Greenlee DM-860A Review

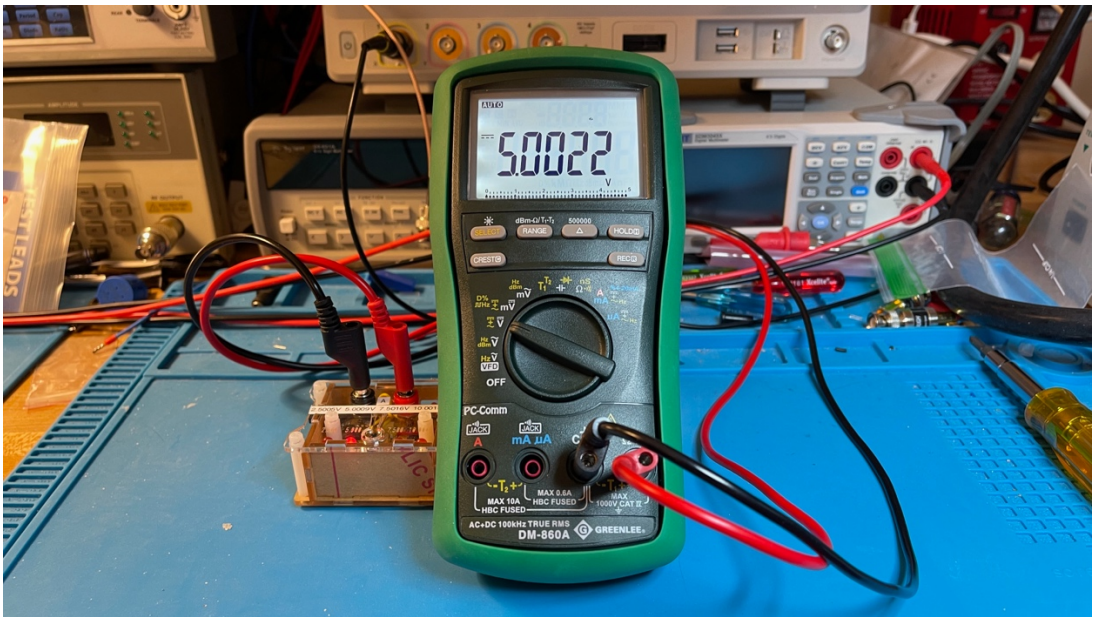
Introduction

Hi, I am Tom, amateur radio call sigh N8FDY. This is a review of the Greenlee DM-860A multimeter for use in hobby electronics projects primarily related to amateur radio.

Disclaimer

I am not a professional, I am a hobbyist. This review is not sponsored; I bought this multimeter with my own money. I only used and tested this multimeter in CAT I and CAT II environments. I do not have a way to review or test the safety of this meter. I leave the CAT III and CAT IV environments to trained and licensed professionals. It may seem like I am a Fluke fan boy, but I recognize their flaws along with their advantages. There may be unintended mistakes and/or errors in this review.

Overview



I am testing and demonstrating this Greenlee DM-860A multimeter that I purchased from electricianshop.com for $346.44. I only used it in CAT I and CAT II environments.
CAT I is for measurements on circuits not directly connected to mains. For example, battery-operated electronics, or radio gear connected to a 13V DC power supply.
CAT II is for measurements performed on circuits directly connected to 120V (240V in some countries) power outlets at least 15 feet from the distribution panel. For example, your 120V AC to 13V DC power supply or a vintage piece of ham radio gear we lovingly call “boat anchors” that plug into a 120V AC outlet.
First, we will look at the features of the multimeter, then we will look at the accuracy of the meter. We will then go over the ergonomics. We will wrap up with the pros, cons and conclusion.
I will not be using the test leads that came with the meter. I have not liked any test leads that came with multimeters except the Fluke TL175 TwistGuard® test leads that were bundled with the Fluke 87V MAX. I also use Probe Master Series 8000 Test Leads.

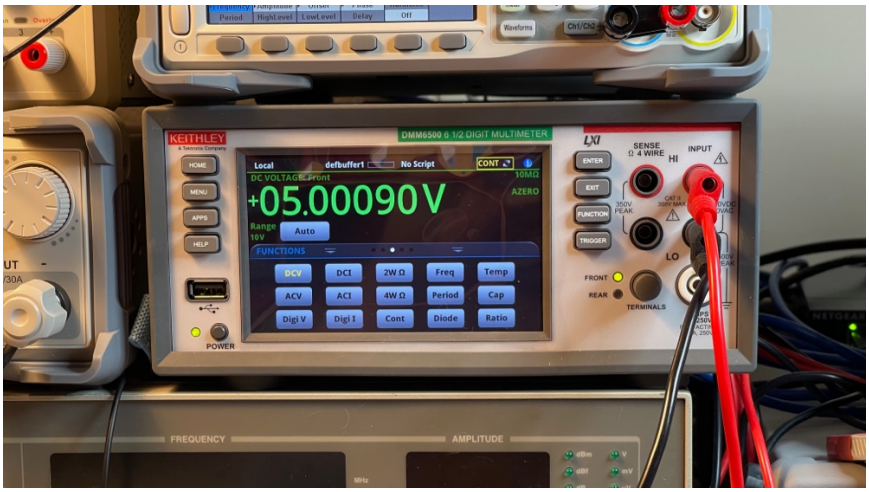
Objectives

This review was produced to help you decide if the Greenlee DM-860A multimeter will fit your purpose and budget. This is part of a series of multimeters reviews.
A good multimeter for hobby electronics projects should be able to measure millivolts, volts, microamps, milliamps, amps, ohms, nanofarads and microfarads.
If you want to measure picofarads, nanohenrys, microhenrys or reactance you will need an LCR meter. I cover the two LCR meters I own in another review.

