EEVblog 121GW Review

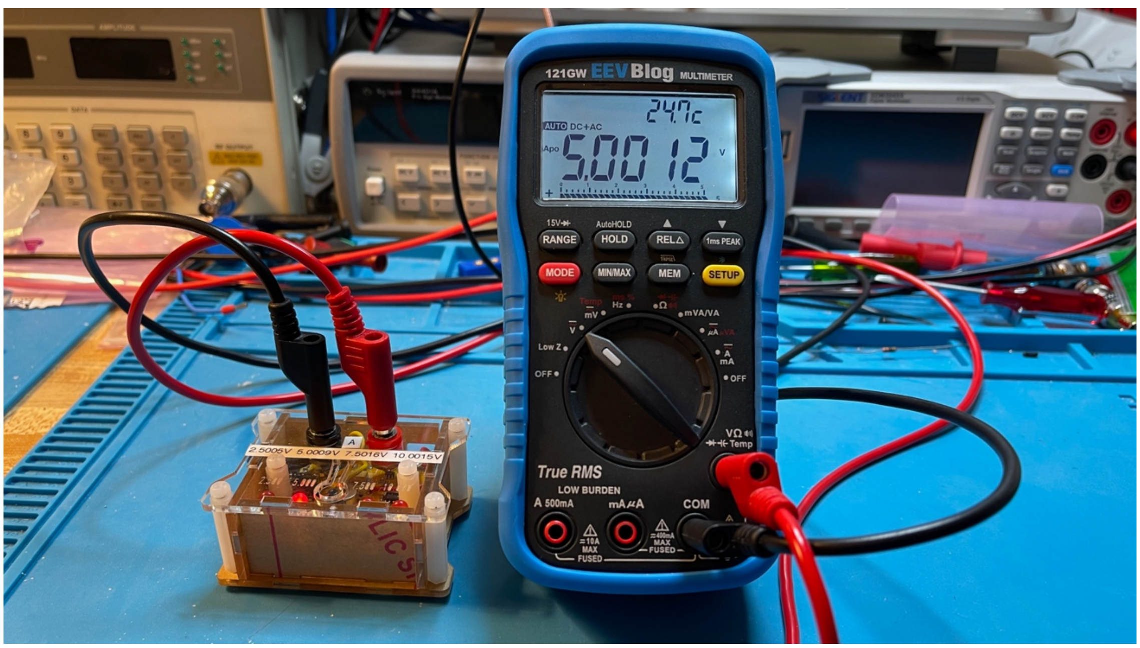
Introduction

Hi, I am Tom, amateur radio call sigh N8FDY. This is a review of the EEVblog 121GW 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 121GW multimeter that I purchased from Amazon for $225.00.
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.

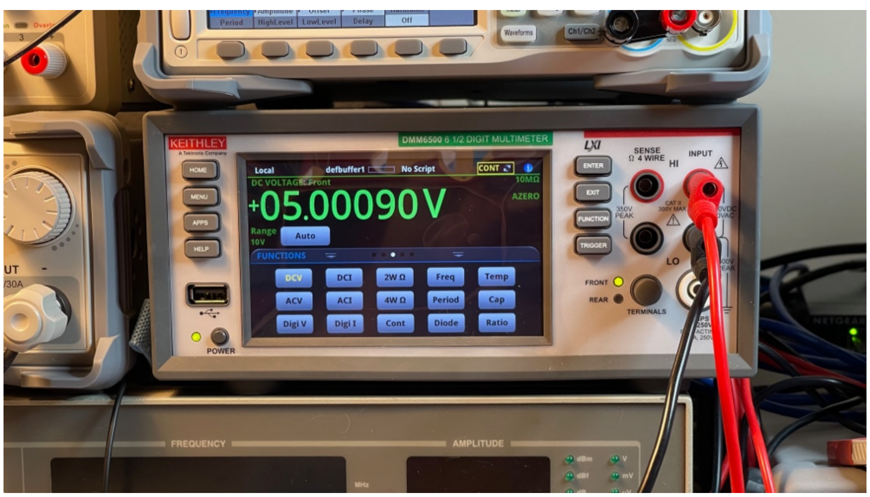
Objectives

This review was produced to help you decide if the EEVblog 121GW 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

