bandwith

AC bandwidth of a digital multimeter (DMM) is the range of frequencies over which AC measurements can be made within the specified accuracy. It is the frequency response of the AC functions—not of the frequency measurement functions. A DMM cannot accurately measure the AC value with frequency spectrums beyond the AC bandwidth of the DMM. Therefore, wide AC bandwidth plays an important role in high performance DMMs. Complex waveforms, noise, and distorted waveforms contain frequency components that are much higher than the fundamental; for example, high frequency noise on a 50/60 Hz power line.

Operation

⚠WARNING

Electric shock hazard:

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

Self-Diagnostic Mode

The message “rE-O” may appear when the meter is turned on. This indicates that the meter is performing a routine self-diagnostic. Do not turn the meter off. Allow the diagnostic procedure to finish. If the message “C_Er” appears on the display when the meter is turned on, some ranges may be well outside of specification. To avoid incorrect measurements, stop using the meter and return it to Greenlee for recalibration.

Operating Procedure

1. Refer to the Settings Table. Set the selector to the proper setting, press **SELECT** (when instructed to do so), and connect the test leads to the meter.
2. Refer to “Typical Measurements” for specific measurement instructions.
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 fuses.
   - If the unit still does not function as expected, call Greenlee for technical assistance at 800-435-0786.
4. Take the reading from the circuit or component to be tested.

Operation (cont'd)

Settings Table

The meter stores the last used function of each selector position in its nonvolatile memory. If this is not the correct function when you turn the selector, press **SELECT** until the desired icon appears.

The dual display options are shown along with the icons. In the table, "~V^{Hz}" indicates that "~" and "V" appear in the primary display, and "Hz" appears in the secondary display. This combination shows the AC voltage measurement in the primary display and frequency in the secondary display.

To measure this characteristic …	Set the selector to this symbol …	Press SELECT until these icons appear on the display …	Connect the red lead to …	Connect the black lead to …
Variable Speed Drive—Voltage and Frequency	VFD	~ V^{Hz} or Hz$^{~V}$	ΩV ⊣⊢	COM
Voltage—AC True RMS (1000 V max)	Ṽ	~ V^{Hz} or Hz$^{~V}$	ΩV ⊣⊢	COM
*Voltage—DC (1000 V max)	V̿	⎓ V or ⎓ V$^{~V}$	ΩV ⊣⊢	COM
Voltage—AC + DC True RMS (1000 V max)	V̿	≂ V$^{~V}$	ΩV ⊣⊢	COM
Voltage—DC (500 mV max)	mV̿	⎓ mV or ⎓ mV$^{~mV}$	ΩV ⊣⊢	COM
Voltage—AC + DC True RMS (500 mV max)	mV̿	≂ mV$^{~mV}$	ΩV ⊣⊢	COM
Voltage—AC True RMS (500 V max)	mṼ	~ mV^{Hz} or Hz$^{~mV}$	ΩV ⊣⊢	COM
Frequency—Line Level Voltage or Current	Set for voltage or current according to this table.	Any display option that includes Hz	—	—
**Frequency—Logic Level	⎍ **Hz**	Hz	ΩV ⊣⊢	COM
% Duty Cycle	**D%**	D%	ΩV ⊣⊢	COM
dBm (0 dB = 1 mW in reference impedance)	**dBm** (Ṽ function 1000 V max; mṼ function 500 mV max.)	Reference impedance and dBm for 1 s, then dBm^{Hz} (press **dBm-Ω** to change reference impedance)	ΩV ⊣⊢	COM

* For precise measurements, press **500000** to toggle between 50,000 counts and 500,000 counts. Applies to DC volts only.

** Logic level frequency has a fixed sensitivity and is for digital signals. Refer to "Accuracy".

This table continues on the next page.

