# PRODUCT REVIEW

# Yaesu FT-450D HF and 6 Meter Transceiver

*Reviewed by Mike Corey, W5MPC*
*ARRL Emergency Preparedness Manager*
**w5mpc@arrl.org**

Over the last decade or so many of Yaesu's popular HF transceivers have undergone improvements and been re-released as D models. The D model improvements have included additional popular accessories such as antenna tuners, DSP filters and the addition of 60 meters in some models. Following in the line of the FT-100D, FT-817ND, FT-857D and FT-897D is the latest version of the FT-450…you guessed it the FT-450D. Much of the information in the original FT-450 review in December 2007 *QST* still applies, and we won't repeat it here.[1]

So what is different on this new and improved FT-450D? There are six significant upgrades to the original FT-450:

- Internal automatic antenna tuner
- New knob design
- New standard hand microphone
- Button illumination
- Foot stand
- 500 Hz and 300 Hz CW filters

Let's see how the advertised improvements stand up.

## New Accessories

The original FT-450 had as an option an internal automatic antenna tuner, the ATU-450. The new D model includes an automatic antenna tuner that covers the 6 to 160 meter bands and will, according to the manual, match impedances between 16.7 and 150 Ω. The manual also cautions that antennas such as non-resonant whips and wire antennas such as G5RVs may not be within the matching range of the tuner.

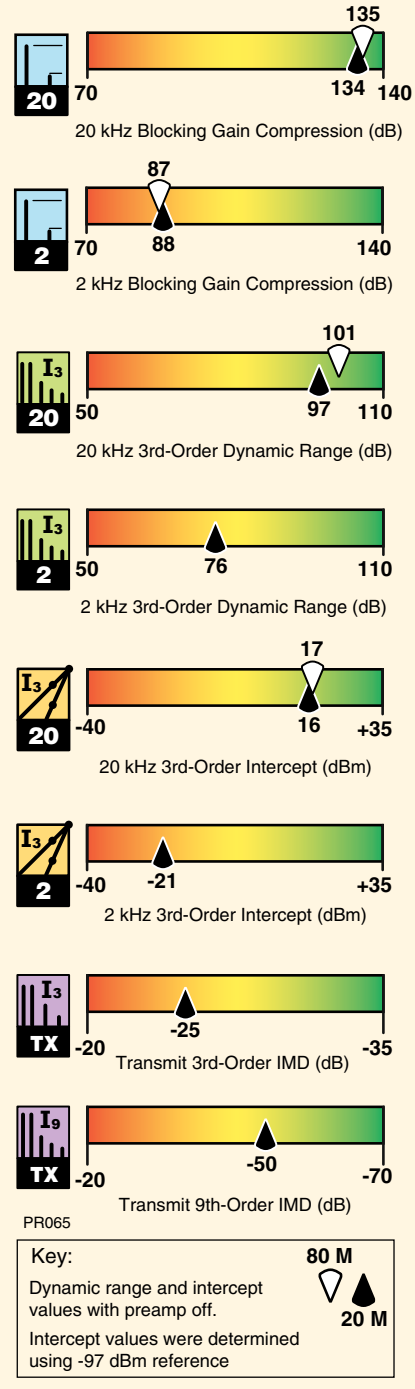
Tuner operation is very easy. Pushing the TUNE button momentarily brings the tuner inline and pushing and holding for about 1 second activates the tuning procedure. I tried matching an 80 meter dipole that was cut for the upper phone portion of the band and was able to get a match from about 3.6 MHz to 3.9 MHz. For a rig in this price class the '450D's tuner did a good job.

The D model DSP filter has width settings on CW for 300 Hz, 500 Hz and 2.4 kHz. Lab tests indicate that the 500 Hz filter setting on the D model measures close to 500 Hz. This is a significant improvement over the CW filter in the original FT-450 transceiver. The original review commented on operation of the DSP filter bandwidths on CW. The filter was not continually adjustable as commonly found on other radios and had fixed settings at different widths for SSB, CW, AM and FM. The filter widths for CW were 500 Hz, 1.8 kHz and 2.4 kHz. The narrowest setting, 500 Hz, tested in the lab at closer to 600 Hz; either way it proved to be too wide for very crowded band conditions.

