

# Fluke Digital Multimeters

## Introduction

Hi, I am Tom, amateur radio call sign N8FDY. This summary is part of a series comparing digital multimeters. I will be comparing the Fluke brand digital multimeters that I have tested for use in hobby electronics projects primarily related to amateur radio.

## Disclaimer

I am not a professional, I am a hobbyist. This video is not sponsored; I bought these multimeters with my own money. I only used and tested the multimeters in CAT I and CAT II environments. I do not have a way to review or test the safety of these meters. 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 document.

## Overview

I am comparing seven Fluke digital multimeters that range in price from \$150 to \$745. They have different resolutions (6000 to 50000 count) and vary in accuracy and features. Each meter also has a dedicated review document and video.

## Resolution, Measurements and Accuracy

The resolution of a portable digital multimeter is usually described in counts. A 50000-count meter can display 49999 on the display. It could be 4.9999, 49.999, 499.99, 4999.9 or 49999. The accuracy of a portable digital multimeter is usually expressed in +- % of reading +- n least significant digits. An example would be  $\pm(0.05\% + 1)$ , so a reading of 10.00 volts would give an uncertainty value of  $(10 \times .0005) + (1 \times .01) = (0.005) + (.01) = 0.015$  volts, so the value could be from 9.985 Volts to 10.015 volts.

## CAT I & CAT II

I am testing and demonstrating these multimeters in CAT I and CAT II measurement categories. CAT I is for measurements performed on circuits not directly connected to mains. For example, battery-operated electronics, or radio gear connected to 13V power supply.

CAT II is for measurements performed on circuits directly connected to the 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".

## Third Party Safety Testing

When I say that Flukes are third party safety test that is a shorthand for saying Fluke runs their own CSA accredits and audited test lab with all results reviewed like all other CSA labs. This is explained in the following article <https://www.fluke.com/en-us/learn/blog/safety/safe-test-tools-real-world-use>. Here are the highlights:

"The Fluke Product Compliance laboratory is accredited through CSA to test and certify products for their certification mark. Test procedures are laid out in detail and adhered to rigorously. Once a product has passed the appropriate tests, documentation is sent on for approval and registration."

"The Fluke lab is regularly audited to ensure that testing meets the requirements imposed by the national and international authorities and standards. Each test is precisely set up and calibrated to meet the requirements of the relevant standard."

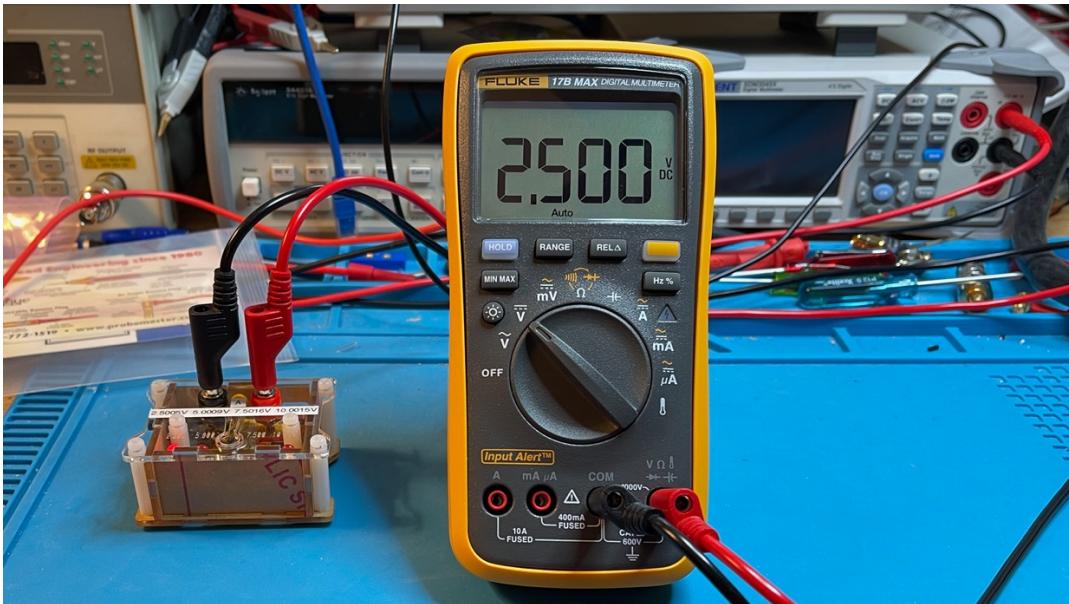
## Overview

For each multimeter we will look at the features, pros, cons, and recommendations. Then we will compare the accuracy performance of the meters.

## Test Leads

I will not be using the test leads that came with the meters. 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.

## Fluke 17B MAX



Fluke 17B MAX purchased from eBay for \$ 149.97. The cheapest I could find it today was at eBay for \$159.99.