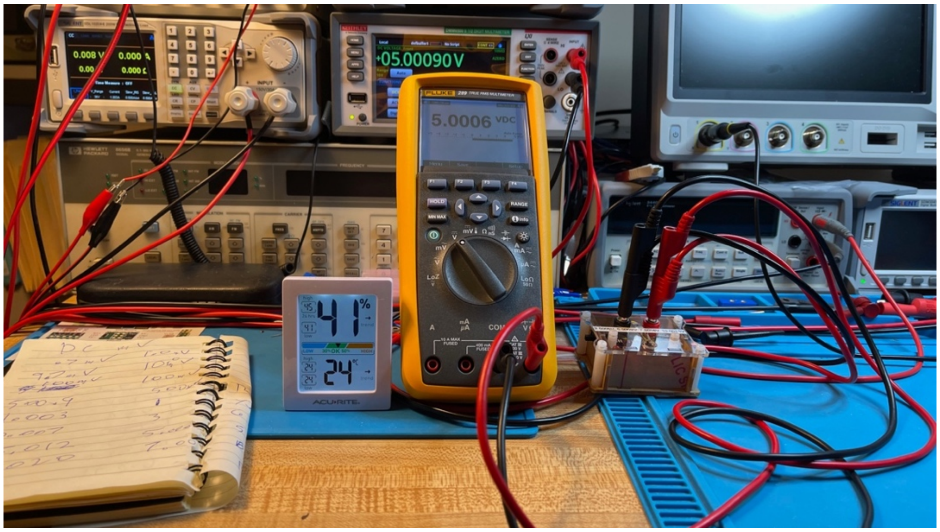
- Dual 50000-count display with bargraph.
- 0.05% + 5 Basic DCV Accuracy.
- Auto-Hold measurement.
- 600V CAT-III with independent UL 61010 certification by ETL.
- Safe operation through HRC fuse + TVS + PTC + MOV + Diode Bridge protection.
- Bluetooth connectivity (multi-device capability).
- Open-Source Cross Platform application software (Android + Windows).
- 15V Diode Test Voltage (useful for Zeners + LED strings etc.).
- VA Power measurement.
- Low Burden™ voltage.
- Unique burden voltage display.
- Micro SD Card data logging + firmware updating.

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	1.017	0.1%+10	0.011017	0.9946	1.0174
10.0012	10.003	0.1%+10	0.020003	9.9805	10.0219
100.0187	100.02	0.1%+10	0.20002	99.8153	100.2221
500.097	500.11	0.1%+10	0.60011	499.4784	500.7156
V					
1.000909	1.0011	0.05% + 5	0.00100055	0.9998	1.0020
2.00013	2.0004	0.05% + 5	0.00150020	1.9985	2.0017
2.50054	2.5009	0.05% + 5	0.00175045	2.4987	2.5024
3.00134	3.0018	0.05% + 5	0.00200090	2.9992	3.0035
4.00001	4.0005	0.05% + 5	0.00250025	3.9974	4.0027
5.00030	5.0013	0.05% + 5	0.00300065	4.9971	5.0035
5.00091	5.0015	0.05% + 5	0.00300075	4.9977	5.0041
6.00142	6.001	0.05% + 5	0.00800050	5.9932	6.0096
7.00018	7.000	0.05% + 5	0.00850000	6.9915	7.0089
7.50167	7.502	0.05% + 5	0.00875100	7.4927	7.5107
10.00153	10.002	0.05% + 5	0.01000100	9.9912	10.0118
97.7528	97.73	0.05% + 5	0.09886500	97.6494	97.8562
191.276	191.25	0.05% + 5	0.14562500	191.1167	191.4353
281.295	281.20	0.05% + 5	0.19060000	281.0871	281.5029
381.899	381.84	0.05% + 5	0.24092000	381.6368	382.1612
490.268	489.96	0.05% + 5	0.29498000	489.9474	490.5886
601.023	600.9	0.1% + 10	1.60090000	599.3900	602.6560