Features

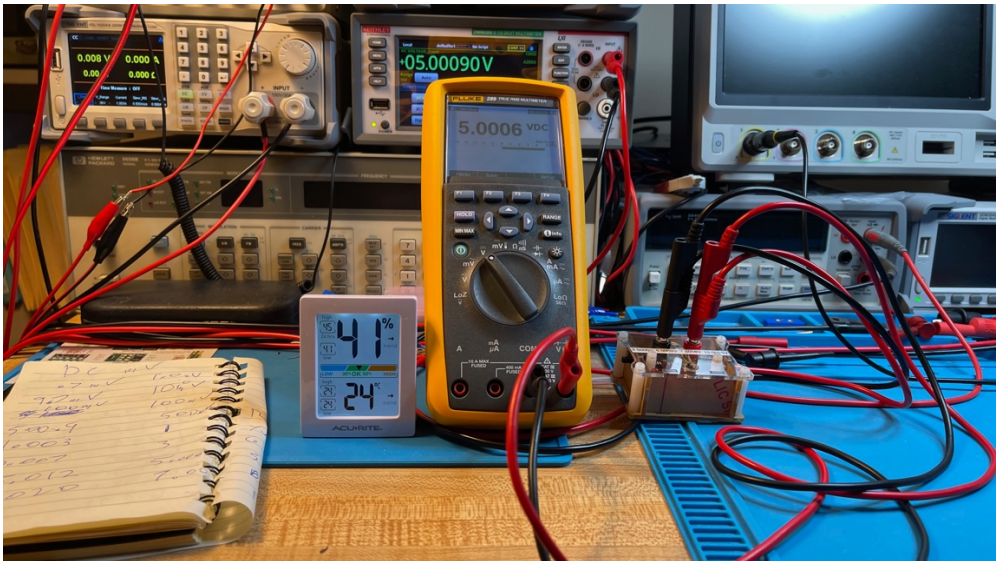
- Dual display shows two measurements, such as AC voltage and frequency, at the same time.
- Beep-JackTM audible warning alerts the user with a beep and an error message on the LCD if the test lead is plugged into the mA µA or A input terminal while the selector switch is not in the mA µA or A position.
- 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 50000 or 500000 counts resolution when measuring DC voltage.
- Relative zero mode.
- Automatic or manual ranging.
- Intelligent automatic power off.
- Backlighted LCD for reading in dim conditions.

Accuracy



I do not have reference standards. Instead, I use a Keithley DMM6500 6.5 digit bench multimeter that was calibrated recently to measure voltages, currents, resistances and capacitances. I take a reading from the Keithley and based on the Keithley stated tolerance for that range and reading, I compute the lowest and highest value the reading could be, then I use the meter under test to take a reading. I calculate the meter-under-test reading uncertainty value and subtract it from the lowest value and add it to the highest value. If the reading is within the range of the lower and higher limits, it meets meter-under-test accuracy specification.
For example, I have a voltage source that is 5 V. I take a reading with the Keithley and I get a value of 5.00090 and based on the Keithley specifications for that range ±(0.0025% of reading + 0.0005% of range); that value could be anywhere from 5.00072 to 5.00108. I then use the meter-under-test (for this example my Fluke 289, my most accurate hand-help meter) reading of 5.0006. The Fluke 289's accuracy at this range is ±(0.025% of

reading + 2 least significant digits) for an uncertainty value of 0.00145015 volts. So, subtracting this from the lowest value the Keithley reading gives us 4.99927V for the low value limit and adding to the highest value, the Keithley gives us 5.00253V for the high value limit. The meter-under-test reading (5.0006) is within the limits, so the meter-under-test meets its accuracy target for 5 volts.



