Uni-T UT181A Review

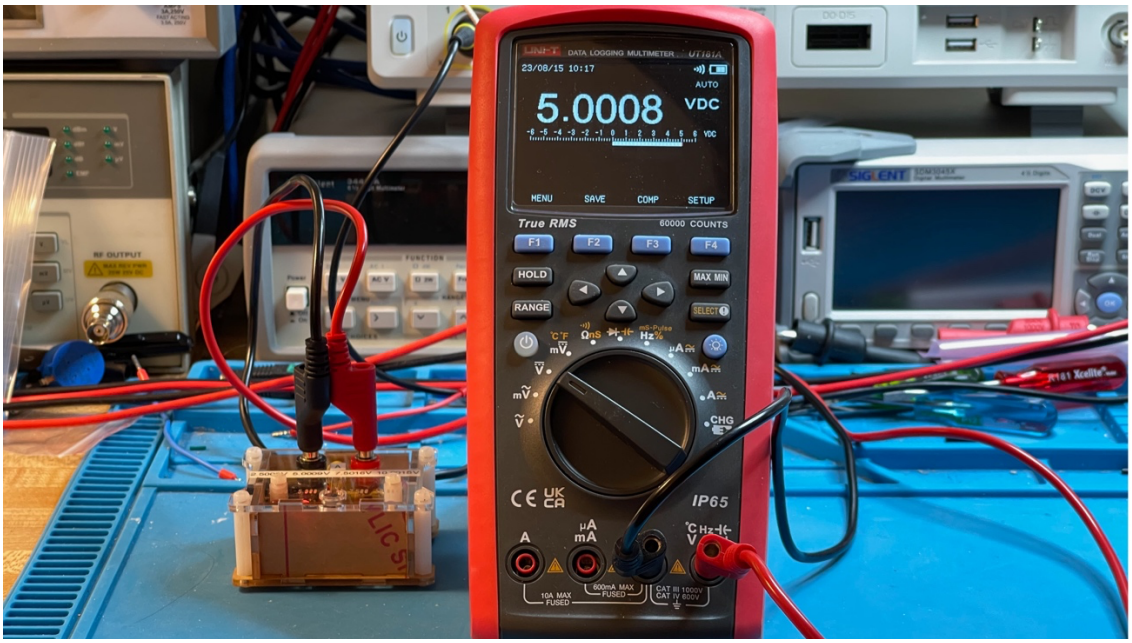
Introduction

Hi, I am Tom, amateur radio call sigh N8FDY. This is a review of the Uni-T UT181A 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 Uni-T UT181A multimeter that I purchased from Amazon at the UNI-T Direct store for $399.00. **If you want the Unit-T Direct USA 18-month warrantee, it must show up as Sold by: UNI-T Direct.** 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.

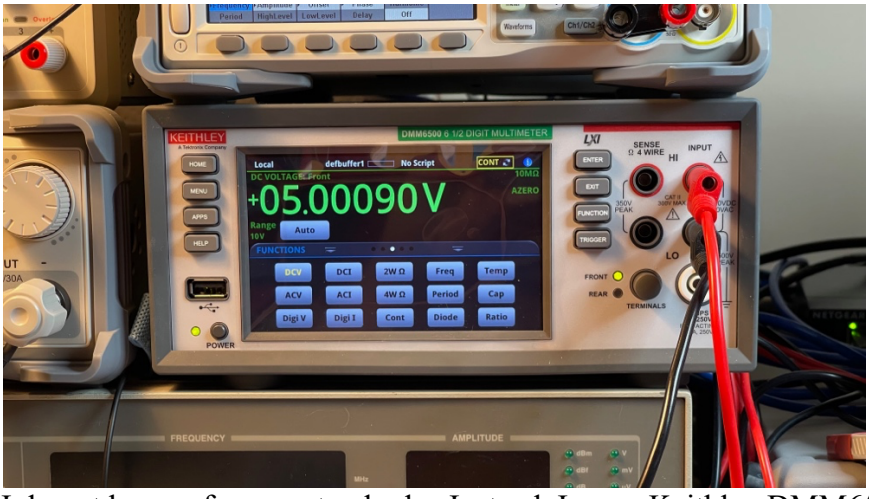
Objectives

This review was produced to help you decide if the Uni-T UT181A 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