Operation (cont'd)

Settings Table (cont'd)

To measure this characteristic …	Set the selector to this symbol …	Press SELECT until these icons appear on the display …	Connect the red lead to …	Connect the black lead to …
Dual Temperature	**T1T2**	°C or °F (press **RANGE** for display options T1, T2, T1T2 or T1-T2T2)	See Notes 1 and 2	—
†Capacitance	⊣⊢	F	ΩV ⊣⊢	COM
Diode	→|	V and diod	ΩV ⊣⊢	COM
Resistance	**Ω**	Ω	ΩV ⊣⊢	COM
Continuity	•))	•)) and Ω	ΩV ⊣⊢	COM
Conductance	**nS**	nS	ΩV ⊣⊢	COM
Current—AC, DC, or AC + DC True RMS (10 A max)	**A**	⎓ A, ⎓ A~A, ≋ A~A, or ∼ AHz	A	COM
Current—AC, DC, or AC + DC True RMS (600 mA max)	**mA**	⎓ mA%4-20mA, ⎓ mA~mA, ≋ mA~mA, or ∼ mAHz	mA µA	COM
Current—AC, DC, or AC + DC True RMS (6000 µA max)	**µA**	⎓ µA, ⎓ µA~µA, ≋ µA~µA, or ∼ µAHz	mA µA	COM
Industrial Process Control Loop Current % 4 to 20 mA	**mA**	⎓ mA%4-20mA	mA µA	COM

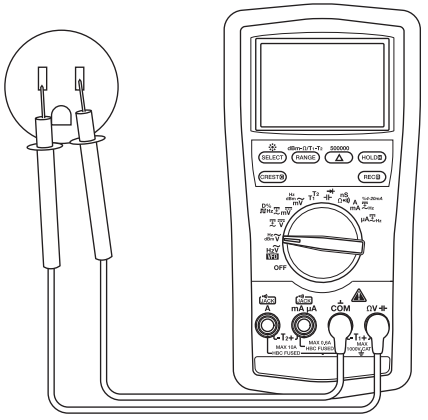
† Discharge capacitor before measurement. Refer to "Typical Measurements" regarding polarized capacitors.

Note 1: T1+ connects to ΩV ⊣⊢ , and T1– connects to COM.

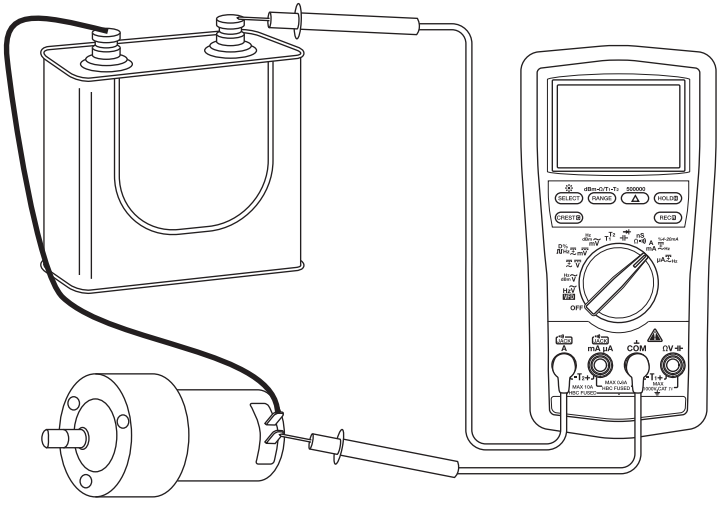
Note 2: T2+ connects to mA µA, and T2– connects to A.

