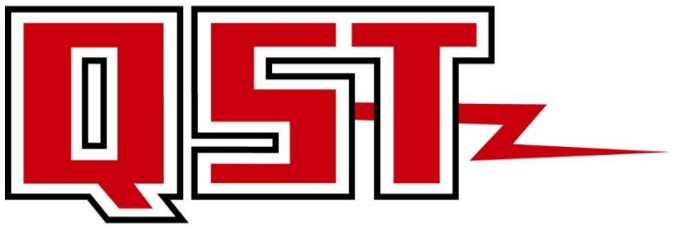

Product Reviews

November 2022

Product Reviews

RF-KIT RF2K-S Solid-State Linear Amplifier

Fluke 106 Multimeter

UNI-T Multimeter UT61E

Tekpower Mastech MS8268

Product Review

RF-KIT RF2K-S Solid-State Linear Amplifier

Reviewed by Mark Wilson, K1RO
k1ro@arrl.net

The RF2K-S is the latest in a line of high-power solid-state amplifiers made by RF-KIT in Germany. Although earlier versions were offered as kits, the RF2K-S is fully assembled and tested. Sales, service, and support for the US and Canada are handled by Island Amplifier USA in California, and amplifiers are shipped directly from Germany. The shipping cost is included in the price, and the RF2K-S took about 3 months to be delivered, but check with Island Amplifier for the current schedule.

The RF-KIT amplifiers have an active online users' group (**https://b26-pa.groups.io**), which I found helpful when setting up the RF2K-S and exploring its various features. Reinhard Foertsch, DH3NAB, from RF-KIT is active in that group and routinely offers assistance via messages or video calls.

The amplifier has two built-in microcontrollers. One fast internal controller is responsible for all measurements — control as well as storing settings and tuner values. The other is a Raspberry Pi, which is responsible for displaying and external interfaces like LAN, Wi-Fi, and USB. The amplifier features silent PIN diode transmit/receive switching (great for full break-in CW), quiet fans, an internal automatic antenna tuner, extensive transceiver interface options, and remote operation features.

Overview

The RF2K-S covers 160 – 6 meters and delivers 1,500 W output from a pair of LDMOS power transistors. These devices have very high gain, so a built-in attenuator raises the drive level to comply with the 15 dB gain maximum required by the FCC. The reviewed unit typically required about 50 W drive for full output on most bands.

An internal power supply senses the line voltage and automatically adjusts for 90 – 290 V ac input without the need to set jumpers or configure a menu. You'll need a 240 V ac line for full-power operation, but the amplifier is rated for 800 W output with a standard household 120 V line.

A 7-inch color touchscreen (see Figure 1) dominates the front panel and is used for all monitoring and control functions except the ac power **ON/OFF** switch. The power meter at the upper left has bars for forward and

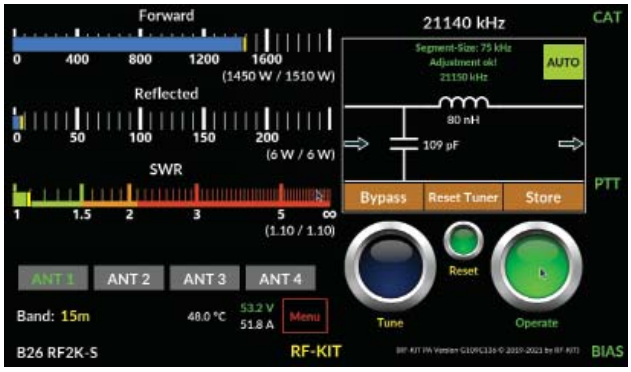

Figure 1 — A 7-inch color touchscreen is used for monitoring and controlling the RF2K-S.

Bottom Line

The RF-KIT RF2K-S offers legal-limit power for 160 – 6 meters in a desktop package. The color touchscreen, quiet fans, silent PIN diode TR switching, built-in antenna tuner, and flexible transceiver and network interfaces are attractive features.

Table 1
RF-KIT RF2K-S, serial number 43/211203

FCC ID number 2AW84RF2K-S. Firmware v. G109C136

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency range: 1.8 – 30 and 50 – 54 MHz.	160-, 80-, 60-, 40-, 30-, 20-, 17-, 15-, 12-, 10-, 6-meter bands, as specified.*
Power output: 1500 W PEP with 230 V ac power; 800 W PEP with 110 V ac.	1500 W as specified with 240 V ac; 900 W typical with 120 V ac.
Driving power required: 50 W.	43 to 67 W, see Figure A.
Spurious and harmonic suppression: Not specified	HF, 57 – 62 dB; 6 meters, 63 – 75 dB; meets FCC requirements.
Third-order intermodulation distortion (IMD): Not specified	3rd/5th/7th/9th-order products (dB below PEP at full output): 14 MHz, –33/–41/–46/–56 dB.
Transmit-receive switching time: <1 ms.	Key to RF output: 2.3 ms CAT/UDP controlled; 3.8 ms UNIVERSAL mode. Unkey to receive: 1.9 ms.
Power requirements: 90 – 290 V ac, 13 A max.	
Size (height, width, depth, including protrusions): 7.4 × 12.2 × 16.7 inches; weight: 35 pounds.	

*In the US, the legal power limit on 30 meters is 200 W PEP output, and on 60 meters it is an ERP of 100 W PEP relative to a half-wave dipole.

reflected power and SWR. If you touch the screen in that area, it changes to a cross-needle display. Four antenna jacks are on the rear panel, and indicators below the wattmeter show which one is in use. The menu has a screen for configuring automatic antenna selection for each band. The current operating band is shown, as well as output stage temperature, voltage, and current.