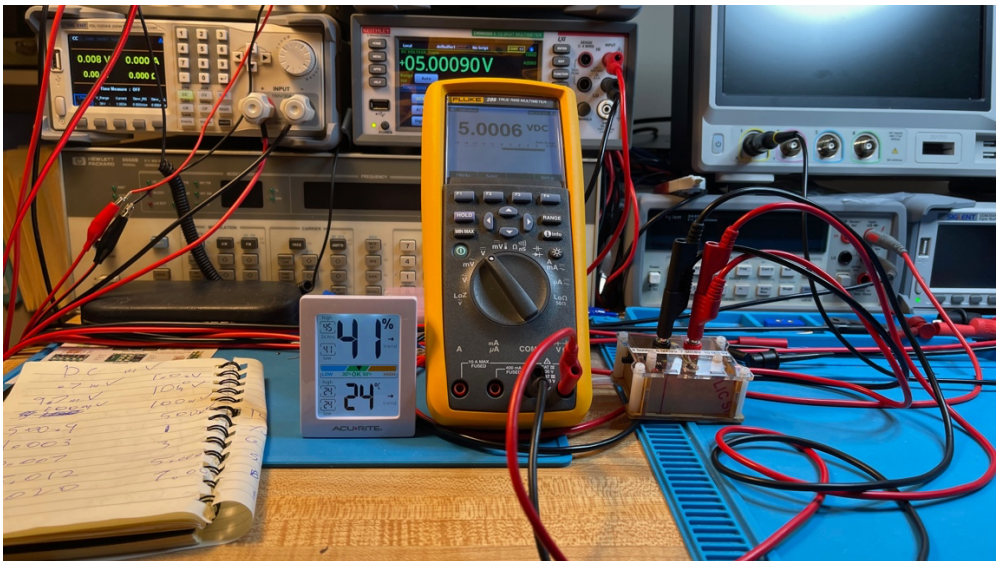
- Third patty safety tested by ETL.
- Trend capture.
- Data logging: 20,000 points.
- Data comparison.
- 3.5-inch 64k color TFT LCD.
- Dual temperature measurement.
- Low pass filter.
- 2000mAh Li-ion battery.
- Real time and date.
- Peak hold.
- Bluetooth/APP.
- USB interface cable /PC software CD.
- IP65.
- 18 Month Warrantee from **Unit-T Direct at Amazon.**

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	1.020	0.025% + 20	0.020255	0.9854	1.0266
10.0012	9.997	0.025% + 20	0.02249925	9.9781	10.0243
100.0187	100.00	0.025% + 5	0.075	99.9403	100.0971
500.097	500.15	0.025% + 5	0.1750375	499.9035	500.2905
V					
1.000909	1.0008	0.025% + 5	0.0007502	1.0001	1.0017
2.00013	2.0002	0.025% + 5	0.00100005	1.9990	2.0012
2.50054	2.5008	0.025% + 5	0.0011252	2.4993	2.5018
3.00134	3.0015	0.025% + 5	0.00125038	3.0000	3.0027
4.00001	4.0002	0.025% + 5	0.00150005	3.9984	4.0017
5.00030	5.0004	0.025% + 5	0.0017501	4.9984	5.0022
5.00091	5.0014	0.025% + 5	0.00175035	4.9990	5.0028
6.00142	6.002	0.025% + 5	0.0065005	5.9947	6.0081
7.00018	7.002	0.025% + 5	0.0067505	6.9932	7.0072
7.50167	7.502	0.025% + 5	0.0068755	7.4946	7.5088
10.00153	10.002	0.025% + 5	0.0075005	9.9937	10.0093
97.7528	97.79	0.03% + 5	0.079337	97.6690	97.8366
191.276	191.25	0.03% + 5	0.107375	191.1550	191.3970
281.295	281.40	0.03% + 5	0.13442	281.1433	281.4467
381.899	381.99	0.03% + 5	0.164597	381.7131	382.0849
490.268	489.89	0.03% + 5	0.196967	490.0454	490.4906
601.023	601.0	0.03% + 5	0.6803	600.3106	601.7354

The meter met its accuracy specifications for almost all the DC voltages I tested, it missed the 490 volt reading by 155.4 millivolts low.