Typical Measurements

Voltage Measurement

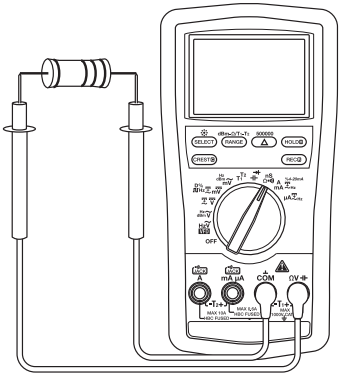


Current Measurement

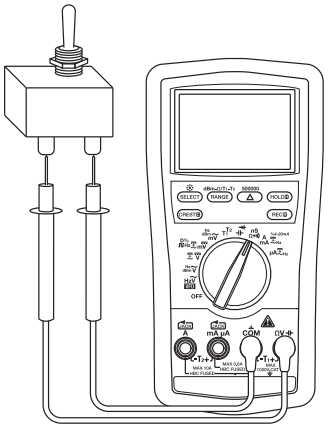


Typical Measurements

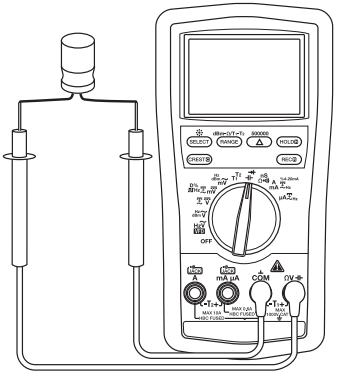
Resistance Measurement



Continuity Check

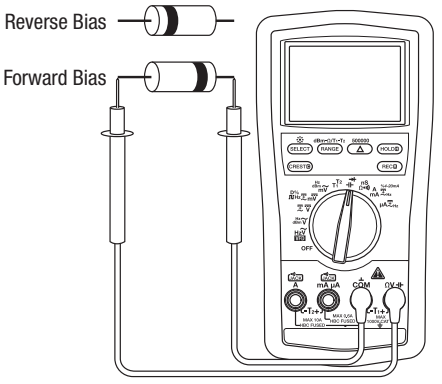


Capacitance Measurement



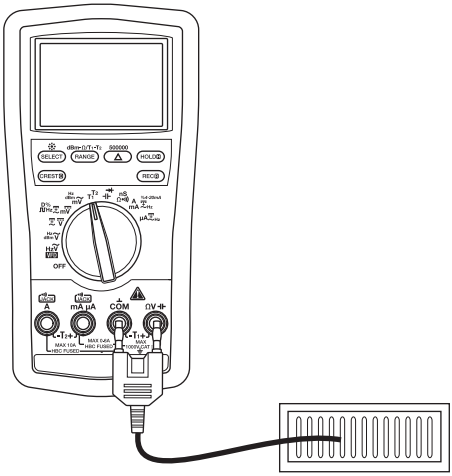
Note: For polarized capacitors, attach red probe to positive terminal and black probe to negative terminal of capacitor.

Diode Measurement



Typical Measurements

Temperature



Using the Optional Software

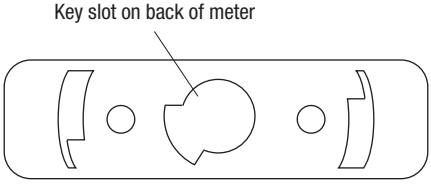
The DM-860A is compatible with Greenlee DMSC-9U, an optically isolated computer interface cable and software. It allows measurements to be logged to a personal computer using the Microsoft® Windows® operating system.

Installing the Software

1. Insert the CD into the computer's CDROM drive.
2. The installation program should launch automatically. If it does not, double click on the CD icon in "My Computer."
3. The installation program menu will appear. Click on "Software Installation."
4. Type your meter's catalog number (for example, "DM-860A") in the dialog box.
5. Complete the remaining dialog boxes according to user preferences.

Connecting the Optical USB Interface Cable

1. Align the key of the connector with the key slot on the meter.
2. Twist the connector clockwise until it locks into place.
3. Connect the cable to a USB port of the PC.



Accuracy

Refer to the “Specifications” section for operating conditions and temperature coefficient.

Accuracy is specified as follows: ± (a percentage of the reading + a fixed amount) at 23 °C ± 5 °C (73.4 °F ± 9 °F), 0% to 75% relative humidity. Specifications are for 50,000 counts mode.

