

# Fluke 87V Review

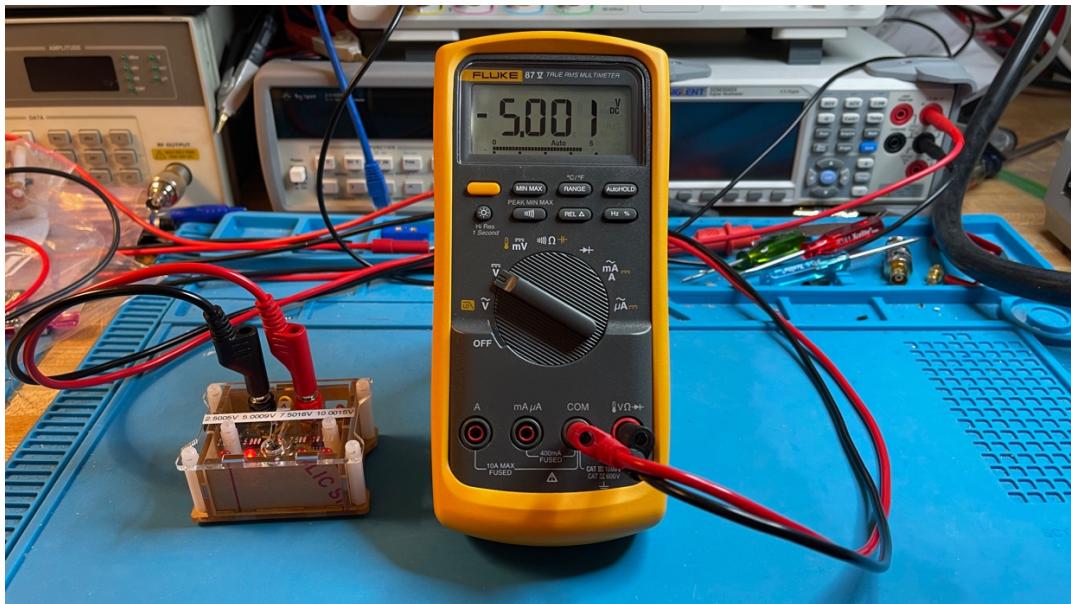
## Introduction

Hi, I am Tom, amateur radio call sign N8FDY. This is a review of the Fluke 87V 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 Fluke 87V multimeter that I purchased from Lowes.com for \$ 371.48. 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 Fluke 87V 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

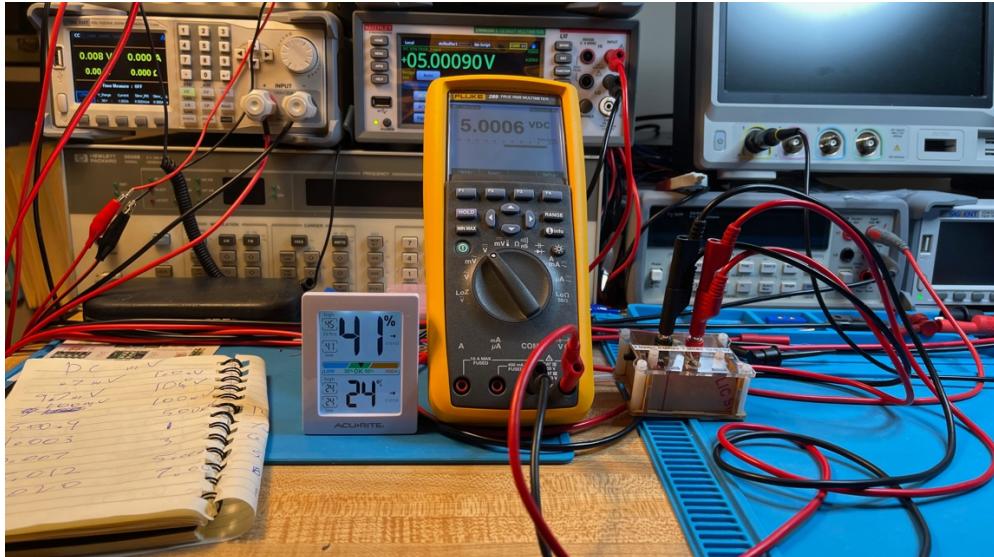
- CSA C US Listed.
- CAT III 1000V, CAT IV 600V.
- 6,000 Count, 19,999 Count, but no greater accuracy.
- Basic DC Accuracy  $\pm(0.05\% + 1)$ .
- True-RMS
- 32 Segment Analog Bar Graph.
- Min/Max/Avg.
- Peak Min/Max.
- Auto Hold.
- Low Pass Filter.
- K-Type Thermocouple.
- Auto-off Override.
- Disable 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.