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	5.0058	0.3% + 30	0.0180174	4.9750	5.0231
60 Hz Sinewave					
mV					
1.0335	1.028	0.6% + 60	0.066168	0.9667	1.1003
10.0397	10.046	0.6% + 60	0.120276	9.9134	10.1660
100.0742	100.13	0.3% + 30	0.60039	99.4137	100.7347
250.565	250.76	0.3% + 30	1.05228	249.3621	251.7679
500.110	500.26	0.3% + 30	1.80078	498.0089	502.2111
Volts					
0.500130	0.4998	0.3% + 30	0.0044994	0.4950	0.5052
1.000213	1.0009	0.3% + 30	0.0060027	0.9933	1.0071
2.00184	2.0048	0.3% + 30	0.0090144	1.9886	2.0151
3.01276	3.0159	0.3% + 30	0.0120477	2.9959	3.0296
4.01248	4.0159	0.3% + 30	0.0150477	3.9920	4.0329
5.01209	5.0145	0.3% + 30	0.0180435	4.9880	5.0361
6.00816	6.007	0.3% + 30	0.048021	5.9535	6.0628
7.00644	7.007	0.3% + 30	0.051021	6.9482	7.0647

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

ACV 1V 3dB cutoff	1.52 MHz

The frequency of the cutoff is first 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.

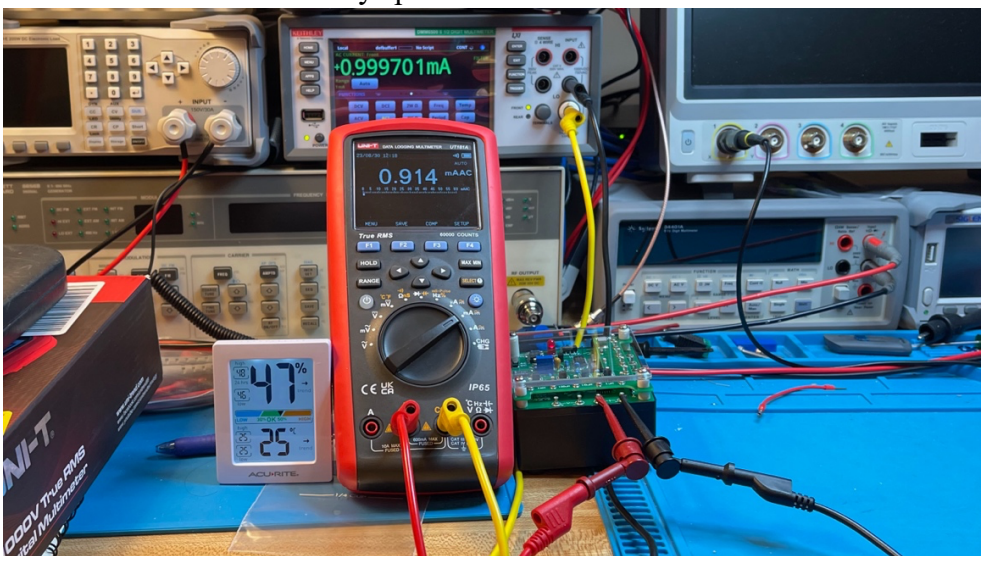
Source	Reading	Specification	Uncertainty	Low Bound	High Bound
AC+DC					
2.067530907	2.072	1% + 80	0.1007	1.9627	2.1723
3.356147086	3.3640	1% + 80	0.1136	3.2382	3.4741
3.36282066	3.3651	1% + 80	0.1137	3.2473	3.4783
4.73159436	4.7255	1% + 80	0.1273	4.6018	4.8614