On the right side of the display, the current operating frequency is shown at the top, along with the transceiver interface in use for switching bands. The center-right portion of the screen displays either the RF-KIT logo or information on the internal automatic antenna tuner. Below that are three touch-sensitive buttons for starting the antenna tuning process, resetting the amplifier after a fault trips the protection circuitry, and switching between standby and operate.

From the **SETTINGS** menu shown in Figure 2, you can add your call sign or other personalized text to the screen. You can also turn off the display if you are controlling the amplifier remotely, or set an adjustable timer to put the amplifier to sleep after a period of inactivity.

Setup

The 34-page, well-illustrated manual is available online in PDF format from the RF-KIT website (**https://rf-kit.de/files/User_Manual_RF2K-S_ENG_V14.pdf**). As of mid-June, there had been a few changes to the amplifier user interface since the manual was last updated. The website also offers an assembly and adjustment manual for the kit version. You won't need this document for the current version, which is fully assembled and tested, but I found it helpful for understanding more about how the amplifier is built and adjusted.

Figure 3 shows the rear panel. The amplifier comes with an ac line cord for 240 V operation, but you may need to change the plug to match the outlet in your station. There are SO-239 connectors for the transceiver and four antennas. The **PTT** phono jack is for transmit/receive (TR) relay control from the transceiver. There is no automatic level control (ALC) connection to the transceiver, as found on some amplifiers, so be careful to not accidentally overdrive the amplifier. The **REM ON/OFF** phono jack is for switching the amplifier power on and off remotely by applying 10 to 15 V dc.

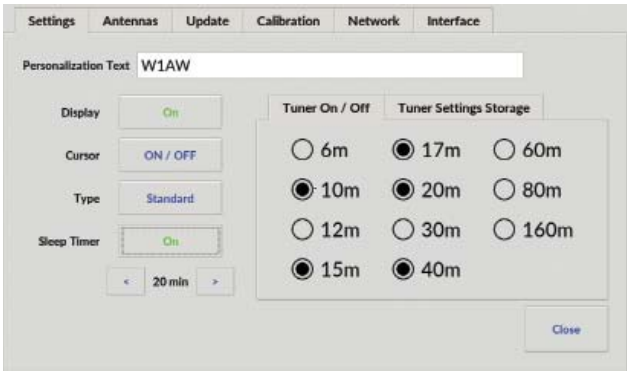

Figure 2 — The six touch-sensitive menu screens are used to configure and customize the RF2K-S for your station.

Figure 3 — The RF2K-S rear panel.

A coupler for predistortion operation with compatible SDR transceivers is built into the RF2K-S. The transmitted signal is attenuated by 55 dB and available at a rear-panel SMA connector labeled **–55dB**. This signal can be used to connect the amplifier to an SDR transceiver with predistortion capability, such as the ANAN radios from Apache Labs, to significantly improve the IMD of the transmitted signal.

The RF2K-S antenna tuner can store tuning data for up to 16 antennas per band, and the **MULTI INTERFACE** DB-15 connector accepts binary coded decimal (BCD) band inputs from an external antenna switching system to tell the tuner which antenna is in use. That connector also provides BCD band data outputs for controlling external devices such as band-pass filters or antenna switches.

Transceiver Interface and Switching Bands

There is no manual band switch. The RF2K-S automatically selects the operating band in one of four ways, set up through the **INTERFACE** menu. The interface in use is shown in the upper right corner of the display.

The Universal interface works with any transceiver. The amplifier measures the frequency of the drive signal and switches to the appropriate band nearly instantaneously when you speak a syllable on voice or send a dit on CW.

In the computer-aided transceiver (CAT) mode, the RF2K-S is capable of interfacing with transceivers from Alinco, ELAD, Elecraft, FlexRadio, Icom, Kenwood, TEN-TEC, and Yaesu via the CAT USB port. In the CAT setup menu, simply select the transceiver make and model and a baud rate (which must match the settings on your transceiver's CAT

Lab Notes: RF-KIT RF2K-S

This was a fun amplifier to test, matching the experiences of the reviewer. A few things stand out to the ARRL Lab staff.

First, as you can see in Figure A, the forward transfer curve of this amplifier is almost a straight line. This means that you get the same gain at lower-power drive as you get at higher power, rather than having the amplifier start to compress and lose gain. An amplifier in heavy gain compression will start to exhibit intermodulation and even harmonic problems. This amplifier doesn't have that issue.

The spectral output is clean. On HF, harmonics are at least 10 dB better than the FCC rules require, and on VHF, the amplifier meets the FCC rules with room to spare.

The transmit intermodulation performance is good. As seen in Figure B, at full rated power, the 20-meter band had third-order IMD performance at about 33 dB below PEP, with fifth-order IMD at about –42 dB PEP. The Lab likes clean signals, so it ran an extra test at 1,000 W PEP. This is a 2 dB reduction in power, or a fraction of an S unit. Figure C shows that a slight reduction in power makes a significant difference in the cleanliness of the transmitted signal, improving the third-order IMD performance to –45 dB PEP.

This amplifier can also make use of predistortion to improve the transmit IMD even further. This can be done with SDR transmitters that have a predistortion feature built in. One example of such a transmitter, the ANAN-8000DLE, is available to the amateur community. Its predistortion capability was discussed in the Product Review Update for the ANAN-8000DLE featured in the November 2018 issue of *QST*. The RF-2K has a predistortion output intended to work with an SDR transceiver with predistortion capability. The Lab didn't have this transceiver to use for testing, but the manufacturer's specification for the predistortion performance is rated to achieve typical 55 dB down from the amplifier's output signal for third-order IMD. — *Ed Hare, W1RFI, ARRL Lab Manager*

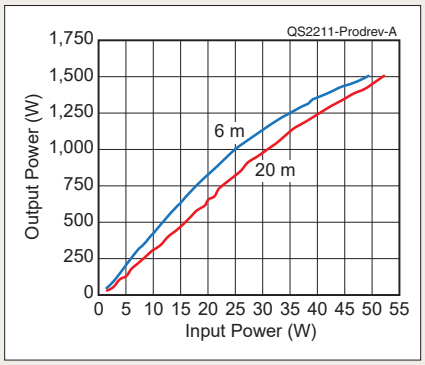

Figure A — RF-KIT RF2K-S, RF input power versus output power.

