# Fluke 87V MAX Review

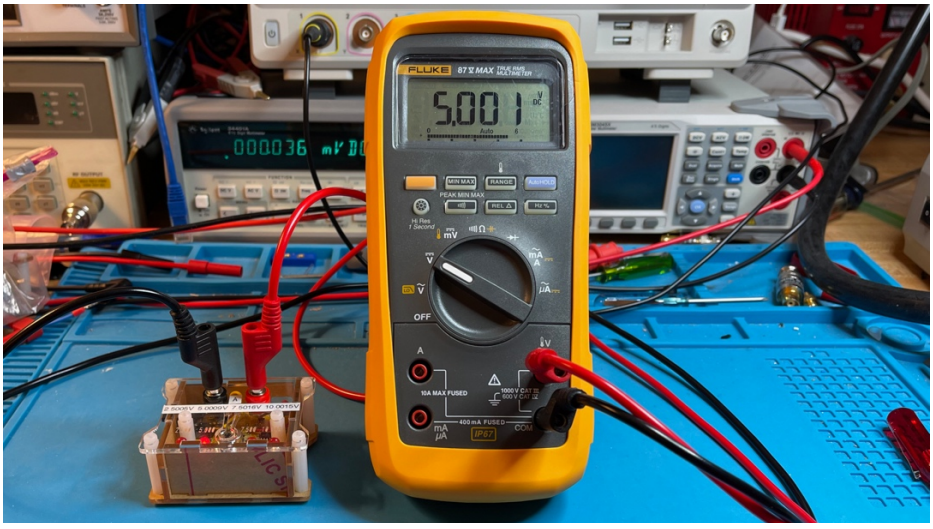
## Introduction

Hi, I am Tom, amateur radio call sigh N8FDY. This is a review of the Fluke 87V MAX multimeter for use in hobby electronics projects primarily related to amateur radio. This is the last review in the 6,000-count meter series.

## 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 MAX multimeter that I purchased from Newark for $530.10. 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 MAX. I also use Probe Master Series 8000 Test Leads.

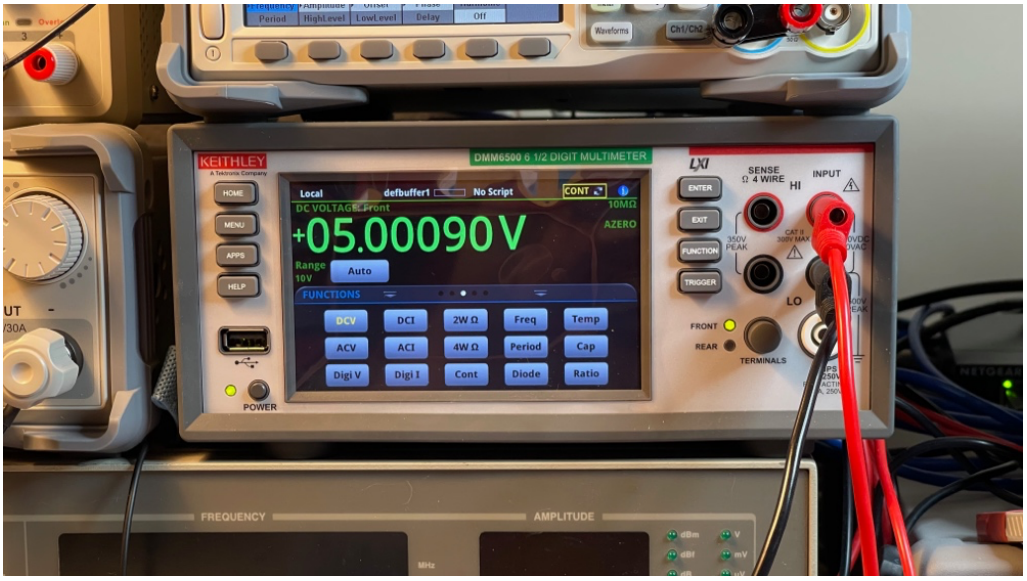
## Objectives

This review was produced to help you decide if the Fluke 87V MAX 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