## 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 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) 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
1 mVDC	1.1	0.1% + 1	0.1011	0.89537	1.10463
10 mVDC	10.1	0.1% + 1	0.1101	9.8861	10.1139
100 mVDC	100.1	0.1% + 1	0.2001	99.7934	100.2066
500 mVDC	500.1	0.1% + 1	0.6001	499.3814	500.6186
1 VDC	1.000	0.05% + 1	0.0015	0.99847	1.00153
3 VDC	3.001	0.05% + 1	0.0025005	2.9973745	3.0026255
5.009 VDC	5.001	0.05% + 1	0.0035005	5.00532428	5.01267573
7 VDC	7.00	0.05% + 1	0.0135	6.986275	7.013725
10.00148 VDC	10.00	0.05% + 1	0.015	9.98618	10.01678
102.5649 VDC	102.6	0.05% + 1	0.1513	102.40890	102.72090
202.781 VDC	202.8	0.05% + 1	0.2014	202.56549	202.99651
298.932 VDC	298.9	0.05% + 1	0.24945	298.66459	299.19941
406.855 VDC	406.9	0.05% + 1	0.30345	406.52928	407.18072
508.473 VDC	508.5	0.05% + 1	0.35425	508.09241	508.85359
634.702 VDC	635	0.05% + 1	1.3175	633.35311	636.05089

The meter met its accuracy specifications for all the DC voltages I tested. The DC millivolts accuracy specification is above average for this group of 6,000 count meters. The DC volts accuracy specifications are the highest in this group of 6,000 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
<b>100Hz Squarewave</b>					
4.999 VAC	5.007 V	1.0% + 4	0.05399	4.9450	5.0530
1.02 mVAC	1.0	0.7% + 4	0.407	0.582388	1.457612
10 mVAC	10.1	0.7% + 4	0.4707	9.4933	10.5067
100.7 mVAC	100.2	0.7% + 4	1.1014	99.50818	101.89182
500 mVAC	500.1	0.7% + 4	3.9007	495.4993	504.5007
1.000 VAC	1.001	0.7% + 2	0.009007	0.990093	1.009907
3.012 VAC	3.013	0.7% + 2	0.023091	2.9841018	3.0398982
5.010 VAC	5.011	0.7% + 2	0.037077	4.966917	5.053083
7.003 VAC	7.02	0.7% + 2	0.06914	6.9266582	7.0793418

The meter met its accuracy specifications for all the AC voltages that I tested. The AC volts and AC millivolts for 60 Hz accuracy specification are the highest for this group of 6,000 count meters.

ACV 1V 3dB cutoff	135 kHz
-------------------	---------

The frequency of the cutoff is the highest for this group of 6,000 count meters.

## Current

Source	Reading	Specification	Uncertainty	Low Bound	High Bound
<b>AC 100Hz Squarewave</b>					
0.999 mA	1.00	1.0% + 2	0.02999	0.9690	1.0290
DC					
0.896 μA	1.0	0.2% + 4	0.402	0.4930968	1.2989032
9.217 μA	9.3	0.2% + 4	0.4186	8.79375235	9.64024765
99.03 μA	99.1	0.2% + 4	0.5982	98.3822365	99.6777635
131.86 μA	132.0	0.2% + 4	0.664	131.136613	132.583387
1.0088 mA	1.03	0.2% + 4	0.04206	0.96623604	1.05136396
9.9917 mA	10.00	0.2% + 4	0.06	9.92920166	10.0541983
99.415 mA	99.4	0.2% + 2	0.3988	98.991317	99.838683
1.000 A	1.001	0.2% + 4	0.006002	0.993548	1.006452
3.000 A	3.001	0.2% + 4	0.010002	2.988378	3.011622

The meter met its accuracy specifications for all the current values I tested. The DC microamps, AC and DC milliamps and the AC and DC amps accuracy specifications are the highest in this group of 6,000 count meters. The AC microamps accuracy specification is above average for this group of meters.