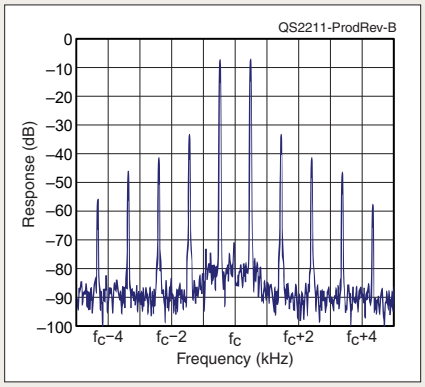

Figure B — RF-KIT RF2K-S, the 20-meter band third- and fifth-order IMD performance at 1,500 W.

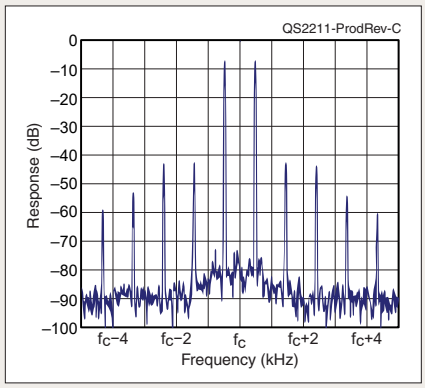

Figure C — RF-KIT RF2K-S, the 20-meter band third- and fifth-order IMD performance at 1,000 W.

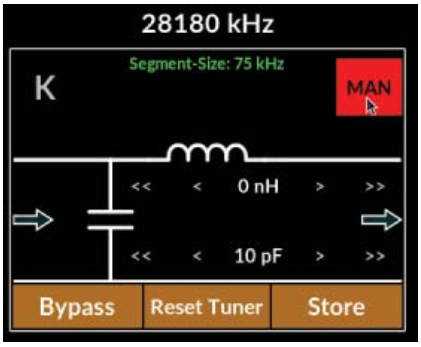

Figure 4 — The **MAN** (manual) setting allows adjustment of inductance and capacitance values if the internal antenna tuner can't find a suitable match automatically. Once values are saved, the amplifier recalls the correct settings when you return to that frequency segment.

setup menu). I used the CAT interface with a serial-to-USB converter between the serial port on my Kenwood TS-590SG transceiver and the USB jack on the amplifier. With my IC-7300, I used a CI-V-to-USB adapter. (In both cases, I was using the transceiver USB port for digital mode software and logging applications.)

The amplifier can also get frequency information using the user datagram protocol (UDP), a method of sharing information among users on a network. Ed Hare, W1RFI, used the UDP interface to control the RF2K-S with an Elecraft K4D transceiver and *N1MM Logger+* software. The final interface is TCI — Transceiver Control Interface — developed by Expert Electronics for their SunSDR transceivers and already adapted by other manufacturers and logging programs.

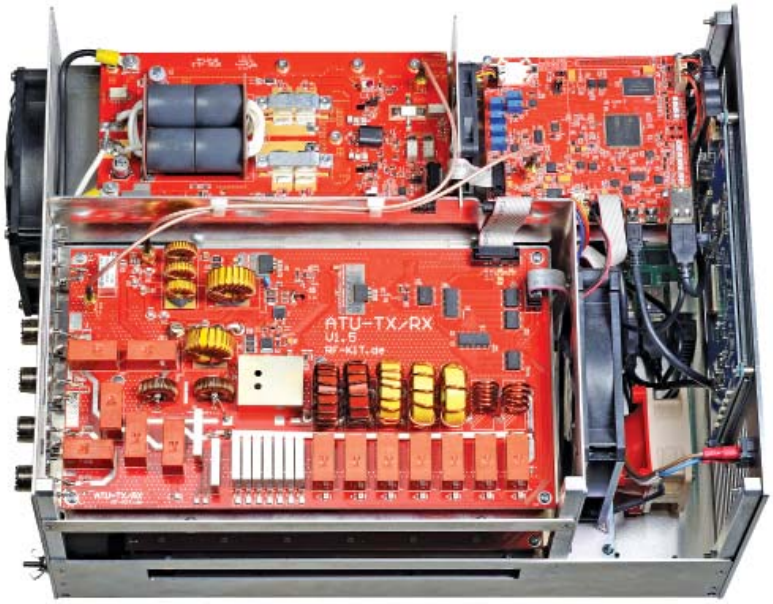

Figure 5 — Inside the RF2K-S. The LDMOS amplifier module is at the top left, with the control board to the right. The automatic antenna tuner and filters are at the bottom. The Raspberry Pi and power supply are not visible.

Antenna Switching and Automatic Antenna Tuner

There are four antenna jacks on the rear panel, with corresponding touch-sensitive indicators on the display. The **ANTENNAS** menu shows a matrix for assigning any or all of antennas 1 – 4 to the various bands. This screen also has checkboxes for enabling an external antenna switch.

The RF2K-S includes an internal automatic antenna tuner (ATU) that is specified to match SWR of up to 3:1. During antenna setup, you can specify whether the ATU is used on each antenna. I used the tuner on 40, 20, 17, 15, and 10 meters.