### Features

- CSA C US Listed.
- CAT III 600V.
- 6,000 Count Voltage, 5,000 Count Frequency, 4,000 Count all others.
- Basic DC Accuracy  $\pm(0.5\% + 3)$ .
- Min/Max.
- Rel/Delta.
- Hold.
- Auto-off Override.
- Backlight Auto-off Override.
- K-Type Thermocouple.
- Two AA Batteries Included.

### Pros

- Under \$150.
- Third-party safety tested by CSA.
- The DC and AC volts ranges' accuracy specifications are OK.
- Resistance ranges' accuracy specifications are OK.
- You can override the auto-power-off and the auto-backlight-off functions.

### Cons

- Capacitance ranges either have low accuracy specifications or have readings that don't meet the accuracy specifications.
- Must download the English manual.
- The DC and AC millivolt ranges accuracy specifications are below average.
- DC current ranges' accuracy specifications are below average.

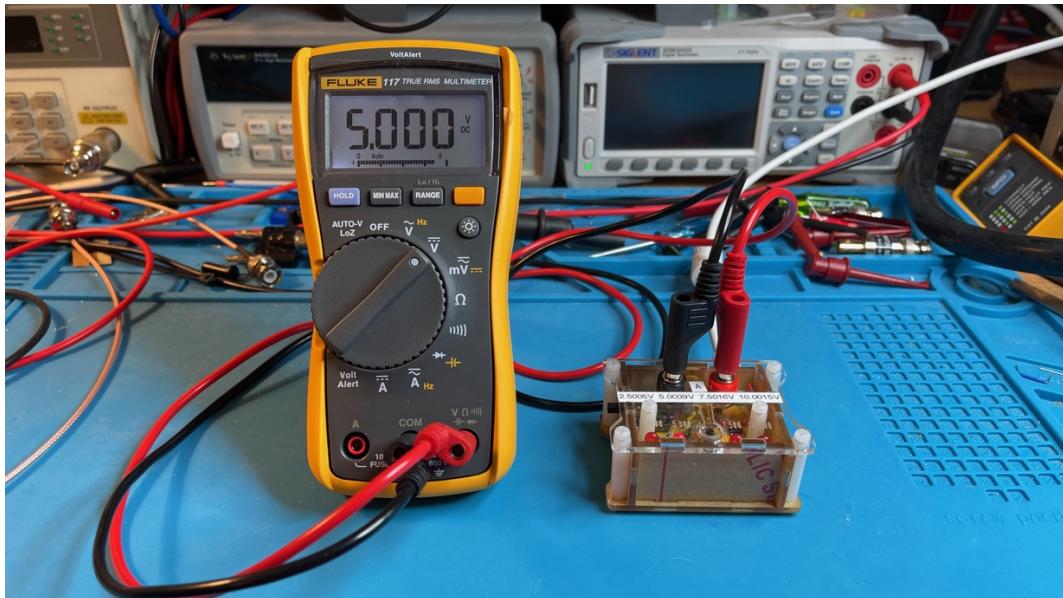
- No measurement range accuracy specification on the meter is above average.
- Only available in US via grey market with no support.
- Must disassemble unit to change fuses.

## Recommendation

It is interesting to see what meter is being sold by Fluke in the Asia and India markets. It is CSA safety tested. The AC & DC volts ranges, and the resistance ranges are OK. The current and capacitance ranges aren't very good compared to some of the lower-priced meters in this group of 6,000 count meters.  
If you are a meter collector, I would say pick up a Fluke 17B MAX for your collection.  
If you are just starting out and want a good starter meter, or you want to upgrade to a new meter, I would recommend the following:

- Buy an EEVblog Brymen BM235 from Amazon for \$150.00. It is a good compromise of performance and price, but one year warranty return to Australia.
- Buy a Greenlee DM-510A from Amazon for \$ 150.13. This is the second-best compromise of performance and price with Greenlee's "Lifetime Limited Warranty".
- Buy a Fluke 87V from globaltestsupply.com for \$433.25 (as of 24-March-2024). It has above average accuracy specifications for most measurement range tests in this group of 6,000 count meters and has Fluke's "Lifetime Limited Warranty".
- Buy a Fluke 87V MAX from testequipmentdepot.com for \$487.95 (as of 24-March-2024). It has above average accuracy specifications for all measurement range tests in this group of 6,000 count meters and is IP67 waterproof and dustproof and has Flukes "Lifetime Limited Warranty".
- Look into the 10,000 to 20,000 count meter reviews.
- Look into the 50,000 count and above meter review.

# Fluke 117



Fluke 117 purchased from Lowe's for \$159.31 in September of 2023, the price at Lowe's now is \$281.99. The cheapest I could find it today was at Amazon for \$235.87.

