

EEVBlog Brymen BM786 Review

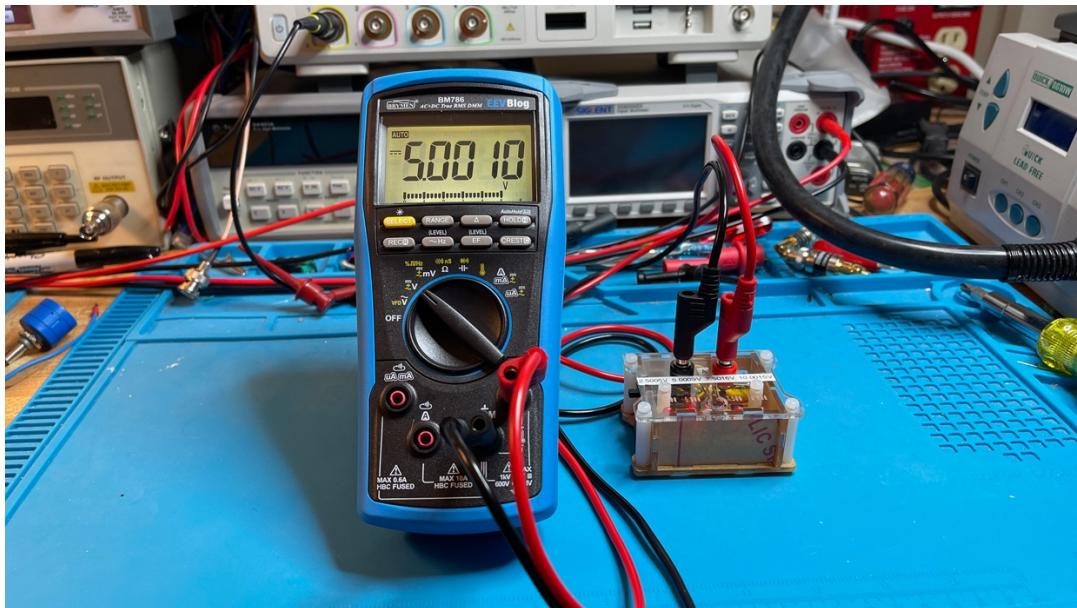
Introduction

Hi, I am Tom, amateur radio call sign N8FDY. This is a review of the EEVBlog Brymen BM786 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 EEVBlog Brymen BM786 multimeter that I purchased from The EEVBlog Store in Australia for \$154.11. You can also buy it from Amazon.com for \$199.00. 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 EEVBlog Brymen BM786 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

