

Klein Tools MM720 Review

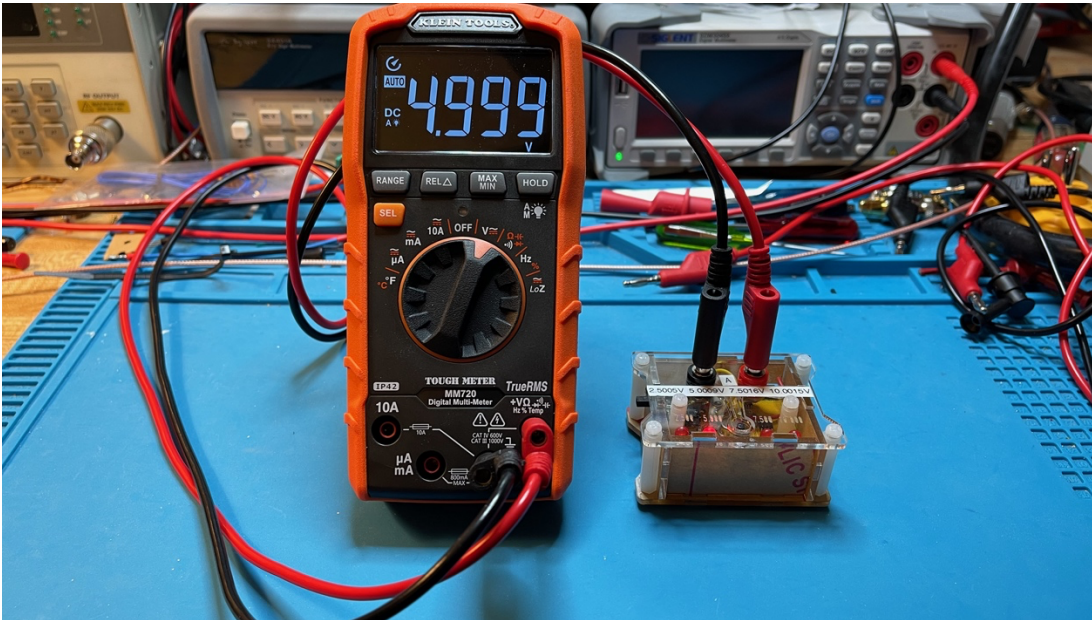
Introduction

Hi, I am Tom, amateur radio call sign N8FDY. This is a review of the Klein Tools MM720 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 Klein Tools MM720 multimeter that I purchased from the from Amazon.com for \$ 89.25. You can also buy it from Home Depot for 99.97, I just check, and my local Home Depot has one in stock and my nearest Lowe's has two in stock. So, if you in the US and need a multimeter quickly this will be one of you options.

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 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" 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 Klein Tools MM720 multimeter will fit your purpose and budget. This is part of a series of multimeters reviews.

A good multimeter for hobby electronic projects should be able to measure millivolts, volts, microamps, milliamps, amps, ohms, nanofarads and microfarads.

If you want to measure picofarads, nanohenry, microhenry or reactance you will need an LCR meter. I cover the two LCR meters I own in another review.

Features

- ETL C US Listed.
- CAT III 1000 Volts, CAT IV 600 Volts.
- True-RMS.
- 0.5% + 5 basic DC volts accuracy.
- Display has white number and symbols on black background.
- Min/Max.
- Hold.
- Relative/Delta.
- Low Impedance (LoZ) mode for eliminating ghost voltages.
- Built to withstand a 6.6-Foot (2 m) drop and is rated IP42.
- Includes thermocouple and two AAA-batteries.
- Two-year warranty.