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					
0.999701	0.914	0.8% + 40	0.047304	0.9510	1.0484
DC µA					
0.89695	0.82	0.08% + 20	0.200656	0.6954	1.0985
9.21851	9.15	0.08% + 20	0.20732	9.0065	9.4305
99.0500	98.97	0.08% + 20	0.279176	98.7213	99.3787
131.913	131.85	0.08% + 20	0.30548	131.5477	132.2783
DC mA					
1.008954	1.004	0.08% + 20	0.0208032	0.9876	1.0303
9.99241	9.986	0.08% + 20	0.0279888	9.9619	10.0229
99.4213	99.39	0.15% + 10	0.249085	99.1473	99.6953
100.7828	100.79	0.15% + 10	0.251185	100.5065	101.0591
200.666	200.63	0.15% + 10	0.400945	200.1847	201.1473
DC Amps					
0.500068	0.498	0.5% + 10	0.10249	0.3973	0.6028
1.000128	0.997	0.5% + 10	0.104985	0.8947	1.1056
2.000383	1.998	0.5% + 10	0.10999	1.8893	2.1115
3.000047	2.997	0.5% + 10	0.114985	2.8834	3.1167

The meter met its accuracy specifications for all the DC current values I tested. The AC milliamp reading did not meet the meters accuracy specification.



A Shunt Resistance	0.046 Ω
mA Shunt Resistance	1.175 Ω
µA Shunt Resistance	46.17 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	1.04	0.05% + 10	0.10052	0.9033	1.1049
10.00762	10.00	0.05% + 10	0.105	9.9016	10.1137
100.0731	100.2	0.05% + 10	0.1501	99.9125	100.2337
Kiloohms					
1.000200	1.0005	0.05% + 2	0.00070025	0.9994	1.0010
10.00230	10.003	0.05% + 2	0.0070015	9.9945	10.0101
100.0375	100.08	0.05% + 2	0.07004	99.9594	100.1156
Megaohms					
0.993891	0.9951	0.3% + 10	0.0039853	0.9898	0.9980
9.96999	9.982	2% + 10	0.20964	9.7563	10.1837
100.1114	N/A				

The meter met its accuracy specifications for all the resistance values I tested. The accuracy specifications for the resistance ohms and kilohms ranges are in first place for this group of meters. The accuracy specifications for the resistance high-megaohm ranges are the worst for this group of meters.

Resistance Test Voltage	
Low Range	3.3 V
Medium Range	1.2 V
High Range	0.60 V

Capacitance

Source	Reading	Specification	Uncertainty	Low Bound	High Bound
nF					
0.0149	0.018	3% + 10	0.01054	0.0000	0.0306
0.1040	0.100	3% + 10	0.013	0.0852	0.1228
1.0073	1.000	3% + 10	0.04	0.9542	1.0604
9.940	9.92	2.5% + 5	0.298	9.5922	10.2878
99.48	99.7	2% + 5	2.494	96.4881	102.4719
µF					
1.0083	1.009	2% + 5	0.02518	0.9781	1.0385
10.841	10.94	2% + 5	0.2688	10.5188	11.1632
112.81	110.9	2% + 5	2.718	109.5408	116.0792
1005.5	986	5% + 5	54.3	945.6725	1065.3275

The meter met its accuracy specifications for all the capacitance values I tested. The uncertainty values are too high for the 10pF reading to be meaningful. The accuracy specifications for the 60nF and lower ranges are the worst in this group of meters. Also, the 6mF range has the worst accuracy specification of this group of meters.

Diode

Max Diode Voltage	3.10 V
Max Diode Current	0.96 mA

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

Continuity

It is fast and latches.

dBm

This meter can measure dBm (decibel-milliwatts) using a selected impedance value from 4, 8, 16, 25, 32, 50, 75, 600, 1000, and 1200.