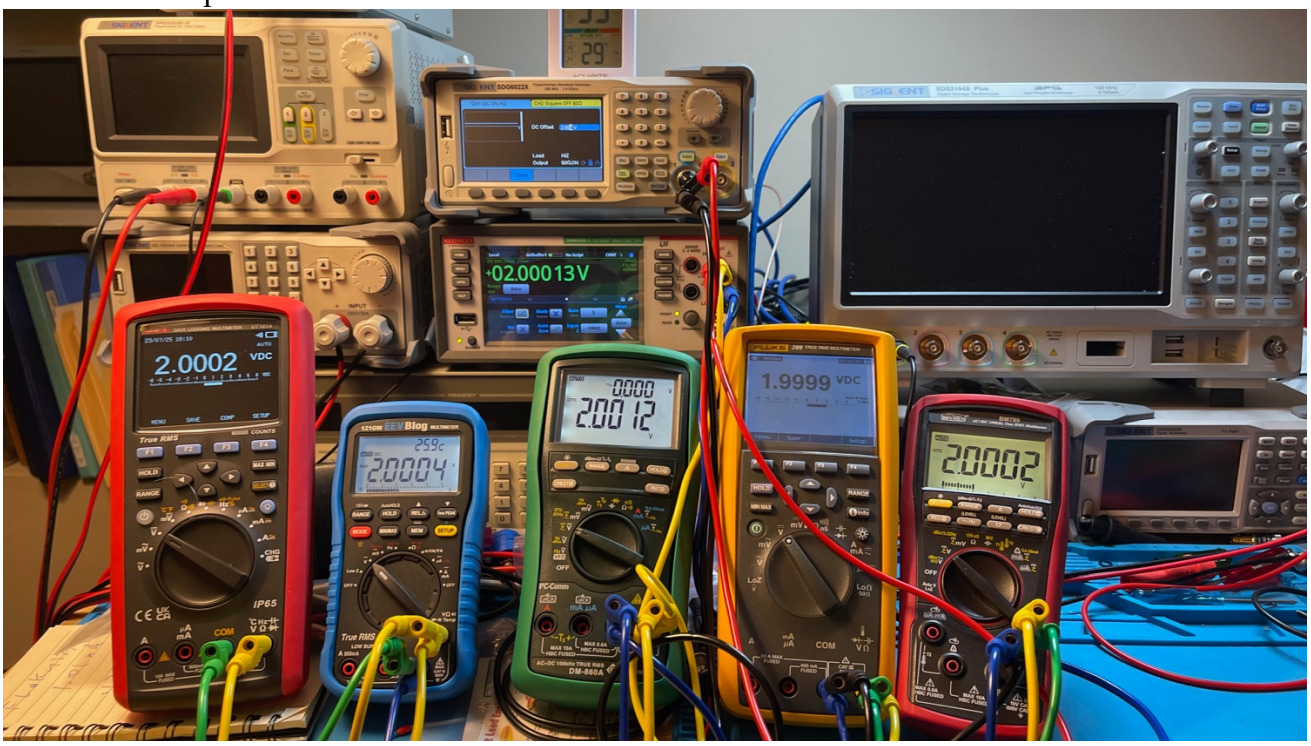
DC Volts

Source	Reading	Specification	Uncertainty	Low Bound	High Bound
mV					
1.0060	1.00	0.02% + 2	0.0202	0.9854	1.0266
10.0012	10.00	0.02% + 2	0.022	9.9785	10.0239
100.0187	100.03	0.02% + 2	0.040006	99.9753	100.0621
500.097	500.17	0.02% + 2	0.120034	499.9585	500.2355
V					
1.000909	1.0015	0.02% + 2	0.0004003	1.0004	1.0014
2.00013	2.0012	0.02% + 2	0.00060024	1.9994	2.0008
2.50054	2.5012	0.02% + 2	0.00070024	2.4997	2.5014
3.00134	3.0029	0.02% + 2	0.00080058	3.0004	3.0023
4.00001	4.0020	0.02% + 2	0.0010004	3.9989	4.0012
5.00030	5.0028	0.02% + 2	0.00120056	4.9989	5.0017
5.00091	5.0023	0.02% + 2	0.00120046	4.9995	5.0023
6.00142	6.003	0.03% + 2	0.0038009	5.9974	6.0054
7.00018	7.003	0.03% + 2	0.0041009	6.9959	7.0045
7.50167	7.504	0.03% + 2	0.0042512	7.4972	7.5062
10.00153	10.005	0.03% + 2	0.0050015	9.9962	10.0068
97.7528	97.82	0.04% + 2	0.059128	97.6892	97.8164
191.276	191.39	0.04% + 2	0.096556	191.1658	191.3862
281.295	281.37	0.04% + 2	0.132548	281.1452	281.4448
381.899	381.95	0.04% + 2	0.17278	381.7049	382.0931
490.268	490.03	0.04% + 2	0.216012	490.0264	490.5096
601.023	601.2	0.15% + 2	1.1018	599.8891	602.1569

The DC millivolts and low volts ranges' accuracy specification are the highest for this group of meters. The high DC volts accuracy specifications are in third place for this group of meters.
The meter failed some of its accuracy specifications for the low DC voltages I tested. It was off specification in the important 5-volt range by from 100 microvolt up to 1.1 millivolt. That is not much but since it has the highest specification of all the meters in this 50000-count group it puts that specification in question.