A Shunt Resistance	0.037 Ω
--------------------	---------

mA Shunt Resistance	1.86 Ω
µA Shunt Resistance	100.72 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
1.0054 Ω	1.0	0.2% + 2	0.202	0.80311454	1.20768546
10.007 Ω	10.0	0.2% + 2	0.22	9.78594941	10.2280506
100.07 Ω	100.1	0.2% + 2	0.4002	99.6592941	100.480706
1.0011 kΩ	1.000	0.2% + 1	0.003	0.99801892	1.00418108
10.001 kΩ	10.00	0.2% + 1	0.03	9.97018993	10.0318101
100.01 kΩ	100.0	0.6% + 1	0.7	99.3014993	100.718501
0.9936 MΩ	1.000	0.6% + 1	0.007	0.98649464	1.00070536
9.97 MΩ	9.96	1.0% + 1	0.1296	9.836312	10.103688

The meter met its accuracy specifications for all the resistance values I tested. The accuracy specifications for the resistance ranges from 600 Ω to 60 kΩ and 60 MΩ are the highest for this group of 6,000 count meters. The 600 kΩ and 6 MΩ ranges are average for this group of meters.

Resistance Test Voltage	
Low Range	7.3 V
Medium Range	3.4 V
High Range	2.6 V

## Capacitance

Source	Reading	Specification	Uncertainty	Low Bound	High Bound
0.0093 nF	N/A				
0.1024 nF	0.1	1.0% + 2	0.021	0.0755808	0.1292192
1.008 nF	1.00	1.0% + 2	0.03	0.964936	1.051064
9.941 nF	9.93	1.0% + 2	0.1193	9.771936	10.110064
99.45 nF	99.5	1.0% + 2	1.195	97.7572	101.1428
1.00081 µF	1.009	1.0% + 2	0.01209	0.9909776	1.0252224
10.916 µF	11.1	1.0% + 2	0.131	10.731336	11.100664
113.83 µF	113	1.0% + 2	1.33	111.94468	115.71532
986.5 µF	1001	1.0% + 2	12.01	964.5575	1008.4425

The meter met its accuracy specifications for all the capacitance values I tested. The meter could not measure the 10pF value. The accuracy specification for capacitance is the highest for this group of 6,000 count meters.

## Diode

Max Diode Voltage	7.305 V
Max Diode Current	1.00 mA

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

## Continuity

It is fast and latches.

## Test Leads

The test leads were a rigid plastic 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.

The display is medium size. The backlight has two level of brightness: dim and medium; the light is even, except for a hotspot on the left side.

The following functions are enabled when you hold down a button when you turn on the meter:

Button	Power On Action
Yellow	Disables automatic power-off
Min Max	Enables the Meter's calibration mode
Range	Enables the Meter's smoothing feature
AutoHOLD	Turns on all LCD segments
Beep	Disables the beeper for all functions
Rel Δ	Enables zoom mode for the bar graph
Hz %	Enables the Meter's mV dc high impedance mode