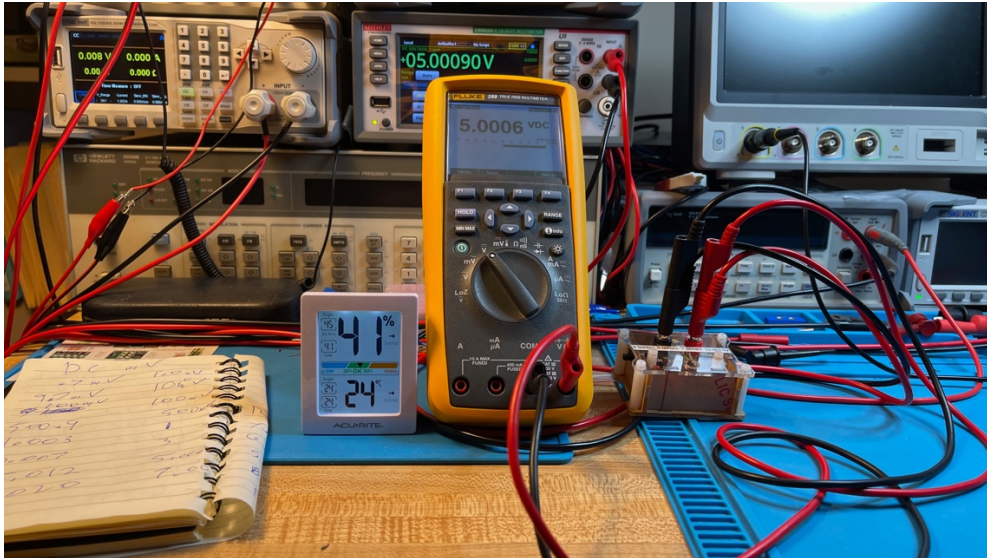
Accuracy



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 take the meter under test and 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 $\pm(0.0025\%$ 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 $\pm(0.025\% \text{ of reading} + 2 \text{ least significant digits})$ 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 DC					
0.9864	1.0	0.5%+5	0.055	0.9	1.0
9.9859	10.0	0.5%+5	0.100	9.9	10.1
25.0568	25.1	0.5%+5	0.176	24.9	25.2
100.0217	100.0	0.5%+5	0.550	99.5	100.6
250.066	250.0	0.5%+5	1.300	248.8	251.4
500.088	500.00	0.5%+5	2.550	497.5	502.7
V DC					
0.500044	0.5000	0.5%+5	0.003	0.4970	0.5031
1.001176	1.000	0.5%+5	0.0055	0.9956	1.0068
2.00040	2.000	0.5%+5	0.0105	1.9898	2.0110
2.50053	2.500	0.5%+5	0.0175	2.483	2.518
3.00046	3.000	0.5%+5	0.02	2.980	3.021
4.00043	4.000	0.5%+5	0.025	3.975	4.026
5.00020	4.998	0.5%+5	0.02999	4.970	5.030
5.00090	4.999	0.5%+5	0.029995	4.971	5.031
6.00091	5.997	0.5%+5	0.034985	5.966	6.036
7.00062	6.99	0.5%+5	0.03995	6.960	7.041
7.50163	7.49	0.5%+5	0.08745	7.41	7.59
10.00172	9.99	0.5%+5	0.09995	9.90	10.10
10.00154	9.99	0.5%+5	0.09995	9.90	10.10
15.0007	14.99	0.5%+5	0.12495	14.87	15.13
30.0008	29.99	0.5%+5	0.19995	29.80	30.20
100.4141	100.4	0.8%+3	0.552	99.9	101.0
196.181	196.3	0.8%+3	1.4815	194.7	197.7
285.861	285.9	0.8%+3	1.9295	283.9	287.8
389.282	389.6	0.8%+3	2.448	386.8	391.8
490.581	490.9	0.8%+3	2.9545	487.6	493.6
620.764	620	0.8%+3	3.6	617	624
1037.2	1037	1.0%+3	13.37	1023	1051

The meter met its accuracy specifications for all the DC voltages I tested.

VDC Input	11 MΩ
mVDC input	11 MΩ

Both VDC and mVDC input have over 10 MΩ 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
V AC 100Hz Squarewave					
4.99870	4.955	1.0%+3	0.07955	4.913	5.084
mV AC 60 Hz Sinewave					
1.0283	0	1.0%+3	3	-2	4
5.0206	9	1.0%+3	3.09	2	8
10.1524	9	1.0%+3	3.09	7	13
25.0932	24	1.0%+3	3.24	22	28
50.0598	50	1.0%+3	3.5	47	54
100.0330	99	1.0%+3	3.99	96	104
250.486	251	1.0%+3	5.51	245	256
500.059	499	1.0%+3	7.99	492	508
V AC 60 Hz Sinewave					
0.500036	0.500	1.0%+3	0.008	0.491	0.509
1.00014	0.999	1.0%+3	0.03999	0.959	1.041
2.00129	2.000	1.0%+3	0.05	1.947	2.055
3.01185	3.012	1.0%+3	0.06012	2.947	3.077
4.01172	4.009	1.0%+3	0.07009	3.936	4.087
5.01052	5.007	1.0%+3	0.08007	4.924	5.097
6.00707	6.002	1.0%+3	0.09002	5.910	6.104
7.00529	6.99	1.0%+3	0.0999	6.90	7.11
10.00695	10.00	1.0%+3	0.13	9.87	10.15
20.4254	20.42	1.0%+3	0.2342	20.15	20.70
25.03750	25.04	1.0%+3	0.2804	24.71	25.36
50.00720	49.98	1.0%+3	0.5298	49.42	50.60
75.0690	75.0	1.0%+3	1.05	73.9	76.2
100.3803	100.4	1.0%+3	1.304	99.0	101.8
140.1246	140.2	1.0%+3	1.702	138.04	142.21