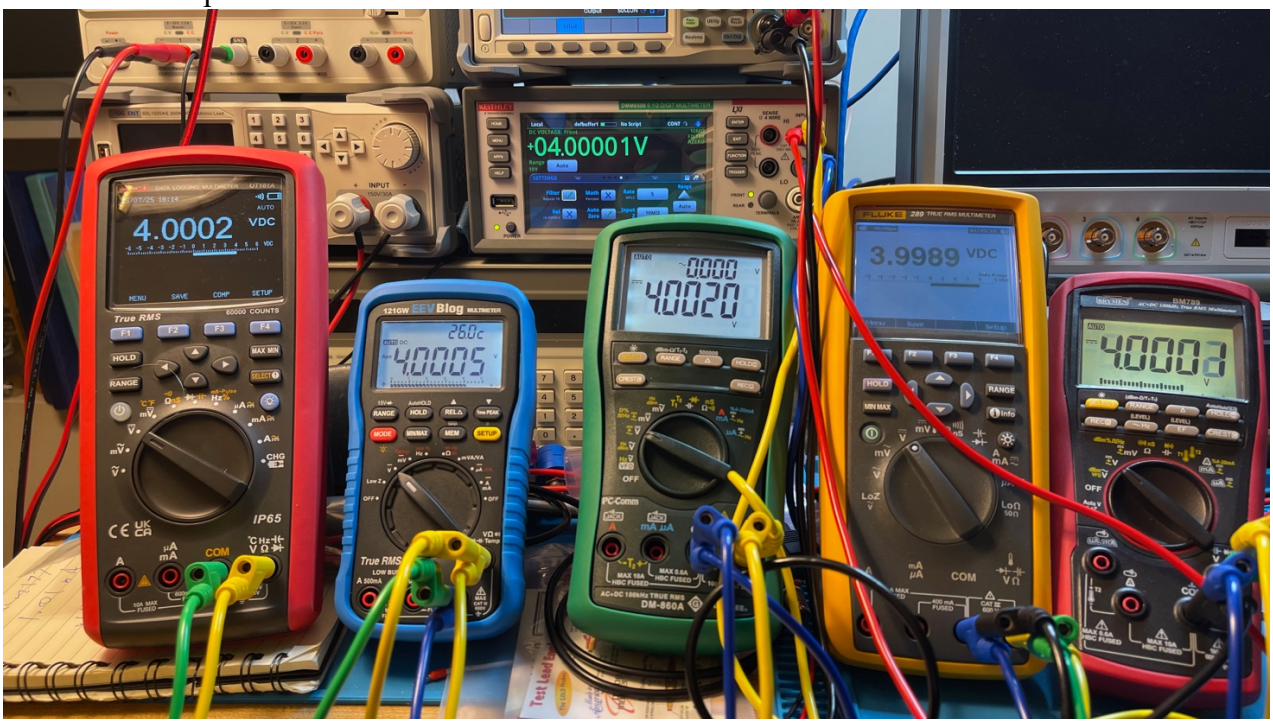
1 Volt out of Specification:

2 Volts out of Specification:



3 Volts out of Specification:

4 Volts out of Specification:



5 Volts out of Specification:

VDC Input	11 MΩ
mVDC input	10 MΩ

Both VDC and mVDC inputs have 10 MΩ or greater resistance, which is good, so the meter is less likely to load down a high-impedance circuit when checking voltage.

AC Volts

Source	Reading	Specification	Uncertainty	Low Bound	High Bound
100Hz Squarewave					
4.99906	4.9999	0.3% + 40	0.0189997	4.9741	5.0241
60 Hz Sinewave					
mV					
1.0335	0.88	0.3% + 20	0.20264	0.8302	1.2368
10.0397	9.92	0.3% + 20	0.22976	9.8039	10.2755
100.0742	100.05	0.3% + 20	0.50015	99.5140	100.6344
250.565	250.57	0.3% + 20	0.95171	249.4627	251.6673
500.110	499.93	0.3% + 20	1.69979	498.1098	502.1102
Volts					
0.500130	0.4996	0.3% + 30	0.0044988	0.4950	0.5052
1.000213	1.0002	0.3% + 30	0.0060006	0.9933	1.0071
2.00184	2.0026	0.3% + 30	0.0090078	1.9886	2.0150
3.01276	3.0132	0.3% + 30	0.0120396	2.9959	3.0296
4.01248	4.0125	0.3% + 30	0.0150375	3.9920	4.0329
5.01209	5.0109	0.3% + 30	0.0180327	4.9881	5.0361
6.00816	6.005	0.3% + 30	0.048015	5.9535	6.0628
7.00644	7.004	0.3% + 30	0.051012	6.9482	7.0647

The meter met its accuracy specifications for all the AC voltages that I tested. The AC millivolts for 60 Hz accuracy specification is the best in this group of meters.

ACV 1V 3dB cutoff	491 kHz

The frequency of the cutoff is second place in this group of meters.

AC+DC

This meter has an AC+DC measurement mode.
The formula for measuring True-RMS with AC and DC components:

$$Vrms = \sqrt{\mathrm{Vac}^2 + \mathrm{Vdc}^2}$$

A meter with AC+DC calculates this for you.