The meter met its accuracy specifications for all the DC voltages I tested. The DC millivolts and volts ranges accuracy specification are the worst for this group of 50000-count 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	4.9946	0.3% + 10	0.0159838	4.9771	5.0210
60 Hz Sinewave					
mV					
1.0335	1.018	1.2% + 15	0.02721600	1.0056	1.0614
10.0397	10.05	1.2% + 15	0.27060000	9.7630	10.3164
100.0742	100.15	0.8% + 10	0.90120000	99.1129	101.0355
250.565	250.75	0.8% + 10	2.10600000	248.3084	252.8216
500.110	499.88	0.8% + 10	4.09904000	495.7106	504.5094
Volts					
0.500130	0.5000	0.3% + 10	0.00250000	0.4970	0.5032
1.000213	1.0013	0.3% + 10	0.00400390	0.9953	1.0051
2.00184	2.0043	0.3% + 10	0.00701290	1.9906	2.0131
3.01276	3.0147	0.3% + 10	0.01004410	2.9979	3.0276
4.01248	4.0130	0.3% + 10	0.01303900	3.9940	4.0309
5.01209	5.0095	0.3% + 10	0.01602850	4.9901	5.0341
6.00816	6.007	0.3% + 10	0.02802100	5.9735	6.0428
7.00644	7.007	0.3% + 10	0.03102100	6.9682	7.0447

The meter met its accuracy specifications for all the AC voltages that I tested. The AC volts for 60 Hz accuracy specification is the highest in this group of 50000-count meters. The

ACV 1V 3dB cutoff	415 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	2.0634	1.0% + 10	0.030634	2.03280819	2.10225408
3.356147086	3.3506	1.0% + 10	0.043506	3.30831091	3.40398455
3.36282066	3.3642	1.0% + 10	0.043642	3.31732839	3.40831644
4.73159436	4.7143	1.0% + 10	0.057143	4.67194386	4.79124782

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					
0.999694	0.9997	1.0%+5	0.014997	0.9833	1.0161
DC µA					
0.89695	0.894	1.5%+15	0.02841000	0.8676	0.9263
9.21851	9.17	1.5%+15	0.15255000	9.0613	9.3757
99.0500	99.06	1.5%+15	1.50090000	97.4995	100.6005
131.913	131.94	1.5%+15	1.99410000	129.8590	133.9670
DC mA					
1.008954	1.0093	0.25%+5	0.00302325	1.0054	1.0125
9.99241	9.993	0.25%+5	0.02998250	9.9599	10.0249
99.4213	99.48	0.25%+5	0.29870000	99.0977	99.7449
100.7828	100.83	0.25%+5	0.30207500	100.4556	101.1100
200.666	200.68	0.25%+5	0.55170000	200.0340	201.2980
DC Amps					
0.500068	0.50012	0.75%+15	0.00390090	0.4959	0.5042
1.000128	1.0004	0.75%+15	0.00900300	0.9907	1.0096
2.000383	2.0011	0.75%+15	0.01650825	1.9828	2.0180
3.000047	3.0012	0.75%+15	0.02400900	2.9744	3.0257

The meter met its accuracy specifications for all the current values I tested. The AC milliamps has the lowest accuracy specifications for this group of 50000-count meters.

A Shunt Resistance	.04 Ω
mA Shunt Resistance	2.84 Ω
µA Shunt Resistance	102.8 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	1.015	0.5%+20	0.025075	0.9787	1.0295
10.00762	10.025	0.5%+20	0.070125	9.9364	10.0788
100.0731	100.26	0.3%+5	0.35078	99.7118	100.4344
Kiloohms					
1.000200	1.0000	0.2%+5	0.0025	0.9976	1.0028
10.00230	10.000	0.2%+5	0.025	9.9765	10.0281
100.0375	100.02	0.2%+5	0.25004	99.7794	100.2956
Megaohms					
0.993891	0.9930	0.3%+5	0.003479	0.9903	0.9975
9.96999	9.970	1.2%+20	0.13964	9.8263	10.1137
100.1114	N/A				

The meter met its accuracy specifications for all the resistance values I tested. The accuracy specifications for the resistance ranges below 1 Megaohm are the worst for this group of 50000-count meters.