## Features

- Third-party safety tested by CSA for Canada and US.
- CAT III 600 Volts.
- 6000 count True-RMS with basic DC accuracy of 0.5%+2.
- 33 segments bar graph that updates 32 times a second.
- Battery life is 400 hours typical, without backlight.
- IP42 rated.
- VoltAlert™ non-contact AC voltage detection.
- AutoVolt automatic AC/DC selection
- Included one nine-volt battery.
- 3 years Warranty.

## Pros

- Third-party safety testing by CSA.
- Most readings taken met the accuracy specifications as stated in the manual.
- You can disable the auto backlight off function.
- The lowest amp range has 1 mA resolution so you can accurately measure 10 mA and higher.

## Cons

- No milliamp or microamp ranges.
- 1 millivolt AC reading shows as 0.
- No better accuracy specifications than lower cost meters.
- Does not have the Fluke Limited-Lifetime Warranty, only 3 years.

## Recommendation

I believe the Fluke 117 is a very good meter for its intended market of electricians.

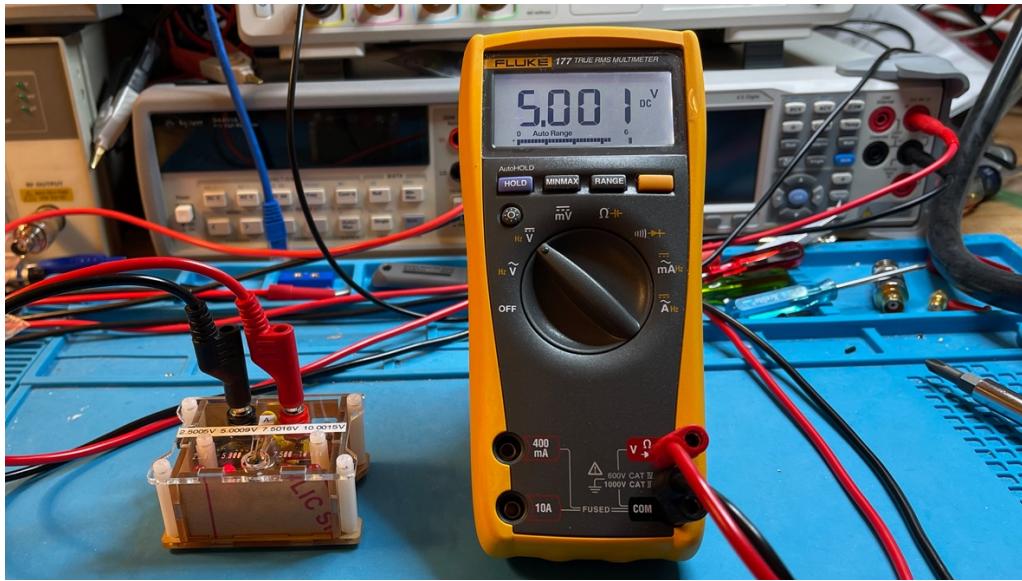
I do not recommend this meter for electronic projects because it is missing millamps and microamps ranges.

If you want a Fluke meter for electronic projects, I recommend the Fluke 87V Max or the Fluke 87V. If you want a lower cost 6000 count meter I would recommend the Greenlee DM-510A or the EEVBlog Brymen BM-235.

For about the same price as the Fluke 117 or less consider these meters.

Meter	Count	Basic DC Accuracy	Price
EEVblog 121GW	50,000	0.05%+5	\$225.00
Brymen BM869s	50,000	0.02%+2	\$206.60
Brymen BM789	60,000	0.03%+2	\$171.62
Brymen BM525s	10,000	0.08%+2	\$171.62
EEVblog Brymen BM786	60,000	0.03%+2	\$154.11
Uni-T UT161E	22,000	0.05%+5	\$128.77

## Fluke 177



Fluke 177 purchased from Circuit Specialists at a special inventory reduction sale for \$274.49. The cheapest I could find it today was at TEquipment.com for \$382.76.

### Features

- CSA C US Listed
- CAT III 1000V, CAT IV 600V
- 6,000 Count
- Basic DC Accuracy  $\pm(0.09\% + 2)$
- True-RMS
- 33 Segment Analog Bar Graph
- Min/Max/Avg
- Rel/Delta
- Hold
- Auto-Hold
- K-Type Thermocouple (only the 179)
- Auto-off Override
- Backlight Auto-off Override
- Option to turn off beeper
- "Smoothing" mode
- 9V Battery Included
- Limited-Lifetime Warranty

### Pros

- Third-party safety tested by CSA.
- DC millivolts accuracy specifications are the best in this group of 6,000 count meters.
- DC volts accuracy specifications are above average in this group of 6,000 count meters.
- Limited-lifetime warranty

## Cons

- No  $\mu$ A range.
- Capacitance readings below 10nF are not meaningful because of high uncertainty value.
- High capacitance value reading accuracy specifications is lowest in this group.
- Battery door is secured with self-tapping screws into plastic.
- Must disassemble meter to change fuses.