Source	Reading	Specification	Uncertainty	Low Bound	High Bound
AC+DC					
2.067530907	2.0685	0.5% + 80	0.0183	2.0451	2.0900
3.356147086	3.3598	0.5% + 80	0.0248	3.3270	3.3853
3.36282066	3.3656	0.5% + 80	0.0248	3.3361	3.3895
4.73159436	4.7257	0.5% + 80	0.0316	4.6975	4.7657

The meter met its accuracy specifications for all the AC+DC values I tested. The accuracy specifications for the AC+DC ranges are the best for this group of 50000-count meters.

Current

Source	Reading	Specification	Uncertainty	Low Bound	High Bound
AC 100Hz Squarewave					
0.999694	0.988	0.7% + 50	0.056916	0.9414	1.0580
DC µA					
0.89695	0.90	0.15% + 20	0.20135	0.6947	1.0992
9.21851	9.22	0.15% + 20	0.21383	9.0000	9.4370
99.0500	99.06	0.15% + 20	0.34859	98.6518	99.4482
131.913	131.94	0.15% + 20	0.39791	131.4552	132.3708
DC mA					
1.008954	1.007	0.15% + 20	0.0215105	0.9869	1.0310
9.99241	9.994	0.15% + 20	0.034991	9.9549	10.0299
99.4213	99.43	0.15% + 30	0.449145	98.9473	99.8953
100.7828	100.80	0.15% + 30	0.4512	100.3064	101.2592
200.666	200.68	0.15% + 30	0.60102	199.9847	201.3473
DC Amps					
0.500068	0.4990	0.5% + 20	0.004495	0.4953	0.5048
1.000128	0.9989	0.5% + 20	0.0069945	0.9927	1.0076
2.000383	1.9999	0.5% + 20	0.0119995	1.9873	2.0135
3.000047	3.0009	0.5% + 20	0.0170045	2.9814	3.0187

The meter met its accuracy specifications for all the current values I tested.

A Shunt Resistance	.025 Ω
mA Shunt Resistance	1.78 Ω
µA Shunt Resistance	101.87 Ω

It is always good to know how much resistance you are adding to your circuit when you make current measurements.

Resistance

Source	Reading	Specification	Uncertainty	Low Bound	High Bound
Ohms					
1.004105	1.02	0.07% + 10	0.100204	0.9036	1.1046
10.00762	10.00	0.07% + 10	0.102	9.9046	10.1107
100.0731	100.06	0.07% + 10	0.120012	99.9426	100.2036
Kiloohms					
1.000200	1.0003	0.07% + 2	0.00090021	0.9992	1.0012
10.00230	10.002	0.1% + 10	0.0090014	9.9925	10.0121
100.0375	100.03	0.1% + 10	0.090021	99.9394	100.1356
Megaohms					
0.993891	0.9944	0.3% + 6	0.0035832	0.9902	0.9976
9.96999	9.984	2% + 6	0.20568	9.7602	10.1798
100.1114	N/A				

The meter met its accuracy specifications for all the resistance values I tested.

Resistance Test Voltage	
Low Range	2.94 V
Medium Range	1.14 V
High Range	0.55 V

Capacitance

Source	Reading	Specification	Uncertainty	Low Bound	High Bound
nF					
0.0149	0.01	0.8% + 3	0.03008	0.0000	0.0501
0.1040	0.10	0.8% + 3	0.0308	0.0674	0.1406
1.0073	1.01	0.8% + 3	0.03808	0.9562	1.0584
9.940	9.93	0.8% + 3	0.10944	9.7808	10.0992
99.48	99.4	0.8% + 3	0.8252	98.1569	100.8031
µF					
1.0083	1.008	1.5% + 3	0.01812	0.9851	1.0315
10.841	10.91	2.5% + 3	0.30275	10.4849	11.1971
112.81	112.9	3.5% + 5	4.4515	107.8073	117.8127
1005.5	1003	5% + 5	55.15	944.8225	1066.1775

The meter met its accuracy specifications for all the capacitance values I tested. The uncertainty values are too high for the 10pF and 100pF reading to be meaningful. The nanofarad range had the highest accuracy specifications of this group of 50000-count meters. The highest microfarad range had the lowest accuracy of this group of 50000-count meters.

Diode

Max Diode Voltage	2.94 V
Max Diode Current	0.375 mA

This lit the LEDs I tested and the Schottky, Small Signal and Power diodes measured correctly.

Continuity

It is fast and latches.

dBm

This meter can measure dBm (decibel-milliwatts) using a selected impedance value from 4, 8, 16, 32, 50, 75, 93, 110, 125, 135, 150, 200, 250, 300, 500, 600, 800, 900, 1000, 1200 Ω.

Test Leads

The test leads were a soft silicone type. The meter also came with a thermocouple for measuring temperature. I did not test temperature measurements.