Resistance Test Voltage	
Low Range	2.11 V
Medium Range	1.00 V
High Range	1.99 V

Capacitance

Source	Reading	Specification	Uncertainty	Low Bound	High Bound
nF					
0.0149	0.009	2.5%+5	0.005225	0.0046	0.0252
0.1040	0.104	2.5%+5	0.0076	0.0906	0.1174
1.0073	0.986	2.5%+5	0.02965	0.9646	1.0500
9.940	9.912	2.5%+5	0.2528	9.6374	10.2426
99.48	99.41	2.5%+5	2.53525	96.4468	102.5132
µF					
1.0083	1.0096	2.5%+5	0.02574	0.9775	1.0391
10.841	10.828	2.5%+5	0.2757	10.5119	11.1701
112.81	110	2.5%+5	7.75	104.5088	121.1112
1005.5	992	3.0%+5	34.76	965.2125	1045.7875

The meter met its accuracy specifications for all the capacitance values I tested. The uncertainty value is too high for the 10pF reading to be meaningful. The high nano-farad and low microfarad ranges have the worst accuracy specifications for this group of 50000-count meters.

Diode

Max Diode Voltage	15.918 V
Max Diode Current	4.85 mA
Low Diode Voltage	3.213 V
Low Diode Current	0.729 mA

This meter has a special 15-volt mode for testing Zener diodes and LEDs. It also has a mode the corresponds with the other meter is this group.
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.

dBm

This meter can measure dBm (decibel-milliwatts) using a one impedance value of 600Ω.

VA Measurements

The EEVBlog 121GW has an unusual function that measures DC power and AC VA. I only had the means to test DC power.

Source	Reading	Specification	Uncertainty	Low Bound	High Bound
DC mVA					
69.89	69	0.5% + 5	5.345	64.51	75.26
699.32	698	0.5% + 5	8.49	690.50	708.15
3503.49	3506	0.5% + 5	22.53	3478.23	3528.74
7513.60	7515	0.5% + 5	42.575	7465.29	7561.91
DC VA					
15.02	15.02	1.0% + 10	0.2502	14.76	15.28

The meter met its accuracy specifications for DC mVA and VA values I tested.

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, it looks washed out at 90° but gets better as you rotate the meter top up to 45°. The backlight is bright and evenly lit, except for a hotspot on the right.
The following features are displayed when you push the Setup button. You can adjust them by holding down the setup button until the secondary display flashes. You can save the change by holding down the Setup button until the secondary display stops flashing.

Second Display	Name	Feature
25.8c	Temperature	Display temperature
bAt5.5	Battery Voltage	Display battery voltage
APOon/APOof	Auto Power Off (*APo*)	Activate or deactivate auto power off after 30 minutes
b-OFF/b-On	Buzzer On/Off (b-Off)	Enable or disable buzzer
LCD-4	LCD Contrast	Adjuct LCD contrast
2023	Year	Set the year for the logger
8-11	Month-Day	Set the month and day for the logger
14-27	Hour-Minute	Set the 24-hour clock for the logger
00000	Multimeter ID	Set the meter id for the logger
Ln 0	Logging Interval (ln 0)	Set logging interval in seconds (0 represents 20 milliseconds)

Setup functions only available in specific modes.

Mode	Second Display	Name	Feature
ACV and ACmV	0060 Hz	Frequency	Display frequency of AC signal
ACV	-70.0 dBm	dBm	Decibels per milliwatt of AC signal
Continuity	dn 30/UP 30/dn 300/UP 300	Level threshold/Short or Open Beep	Choose trigger threshold between 30Ω and 300Ω; Choose to beep on open (UP) or beep on short (dn).
Temperature	26.8c/80.1F	Celsius or Fahrenheit	Select temperature scale for primary and secondary display