Each band is divided into segments shown in a chart in the manual. For example, 20 meters is divided into 51 kHz segments, and 10 meters uses 75 kHz segments. Tune the transceiver to the center of the first segment. With the amplifier in standby and the transceiver set to between 4 and 39 W output, press **TUNE** and briefly transmit a steady carrier to start the automatic tuning process. Tune to the next segment and repeat the process.

If the amplifier cannot find a match automatically, you can adjust the inductance and capacitance manually while watching indicators that appear on the display (see Figure 4). In my station, the automatic tuning algorithm only found a tuning solution on 20 meters, but I was able to tune the other bands manually and save the settings. There are three memory banks for saving antenna tuner settings, which would be a big time-saver if you used the amplifier in multiple locations.

Other Features

A common complaint about solid-state high-power amplifiers is fan noise. I have used quite a few solid-state amps over the years, and I have found the RF2K-S to be quieter than other models. The amplifier has a fan on the rear panel and several internal fans visible in Figure 5, but they don't run all of the time. They start when the power amplifier (PA) temperature reaches 42 °C and increase to maximum speed at 55 °C. With the fans running at maximum speed, I could operate without headphones if I wanted to. That's not to say that the amp is *quiet* at maximum fan speed, but I didn't find the level or pitch of the noise bothersome.

For most casual SSB and CW operation, I found that the temperature stayed below 42 °C and the fans stayed off. When oper-

ating RTTY or FT8, it took about 5 minutes to reach maximum fan speed. During prolonged digital mode or CW contest operation, the temperature generally stayed between 55 and 70 °C.

The manual does not discuss a protection system, but I found that the RF2K-S will switch to standby and display an alarm message on the touchscreen if the PA temperature exceeds 72 °C or if the SWR is too high. Touch **RESET** on the screen to restore operation when the fault is cleared. The temperature alarm tripped occasionally when I was running high-duty-cycle digital modes on 10 meters.

The **CALIBRATION** menu includes a screen for calibrating the power meter. The amplifier's forward and reflected power meter readings can be increased or decreased to match an accurate external power meter. Separate settings are available for 160, 80/60, 40/30, 20/17, 15/12/10, and 6 meters.

The RF2K-S was designed for easy internet connectivity, and a number of operators on the **https://b26-pa.groups.io** site use the amplifier in remote stations. You can connect to a local area network (LAN) via the rear-panel Ethernet jack, or via the Raspberry Pi's Wi-Fi feature. From the **NETWORK** screen, I easily connected the RF2K-S to my home Wi-Fi network and was able to check for firmware updates from the **UPDATE** screen. The display clearly shows the graphical user interface (GUI) and controller versions currently installed, along with the latest available version. If you're behind, just touch the **UPDATE** button.

With the Wi-Fi connection running smoothly, I installed the free *VNC Viewer* app from RealVNC on my iPad and was able to monitor and control the amplifier from anywhere in the house. The iPad display is an exact replica of the RF2K-S touchscreen.

Final Thoughts

The RF-KIT RF2K-S has a lot to offer for use in home or remote stations. It delivers legal-limit power from 160 through 6 meters in a compact and quiet package. The color touchscreen and menus are easy to navigate, with flexible transceiver/CAT and LAN interfaces. The internal antenna tuner worked well to match a variety of loads, but the automatic tuning feature could be improved. Once the amplifier is set up, it requires very little involvement from the operator.

Manufacturer: RF-KIT, Gräfenberg, Germany, **https://rf-kit.de**. Distributed in the US and Canada by Island Amplifier USA, 1260 Vina Del Mar Ave., Placentia, CA 92870, **https://islandamplifier.com**. Price: $5,490.

Digital Multimeters (VOMs)

Reviewed by Paul Danzer, N1II
n1ii@arrl.net

For many years I had a volt-ohm-milliammeter (VOM) in the trunk of my car. I needed only a few basic functions: continuity, to see if a fuse was blown; measuring a 12 V line where accuracy was not important (I just needed to see if the 12 V — and years before, 6 V — was at a particular point); and finally, when I forgot about the meter (as I usually did), the battery did not leak and corrode so badly that with a little scraping I could change it. They usually cost between $5 and $10 and were forgotten in the trunk of the car when I sold it.

Needless to say, I had something better in my shack. Typically there was a meter known as the Simpson 260 — or a clone of it. Usually these clones had an analog dial with a mirror strip to reduce the phenomenon known as parallax — a reading that was slightly off due to the fact that you were seeing the needle at an angle. This inexpensive compensation was hardly important, because often the basic accuracy was 10 – 15%, if even known for the clones!

Often lacking was any sort of protection. It was not uncommon to accidentally have the meter on the wrong scale or to connect the leads backwards, resulting in a bent needle; very often a minute puff of smoke would be generated when the meter was set to measure ohms but connected to a voltage.

Today, models and clones of the Simpson 260 meter are still available from both well-established and import sources. Online pricing runs approximately $50 and up, and while the exterior style often resembles the 260, the accuracy of the circuits used is usually unknown.

Bottom Line

A multimeter should be one of the first tools to buy for any new amateur radio operator. Most digital VOMs will do the job, but one of the most useful features for hams is the continuity test with sound (beeps) to check all connections and avoid any shorts.

Replacing these analog meters in many shacks are digital units. Selected for this review is a set of four typical digital meters in the $50 – $80 price range, with various features and capabilities. Some hams still prefer analog meters, because a digital meter whose lowest digit keeps jumping up and down is difficult to tune for a maximum voltage.

However, one way to find a maximum, such as when tuning a circuit (followed by a detector), is to use a digital meter that has the capability of finding and storing maximum and minimum. Then, after tuning past the maximum point, you can read the maximum and re-tune the circuit to match the maximum value stored with no jumping around of the lowest digit.