Ergonomics

The rotary switch is easy to turn and firmly clicks into place.
It has a large display with big numbers on the primary display and small numbers on the secondary display.
The backlight is bright and evenly lit except for a hotspot on the left.
The following functions are enabled when you hold down a button when you turn on the meter:

Button	Power On Action
Range	Disable beep tone
SELECT	Disable Auto Power Off (APO)

Accuracy Specifications Within the Group

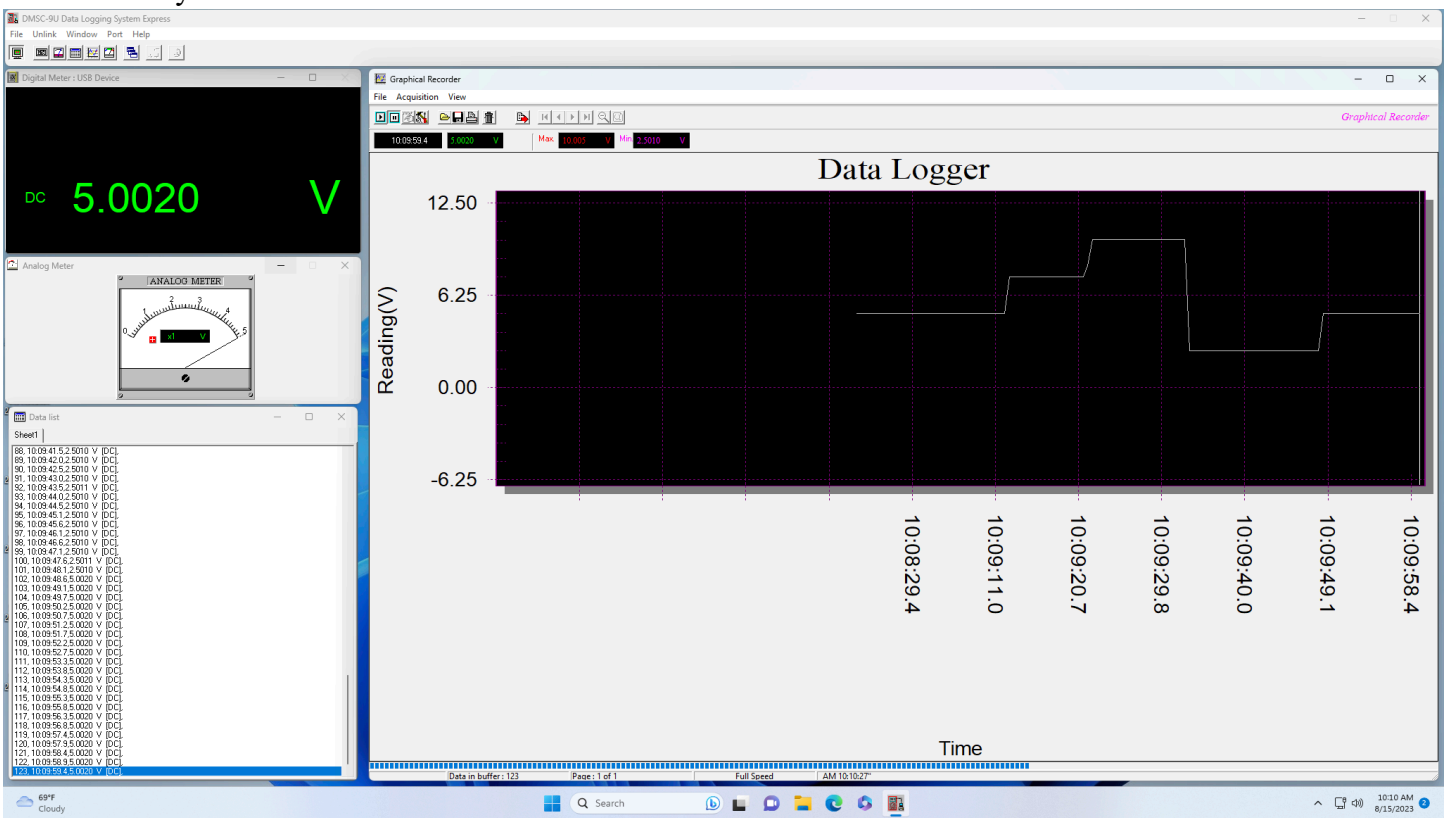
Value	Brymen BM789	EEVblog 121GW	Greenlee DM-860A	Uni-T UT181A	Fluke 289FVF
Cost	$173.52	$225.00	$346.44	$399.75	$876.59
Count	60,000	50,000	50,000	60,000	50,000
DC mV Low	0.03%+2	0.1%+10	0.02%+2	0.025%+20	0.05%+20
DC mV High	0.03%+2	0.1%+10	0.02%+2	0.025%+5	0.025%+2
DC V Low	0.03%+2	0.05%+5	0.02%+2	0.025%+5	0.025%+2
DC V High	0.05%+5	0.1%+10	0.04%+2	0.03%+5	0.03%+2
AC mV	0.5%+30	0.8%+10	0.3%+20	0.6%+60	0.3%+25
AC V	0.5%+30	0.3%+10	0.3%+30	0.3%+30	0.3%+25
AC V + DC V	1.2% + 40	1.0% + 10	0.5% + 80	1% + 80	0.5% + 80
DC µA	0.075%+20	1.5%+15	0.15%+2	0.08%+20	0.075%+20
DC mA	0.15%+20	0.25%+5	0.15%+20	0.15%+10	0.15%+2
DC A	0.3%+20	0.75%+15	0.5%+2	0.5%+10	0.3%+10
AC µA	0.9%+20	2.0%+20	0.5%+5	0.6%+40	1%+20
AC mA	0.9%+20	1.0%+5	0.5%+5	0.6%+20	0.6%+5
AC A	1%+30	1.5%+15	0.5%+5	1%+20	0.8%+20
Ω	0.085%+10	0.5%+20	0.07%+1	0.05%+10	0.15% + 20
Low kΩ	0.085%+4	0.2%+5	0.07%+2	0.05%+2	0.05%+2
High kΩ	0.15%+4	0.2%+5	0.1%+2	0.05%+2	0.05%+15
Low MΩ	1.5%+5	0.3%+5	0.3%+6	0.3%+10	0.15%+4
High MΩ	2.0%+5	1.2%+20	2%+6	2%+10	3.0%+2
Low nF	1%+10	2.5%+5	0.8%+3	3%+10	1%+5
High nF	1%+2	2.5%+5	0.8%+3	2%+5	1%+5
Low µF	1%+2	2.5%+5	1.5%+3	2%+5	1%+5
High µF	1.8%+4	3.0%+5	5% + 5	5% + 5	1%+5