Test Leads

The test leads were a hard plastic type. The meter also came with two thermocouples for measuring two temperatures at once. I did not test temperature measurements.

Ergonomics

The rotary switch is easy to turn and firmly clicks into place.
It has a large color display with big numbers for the primary scale. The screen is reversed so the background is black, and the backlight button control the brightness of the info on the display.

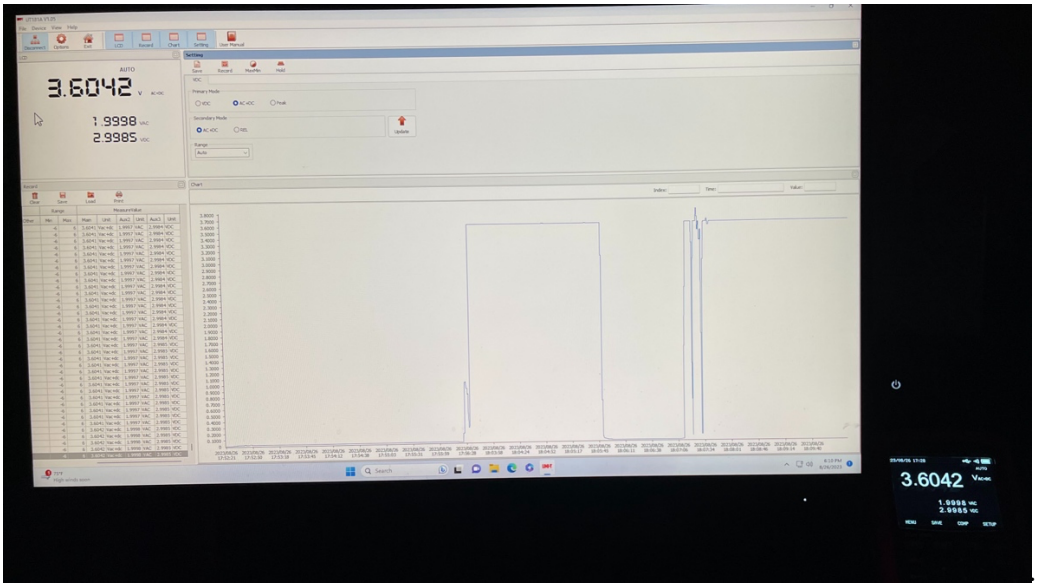
Accuracy Specifications Within the Group

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	0.8%+40	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

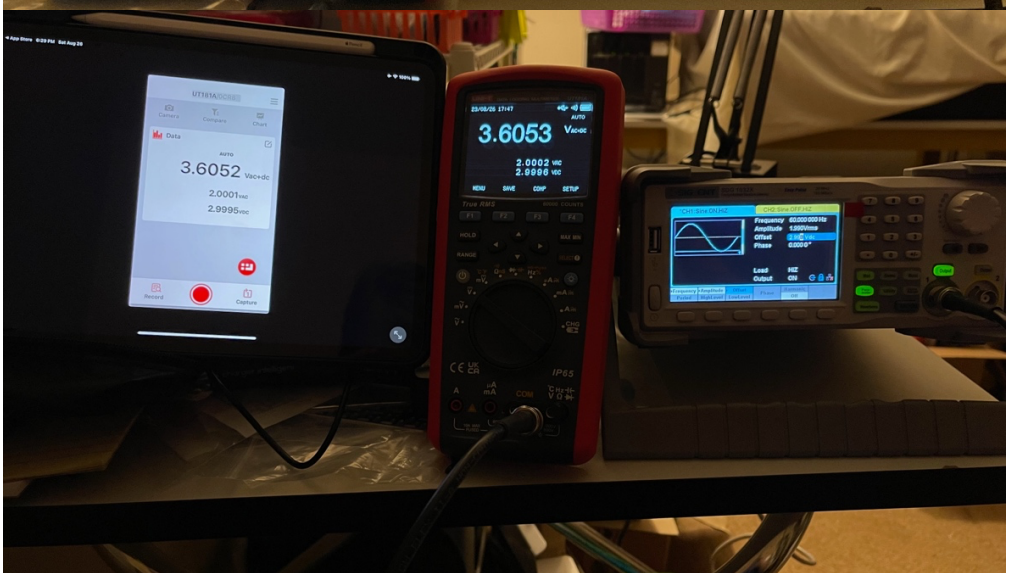
The accuracy specifications are from the meters' respective manuals. Red lettering for the meter's name indicates the meter has failed to meet an accuracy specification. The red lettering in the accuracy specification indicates that one, or more meter readings did not meet this accuracy specification. 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 Uni-T UT181A is in about third place in overall accuracy specifications. It did miss its accuracy specifications on a voltage reading in the high DC volts range. It also missed its accuracy specification for a reading in the AC milliamp range.