Accuracy Specifications Within the Group

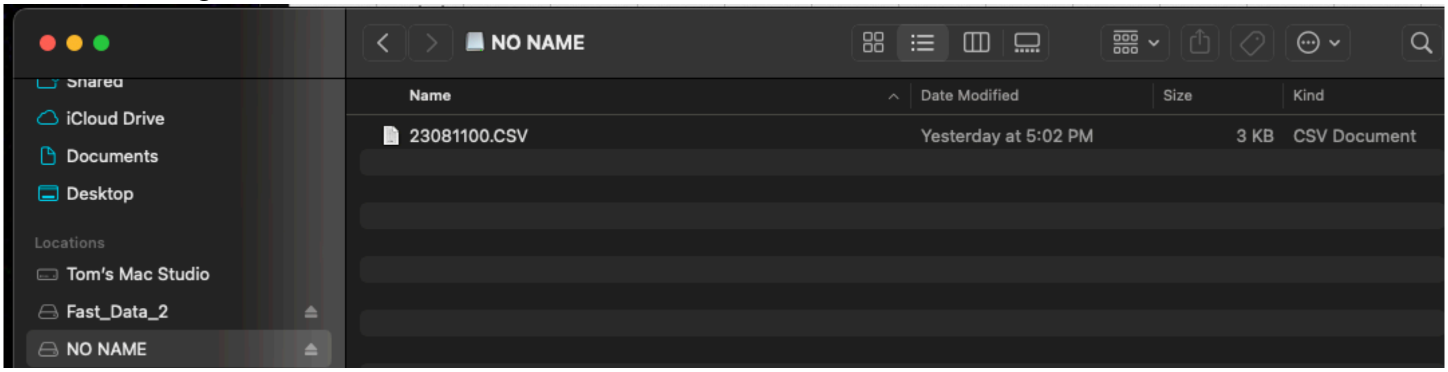
Value	Brymen BM789	EEVblog 121GW	Greenlee DM-860A	Uni-T UT181A	Fluke 289FVF
Cost	$173.52	$225.00	$346.44	$399.75	$876.59
Count	60,000	50,000	50,000	60,000	50,000
DC mV Low	0.03%+2	0.1%+10	0.02%+2	0.025%+20	0.05%+20
DC mV High	0.03%+2	0.1%+10	0.02%+2	0.025%+5	0.025%+2
DC V Low	0.03%+2	0.05%+5	0.02%+2	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 EEVblog 121GW is in about last place in overall accuracy specifications. It is one of the two meters in this group that met its accuracy specifications for all measurements taken.

Logging

I was able to log to the Micro SD card.

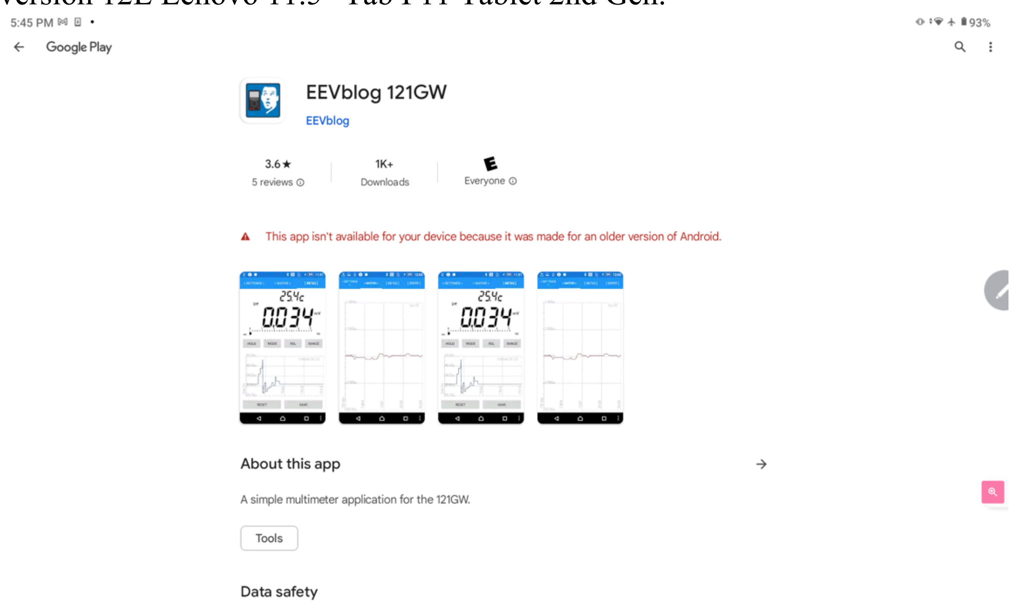


I opened the file in Excel.