The accuracy specifications are from the meters' respective manuals. Red lettering for the meter's name indicates the meter has failed to meet an accuracy specification. The red lettering in the accuracy specification indicates that one, or more meter readings did not meet this accuracy specification. The background color code shows the extreme low and high accuracy specifications. Green is the highest, yellow is lowest, and white is everything in-between.
The Greenlee DM-860A is in about first place in overall accuracy specifications. The only concern is that the DC 5 volt range did not meet accuracy specifications in my random sample of one meter.

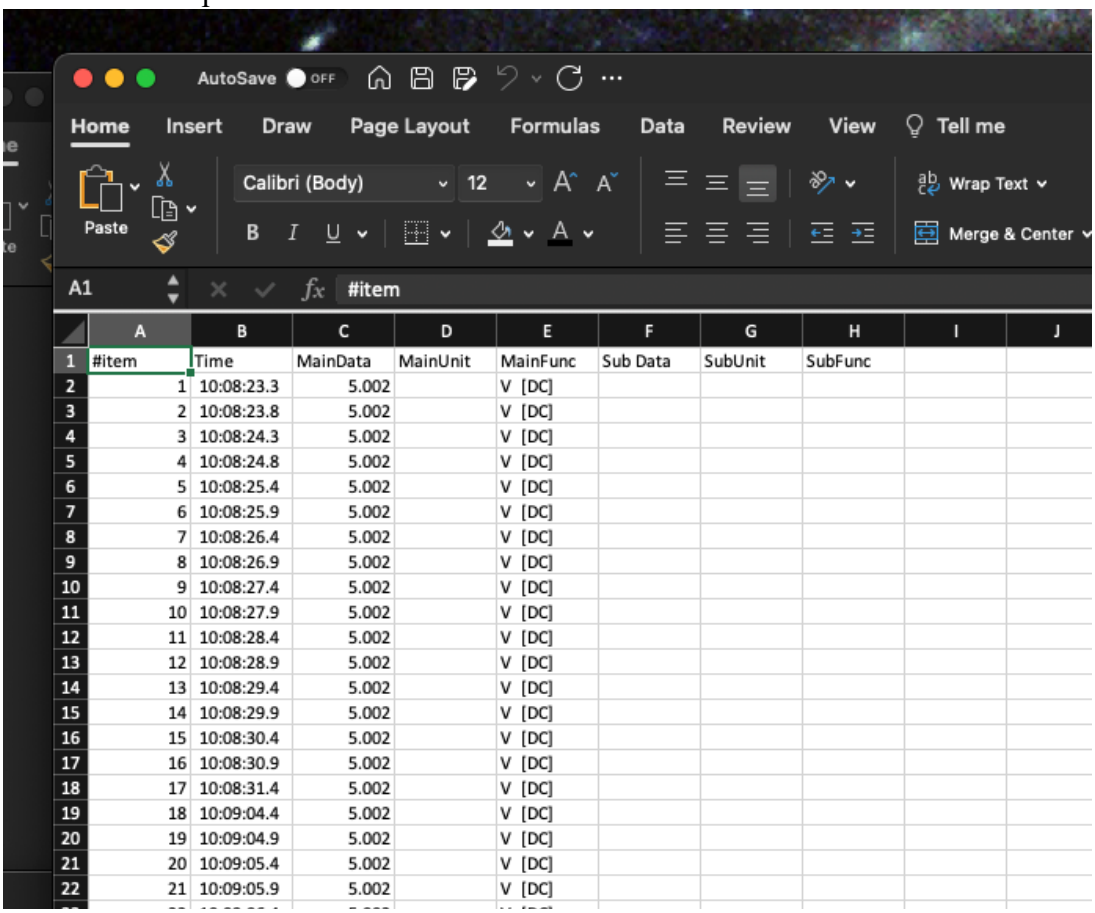
Logging

Greenlee has an optional Optical to USB cable interface with software (DMSC-9U INTERFACE, KIT-USB for $77.99 at Amazon) to connect the meter to a PC running Windows.