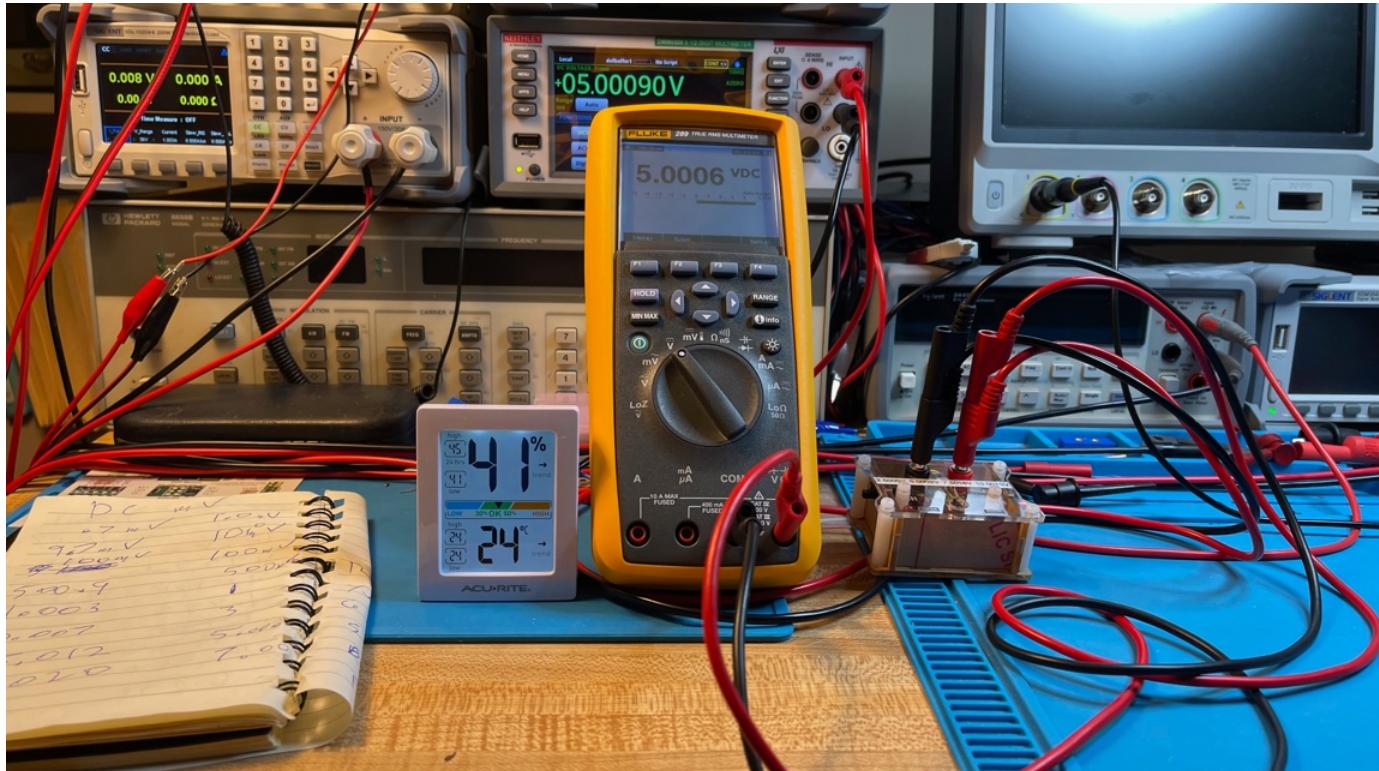
- UL C US Listed.
- 60,000 Counts.
- 31 Segment Analog Bar-graph Updates 50/Sec.
- True-RMS.
- DC+AC.
- Hold.
- AutoHold.
- Delta/Relative Zero Mode.
- Crest (Peak Hold) Captures MaxMin Changes > 0.25ms in Durations.
- MaxMinAvg.
- VFD-V & VFD-Hz Measures Fundamental V & Hz of Most Variable Frequency Drives.
- Three AAA batteries included.

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 $\pm(0.0025\% \text{ of reading} + 0.0005\% \text{ of range})$; 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 $\pm(0.025\% \text{ of reading} + 2 \text{ least significant digits})$ 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					
1.0361	1.06	0.03% + 2	0.020318	1.02	1.06
10.0674	10.08	0.03% + 2	0.023024	10.04	10.09
25.0161	25.03	0.03% + 2	0.027509	24.99	25.04
100.0222	100.01	0.03% + 2	0.050003	99.97	100.08
250.049	250.07	0.03% + 2	0.095021	249.94	250.16
500.118	500.12	0.03% + 2	0.170036	499.93	500.31
V					
1.000034	1.0000	0.03% + 2	0.0005	0.9995	1.0006
2.00140	2.0016	0.03% + 2	0.00080048	2.0005	2.0023
2.50052	2.5006	0.03% + 2	0.00095018	2.4995	2.5016
3.00123	3.0014	0.03% + 2	0.00110042	3.0000	3.0025
4.00028	4.0004	0.03% + 2	0.00140012	3.9987	4.0018
5.00085	5.0003	0.03% + 2	0.00170009	4.9990	5.0027
5.00092	5.0012	0.03% + 2	0.00170036	4.9990	5.0028
6.00009	6.0006	0.03% + 2	0.00200018	5.9979	6.0023
7.00023	7.001	0.03% + 2	0.0041003	6.996	7.005
7.50164	7.503	0.03% + 3	0.0042509	7.497	7.506
10.00150	10.003	0.03% + 4	0.0050009	9.996	10.007
100.3293	100.35	0.05% + 5d	0.100175	100.22	100.43
198.071	198.04	0.05% + 5d	0.14902	197.91	198.23
291.092	291.16	0.05% + 5d	0.19558	290.88	291.31
395.481	395.50	0.05% + 5d	0.24775	395.21	395.75
494.854	494.99	0.05% + 5d	0.297495	494.53	495.18
618.196	618.32	0.05% + 5d	0.35916	617.80	618.59

The meter met its accuracy specifications for all the DC voltages I tested. The DC millivolts and low volts ranges accuracy specification is in third place for this group of meters. The high DC volts accuracy specifications are in fourth place for this group of meters.