Often the digital meters offer specific capabilities that the analog meters do not have. Table 2 compares the features of the four meters evaluated. The information was taken from the instruction booklet and/or the unit packaging. When no information is known, the entry is "n/a." If a meter is known not to have certain features, "No" is entered.

One critical point is the accuracy of readings and the number of digits displayed. Often this information is not supplied with full applicability by the manufacturer. Some of the main considerations affecting accuracy are discussed in the sidebar.

VOM Accuracy

The accuracy of a digital VOM depends on several things, including the analog-to-digital converter (ADC) design, the number of bits in the conversion, and the number of digits on the display. The chain to measure an analog value, such as voltage, starts with the ADC.

Many ADC circuits use a reference, often a voltage. The accuracy of the conversion depends on both the reference and the quality of the design.

Many VOMs have autoranging, which is a circuit that selects the meter range based on the item being measured. For example, if the VOM uses a five-bit converter (perhaps a poor choice), $2^5 = 32$. For a maximum scale of 100 V, the smallest difference the meter can see is 100/32, or approximately 3.125 V, so the measurement won't be any better than that. However, if the full scale is 10 V, the smallest difference that can be seen is 10/32, or 0.3125 V.

After the conversion scaling, the accuracy may be affected by the display. For example, a three-digit display will only have the capability to display plus or minus 999. Some meters are designed to display a half digit, such as 3½. This means the leftmost digits can be either a zero or one. Thus, the highest number that can be displayed is 1999.

Finally, many meters have a specified total accuracy as a percentage plus or minus one or more bits. To be safe, this is often a way of saying that the last display digit will be in doubt.

Table 2
Digital Multimeters: Manufacturers' Specifications

	Fluke 106	Klein MM600	Mastech MS8268	UNI-T UT61E
Autoranging	Yes	Yes	Yes	Yes
AC voltage max	600 V	1,000 V	750 V	750 V
DC voltage max	600 V	1,000 V	1,000 V	1,000 V
AC current max	10 A	10 A	10 A	10 A
DC current max	10 A	10 A	10 A	10 A
Resistance max	40 MΩ	40 MΩ	40 MΩ	220 MΩ
Capacitance max	1,000 µF	1,000 µF	200 µF	220 mF
Frequency	No	10 Hz to 500 kHz	10 Hz to 200 kHz	10 Hz to 220 MHz
Pulse duty cycle	No	1% to 99%	0.1% to 99.9%	No
Temperature	No	0 to 1,000°	No	No
Diode test	No	Yes	Yes	Yes
Continuity check with tone	Yes	Yes	Yes	Yes
Auto power off	Yes	Yes	Yes	No
Data hold	Yes	Yes	Yes	Yes
Sampling frequency	n/a	3/second	n/a	2 – 3 updates per second
Overload/over-range indication	n/a	Yes	n/a	Yes
Shows reverse polarity	Yes	Yes	Yes	Yes
Display counts	6,000	4,000	4,000	22,000
Display digits	4	4	4	5
Battery	2 × AAA	2 × AAA	3 × AAA	9 V
Test probes included	Yes	Yes	Yes	Yes
Thermocouple included	No	Yes	No	No
Case included	No	Yes	No	No
Dimension (H × W × D)	5.59 × 2.72 × 1.10 inches	7.00 × 3.55 × 2.09 inches	7.70 × 3.60 × 2.20 inches	7.09 × 3.43 × 1.54 inches
Weight	0.44 pounds (7.05 ounces)	0.90 pounds (14.4 ounces)	0.83 pounds (13.28 ounces)	0.79 pounds (12.64 ounces)

Fluke 106 Multimeter

This nearly shirt pocket-sized package (see the dimensions in Table 2), plus test probes, weighs only 7 ounces. It comes in the 106 model (tested here) and the 107 model. The 107 has a few more modes that are lacking in the 106: frequency measurement, diode test, duty cycle measurement, and a display backlight.

Three jacks are on the lower part of the front panel. The center jack is coded black and used for all functions. The left jack is coded red and is used for current, up to 10 A, and is internally fused. Unfortunately, there is no instruction manual included in the package or online. A ¼-inch-thick booklet contains just a few lines of specifications. The rest of the booklet consists of safety information repeated in over a dozen languages.

Measurement type is controlled by a center rotary dial, starting with an **OFF** position followed clockwise around the dial with six standard symbols: ac voltage, dc voltage, ac millivolts, resistance measurement, capacitance measurement, and amperes. Just below the display are two buttons. The left button, **HOLD**, will retain the value being measured until pressed a second time. The right button is for mode selection. When the resistance symbol is selected, this button toggles the measurement mode between ohms and audible continuity check. It also toggles the selection of current measurement between ac and dc.

There is no built-in desk stand. However, there is a slot at the top of the back that can be used for a retaining strap or lanyard. The probes come with partial covers. With the covers on, there is a small protruding tip; when off, a full-size tip is exposed.

In Summary

This small unit covers the usual Ohm's law-related measurements: voltage and current, both ac and dc, as well as resistance. Capacitor measurement is included as a bonus. It won't take up much room on your workbench, and it may come in handy in your shirt pocket on ARRL Field Day.

Manufacturer: Fluke, 6920 Seaway Blvd, Everett, WA 98203, **www.fluke.com**. Price: $88.

Klein Tools MM600 Multimeter

Packaged in a shock-absorbent case, this meter is a large handful, weighing just under 15 ounces. It comes complete with a pair of test probes and two insulated alligator clips that mount on the ends of the probes. Its specifications show that it holds 14 – 140 °F with a claimed drop protection of 6.6 feet. The back of the case has a compartment for the two needed AAA batteries, and on its exterior, two clips hold the probes for storage.