The meter met its accuracy specifications for most of the AC voltages I tested. It failed to meet specifications on the 1mV and 5mV reading.

ACV 1V 3dB cutoff	3.0 kHz
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The low frequency of the cutoff is typical of low-cost meters.

Current

Source	Reading	Specification	Uncertainty	Low Bound	High Bound
AC mA 100Hz Squarewave					
0.999676	0.98	1.0%+5	0.0598	0.94	1.06
DC μ A					
0.89710	0.9	1.0%+3	0.309	0.6	1.2
9.21853	9.2	1.0%+3	0.392	8.8	9.6
99.0501	99.0	1.0%+3	1.29	97.7	100.4
131.931	131.8	1.0%+3	1.618	130.3	133.6
DC mA					
1.009102	1.00	1.0%+3	0.04	0.97	1.05
9.99278	10.00	1.0%+3	0.13	9.86	10.13
99.4435	99.5	1.0%+3	1.025	98.39	100.49
250.195	250.5	1.0%+3	2.535	247.60	252.79
500.164	500.7	1.0%+3	5.037	494.93	505.40
DC A					
1.000331	1.000	1.5%+3	0.013	0.987	1.014
2.000799	2.002	1.5%+3	0.02302	1.977	2.025
3.000319	3.005	1.5%+3	0.03305	2.966	3.035

The meter met its accuracy specifications for all the current values I tested.

A Shunt Resistance	0.028 Ω
mA Shunt Resistance	1.65 Ω
μ A Shunt Resistance	100.63 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
Ω					
1.00026	1.002	1.2%+5	0.017024	0.983	1.017
10.0025	10.01	1.2%+5	0.17012	9.83	10.17
100.04	100.1	1.2%+5	1.7012	98.3	101.7
k Ω					
1.00026	1.002	1.2%+5	0.017024	0.983	1.017
10.0025	10.01	1.2%+5	0.17012	9.83	10.17
100.04	100.1	1.2%+5	1.7012	98.3	101.7
M Ω					
0.9941	0.995	1.2%+5	0.01694	0.977	1.011
9.964	9.99	1.2%+5	0.2998	9.66	10.27

The meter met its accuracy specifications for all the resistance values I tested.

Resistance Test Voltage	
Low Range	1.03 V
Medium Range	0.93 V
High Range	.51 V

Capacitance

Source	Reading	Specification	Uncertainty	Low Bound	High Bound
nF					
0.9941	0.94	3.5%+10	0.1329	0.85	1.14
9.935	10.24	3.5%+10	0.4584	9.43	10.44
99.50	100.5	3.0%+5	3.515	95.5	103.5
μF					
1.0084	0.94	3.5%+10	0.1329	0.85	1.14
10.818	10.24	3.5%+10	0.4584	9.43	10.44
112.91	100.5	3.0%+5	3.515	95.5	103.5
1000	995	3.5%+5	39.825	955	1045

The meter met its accuracy specifications for all of the capacitance values I tested.

Diode

Max Diode Voltage	3.24 V
Max Diode Current	.97 mA

This will light some LEDs, for those who test LEDs with multimeters. The meter will sound a short beep when the diode voltage drop is in the normal range. I will continuously beep if the diode is shorted.

Continuity

Slow but it does latch.