## Recommendation

The Fluke 179 shows me why Fluke has a reputation for reliable meters. After twenty years it is almost as accurate as the new Fluke 177. The newer 17x line of meters have some function that my old 179 doesn't, so it shows Fluke is quietly upgrading the series.

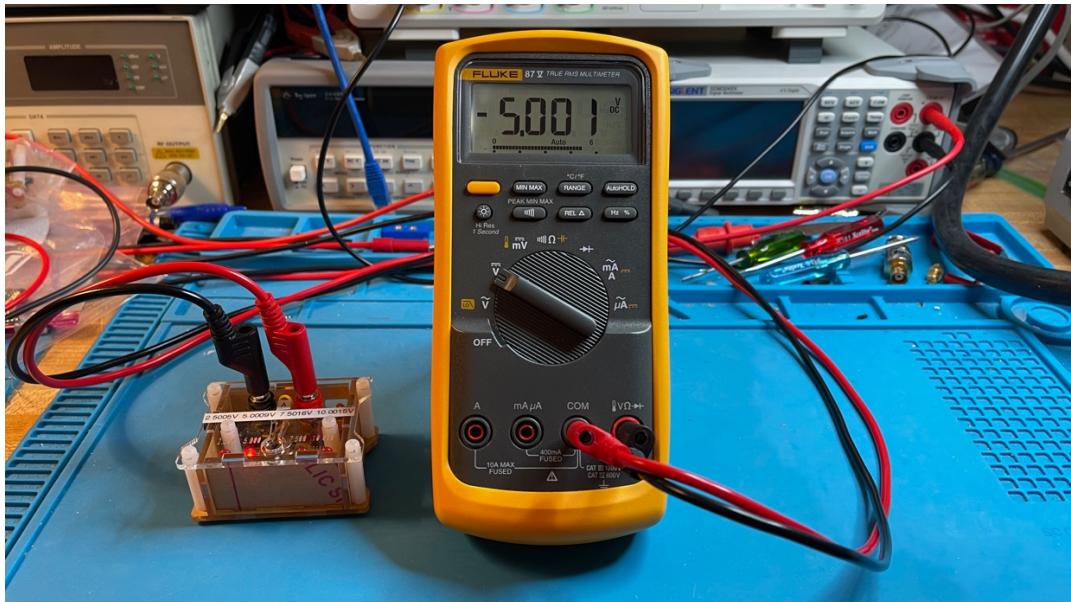
If you need millivolt DC accuracy specification from a 6,000-count meter above all else, consider the Fluke 177 if you can find it at a low price. Also, if you want a small voltage and resistance meter and you don't need microamps the Fluke 177 would be a good fit. If you need temperature readings the Fluke 179 would work but it seems to cost more than the Fluke 87V when Lowe's website has the 87V on sale.

I would not recommend these meters for electronics projects because it lacks a microamp range.

If you are just starting out and want a good starter meter, or you want to upgrade to a new meter, I would recommend the following:

- Buy an EEVblog Brymen BM235 from Amazon for \$150.00. It is a good compromise of performance and price, but one year warranty return to Australia.
- Buy a Greenlee DM-510A from Amazon for \$ 150.13. This is the second-best compromise of performance and price with Greenlee's "Lifetime Limited Warranty".
- Buy a Fluke 87V from globaltestsupply.com for \$433.25 (as of 24-March-2024). It has above average accuracy specifications for most measurement range tests in this group of 6,000 count meters and has Fluke's "Lifetime Limited Warranty".
- Buy a Fluke 87V MAX from testequipmentdepot.com for \$487.95 (as of 24-March-2024). It has above average accuracy specifications for all measurement range tests in this group of 6,000 count meters and is IP67 waterproof and dustproof and has Flukes "Lifetime Limited Warranty".
- Look into the 10,000 to 20,000 count meter reviews.
- Look into the 50,000 count and above meter review.

## Fluke 87V



Fluke 87V purchased from Lowes.com for \$ 371.48. The cheapest I could find it today was at globaltestsupply.com for \$433.25.

### Features

- CSA C US Listed.
- CAT III 1000V, CAT IV 600V.
- 6,000 Count, 19,999 Count, but no greater accuracy.
- Basic DC Accuracy  $\pm(0.05\% + 1)$ .
- True-RMS
- 32 Segment Analog Bar Graph.
- Min/Max/Avg.
- Peak Min/Max.
- Auto Hold.
- Low Pass Filter.
- K-Type Thermocouple.
- Auto-off Override.
- Disable beeper.
- "Smoothing" mode.
- Enable zoom mode for the bar graph.
- Enable the Meter's mV dc high impedance mode.
- 9V Battery Included.
- Limited Lifetime Warranty.