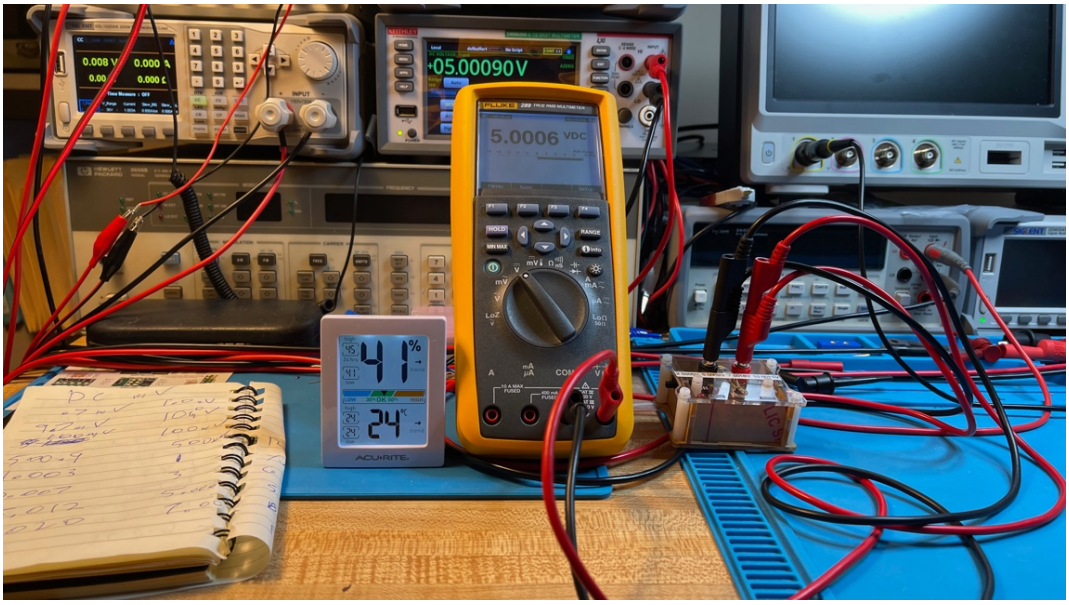
- CSA C US Listed.
- CAT III 1000V, CAT IV 600V.
- 6,000 Count, 19,999 Count, but no greater accuracy.
- Basic DC Accuracy ±(0.05% + 1).
- True-RMS.
- 32 Segment Analog Bar graph.
- Min/Max/Avg.
- Peak Min/Max.
- Auto Hold.
- Low Pass Filter.
- K-Type Thermocouple.
- Auto-off Override.
- Backlight Auto-off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

## 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 ± (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 |
|---|---|---|---|---|---|
| 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 | 100.0 | 0.1% + 1 | 0.2 | 99.7935 | 100.2065 |
| 500 mVDC | 500.0 | 0.1% + 1 | 0.6 | 499.3815 | 500.6185 |
| 1 VDC | 1.001 | 0.05% + 1 | 0.0015005 | 0.9984695 | 1.0015305 |
| 3 VDC | 3.000 | 0.05% + 1 | 0.0025 | 2.997375 | 3.002625 |
| 5.009 VDC | 5.000 | 0.05% + 1 | 0.0035 | 5.00532478 | 5.01267523 |
| 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 |
| 103.7443 VDC | 103.69 | 0.05% + 1 | 0.151845 | 103.58771 | 103.90089 |
| 204.187 VDC | 204.2 | 0.05% + 1 | 0.2021 | 203.97073 | 204.40327 |
| 300.799 VDC | 300.8 | 0.05% + 1 | 0.2504 | 300.53057 | 301.06743 |
| 408.483 VDC | 408.6 | 0.05% + 1 | 0.3043 | 408.15636 | 408.80964 |
| 511.088 VDC | 511.1 | 0.05% + 1 | 0.35555 | 510.70601 | 511.46999 |
| 639.084 VDC | 639.2 | 0.05% + 1 | 0.4196 | 638.63284 | 639.53516 |

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 6000 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 |
|---|---|---|---|---|---|
| **100Hz Squarewave** | | | | | |
| 4.999 VAC | 5.009 | 1.0% + 4 | 0.05399 | 4.9450 | 5.0530 |
| **60Hz Sinewave** | | | | | |
| 1.02 mVAC | 1.0 | 0.7% + 4 | 0.407 | 0.582388 | 1.457612 |
| 10 mVAC | 10.0 | 0.7% + 4 | 0.47 | 9.494 | 10.506 |
| 100.7 mVAC | 100.2 | 0.7% + 4 | 1.1014 | 99.50818 | 101.89182 |
| 500 mVAC | 500.3 | 0.7% + 4 | 3.9021 | 495.4979 | 504.5021 |
| 1.000 VAC | 1.002 | 0.7% + 2 | 0.009014 | 0.990086 | 1.009914 |
| 3.012 VAC | 3.014 | 0.7% + 2 | 0.023098 | 2.9840948 | 3.0399052 |
| 5.010 VAC | 5.013 | 0.7% + 2 | 0.037091 | 4.966903 | 5.053097 |
| 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 6000-count meters.

| | |
|---|---|
| ACV 1V 3dB cutoff | 108 kHz |

The frequency of the cutoff is the second highest for this group of 6000-count meters.