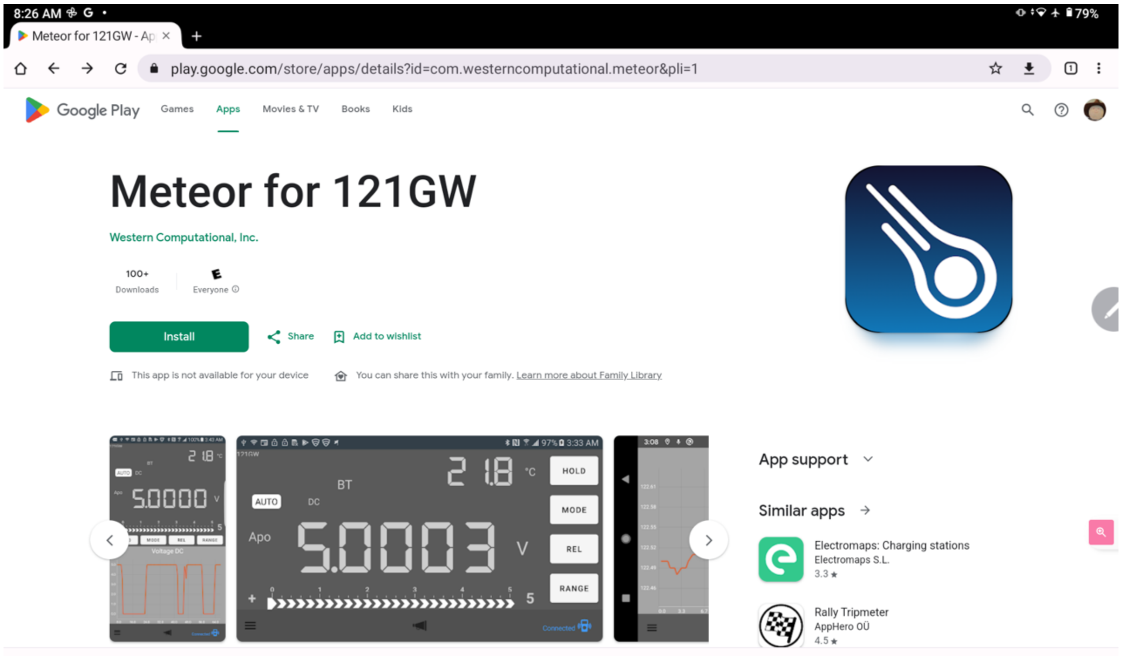
A1 | START

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	TART	8/11/23	17:02:02										
2	D	170800000											
3	NTERVAL	1	sec										
4				MAIN			SUB-1			SUB-2			Remark
5	lo.	Date	Time	Func.	Value	Unit	Func.	Value	Unit	Func.	Value	Unit	
6	1	8/11/23	17:02:03	DCmVA	297	mVA	DCV	14.831	V	DCmA	-20.027	mA	
7	2	8/11/23	17:02:04	DCmVA	297	mVA	DCV	14.831	V	DCmA	-20.027	mA	
8	3	8/11/23	17:02:05	DCmVA	297	mVA	DCV	14.832	V	DCmA	-20.027	mA	
9	4	8/11/23	17:02:06	DCmVA	296.5	mVA	DCV	14.832	V	DCmA	-19.997	mA	
10	5	8/11/23	17:02:07	DCmVA	296.5	mVA	DCV	14.832	V	DCmA	-19.997	mA	
11	6	8/11/23	17:02:08	DCmVA	296.5	mVA	DCV	14.831	V	DCmA	-19.997	mA	
12	7	8/11/23	17:02:09	DCmVA	296.5	mVA	DCV	14.831	V	DCmA	-19.997	mA	
13	8	8/11/23	17:02:10	DCmVA	296	mVA	DCV	14.831	V	DCmA	-19.961	mA	
14	9	8/11/23	17:02:11	DCmVA	296	mVA	DCV	14.831	V	DCmA	-19.961	mA	
15	10	8/11/23	17:02:12	DCmVA	296	mVA	DCV	14.831	V	DCmA	-19.961	mA	

I also tried the Bluetooth software. The Android EEVBlog 121GW software would not install on my Android version 12L Lenovo 11.5" Tab P11 Tablet 2nd Gen.



Also, the Android version of Meteor for 121GW would not install.



I was able to install and run Meteor for 121GW on my iPhone and iPad both running IOS 16. 5.1(c).