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	4.9964	1.2% + 30	0.0629568	4.9300	5.0680
60 Hz Sinewave					
mV					
1.0229	1.01	0.5% + 30	0.30505	0.72	1.33
5.0231	5.01	0.5% + 30	0.32505	4.70	5.35
10.0442	10.04	0.5% + 30	0.3502	9.69	10.40
25.1047	25.10	0.5% + 30	0.4255	24.66	25.55
50.0685	50.07	0.5% + 30	0.55035	49.49	50.65
100.074	100.07	0.5% + 30	0.80035	99.21	100.93
250.531	250.54	0.5% + 30	1.5527	248.83	252.23
500.145	500.18	0.5% + 30	2.8009	497.04	503.25
Volts					
0.500161	0.5002	0.5% + 30	0.005501	0.4941	0.5063
1.000235	1.0004	0.5% + 30	0.008002	0.9913	1.0091
2.00150	2.0022	0.5% + 30	0.013011	1.9843	2.0187
3.01243	3.0136	0.5% + 30	0.018068	2.9896	3.0353
4.01223	4.0136	0.5% + 30	0.023068	3.9838	4.0407
5.01005	5.0118	0.5% + 30	0.028059	4.9760	5.0441
6.00811	6.0097	0.5% + 30	0.0330485	5.9685	6.0478
7.00577	7.008	0.5% + 30	0.03804	6.9605	7.0510

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

ACV 1V 3dB cutoff	20.5 kHz
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The frequency of the cutoff is last 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:

$$V_{rms} = \sqrt{V_{ac}^2 + V_{dc}^2}$$

A meter with AC+DC calculates this for you.

Source	Reading	Specification	Uncertainty	Low Bound	High Bound
AC+DC					
2.0675	2.0647	0.7% + 40	0.0185	2.0450	2.0901
3.3561	3.3667	0.7% + 40	0.0275	3.3243	3.3880
3.3628	3.3556	0.7% + 40	0.0275	3.3334	3.3922
4.7316	4.7224	0.7% + 40	0.0370	4.6921	4.7711

The meter met its accuracy specifications for all the AC+DC values I tested.

Current

Source	Reading	Specification	Uncertainty	Low Bound	High Bound
AC 100Hz Squarewave					
0.999652	0.998	0.9% + 20	0.028982	0.9693	1.0300
DC μ A					
0.89708	0.89	0.075% + 20	0.2006675	0.70	1.10
9.21579	9.21	0.075% + 20	0.2069075	9.00	9.43
99.0382	99.01	0.075% + 20	0.2742575	98.71	99.36
131.943	131.92	0.075% + 20	0.29894	131.58	132.30
DC mA					
1.009076	1.008	0.075% + 20	0.020756	0.988	1.030
9.99224	9.990	0.075% + 20	0.0274925	9.962	10.022
99.4326	99.41	0.15% + 20	0.349115	99.06	99.81
250.558	250.6	0.15% + 20	0.575900	249.9	251.2
500.868	500.8	0.15% + 20	0.9512	499.7	502.0
DC Amps					
1.000845	1.0008	0.3% + 20	0.0050024	0.9954	1.0063
2.00114	2.0011	0.3% + 20	0.0080033	1.9920	2.0103
3.001369	3.0017	0.3% + 20	0.0110051	2.9887	3.0140

The meter met its accuracy specifications for all the current values I tested. The DC microamps has the highest accuracy specifications for this group of meters.

A Shunt Resistance	0.02 Ω
mA Shunt Resistance	2.4 Ω
μ A Shunt Resistance	102.4 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	1.01	0.085%+10	0.1008585	0.90	1.11
10.00762	10.04	0.085%+10	0.108534	9.90	10.12
100.0731	100.12	0.085%+10	0.185102	99.88	100.27
Kilohms					
1.000200	1.0005	0.085%+4	0.00125043	0.9989	1.0015
10.00230	10.003	0.085%+4	0.01250255	9.989	10.016
100.0375	100.07	0.15%+4	0.1250595	99.90	100.17
Megaohms					
0.993891	0.9950	1.5%+5	0.015425	0.9784	1.0094
9.96999	9.984	2.0%+5	0.20468	9.761	10.179
100.1114	N/A				

The meter met its accuracy specifications for all the resistance values I tested. The accuracy specifications for the resistance low-megaohm ranges are the worst for this group of meters. The accuracy specifications for the resistance higher megaohm range is in second place for this group of meters.