## Current

| Source | Reading | Specification | Uncertainty | Low Bound | High Bound |
|---|---|---|---|---|---|
| AC 100Hz Squarewave | | | | | |
| 0.999 mA | 0.999 | 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 | 1.02 | 0.2% + 4 | 0.04204 | 0.96625604 | 1.05134396 |
| 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 | 3.002 | 0.2% + 4 | 0.010004 | 2.988376 | 3.011624 |

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 6000-count meters. The AC microamps accuracy specification is above average for this group of meters.

| | |
|---|---|
| A Shunt Resistance | 0.033 Ω |
| mA Shunt Resistance | 1.47 Ω |
| µA Shunt Resistance | 100.24 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 | 10.1 | 0.2% + 2 | 0.2202 | 9.78574941 | 10.2282506 |
| 100.07 Ω | 100.2 | 0.2% + 2 | 0.4004 | 99.6590941 | 100.480906 |
| 1.0011 kΩ | 1.000 | 0.2% + 1 | 0.003 | 0.99801892 | 1.00418108 |
| 10.001 kΩ | 10.01 | 0.2% + 1 | 0.03002 | 9.97016993 | 10.0318301 |
| 100.01 kΩ | 100.1 | 0.2% + 1 | 0.7006 | 99.3008993 | 100.719101 |
| 0.9936 MΩ | 0.993 | 0.2% + 1 | 0.006958 | 0.98653664 | 1.00066336 |
| 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 all the resistance ranges except 50MΩ are the highest for this group of 6000 count meters.

| Resistance Test Voltage | |
|---|---|
| Low Range | 2.3 V |
| Medium Range | 1 V |
| High Range | 0.5 V |

### Capacitance

| Source | Reading | Specification | Uncertainty | Low Bound | High Bound |
|---|---|---|---|---|---|
| 0.0093 nF | 0.02 | 1.0% + 2 | 0.0202 | 0 | 0.0345744 |
| 0.1024 nF | 0.11 | 1.0% + 2 | 0.0211 | 0.0754808 | 0.1293192 |
| 1.008 nF | 1.02 | 1.0% + 2 | 0.0302 | 0.964736 | 1.051264 |
| 9.941 nF | 9.94 | 1.0% + 2 | 0.1194 | 9.771836 | 10.110164 |
| 99.45 nF | 99.80 | 1.0% + 2 | 1.198 | 97.7542 | 101.1458 |
| 1.00081 µF | 1.009 | 1.0% + 2 | 0.01209 | 0.9909776 | 1.0252224 |
| 10.916 µF | 11.00 | 1.0% + 2 | 0.13 | 10.732336 | 11.099664 |
| 113.83 µF | 112.0 | 1.0% + 2 | 1.32 | 111.95468 | 115.70532 |
| 986.5 µF | 1003 | 1.0% + 2 | 12.03 | 964.5375 | 1008.4625 |

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 useful. The accuracy specification for capacitance is the highest for this group of 6000-count meters.

### Diode

| | |
|---|---|
| Max Diode Voltage | 2.38V |
| Max Diode Current | 1 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 soft silicon 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 but it feels damped with less solid click stops as compared to many of the meters in this 6,000-count group.
The display is medium size. The backlight has two level of brightness, very dim and dim, the light is even, except for a hotspot on the left side. You can override the backlight timeout. The eight buttons are backlit.
The beeper is quieter than most meters in this group.
The following functions are enabled when you hold down a button when you turn 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 |
| Backlight | Disables auto backlight off |
| 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 | Triplett MM650 | Triplett 9055 | Brymen BM235 | Greenlee DM- | Fluke 17B MAX | Fluke 177 & 179 | Fluke 87V | 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, and 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 Fluke 87V MAX has the highest accuracy specification in this group, except for DC millivolts, AC microamps and high megaohm ranges.

## Battery

The meter uses three AA batteries accessible from the back by removing the boot then the battery cover. The battery cover has six Torx screws that are not captured that thread into metal inserts.


## Fuses

The fuses are accessible from the battery compartment. You must lift off the rubber seal and lift out the plastic holder to get to the fuses. The manual states the fuses are:

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

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


## 19999 Counts 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 test were done with this active.

## Lifetime Limited Warranty

From the Fluke 87V MAX manual, “Each Fluke 20, 70, 80, 170, 180 and 280 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.
- 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 milliamps 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.

## Conclusion

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 $500.98 at TEquipment.net (price as of 30-July-2023, but out of stock). If they run out, try Newark; their price is $530.10 (as of 30-Jul-23, with 51 in stock).
You may want to investigate a higher count meter with better accuracy specification, if so, I will have review of 50,000 and above count meters in the fall and 10000 to 20000s in the winter.