### Pros

- Third party tested for safety by CSA.
- Met **all** accuracy specifications for all tests.
- Highest accuracy specifications for DC volts and DC current among the 6,000-count meters tested.
- Highest accuracy specifications for AC volts, AC millivolts, AC milliamps and AC amps among the 6,000-count meters tested.

- Highest accuracy specifications for  $600\ \Omega$ ,  $6\ k\Omega$ ,  $60\ k\ \Omega$  and  $50\ M\ \Omega$  ranges among the 6,000-count meters tested.
- Highest accuracy specifications for capacitance ranges among the 6,000-count meters tested.
- Above average accuracy specifications for DC millivolts, AC microamps among the 6,000-count meters tested.
- Highest diode test voltage among the 6,000-count meters tested.
- Lifetime Limited Warranty.

## Cons

- Only average accuracy specifications for  $600\ k\Omega$  and  $6\ M\Omega$  ranges among the 6,000-count meters tested.
- Meter must be disassembled to change fuses.

## Recommendation

This is my meter of choice for the radio shack, so I am a little biased in favor of the Fluke 87V. If you want a 6,000-count meter with high accuracy (except for the  $600\ k\Omega$  and  $6\ M\Omega$  ranges) this is the meter for you, especially if you can get it for \$433.25 (globaltestsupply.com web price on 24-March-2024).

## Fluke 87V MAX



Fluke 87V MAX purchased from Newark for \$530.10. The cheapest I could find it today was at [testequipmentdepot.com](http://testequipmentdepot.com) for \$487.95.

## Features

- CSA C US Listed.
- CAT III 1000V, CAT IV 600V.
- 6,000 Count, 19,999 Count, but no greater accuracy.
- Basic DC Accuracy  $\pm(0.05\% + 1)$ .
- True-RMS.
- 32 Segment Analog Bar graph.
- Min/Max/Avg.
- Peak Min/Max.
- Auto Hold.
- Low Pass Filter.
- K-Type Thermocouple.
- Auto-off Override.
- Backlight Auto-off Override.
- Disables beeper.
- "Smoothing" mode.
- Enables zoom mode for the bar graph.
- Enables the Meter's mV dc high impedance mode.
- IP67.
- Three AA Batteries Included.
- Limited lifetime Warranty.

## Pros

- Third party tested for safety by CSA.
- IP 67 water and dust protection.
- Met **all** accuracy specifications for all tests.
- Highest accuracy specifications for DC volts and DC current among the 6,000-count meter tested.

- Highest accuracy specifications for AC volts, AC millivolts, AC millamps and AC amps among the 6,000-count meters tested.
- Highest accuracy specifications for resistance ranges among the 6,000-count meters teste.
- Highest accuracy specifications for capacitance ranges among the 6,000-count meters tested.
- Above average accuracy specifications for DC millivolts, AC microamps among the 6,000-count meters tested.
- Ability to disable backlight auto-off.
- Lifetime Limited Warranty.

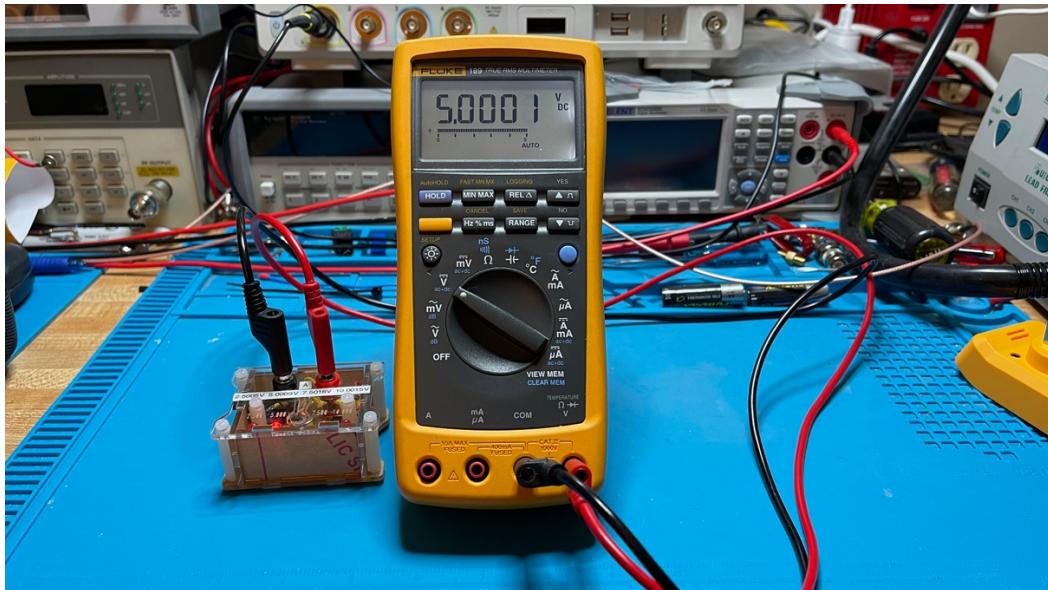
## Cons

- Capacitance reading below 1nF not useful because of high uncertainty value.
- Dim backlight.
- Bulkier and heaver then the other meters in this 6,000-count group.
- Most expensive in the group of 6,000-count meters.