True RMS Readings: Voltage and current accuracies are specified from 5% to 100% of the range unless otherwise specified. Frequency must be within the specified bandwidth for non-sinusoidal waveforms. Crest factors are as follows:

- Crest factor < 2.1:1 at full scale
- Crest factor < 4.2:1 at half scale

AC, DC^{AC}, and AC + DC^{AC} Current

Range	Accuracy at DC and 50 Hz to 60 Hz	Accuracy at 40 Hz to 1 kHz	Accuracy at 1 kHz to 20 kHz	Accuracy at 20 kHz to 100 kHz
500.00 µA	± (0.5% + 0.5 µA)	± (0.7% + 0.5 µA)	± (2.0% + 0.5 µA)	± (5.0% + 0.5 µA)
5000.0 µA	± (0.5% + 5.0 µA)	± (0.7% + 5.0 µA)	± (2.0% + 5.0 µA)	± (5.0% + 5.0 µA)
50.000 mA	± (0.5% + 0.05 mA)	± (0.7% + 0.05 mA)	± (2.0% + 0.05 mA)	± (5.0% + 0.05 mA)
500.00 mA	± (0.5% + 0.5 mA)	± (0.7% + 0.5 mA)	± (2.0% + 0.5 mA)	± (5.0% + 0.5 mA)
5.0000 A	± (0.5% + 0.005 A)	± (0.7% + 0.005 A)	Unspecified	Unspecified
10.000 A*	± (0.5% + 0.05 A)	± (0.7% + 0.05 A)	Unspecified	Unspecified

*10 A continuous; 20 A maximum (Duty Cycle: 30 seconds on, 5 minutes off).

Range	Burden Voltage (all frequency ranges)
500.00 µA	0.15 mV/µA
5000.0 µA	
50.000 mA	3.3 mV/mA
500.00 mA	
5.0000 A	45 mV/A
10.000 A	

DC Current

Range	Accuracy	Burden Voltage
500.00 µA	± (0.15% + 0.2 µA)	0.15 mV/µA
5000.0 µA	± (0.1% + 2.0 µA)	
50.000 mA	± (0.15% + 0.02 mA)	3.3 mV/mA
500.00 mA	± (0.15% + 0.3 mA)	
5.0000 A	± (0.5% + 0.002 A)	45 mV/A
10.000 A*	± (0.5% + 0.02 A)	

*10 A continuous; 20 A maximum (Duty Cycle: 30 seconds on, 5 minutes off).

Accuracy (cont'd)

DC^{AC} and AC + DC^{AC} Voltage

Range	Accuracy* at 20 Hz to 45 Hz	Accuracy* at DC and 45 Hz to 1 kHz	Accuracy* at 1 kHz to 20 kHz	Accuracy* at 20 kHz to 40 kHz
500.00 mV	± (1.5% + 0.4 mV)	± (0.5% + 0.4 mV)	± (1.0% + 0.4 mV)	± (3.5% + 0.4 mV)**
5.0000 V	± (1.5% + 0.004 V)	± (0.5% + 0.008 V)	± (1.2% + 0.004 V)	± (4.0% + 0.004 V)**
50.000 V	± (1.5% + 0.04 V)	± (0.5% + 0.08 V)	± (1.2% + 0.04 V)	± (4.0% + 0.04 V)**
500.00 V	Unspecified	± (0.5% + 0.8 V)	Unspecified	Unspecified
1000.0 V	Unspecified	± (0.5% + 8 V)	Unspecified	Unspecified

*From 5% to 10% of range: Accuracy percentage of reading + 80 digits.

** From 5% to 10% of range: Accuracy percentage of reading + 180 digits.
From 10% to 15% of range: Accuracy percentage of reading + 100 digits.

Residual reading less than 50 digits with test leads shorted.

Note: "Digits" refers to the least significant digit (the number in the right-most position).

VFD AC Voltage

Range	Accuracy* at 5 Hz to 20 Hz	Accuracy* at 20 Hz to 200 Hz	Accuracy* at 200 Hz to 440 Hz
5.0000 V	± (3% + 0.008 V)	± (2% + 0.005 V)	± (6% + 0.008 V)**
50.000 V	± (3% + 0.08 V)	± (2% + 0.05 V)	± (6% + 0.08 V)**
500.00 V	± (3% + 0.8 V)	± (2% + 0.5 V)	± (6% + 0.8 V)**
1000.0 V	± (3% + 8 V)	± (2% + 5 V)	± (6% + 8 V)**

*Not specified for fundamental frequency greater than 440 Hz.