On the front panel is a set of input jacks. Starting on the lower right is a black jack labeled **COM** (common). The rest of the jacks are colored red. The most often used jack, just above and slightly to the right of the **COM** jack, has icons representing its use for voltage, resistance, continuity, diode test, frequency measurement, duty cycle, and temperature.

To the left of the **COM** jack is a current jack labeled **µA** and **mA**, with an additional icon as a reminder not to exceed 500 mA when using this jack. However, if you need to measure higher currents, the remaining jack, labeled **10A**, is another reminder not to exceed current measurements of greater than 10 A.

The center dial, starting with an **OFF** position, allows you to select the measurement function. When not used, the unit shuts itself off after 30 minutes. You are able to turn off this automatic function. Normally, pressing any button will restore the function. Around the dial, icons for the functions are printed in orange and white. The orange pushbutton toggles the function for each dial setting (for example, ac or dc for voltage measurement, and °F or °C for temperature).

To capture and hold a reading, press the **HOLD** button. If pressed again, the hold value is released. This button has a secondary function. The lightbulb icon below is a reminder that a backlight can be turned on if the button is pressed for more than 1 second.

In the default setting, measurements are made with autoranging. The instruction book provides a list of measurement ranges that can be selected with the **RANGE** button.

One interesting function is controlled by the **RELΔ** button. It allows you to make two successive measurements and display the difference between the two. Finally, the **MAX MIN** button reads the values of a set of measurements — for example, when connected to a voltage for some period — and then displays the maximum and minimum values of the measurements made.

In Summary

This is a complete kit for the workbench. You can hold the unit in one hand, or you can place it on your workbench with the built-in stand. Controls are well labeled, and for the most part you probably will not use the instruction book.

Manufacturer: Klein Tools, 450 Bond Street, Lincolnshire, IL 60069, **www.kleintools.com**. Price: $69.

Tekpower Mastech MS8268

This digital VOM comes as an interesting package; inside are the meter, test leads, a test adapter for transistors, a calibration certificate, and an instruction sheet. On one side of the instruction sheet is contact information for five countries, a mini table of accuracies, and a set of warnings in six languages. The instructions are on the reverse side — no words, just eight cartoons plus one for battery replacement.

Most of the accuracy information is replicated on the outside of the box without the cartoons (again in several languages). The nearly 1-pound unit has a shock-absorbing outer case, probe holders on the back side, and a built-in desk stand on the rear. A set of six push-buttons (for input jacks) and a 12-position rotary switch, including an off position, are used to select the measurement settings.

Because this was the only meter that came with a transistor test capability — meant to read out a value of hFE — this was the first mode tried. To test transistors you will need the provided converter.

My junk box yielded an NPN 2N2222 that read out a value of 130. The junk box also had a PNP 2N2907, which in the past might have been used as a complementary pair to the 2N2222. The 2N2907 gave a value of 145.

The meter has well-marked functions, usually in white on the panel. The leftmost input jack is a **10 A** fused input used in conjunction with the jack marked **COM** (second from the right). With the included adapter plugged into the **COM** jack and the jack to its left, which is labeled **hFE µA mA**, and the rotary switch placed in the hFE position, transistors can be measured.

Using the same adapter, and with the switch turned to a capacitor symbol, the capacitor value can be read. A 2.00 nF non-polarized cap was used to test this function. It read 1.895 nF. However, the adapter must be plugged in between the common jack and the rightmost jack. If you leave it in the position for transistor testing — as I did — the meter will emit a series of beeps and flash red. However, the rightmost jack is clearly marked for testing diodes, continuity, resistance, voltage, frequency, and capacitance.

Starting clockwise on the center rotary control, there are three current selections. Each is marked with a horizontal line and a sine wave, indicating that each is used for both ac and dc. The **SELECT** button toggles these inputs between ac and dc. In addition, for the mA and µA scales, the **RANGE** button cycles through the available ranges.

With the rotary switch in the ohm position, one clicks CW from **OFF**. Again, the **RANGE** button is used to select a resistance range. With a further click on CW, the position is marked with both a diode symbol and an audio symbol; the **SELECT** button toggles between these two functions. The final CW position is marked with **Hz/%**; the top right-hand button has these two symbols and is used to toggle between these two functions.

The **REL** button operates in the usual manner of comparing one measurement with a second to show the relative difference between the two. The **HOLD** button is used to freeze the display output. Finally, pressing the **LIGHT** button turns on the back light; to turn it off, you must rotate the center dial to the **OFF** position.

In Summary

As the largest reviewed meter, it has more buttons, jacks, and switch positions, but everything is well marked. For the most part, there are only three things to remember: First, the function you wish to measure plugs into the appropriate jack at the bottom; the rotary dial setting should match this selection. Next, if you do

not want to use the **AUTORANGING** feature, the **RANGE** button can be used to select the measurement range. Finally, when two functions are marked on the dial, the **SELECT** button toggles between the two.

Manufacturer: Mastech (MGL International Group), MGL America, Inc., 6509 Northpark Blvd Unit 400, Charlotte, NC, 28216, **www.mastech-group.com**. Price: $60.

UNI-T Multimeter UT61E

This meter comes with two instruction books, one entirely in Japanese and the other in English. Contact information is provided at an address (in English) in Guangdong province, China.

The instruction book covers a range of models, from the UT61A to the UT61E. Unfortunately, it was occasionally difficult to determine which feature applied to the evaluated E model. To further confuse the issue, the package came with an adapter to measure transistor gain, but there is no such function on the E model. The same is true for data output; a connecting cable is included in the package, but no function is built into the E model to make a connection. However, the instructions contain exact values for each of the measurement value ranges.