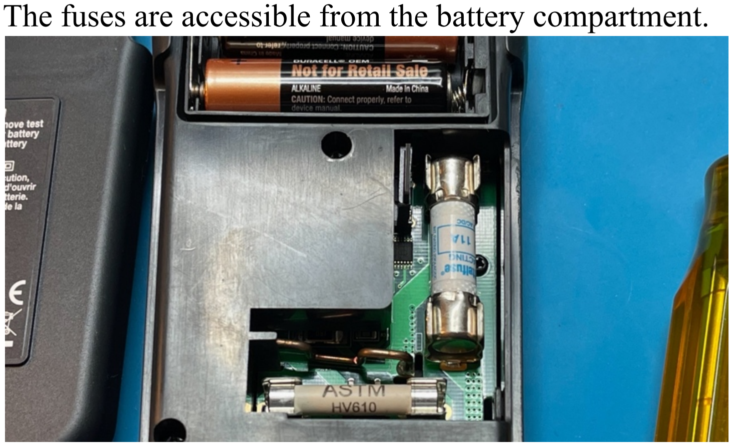
I also was able to run the PC software on a Virtual Windows 11 ARM running on Parallels on my Mac Studio.

Battery

The meter uses four AA batteries accessible from the back by removing the boot, then removing the battery compartment door. The battery door has two captive Philips screws screwed into metal inserts. The manual claims 500-hour battery life.

Fuses

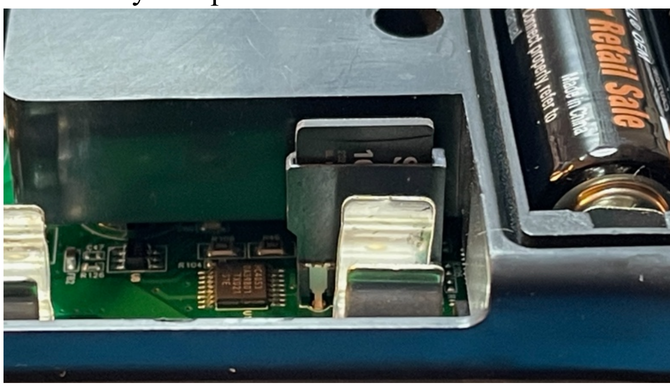
The fuses are accessible from the battery compartment.



The manual states the fuses are:
mA/µA current input fuse: 400 mA / 600 V DC/AC, IR 10 kA HRC FAST; Designed to UL 248-1; Dimension: 6mm x 32 mm; Recommended: ASTM HV610.0.4 400 mA (600V) or HV620.0.4 (1000V)
A/500 mA current input fuse: 11 A/1000 V DC/AC, IR 20 kA HRC FAST; Dimension: 10mm x 38 mm 5AG; Recommended: ASTM HV110.11A, Bussmann DMM-B-11A, or Little-fuse FLU011

Micro SD Card Slot

The battery compartment also has a Micro SD card slot for data logging and firmware updates.



Pros

- Third-party safety tested by ETL for US and Canada.
- The AC Volts accuracy specification is the highest in this group of 50000-count meters.
- The high megaohm accuracy specification is the highest in this group of 50000-count meters.
- All measurements taken met accuracy specifications in the manual.
- Micro SD card and Bluetooth logging.
- Remembers last mode used at each switch position.
- Setup menu to customize many operations.
- Useful secondary display.
- VA measurements.
- Built-in ambient temperature reading.
- Fuses can be changed from the battery compartment.

Cons

- Most ranges have the lowest accuracy specifications in this group of 50000-count meters.
- Only measures up to 600 Volts.
- Must send to Australia for service.
- Android software will not install on a device running 12L.
- Red writing around dial is difficult to read.

Conclusion

The EEVblog 121GW is the only meter in the 50000-count group I tested that that has a Micro SD card for data logging and firmware upgrade. It is also the only meter in this group that can measure AC Volt-Amps and DC power. If also has Bluetooth connectivity. In general, it has higher accuracy specifications than 6000-count meters and of course higher resolution. If also has AC+DC True-RMS. It also can measure dBm at 600Ω impedances.

The EEVblog 121GW has everything and more, except tight accuracy specifications. In many of my tests the reading exceeded accuracy specifications, but this is a random sample of one. So, this meter is a tradeoff between low price, many features, small size vs accuracy specifications.
After this meter testing project is done, this is one of the meters I am keeping.