**Accuracy decreases linearly from ± (2.0% + 50 digits) at 200 Hz to ± (6% + 80 digits) at 440 Hz.

Accuracy (cont'd)

AC Voltage

Range	Accuracy* at 20 Hz to 45 Hz	Accuracy* at 45 Hz to 65 Hz	Accuracy* at 65 Hz to 10 kHz
500.00 mV	± (1.2% + 0.4 mV)	± (0.3% + 0.2 mV)	± (0.4% + 0.25 mV)
5.0000 V	± (1.2% + 0.004 V)	± (0.3% + 0.003 V)	± (0.3% + 0.004 V)
50.000 V	± (1.2% + 0.04 V)	± (0.3% + 0.03 V)	± (0.3% + 0.04 V)
500.00 V	Unspecified	± (0.5% + 0.3 V)	± (0.5% + 0.4 V)
1000.0 V	Unspecified	± (0.5% + 3 V)	± (0.8% + 4 V) (65 Hz to 1 kHz)

Range	Accuracy* at 10 kHz to 20 kHz	Accuracy* at 20 kHz to 100 kHz
500.00 mV	± (0.5% + 0.3 mV)	± (2.5% + 0.4 mV)**
5.0000 V	± (0.7% + 0.004 V)	± (3.5% + 0.004 V)**
50.000 V	± (0.7% + 0.04 V)	± (3.5% + 0.04 V)**
500.00 V	± (0.7% + 0.4 V)	Unspecified
1000.0 V	Unspecified	Unspecified

*From 5% to 10% of range: Accuracy percentage of reading + 80 digits.

**From 5% to 10% of range: Accuracy percentage of reading + 180 digits.

Residual reading less than 50 digits with test leads shorted.

Note: "Digits" refers to the least significant digit (the number in the right-most position).

DC Voltage

Range	Accuracy	Input Impedance
500.00 mV	± (0.02% + 0.02 mV)	10 MΩ, 80 pF nominal
5.0000 V	± (0.02% + 0.0002 V)	10 MΩ, 60 pF nominal
50.000 V	± (0.03% + 0.002 V)	
500.00 V	± (0.04% + 0.02 V)	
1000.0 V	± (0.15% + 0.2 V)	

Accuracy (cont'd)

Resistance and Conductance

Range	Accuracy	Typical Open Circuit Voltage
500.00 Ω	± (0.07% + 0.10 Ω)	3.0 VDC
5.0000 kΩ	± (0.07% + 0.0002 kΩ)	1.3 VDC
50.000 kΩ	± (0.1% + 0.002 kΩ)	
500.00 kΩ	± (0.1% + 0.02 kΩ)	
5.0000 MΩ	± (0.3% + 0.0006 MΩ)	
50.000 MΩ	± (2.0% + 0.006 MΩ)	
99.99 nS	± (0.8% + 0.10 nS)*	

* ± (2.0% + 0.40 nS) below 9.99 nS.

Capacitance

Range	Accuracy*
50.00 nF	± (0.8% + 0.03 nF)
500.0 nF	± (0.8% + 0.3 nF)
5.000 µF	± (1.5% + 0.003 µF)
50.00 µF	± (2.5% + 0.03 µF)
500.0 µF**	± (3.5% + 0.5 µF)
5.000 mF**	± (5.0% + 0.005 mF)
25.00 mF**	± (6.5% + 0.05 mF)

*Accuracies are for film capacitors (capacitors with negligible dielectric absorption).

** In manual ranging mode, the 500.0 µF, 5.000 mF, and 25.00 mF ranges are not specified below 45.0 µF, 0.450 mF, and 4.50 mF, respectively.

T1, T2, T1-T2 Dual Temperature

Range	Accuracy*
–50 °C to 1000.0 °C	± (0.3% + 1.5 °C)
–58 °F to 1832.0 °F	± (0.3% + 3.0 °F)

*Thermocouple range and accuracy not included.