## Recommendation

This is my meter of choice for outside work, so I am a little biased in favor of the Fluke 87V MAX. If you want a 6,000-count meter with high accuracy and water and dust resistant, this is the meter for you, especially if you can get it for \$487.95 at [testequipmentdepot.com](http://testequipmentdepot.com) (price as of 24-March-2024).

## Fluke 189



Price: \$650 from HRS EQUIPMENT OUTLET on eBay, open box new old stock (NOS).

### Features

- Third party safety tested by UL and CSA.
- Meets Category III 1000V and Category IV 600V safety standards.
- True-RMS, 100 kHz bandwidth for precise measurement of nonlinear signals.
- 0.025%+10 dc accuracy, 1 microvolt resolution.
- Large bright white display with dual parameter readout.
- Built in data logger records reading and time of day for catching intermittent problems.
- View stored readings on the meter.
- MIN / MAX with timestamp to record signal fluctuations.
- Peak capture to measure transients as short as 250 µS.
- Relative mode to monitor small variations.
- Isolated IR communication port to send data to a PC.
- Auto and Manual ranging.

### Pros

- This meter is at least 16-year-old and all measurements taken met the accuracy specification.
- Don't have to turn the meter off to get to setup mode.
- Has almost as much customization as the EEVBlog 121GW.

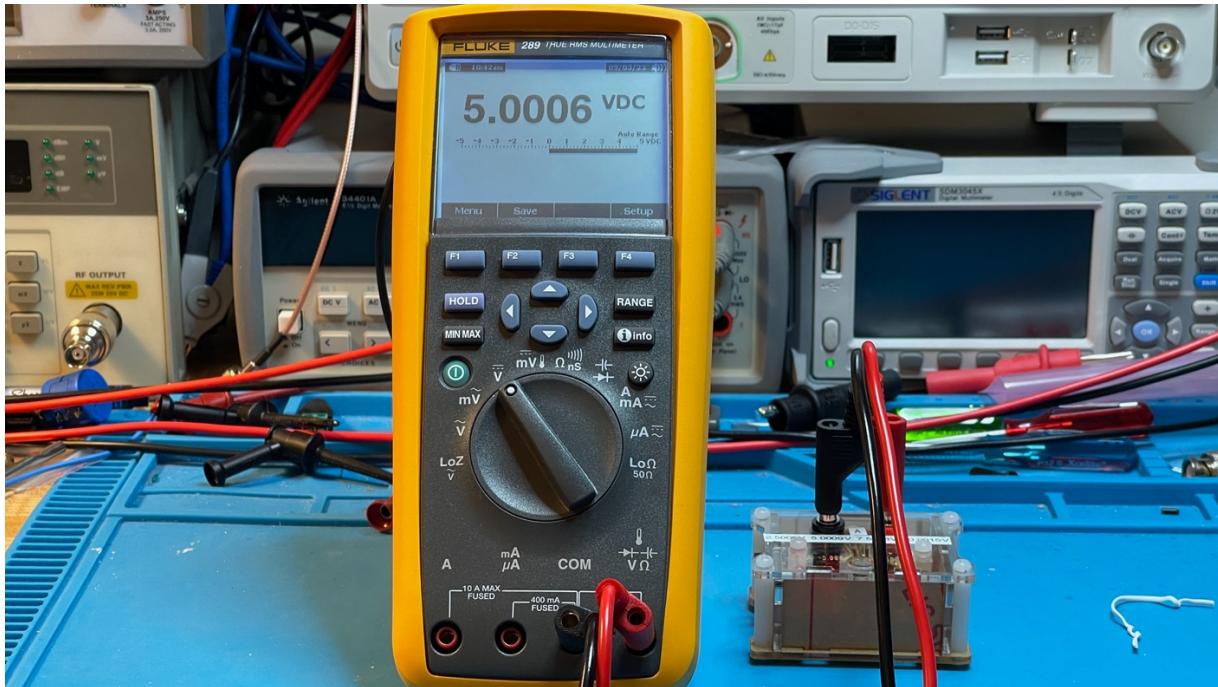
### Cons

- Discontinued around 2008, can only buy used or NOS (New Old Stock).
- PC Interface an extra cost option.