The meter has a plastic shock cover with the main function selector switch in the center. Along the bottom are four input jacks; the jack second from the right is the common input, used for all functions. To its left are separate jacks for measuring current; the 10 A maximum individually fused with the leftmost jack and the next, also individually fused, is a jack for the current up to 1 A. A limit is placed on the current-measuring capability. Measurement time for a current greater than 5 A should be limited to less than 10 seconds, and the interval between any two current measurements should be limited to 15 minutes. (No, that is not a typo. The instructions actually say “15 minutes”!) While not explicitly stated, it appears that the 15-minute time limit applies to currents greater than 5 A.

The rotary dial has an **OFF** position (maximum CCW) and eight selections, each marked with a primary function in white. Alternates are marked in orange. Some selections are made by pressing both the orange and blue buttons. For example, the milliampere selection, second from the maximum CW position, is shown in white as the standard selection with a white bar. The blue sine wave indicates that toggling this input measures the mode between ac and dc. The orange lettering just below **Hz** shows that pressing the orange button switches the measurement type from mA to frequency (Hz).

Just below the display are four buttons. Pressing the leftmost **HOLD** button grabs and stores the current value of the item being measured. Pressing it again releases the stored value. The **RANGE** button allows for the selection of the standard scale, set by the **AUTORANGE** function, or change of the range selection to manual. Accuracy and resolution for each range selection are listed in the section of that type in the instruction manual.

The **RELΔ** button, second from the right, allows you to make a measurement, store it, and make a second measurement, but instead of reading out the second measurement it reads out the difference between the two measurements. The final, right-hand button permits measurements of maximums and minimums.

Display icons are neatly tabled in the instruction book. The entire set flashes when you go from the **OFF** position on the rotary dial to any other position. Finally, at the bottom of the LCD display is a bar graph whose length is relative to the measured value.

In Summary

Despite some confusion among models, transistor testing, and data output, this is a complete unit whose accuracies, warranted for 1 year, are explicitly given for each type of item measured. The package may be too big to carry in your shirt pocket, but the built-in back stand allows for convenient bench use. The main advantage of this unit is that you know what you are getting in terms of accuracy. The main disadvantage is the learning curve. Be careful not to lose the instruction manual!

Manufacturer: Uni-Trend Technology (China) Co., Ltd., No. 6, 1st Industrial North Road, Songshan Lake Park, Dongguan, Guangdong, China, 523808, **www.uni-trend.com**. Price: $73.

SDR-Control for Icom Radios — iOS and macOS Versions

Reviewed by Pascal Villeneuve, VA2PV
va2pv@arrl.org

Often, Mac users are left behind, as most amateur radio software is developed for Windows PC. However, this software is available for only iOS (iPad) and macOS devices.

In June 2022, Al Hearn, WA4GKQ, suggested that I look at the new *SDR-Control* software for Icom radios. A few days later, Michael Crestohl, W1RC, submitted a product review of the iOS (iPad) version of this software. I've been hoping to remote control my Icom radios with my iPad for a long time, so I immediately bought the app for iOS, and later I bought the macOS version for my MacBook Pro.

The *SDR-Control* app is the latest creation of Marcus Roskosch, DL8MRE. He's also the creator of *SmartSDR*, a similar software used with FlexRadio, also for macOS and iOS. The *SDR-Control* app is not available yet for the iPhone, but I'm expecting it will be available in the future, as there is an iPhone version for the *SmartSDR* software. Currently, if you buy the app for iPad (iOS) and you also want the macOS version, you have to buy both separately, which is expensive. Hopefully, if there's an iPhone version, it will be available for those who bought the iPad iOS version.

Differences Between the iOS and macOS Versions

Most of the features are the same, but the macOS version is more complete. Here are a few features that the macOS has and the iOS iPad version doesn't: The macOS version has a power button to turn off the radio (remote standby), it's compatible with the Icom RC-28 remote encoder, you can decode CW, and there are more visible controls on the interface (because the screen of a computer is always larger than that of a tablet). Figures 6 (iOS) and 7 (macOS) show the available tools for each version.

Bottom Line

With *SDR-Control* software you can operate remotely the IC-705, IC-7610, and IC-9700 without compromise. If you have the IC-705, you can also connect your iPad (iOS version) or Mac (macOS version) directly to your radio in Access Point mode without an internet connection — perfect for digital field operations.

Above: iOS.

Right: MacOS.

Setting Up Your Radios

Both software versions are compatible with the Icom IC-705, IC-7610, and IC-9700. All three of these radios are of the same generation (SDR) and are able to connect to your home IP network, using their Ethernet port or a Wi-Fi connection (IC-705).

Setting up any of the compatible Icom radios is the same as setting up the *RS-BA1*, the Icom Windows PC software. I have these three radios, and they were already set up for the *RS-BA1*. Therefore, I went into the radio's menu and wrote down the IP address, the ports (more on this later), the username, and the password. Then I went into the app and added all three radios, and I was able to connect to all of them immediately. Keep in mind that you can only connect to one radio at a time.

If you intend to use these apps only at home, you don't need to configure any port forwarding into your router. But if you want to use it remotely over the internet, the port forwarding is necessary. And if you have more than one compatible radio, you have to configure them with different control, serial, and audio ports. For example, my IC-7610 uses the default Icom UDP ports — 50001 (control), 50002 (serial), and 50003 (audio). I changed my IC-9700 to use 50004, 50005, and 50006, and my IC-705 to use 50007, 50008, and 50009. Thus, in my home router I have three ports forwarding configured — the internal (LAN) IP address of the IC-7610 with 50001 to 50003 UDP ports, the LAN IP address of the IC-9700 with 50004 to 50006 UDP ports, and the LAN IP address of the IC-705 with 50007 to 50009.