Accuracy Specifications Comparison

Model	Uni-T UT161D	Klein MM720	EEVBlog Brymen BM235	Fluke 17B MAX	Greenlee DM-510A	Fluke 117	Fluke 177	Fluke 87V	Fluke 87V MAX
Cost	\$89.98	\$99.99	\$114.69	\$139.97	\$148.99	\$219.99	\$382.50	\$433.25	\$530.10
Count	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000
DC mV Low	0.8%+3	0.5%+5	0.3%+2	1%+10	0.4%+5	0.5%+2	0.09%+2	0.1%+1	0.1%+1
DC mV High	0.8%+3	0.5%+5	0.3%+2	1%+10	0.4%+5	0.5%+2	0.09%+2	0.1%+1	0.1%+1
DC V Low	0.5%+3	0.5%+5	0.4%+2	0.5%+3	0.2%+3	0.5%+2	0.09%+2	0.05%+1	0.05%+1
DC V High	0.5%+3	0.8%+3	0.4%+2	0.5%+3	0.2%+3	0.5%+2	0.15%+2	0.05%+1	0.05%+1
AC mV	1.2%+5	1.0%+3	1%+3	3%+3	1%+5	1.0%+3	1.0%+3	0.7%+4	0.7%+4
AC V	1%+3	1.0%+3	0.7%+3	1%+3	1%+5	1.0%+3	1.0%+3	0.7%+2	0.7%+2
DC μ A	1%+2	1.0%+3	1%+3	1.5%+3	0.5%+5	N/A	N/A	0.2%+4	0.2%+4
DC mA	1%+3	1.0%+3	0.7%+3	1.5%+3	0.5%+5	N/A	1.0%+3	0.2%+4	0.2%+4
DC A	1.2%+5	1.5%+3	0.7%+3	1.5%+3	1.2%+6	1.0%+3	1.0%+3	0.2%+4	0.2%+4
AC μ A	1.2%+5	1.0%+5	1.5%+3	1.5%+3	1%+3	N/A	N/A	1%+2	1%+2
AC mA	1.5%+5	1.0%+5	1%+3	1.5%+3	1%+3	N/A	1.5%+3	1%+2	1%+2
AC A	2%+5	2.0%+3	1%+3	1.5%+3	1.2%+6	1.5%+3	1.5%+3	1%+2	1%+2
Ω	1.2%+2	1.2%+5	0.3%+3	0.5%+3	0.5%+4	0.9%+2	0.9%+2	0.2%+2	0.2%+2
Low k Ω	1%+2	1.2%+5	0.3%+3	0.5%+2	0.5%+4	0.9%+1	0.9%+1	0.2%+1	0.2%+1
High k Ω	1%+2	1.2%+5	0.5%+3	0.5%+2	0.5%+4	0.9%+1	0.9%+1	0.6%+1	0.2%+1
Low M Ω	1.2%+2	1.2%+5	0.9%+2	0.5%+2	0.7%+4	0.9%+1	0.9%+1	0.6%+1	0.2%+1
High M Ω	2%+5	2.0%+10	0.9%+2	1.5%+3	1.2%+4	5%+2	1.5%+3	1%+3	1%+1
Low nF	3%+5	3.5%+10	1.5%+8	2%+5	2%+5	N/A	N/A	1%+2	1%+2
High nF	3%+5	3.0%+5	1.5%+8	2%+5	2%+5	1.9%+2	1.2%+2	1%+2	1%+2
Low μ F	3%+5	3.0%+5	1.5%+2	5%+5	1.5%+5	1.9%+2	1.2%+2	1%+2	1%+2
High μ F	10%+5	3.5%+5	4.5%+10	5%+5	2%+5	1.9%+2	10%	1%+2	1%+2

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.

In general, the higher cost of the meter corresponds with higher accuracy specifications with notable exceptions of the high megaohm range.

The Klein MM720 has many of the least accurate specified ranges, but it is one of the few economical third-party safety tested meters you can walk in and buy off the shelf at your local Lows or Home Depot.

LowZ

The meter has a LowZ position on the rotary switch. It measures AC or DC voltage with 3.3 k Ω resistance. It is used by electricians to eliminate ghost voltages when checking a circuit. I did not test this feature.

Test Leads

If you are in the market for an \$100 meter, you probably will not buy \$40 Probe Master test leads to use with it, so I looked at the included test leads. The test leads were a medium rigid plastic type and are not gold plated. The meter also came with a thermocouple for measuring temperature. I did not test temperature measurements.

Ergonomics

The screen is reverse dark, and light compared to most other 6,000 count meters. By default, the brightness of the display is automatically adjusted. You can override the auto brightness by holding down the HOLD button for a few seconds, then it goes to full brightness, if you hold the button down again for a few seconds it goes to it lowest brightness.