Accuracy (cont'd)

Frequency—Line Level
Range: 5.000 Hz to 200.00 kHz
Accuracy: ± (0.02% + 4 digits)

AC Function Range	Sensitivity (Sine RMS)	Range
500 mV	100 mV	10 Hz to 200 kHz
5 V	0.5 V	
50 V	5 V	10 Hz to 100 kHz
500 V	50 V	
1000 V	500 V	10 Hz to 10 kHz
VFD 5 V	0.5 V to 2 V*	10 Hz to 440 Hz
VFD 50 V	5 V to 20 V*	
VFD 500 V	50 V to 200 V*	

AC Function Range	Sensitivity (Sine RMS)	Range
500 µA	50 µA	10 Hz to 10 kHz
5000 µA	500 µA	
50 mA	5 mA	
500 mA	50 mA	
5 A	1 A	10 Hz to 3 kHz
10 A	10 A	

*VFD sensitivity linearly decreases from 10% of range @ 200 Hz to 40% of range @ 440 Hz.

Frequency—Logic Level
Range: 5.000 Hz to 2.0000 MHz
Accuracy: ± (0.002% + 4 digits)
Sensitivity: 2.5 Vp square wave

% Duty Cycle
Range: 0.1% to 99.99%
Accuracy: ± (3 digits/kHz + 2 digits)
Input Frequency: 5 Hz to 500 kHz, 5 V logic family

Diode Test
Measuring Range: 2.0000 V
Test Current (typical): 0.4 mA
Open Circuit Voltage: < 3.0 VDC
Accuracy: ± (1% + 0.0001 V)

Continuity
Tone Threshold: Between 20 Ω and 200 Ω
Response Time: < 100 µs

dBm
The range and accuracy depend on the AC voltage function used and the selected reference impedance.
Selectable Reference Impedance: 4, 8, 16, 32, 50, 75, 93, 110, 125, 135, 150, 200, 250, 300, 500, 600, 800, 900, 1000, 1200 Ω

Crest Capture (Voltage and Current) for Crests > 0.8 ms in duration
Accuracy: Specified accuracy ± 100 digits
Resolution: 5000 digits

Specifications

Display: LCD
- Normal Mode: 50,000 counts
- High Resolution Mode: 500,000 counts
- Frequency: 99,999 counts
- 41-segment bar graph

Polarity: Automatic

Input Impedance: 10 MΩ, 60 pF nominal (80 pF for 500 mV ranges).

Sampling Rate:
- 50,000 Counts Mode: 5 per second nominal
- 500,000 Counts Mode: 1.25 per second nominal
- Bar Graph Display: 60 per second

Temperature Coefficient: Nominal 0.15 x (Accuracy) per °C below 18 °C from 0 °C to 18 °C (32 °F to 64 °F) or above 28 °C from 28 °C to 40 °C (82 °F to 104 °F) or otherwise specified

Intelligent Automatic Power Off: After 17 minutes of inactivity

Low Battery Indication: Below approximately 7 V

Noise Rejection*:
- Normal Mode Rejection Ratio > 60 dB at 50 Hz and 60 Hz when measuring DCV
- Common Mode Rejection Ratio > 90 dB from 0 Hz to 60 Hz when measuring ACV
- Common Mode Rejection Ratio > 120 dB at 50 Hz and 60 Hz when measuring DCV

Operating Conditions:
- 0 °C to 31 °C (32 °F to 88 °F), 0% to 80% relative humidity
- 31 °C to 45 °C (88 °F to 113 °F), relative humidity decreasing linearly from 80% to 50% (non-condensing)
- Altitude: 2000 m (6500') maximum
- Indoor use only
- Pollution Degree: 2

Storage Conditions: –20 °C to 60 °C (–4 °F to 140 °F), 0% to 80% relative humidity (non-condensing)
- Remove battery

Battery: 9 V battery (NEDA 1604, JIS 006P or IEC 6F)

E.M.C.: Meets EN61326-1:2006
- In an RF field of 3 V/m:
  - Capacitance function is not specified
  - Other function ranges: Total Accuracy = Specified Accuracy + 100 digits
- Performance above 3 V/m is not specified

* Noise rejection is the ability to reject unwanted signals, or noise.