Resistance Test Voltage	
Low Range	2.27 V
Medium Range	2.76 V
High Range	0.19 V

Capacitance

Source	Reading	Specification	Uncertainty	Low Bound	High Bound
nF					
0.0149	0.01	1%+10	0.1001	0.00	0.12
0.1040	0.11	1%+10	0.1011	0.00	0.21
1.0073	1.04	1%+10	0.1104	0.88	1.13
9.940	9.96	1%+10	0.1996	9.69	10.19
99.48	99.7	1%+2	1.197	97.8	101.2
μF					
1.0083	1.008	1%+2	0.01208	0.991	1.025
10.841	10.95	1.8%+4	0.2371	10.55	11.13
112.81	112.9	1.8%+4	2.4322	109.8	115.8
1005.5	996	1.8%+4	21.928	978	1033

The meter met its accuracy specifications for all the capacitance values I tested. The 100.0nF~1μF range had the best accuracy specification in this group of meters. The uncertainty values are too high for the 10pF and 100pF reading to be meaningful.

Diode

Max Diode Voltage	3.166 V
Max Diode Current	511 µA

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

Continuity

It is fast and latches; the backlight also flashes.

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. The backlight is bright and evenly lit except for a hotspot on the bottom.

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)
EF	Enable centigrade and Fahrenheit temperature readings
CREST	Enable centigrade only or Fahrenheit only temperature readings