The rotary switch stiffer then most but it has good detents that snap into place as you turn it. Like most meters maid in China the unit beeps every time you change position on the rotary dial. The off position of the rotary dial is at 0 degrees, and you turn it left to access the current function or right to access all the other functions.

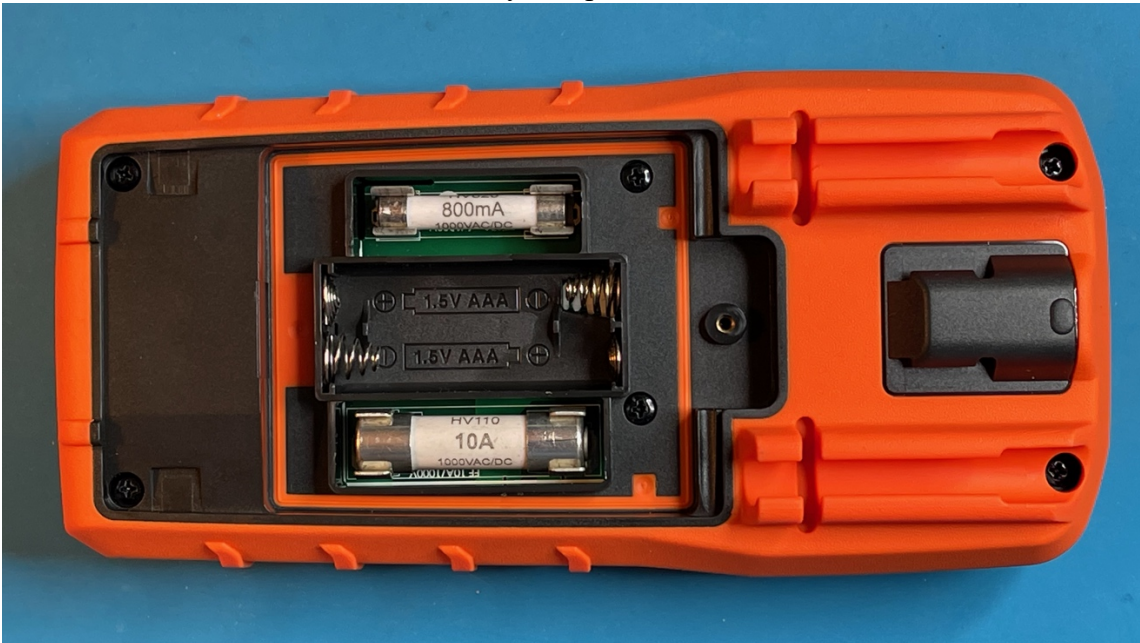
Battery

The meter uses two AAA batteries accessible from the back by removing the battery cover. The battery cover has one captured Philips screw that mates with a brass insert.



Fuses

The fuses are accessible from the battery compartment.



The manual states the fuses are as follows.
800mA/1000V fast-blow fuse (Klein Cat. No. 69399).
10A/1000V fast-blow fuse (Klein Cat. No. 69034).

Pros

- Third-party safety testing by ETL to meet US and Canada standards.
- Most measurements taken met the accuracy specifications.
- Fuses are accessible for the battery compartment.
- IP42 rating
- Two-year warranty.
- Can purchase locally in US at most Home Depot and Lowe's locations.

Cons

- Did not meet its accuracy specification for the 1 mV AC and 5 mV AC readings.
- Tied with the Fluke 17B MAX for having the lowest accuracy specifications for 11 ranges.
- Continuity has a slow response time.
- Beeps every time you change the rotary dial.

Conclusion

If you need a meter in a hurry in the US, you can pick one up at most Home Depot and Lowe's locations. The meter is light and comes with a soft case. The screen with white number and symbols on a black background looks good on this meter. I was disappointed that so many ranges had the lowest accuracy specification in this group of 6000 count meters.

I would recommend for a little more money get the EEVBlog Brymen BM235 (\$139.00 IS at Amazon or \$154.55 AUD [105.83 US as of December 27, 2023] at the EEVBlog Shop).

For a little less money go for the Uni-T UT161D (89.99 at the Uni-T Direct store at Amazon).

If price is not a barrier, you will get the best accuracy specifications and a Limited Lifetime Warranty if you get the Fluke 87V MAX or Fluke 87V.

Alternatively, you could look at 10000 count meters.