## Recommendation

I do not recommend the Fluke 189, don't get me wrong I like this meter a lot and I am keeping it. But for your first meter it is too expensive, eBay prices range from \$350 for a beat-up looking unit to \$800 for NOS (New Old Stock) unit from Japan. I bought my unit as NOS from a company in Texas (May 2023) and it works great. If you are willing to spend up to \$800, consider one of the other meters in this summary.

## Fluke 289



Fluke 289/FVF/IR3000 purchased from TEquipment.com for \$1,057.63. The cheapest I could find the bundle today was at Newark for \$1,272.39. For a base Fluke 289 the lowest price I could find today was at testequipmentdepot.com for \$725.95.

### Features

- Third party safety tested by CSA.
- 50,000 count, 1/4 VGA dot matrix display with white backlight.
- 15,000 recorded events memory.
- 50-ohm range.
- True-RMS with 100 kHz bandwidth
- AC+DC RMS.
- AC Low Pass Filter.
- dBm and DBV.
- Measure up to 500 MΩ resistance.
- Real time clock.
- USB PC interface and Bluetooth mobile interface.
- Fluke limited lifetime warranty.

### Pros

- Third party safety tested by CSA.
- Best accuracy specifications in this group of 50000 count meters for High DC Volts, AC+DC RMS, DC current, Low kΩ, Low MΩ and High μF ranges.
- Easy access to change fuses.
- Fluke limited lifetime warranty.

## Cons

- Did not meet accuracy specifications for 1 reading in the mV range, 3 reading in the high DC voltage range and 1 reading in the low ohms range [UPDATE: during testing three months later all the readings met the specifications.]
- Worst accuracy specifications in this group of 50000 count meters for the High MΩ range.
- Six AA batteries only provide 100 hours of operation.

## Recommendation

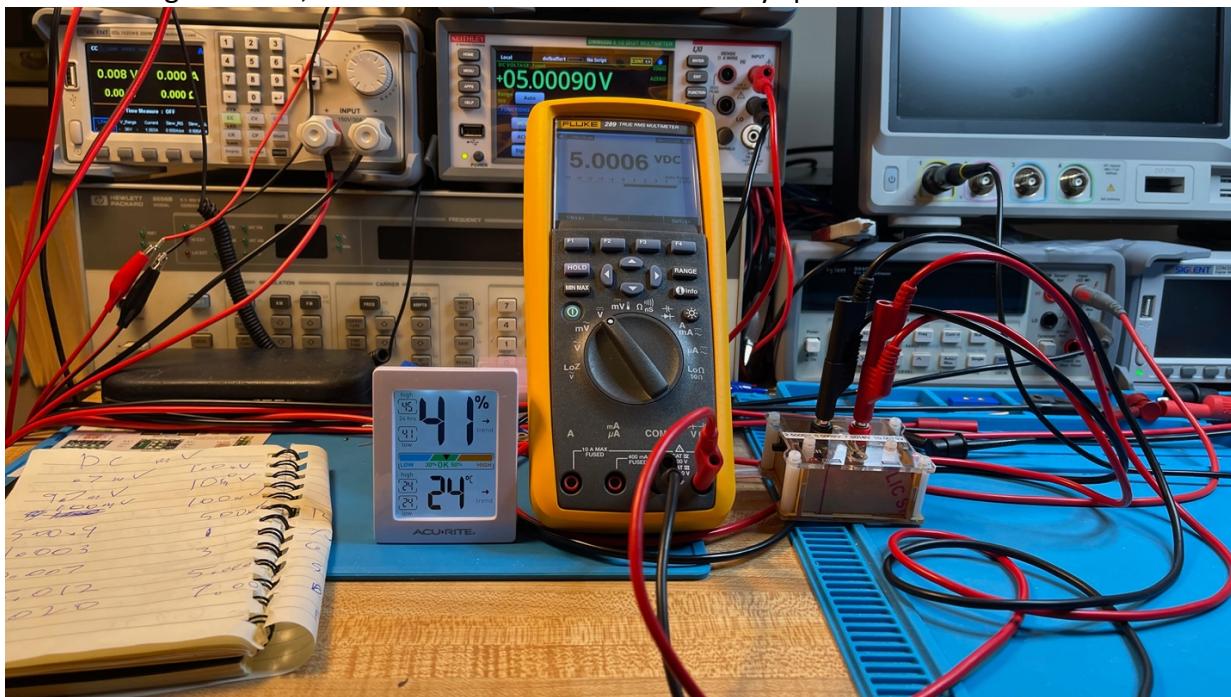
The Fluke 289 has lots of features and has the Fluke reputation and limited lifetime warranty. Unlike the 6000 count meters where Fluke dominates the accuracy specifications, the Fluke 289 is in second place compared to the Brymen 869s and the Greenlee DM-860A (rebranded by Greenlee with limited lifetime warrantee). ~~I was disappointed that my 289 had 5 readings out of specification, the most in this group of 50000 count meters.~~ [Repeat testing three months later did not show this problem.]