## Accuracy Specifications Within the Group

Value	Thsinde 18B+	Zotek ZT- 300AB	Uni-T UT139S	Triplet MM650	Triplet 9055	Brymen BM235	Greenlee DM-	Fluke 17B MAX	Fluke 177 & 179	Fluke 87V MAX	Fluke 87V MAX
DC mV	0.5%+3	0.5%+3	0.5%+2	1.0%+8	1.0%+4	0.3%+2	0.4%+5	1.0%+10	0.09%+2	0.1%+1	0.1%+1
DC V	0.5%+3	0.5%+3	0.7%+3	1.0%+3	1.5%+4	0.4%+2	0.2%+3	0.5%+3	0.09%+2	0.05%+1	0.05%+1
AC mV	0.8%+5	1.0%+3	1.0%+3	N/A	1.5%+15	1.0%+3	1.0%+5	3.0%+3	1.0%+3	0.7%+4	0.7%+4
AC V	0.8%+5	1.0%+3	0.8%+3	1.0%+5	1.5%+4	0.7%+3	1.0%+5	1.0%+3	1.0%+3	0.7%+2	0.7%+2
DC μA	0.8%+10	1.2%+3	0.7%+2	1.0%+3	1.0%+4	1.0%+3	0.5%+5	1.5%+3	N/A	0.2%+4	0.2%+4
DC mA	2%+30	1.2%+3	0.7%+2	1.0%+3	1.2%+4	0.7%+3	0.5%+5	1.5%+3	1.0%+3	0.2%+4	0.2%+4
DC A	2%+30	1.2%+3	1.0%+3	1.5%+8	2.0%+5	0.7%+3	1.2%+6	1.5%+3	1.0%+4	0.2%+4	0.2%+4
AC μA	0.8%+10	1.5%+3	1.0%+3	1.5%+3	1.2%+4	1.5%+3	1.0%+3	1.5%+3	N/A	1.0%+2	1.0%+2
AC mA	2%+30	1.5%+3	1.0%+3	1.5%+3	1.5%+4	1.0%+3	1.0%+3	1.5%+3	1.5%+3	1.0%+2	1.0%+2
AC A	2%+30	1.5%+3	1.2%+3	2%+8	2.0%+5	1.0%+3	1.2%+6	1.5%+3	1.5%+4	1.0%+2	1.0%+2
Ω	0.8%+5	0.5%+3	1.0%+2	1.5%+5	1.5%+4	0.3%+3	0.5%+4	0.5%+3	0.9%+2	0.2%+2	0.2%+2
Low kΩ	0.8%+3	0.5%+3	0.8%+2	1.5%+5	1.5%+3	0.3%+3	0.5%+4	0.5%+2	0.9%+1	0.2%+1	0.2%+1
High kΩ	0.8%+3	0.5%+3	0.8%+2	1.5%+5	1.5%+3	0.5%+3	0.5%+4	0.5%+2	0.9%+2	0.6%+1	0.2%+1
Low MΩ	0.8%+3	0.5%+3	1.2%+3	2%+10	2.0%+3	0.9%+2	0.7%+4	0.5%+2	0.9%+3	0.6%+1	0.2%+1
High MΩ	1.0%+25	1.5%+3	1.5%+5	2%+10	2.5%+3	0.9%+2	1.2%+4	1.5%+3	1.5%+3	1.0%+3	1.0%+1
nF	3.5%+20	5%+20	4%+10	5%+35	15%+70	1.5%+8	2%+5	2%+5	1.2%+2	1%+2	1.0%+2
Low μF	3.5%+20	2%+5	4%+5	3%+5	4%+5	1.5%+2	1.5%+5	5%+5	1.2%+2	1%+2	1.0%+2
High μF	5%+5	5%+5	10%	5%+5	N/A	4.5%+10	2%+5	5%+5	10%	1%+2	1.0%+2

The accuracy specifications are from the meters' respective manuals. The color code shows the extreme low and high accuracy specifications. Green is the highest, yellow is lowest, and white is everything in-between. The pink background in the meter name and model indicate that meter does not have third party safety testing indications in the manual or on the meter.

The 87V has the highest accuracy specifications in this group of meters, except for DC millivolts, AC microamps, high kiloohm, low & high megaohm ranges.

## Battery

The meter uses a nine-volt battery accessible from the back by removing the boot, then removing the battery cover. The battery cover has two slotted latches that you turn to open.