Accuracy Specifications Within the Group

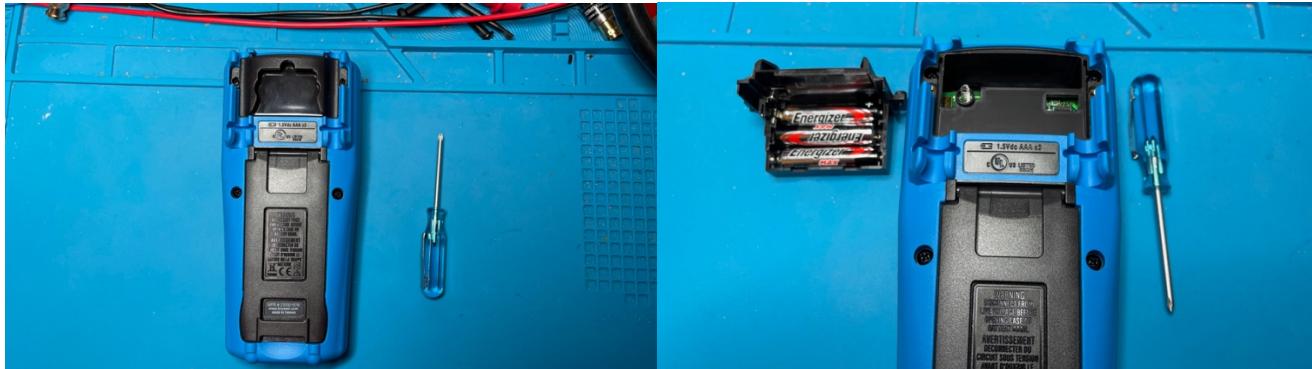
Value	EEVblog Brymen BM786	Brymen BM789	Brymen BM869s	EEVblog 121GW	Greenlee DM-860A	Uni-T UT181A	Fluke 289FVF
Cost	\$154.11	\$173.52	\$206.60	\$225.00	\$346.44	\$400.99	\$876.59
Count	60,000	60,000	50,000	50,000	50,000	60,000	50,000
DC mV Low	0.03%+2	0.03%+2	0.02%+2	0.1%+10	0.02%+2	0.025%+20	0.05%+20
DC mV High	0.03%+2	0.03%+2	0.02%+2	0.1%+10	0.02%+2	0.025%+5	0.025%+2
DC V Low	0.03%+2	0.03%+2	0.02%+2	0.05%+5	0.02%+2	0.025%+5	0.025%+2
DC V High	0.05%+5	0.05%+5	0.04%+2	0.1%+10	0.04%+2	0.03%+5	0.03%+2
AC mV	0.5%+30	0.5%+30	0.3%+20	0.8%+10	0.3%+20	0.6%+60	0.3%+25
AC V	0.5%+30	0.5%+30	0.4%+30	0.3%+10	0.3%+30	0.3%+30	0.3%+25
AC V+DC V	0.7%+40	1.2% + 40	0.7%+80	1.0% + 10	0.5% + 80	1% + 80	0.5% + 80
DC μ A	0.075%+20	0.075%+20	0.15%+20	1.5%+15	0.15%+2	0.08%+20	0.075%+20
DC mA	0.15%+20	0.15%+20	0.15%+20	0.25%+5	0.15%+20	0.15%+10	0.15%+2
DC A	0.3%+20	0.3%+20	0.5%+20	0.75%+15	0.5%+2	0.5%+10	0.3%+10
AC μ A	0.9%+20	0.9%+20	0.5%+50	2.0%+20	0.5%+50	0.6%+40	1%+20
AC mA	0.9%+20	0.9%+20	0.5%+50	1.0%+5	0.5%+50	0.8%+40	0.6%+5
AC A	1%+30	1%+30	0.5%+50	1.5%+15	0.5%+50	1%+20	0.8%+20
Ω	0.085%+10	0.085%+10	0.07%+10	0.5%+20	0.07%+1	0.05%+10	0.15%+20
Low k Ω	0.085%+4	0.085%+4	0.07%+2	0.2%+5	0.07%+2	0.05%+2	0.05%+2
High k Ω	0.15%+4	0.15%+4	0.1%+2	0.2%+5	0.1%+2	0.05%+2	0.05%+15
Low M Ω	1.5%+5	1.5%+5	0.3%+6	0.3%+5	0.3%+6	0.3%+10	0.15%+4
High M Ω	2.0%+5	2.0%+5	2%+6	1.2%+20	2%+6	2%+10	3.0%+2
Low nF	1%+10	1%+10	0.8%+3	2.5%+5	0.8%+3	3%+10	1%+5
High nF	1%+2	1%+2	0.8%+3	2.5%+5	0.8%+3	2%+5	1%+5
Low μ F	1%+2	1%+2	1.5%+3	2.5%+5	1.5%+3	2%+5	1%+5
High μ F	1.8%+4	1.8%+4	5% + 5	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 EEVBBlog Brymen BM786 is in about fourth place in overall accuracy specifications. It is one of the four meters in this group that met its accuracy specifications for all measurements taken.

Battery

The meter uses three AAA batteries accessible from the back by removing the battery holder. The battery holder has two Philips screws.



Fuses

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



The manual states the fuses are:

Fuse (F1) for A input: Bussmann DMM-11AR; 11A/1000Vac & Vdc, IR 20kA, F fuse; Dimension: 10 x 38mm

Fuse (F2) for μ A/mA input: SIBA 7017240; 0.4A/1000Vac & Vdc, IR 30kA, F fuse; Dimension: 6 x 32 mm



Pros

- Third-party tested for safety by UL.
- Lowest cost 50,000-count meters tested.
- All measurements taken met the accuracy specifications in the manual.
- One of the best DC microamps accuracy specifications.
- The best low microfarad accuracy specifications.
- One of the smaller and lighter 50000-count meters

Cons

- Lowest 3dB cutoff frequency for AC Voltage for this group of meters.
- Worst AC volts accuracy specifications.
- Worst AC+DC volts accuracy specifications.
- Worst low megaohms accuracy specifications.
- Must disassemble the meter to change fuses.

Conclusion

The EEVBlog Brymen BM786 is the one of two meters in the 50000-count group I tested that does not have some form of data logging. In general, it has higher accuracy specifications than 6000-count meters and of course higher resolution. It also has AC+DC True-RMS.

Amazon.com sells this meter for \$199.00 in the US, but you can buy it directly for EEVBlog at a much better price.

If you want an entry level 50000-count meter that does not do any data logging or dBm measurements, this is the meter for you.