If you implement port forwarding and you don't want to reconfigure the software settings for home (LAN) and remote operation (WAN), use the radio settings the public IP assigned to your home router. In my case, all three radios have my public IP (it's the same for all three, with different port forwarding). If you don't have a public static IP, this address can change over time depending on the IP address lease time of your internet provider. To ensure it still works after an IP address change, both versions of the software can use a domain name instead of an IP address; therefore, it's possible to use dynamic DNS services to connect to your radio remotely. This may be overwhelming for some users, as it requires minimal networking skills. Every remote operation setup will require some networking skills. If you want to learn the basics to be functional, I suggest watching my "IP Networking Basics Explained" video (**https://youtu.be/HAVcXPI7oUY**).

Figure 6 — The *SDR-Control* available tools on the iOS app version (screen capture on an iPad).

You will also find information in the *SDR-Control* online manual (**https://manuals.roskosch.de/sdrcontrol**).

macOS Version

The software will run on any Mac that uses macOS 11 or later. My test was done with the latest Monterey 12.5. There are no minimum hardware requirements, and the software works on both Intel and Apple (M1) processors.

For example, with the most recent OS versions, you can use your iPad as a secondary screen for your Mac. The feature is called Sidecar, and the *SDR-Control* macOS software is compatible with it (see Figure 8).

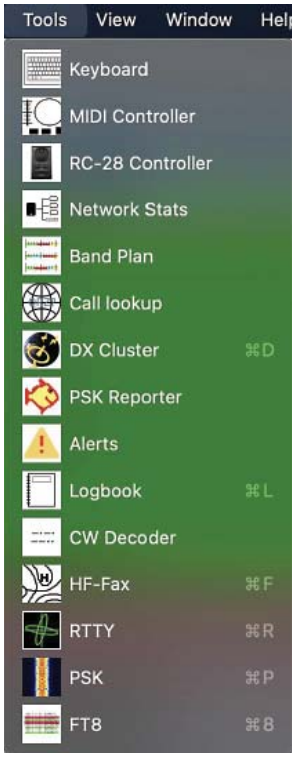

Figure 7 — The *SDR-Control* available tools in the drop-down menu of the macOS software version (screen capture on a MacBook Pro).

Operation on the Air

Remote operation with both software versions is very intuitive, and both reception and transmission audio are good if you have a stable internet connection. I operated remote from my camper, where the internet wasn't very good, and it lagged a lot, the audio was choppy, the waterfall stopped working, and I lost the connection a few times. On the other hand, if you have

Figure 8 — The SDR-Control with the Icom RC-28 remote encoder running on a MacBook Pro, with the iPad Pro used as a secondary display (with Apple Sidecar) while in FT8.

a good connection, everything works as expected. Keep in mind that this is true for any real-time application. You can use the device's integrated mic or any compatible external audio devices, like Apple AirPods.

One of the best features I found is the memory channel indication on the waterfall (see Figure 9). You can recall any memory (on the active main band only) of the displayed band just by touching the screen of your iPad or using your mouse on the Mac.

Both software versions have the built-in FT8 software with a logbook, and it works like a charm. You also have the DX call sign displayed on the waterfall, a map with the station receiving your call, and the comprehensive FT8 windows.

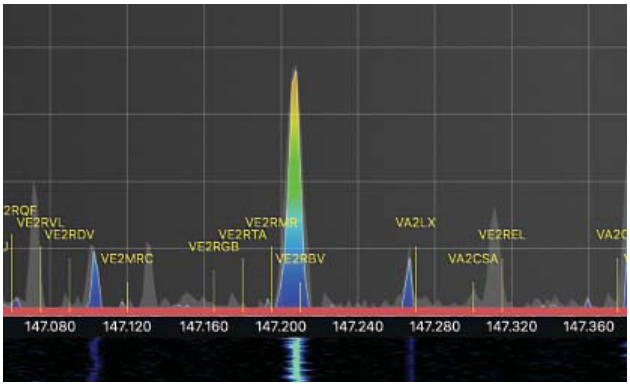

Figure 9 — The SDR-Control connected to the Icom IC-9700 showing the memory channels for the main VFO on the waterfall.

Using *SDR-Control* on an iPad

Michael Crestohl, W1RC

With *SDR-Control* it is simple to set up an online remote station using an iPad or Mac without a lot of hair-pulling. My review of *SDR-Control* for Icom was conducted using my iPad Air 2 (OS 15.5).

In addition to SSB, CW, AM, RTTY, and FM (which means you can also work repeaters), SDR-Control handles digital modes like D-STAR and FT8 — all on your iPad or Mac without any physical connection.

All stations I worked reported clear audio using the iPad's internal microphone. However, an external mic can also be used. Transmitter keying is accomplished by using a pop-up PTT on-screen button. The app can also be set up as a public safety scanner, and you can even listen to the airband as well as your favorite AM and FM broadcast stations. There are several integrated tools such as PSK Reporter, a logbook, DX Cluster, and call sign lookup sites.

While away from my QTH, I used my iPad connected to the internet through the cellular data network. It works well, but as with anything related to internet connectivity, your mileage may vary.

The user documentation is clear, concise, and straightforward; for those with advanced questions, user support is provided. *SDR-Control* offers IC-705, IC-7610, and IC-9700 users a convenient remote online operation alternative that works well and, in my opinion, was extremely well designed.

If you have the IC-705, you can connect your iPad or Mac directly to your radio in Access Point mode without an internet connection — perfect for digital field operations.

Conclusion

I'm so happy that I can operate all of my Icom radios from my iPad or laptop anywhere in my home and when I'm on the move. I can now enjoy my shack setup while sitting outside in my backyard without any compromise, and that alone makes *SDR-Control* a good investment for me.

Manufacturer: Marcus Roskosch, DL8MRE. Kaldemorgenweg 35, 45276 Essen, Germany, **www.roskosch.de/sdr-control**. Price: iPad iOS version: $49.99; macOS version: $99.99.