- Normal mode voltages are AC signals that can cause inaccurate DC measurements. NMRR (Normal Mode Rejection Ratio) is a measure of the ability to filter out these signals.
- Common mode voltages are signals present at the COM and + input terminals, with respect to ground, that can cause digit rattle or offset in voltage measurements. CMRR (Common Mode Rejection Ratio) is a measure of the ability to filter out these signals.

Specifications (cont'd)

Safety: Double insulation per IEC61010-1 2nd Ed., EN61010-1 2nd Ed., UL61010-1 2nd Ed. and CAN/CSA C22.2 No. 61010.1-04 to Category IV 1000 VAC and VDC
All Terminals: Category IV 1000 VAC and VDC

Overload Protections:
Volts: 1050 V RMS AC/DC, 1450 V peak AC/DC
Millivolts: 1050 V RMS AC/DC, 1450 V peak AC/DC
A: 11 A/1000 V fuse, interrupting rating 20 kA, F fuse, 13/32" x 1-1/2"
µA and mA: 0.44 A/1000 V fuse, interrupting rating 10 kA, F fuse, 13/32" x 1-3/8"
Other Functions: 1050 V RMS AC/DC, 1450 V peak AC/DC

Measurement Categories

These definitions were derived from the international safety standard for insulation coordination as it applies to measurement, control, and laboratory equipment. These measurement categories are explained in more detail by the International Electrotechnical Commission; refer to either of their publications: IEC 61010-1 or IEC 60664.

Measurement Category I

Signal level. Electronic and telecommunication equipment, or parts thereof. Some examples include transient-protected electronic circuits inside photocopiers and modems.

Measurement Category II

Local level. Appliances, portable equipment, and the circuits they are plugged into. Some examples include light fixtures, televisions, and long branch circuits.

Measurement Category III

Distribution level. Permanently installed machines and the circuits they are hard-wired to. Some examples include conveyor systems and the main circuit breaker panels of a building's electrical system.

Measurement Category IV

Primary supply level. Overhead lines and other cable systems. Some examples include cables, meters, transformers, and other exterior equipment owned by the power utility.

Statement of Conformity

Greenlee Textron Inc. is certified in accordance with ISO 9001 (2000) for our Quality Management Systems.

The instrument enclosed has been checked and/or calibrated using equipment that is traceable to the National Institute for Standards and Technology (NIST).

Maintenance

⚠WARNING

Electric shock hazard:

Before opening the case, remove the test leads from the circuit and shut off the unit.

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

⚠WARNING

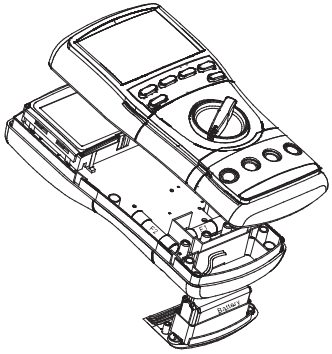
Electric shock hazard:

The fuses are an integral part of the overvoltage protection. When fuse replacement is necessary, refer to "Specifications" for the correct type, size, and capacity. Using any other type of fuse will void the overvoltage protection rating of the unit.

Failure to observe this warning could result in severe injury or death.

Replacing the Battery

1. Disconnect the unit from the circuit. Turn the unit OFF.
2. Remove the two screws from the battery access door and remove it.
3. Replace the battery making sure to observe the polarity.



Replacing the Fuses

1. Disconnect the unit from the circuit. Turn the unit OFF.
2. Remove the two screws from the battery access door and remove it.
3. Unscrew the two screws inside the battery compartment and the two screws on the back case.
4. Remove the back cover and replace the fuses.
5. Align the two halves of the unit and the rubber gaskets.
6. Be sure the selector is in the original position so that it lines up properly with the internal switch.
7. Replace the cover and screws.

Cleaning and Storage

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

If the meter will not to be used for periods longer than 60 days, remove the battery and store it separately.