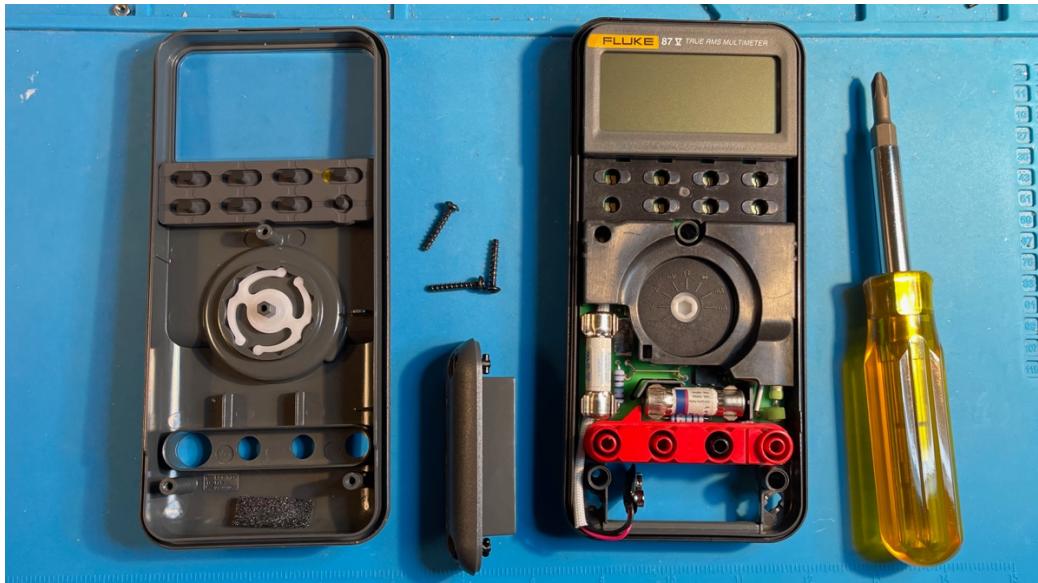


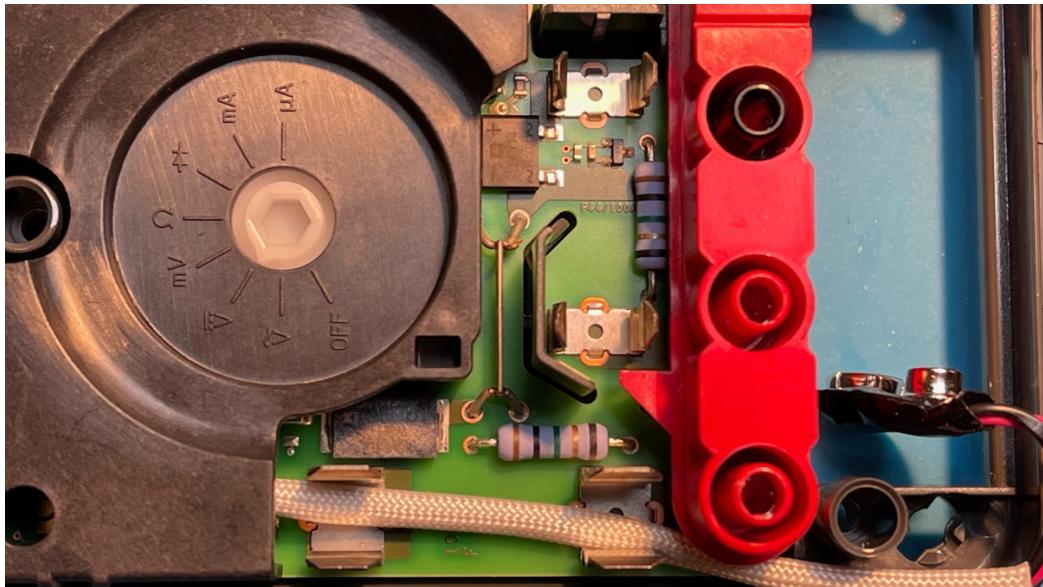
## Fuses

The meter must be disassembled to change the fuses. You must open the battery compartment and remove two Philips self-tapping screws, then remove the Philips self-tapping screw below the serial number. The manual states the fuses are:

Fuse, 0.440 A, 1000 V, FAST part # 943121

Fuse, 11 A, 1000 V, FAST part # 803293





## 19,999 Count Mode

If you press and hold the backlight button for one second you will turn on 4 1/2-digit resolution for volts, current and resistance. The manual states, “For Model 87 in the 4 1/2-digit mode, multiply the number of least significant digits (counts) by 10.” This only increases resolution but does NOT increase accuracy, so none of my tests were done with this active.

## Lifetime Limited Warranty

From the Fluke 87V manual, “Each Fluke 20, 70, 80, 170 and 180 Series DMM will be free from defects in material and workmanship for its lifetime. As used herein, “lifetime” is defined as seven years after Fluke discontinues manufacturing the product, but the warranty period shall be at least ten years from the date of purchase.”

## 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  $600\text{ k}\Omega$  and  $6\text{ M}\Omega$  ranges among the 6,000-count meters tested.
- Meter must be disassembled to change fuses.

## Conclusion

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  $600\text{ k}\Omega$  and  $6\text{ M}\Omega$  ranges) this is the meter for you, especially if you can get it for \$318.62 (Lowe's web price on 16-July-2023).