Logging

The meter includes a USB interface, and you can download free software for Windows PC to communicate with the meter.

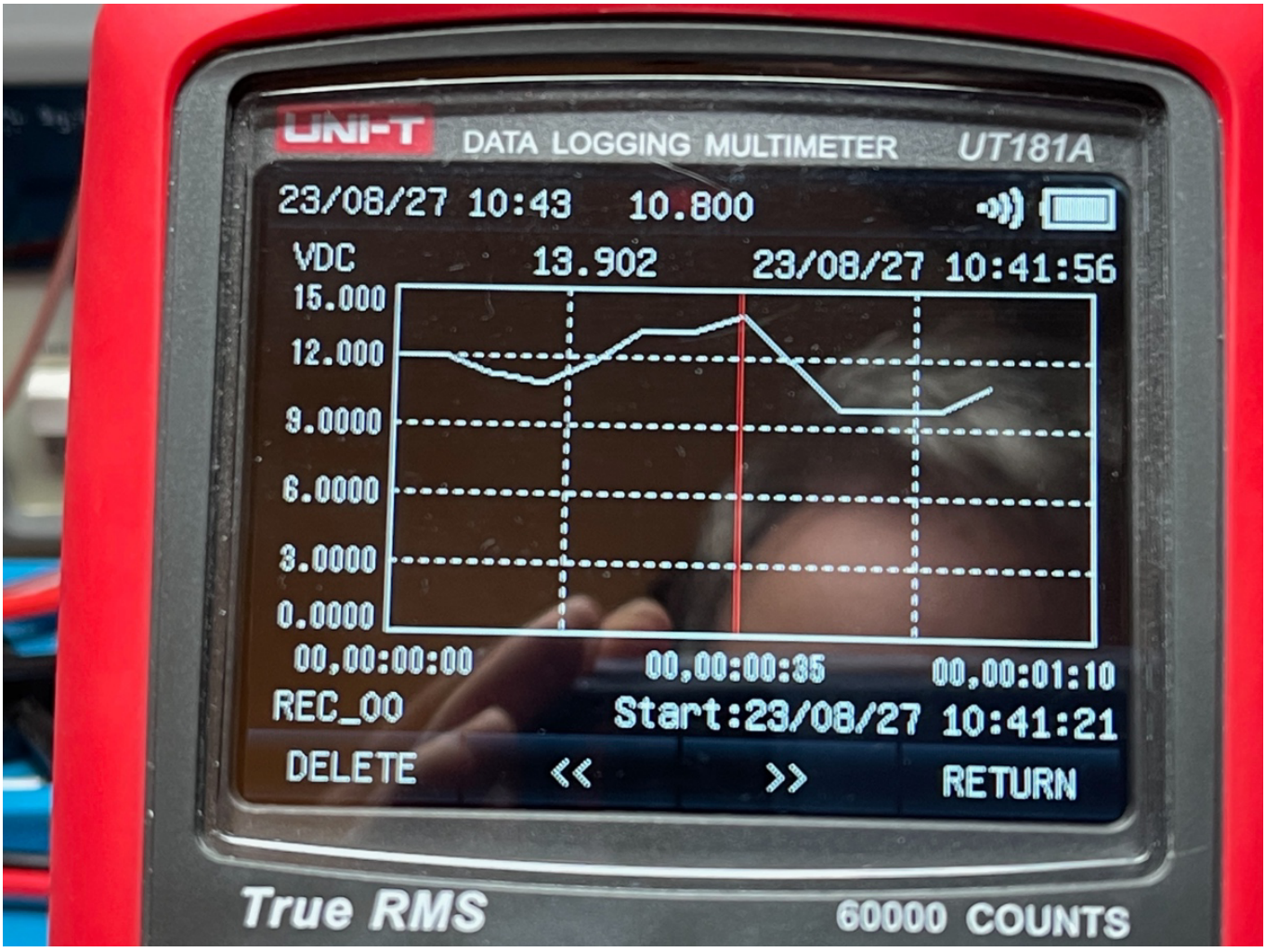


You can buy an optional Bluetooth interface: UNI-T UT-D07B Bluetooth Adapter for Digital Multimeter Tester UT171 Series, True RMS Data Logging Multimeter UT181 Series, 1000V AC DC Volt Ohm Meter UT161 Series $29.99. Download the free iDMM2.0 Smart Phone APP. The Android version would not work on my Android Tablet because I don't have GPS on it, the IOS app worked on my iPad and iPhone.



Graphing

You can take automatic reading for a set interval and duration or stop time, and show the reading on a graph on the meters screen.



You can retrieve the graph data using the PC software, but I could not retrieve it using the Bluetooth application.

Battery

The meter uses a rechargeable battery. You cannot use the meter while the battery is charging.

The battery is accessible from the back by removing 5 screws. Three of the screws are captured and two are not. The two non-captured screws are small and easy to lose or drop down the meter.

Fuses

The fuses are accessable from the battery door..

The manual states the fuses are:
Fuse (F1) for µA/mA input: 0.8A H 1000V Fuse Type 6X32 mm
Fuse (F2) for A input: 10A H 1000V Fuse Type 10X38 mm

Inside

I dropped one of the non-captured screws inside the meter and I could not get it to come out, so I had to fully disassemble the meter. I was not careful enough when I put it back together and the USB interface stopped working.

The two white columns that look like straws with LEDs sticking out are used by the USB Interface and they easily bend and can misalign and not go into the special guide holes in the other half of the case. Once I got them aligned and very carefully put the case back together the USB Interface start working again.