The software is from 2016 but I was able to get it to run on a virtual copy on Windows 11 ARM running under Parallels on by Mac Studio M1.



I was able to export a CSV file:



	A	B	C	D	E	F	G	H	I	J
1	#item	Time	MainData	MainUnit	MainFunc	Sub Data	SubUnit	SubFunc		
2	1	10:08:23.3	5.002		V [DC]					
3	2	10:08:23.8	5.002		V [DC]					
4	3	10:08:24.3	5.002		V [DC]					
5	4	10:08:24.8	5.002		V [DC]					
6	5	10:08:25.4	5.002		V [DC]					
7	6	10:08:25.9	5.002		V [DC]					
8	7	10:08:26.4	5.002		V [DC]					
9	8	10:08:26.9	5.002		V [DC]					
10	9	10:08:27.4	5.002		V [DC]					
11	10	10:08:27.9	5.002		V [DC]					
12	11	10:08:28.4	5.002		V [DC]					
13	12	10:08:28.9	5.002		V [DC]					
14	13	10:08:29.4	5.002		V [DC]					
15	14	10:08:29.9	5.002		V [DC]					
16	15	10:08:30.4	5.002		V [DC]					
17	16	10:08:30.9	5.002		V [DC]					
18	17	10:08:31.4	5.002		V [DC]					
19	18	10:09:04.4	5.002		V [DC]					
20	19	10:09:04.9	5.002		V [DC]					
21	20	10:09:05.4	5.002		V [DC]					
22	21	10:09:05.9	5.002		V [DC]					

Battery

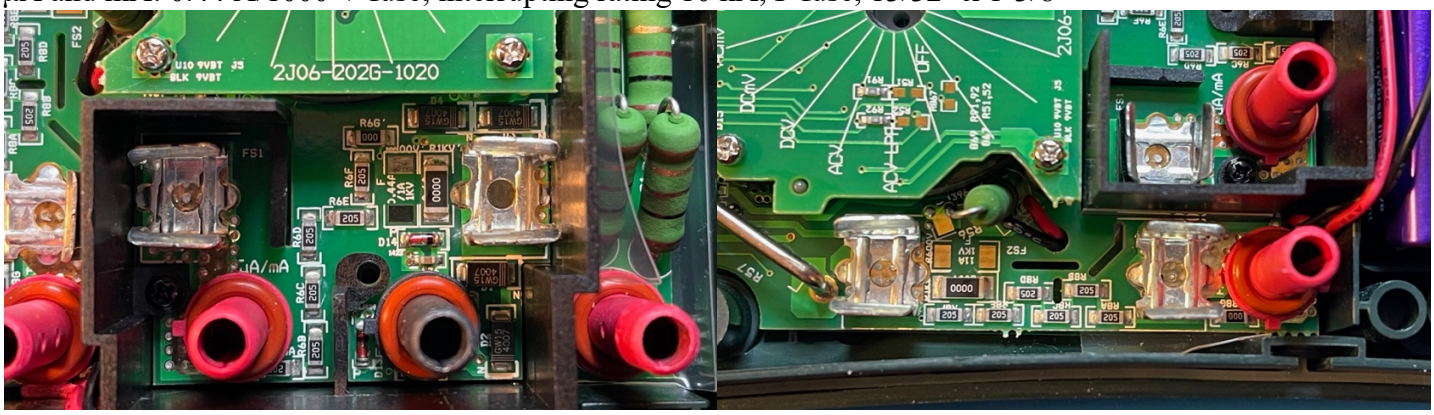
The meter uses one 9-Volt battery accessible from the back by removing the boot, then removing the battery door. The battery door has two captured Philips screws.

Fuses

The meter must be disassembled to change the fuses. You must remove the battery door and remove four Philips captured self-tapping screws.

The manual states the fuses are:
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"



Pros

- Third-party safety tested by UL.
- Dual Display with bright backlight.
- Leader in accuracy specifications in more categories than any other meter in this group.
- Greenlee limited lifetime warrantee.

Cons

- Did not meet accuracy specifications on the 5-Volt DC range.
- USB PC interface is an extra-cost option.
- No Bluetooth support.
- Must disassemble meter to change fuses.

Conclusion

I think the Greenlee DM-860A is a very good price for a performance meter. The only concern is the slight out-of-specification 5-Volt DC range on my unit. At worst it was 1.1 millivolt out. Am I going to lose any sleep over 1.1 millivolt? No. After this meter project is over, I may contact Greenlee support and see what they say. If anything comes of that I will do a follow-up.
If you don't need the graphing functions of the two higher priced meters in this group of 50000-count meters but you want the PC interface for an extra $78, this could be the one for you.