I can't recommend this meter for hobby use because of its high price, if you need graphing on the meter, consider the Uni-T UT181A. If you only need logging to a PC and mobile device, then consider the Greenlee DM-860A or the almost identical (some specifications are different when comparing the manuals) Brymen BM869s depending on what is available in your country. If you want logging to a microSD card, the only choice is the EEVblog 121GW. If you don't need logging the Bryman BM789 or the slightly lesser (no dBm, lower bandwidth) EEVBlog BM786 depending on what is available in your country.

## Accuracy



I do not have reference standards. I use a Keithley DMM6500 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 take the meter under test and take a reading. I compute the meter-under-test reading uncertainty value and subtract it from the lowest value and add it to the highest value and 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 volts. 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 for DC Volts) 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.

## Accuracy Specifications

Value	Fluke 17B MAX	Fluke 117	Fluke 177	Fluke 87V	Fluke 87V MAX	Fluke 189	Fluke 289
Price	\$159.99	\$235.87	\$382.76	\$433.25	\$487.95	\$650.00	\$725.95
Count	6,000	6,000	6,000	6,000/20,000	6,000/20,000	50,000	50,000
DC mV Low	1%+10	0.5%+2	0.09%+2	0.1%+1	0.1%+1	0.1%+20	0.05%+20
DC mV High	1%+10	0.5%+2	0.09%+2	0.1%+1	0.1%+1	0.03%+2	0.025%+2
DC V Low	0.5%+3	0.5%+2	0.09%+2	0.05%+1	0.05%+1	0.025%+10	0.025%+2
DC V High	0.5%+3	0.5%+2	0.15%+2	0.05%+1	0.05%+1	0.1%+2	0.03%+2
AC mV	3%+3	1.0%+3	1.0%+3	0.7%+4	0.7%+4	0.4%+40	0.3%+25
AC V	1%+3	1.0%+3	1.0%+3	0.7%+2	0.7%+2	0.4%+40	0.3%+25
AC V + DC V	N/A	N/A	N/A	N/A	N/A	0.5%+40	0.5%+80
DC $\mu$ A	1.5%+3	N/A	N/A	0.2%+4	0.2%+4	0.25%+20	0.075%+20
DC mA	1.5%+3	N/A	1.0%+3	0.2%+4	0.2%+4	0.15%+10	0.15%+2
DC A	1.5%+3	1.0%+3	1.0%+3	0.2%+4	0.2%+4	0.5 %+10	0.3%+10
AC $\mu$ A	1.5%+3	N/A	N/A	1%+2	1%+2	0.75%+20	0.6%+20
AC mA	1.5%+3	N/A	1.5%+3	1%+2	1%+2	0.75%+20	0.6%+5
AC A	1.5%+3	1.5%+3	1.5%+3	1%+2	1%+2	1.5%+20	1.5%+20
$\Omega$	0.5%+3	0.9%+2	0.9%+2	0.2%+2	0.2%+2	0.05%+10	0.05%+10
Low k $\Omega$	0.5%+2	0.9%+1	0.9%+1	0.2%+1	0.2%+1	0.05%+2	0.05%+20
High k $\Omega$	0.5%+2	0.9%+1	0.9%+1	0.6%+1	0.2%+1	0.05%+2	0.05%+15
Low M $\Omega$	0.5%+2	0.9%+1	0.9%+1	0.6%+1	0.2%+1	0.15%+4	0.15%+4
High M $\Omega$	1.5%+3	5%+2	1.5%+3	1%+3	1%+1	3.0%+2	3.0%+2
Low nF	2%+5	N/A	N/A	1%+2	1%+2	2%+5	1%+5
High nF	2%+5	1.9%+2	1.2%+2	1%+2	1%+2	1%+5	1%+5
Low $\mu$ F	5%+5	1.9%+2	1.2%+2	1%+2	1%+2	1%+5	1%+5
High $\mu$ F	5%+5	1.9%+2	10%	1%+2	1%+2	1%+5	1%+5

The accuracy specifications are from the meters' respective manuals. 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.

## Conclusion

Fluke designs their meters for specific functions for a specific target audience. Most companies offering lower cost meters seem to throw in as many options as possible and varie the accuracy and resolution for different price points.

For hobbyists who don't prefer Fluke branded multimeters, there are cheaper alternatives to every Fluke model I tested. If you want a Fluke meter, I recommend the Fluke 87V MAX as your first meter.

For your second meter, if you are not ready to buy a bench meter, I recommend the Fluke 289.