Pros

- Third party safety tested by ETL for US and Canada.
- 3.5-inch 64k color TFT LCD.
- All but two readings met accuracy specifications as stated in the manual.
- Store and graph readings on local screen.
- Includes USB interface cable.
- Bluetooth option available.
- No cost Windows PC and mobile software available for download.

Cons

- 490 volts reading missed its accuracy specifications by 155.4 mV.
- 1 mA AC 100Hz Squarewave reading missed its accuracy specifications by 38 µA.
- Can't use meter while recharging battery.

Conclusion

The Uni-T UT181A is the only meter in the 50000-count group I tested that has a color screen. This meter is very good for graphing data, PC interface and good at mobile interface (at least iOS, I could not test Android). The meter is good for voltage except for the 490 volts reading (sample of 1 so insignificant). It is strong in resistance measurements and weak in capacitance measurements.
For the first six months I had this meter it had a strange odor like some sort of solvent or strange plastic. When I decided to keep this meter, I left it out of its case for a few weeks and the odor finally disappeared.
I you want a graphing meter, take a close look at the Uni-T UT181A. The current price of the Uni-T UT181A ($400.99) combined with the Bluetooth interface ($29.99) is $430.98 while the equivalent Fluke 289/FVF/IR3000 with a monochrome screen cost $1,179.99. The Fluke has the lifetime limited warrantee and the reputation for quality, but for a hobbyist I don't this it is worth it.
I prefer the Uni-T UT181A over the Fluke 289. If you buy the Uni-T UT181A from the Amazon Uni-T Direct store you get a 30 days Money Back Guarantee for any reason and also an 18-month Warranty for quality-related issues from Uni-Direct.