While the addition of a 300 Hz setting is

[1]R. Lindquist, N1RL, "Yaesu FT-450 HF and 6 Meter Transceiver," Product Review, *QST*, Dec 2007, pp 53-57. This review is available to ARRL members online at **www.arrl.org/product-review**.

## Key Measurements Summary




## Bottom Line

The FT-450D adds a standard internal antenna tuner, new CW filter bandwidths and several ergonomic upgrades to the original FT-450. These refinements make a popular low cost transceiver even better.

Mark J. Wilson, K1RO ♦ Product Review Editor ♦ k1ro@arrl.org

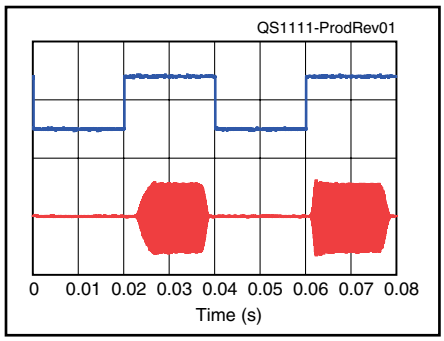



**Figure 1 — CW keying waveform for the FT-450D showing the first two dits in full-break-in (QSK) mode using external keying. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. (Note that the first key closure starts at the left edge of the figure.) Horizontal divisions are 10 ms. The transceiver was being operated at 100 W output on the 14 MHz band.**

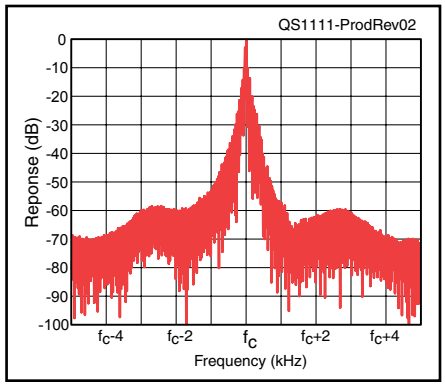



**Figure 2 — Spectral display of the FT-450D transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 100 W PEP output on the 14 MHz band, and this plot shows the transmitter output ±5 kHz from the carrier. The reference level is 0 dBc, and the vertical scale is in dB.**

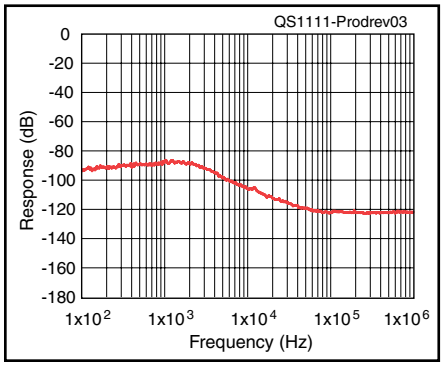



**Figure 3 — Spectral display of the FT-450D transmitter output during composite noise testing. Power output is 100 W on the 14 MHz band. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 100 Hz to 1 MHz from the carrier. The reference level is 0 dBc, and the vertical scale is in dB.**

## Table 1

## Yaesu FT-450D, serial number 0N530112

| Manufacturer's Specifications | Measured in the ARRL Lab |
|---|---|
| Frequency coverage: Receive, 0.03-56 MHz; transmit, 1.8-2.0, 3.5-4, 5.3305, 5.3465, 5.3665, 5.3715, 5.4035, 7-7.3, 10.1-10.15, 14-14.35, 18.068-18.168, 21-21.45, 24.89-24.99, 28-29.7, 50-54 MHz. | Receive and transmit, as specified. |
| Power requirement: 13.8 V dc ±10%; receive, 1.5 A (no signal); transmit, 22 A (100 W). | 13.8 V dc; receive 1.0 A (max audio, max lights); 0.85 A (max audio, min lights); transmit, 16 A (100 W out). Operation confirmed at 12.4 V dc (85 W out). |
| Modes of operation: SSB, CW, AM, FM. | As specified. |

### Receiver

| | Receiver Dynamic Testing |
|---|---|
| SSB sensitivity (2.4 kHz bandwidth, 10 dB S+N/N): SSB, 0.25 µV (1.8-2.0, 3.5-30, 50-54 MHz). | Noise floor (MDS), 500 Hz bandwidth:<br>*Preamp off* / *Preamp on*<br>0.137 MHz –90 dBm / –93 dBm<br>0.505 MHz –103 dBm / –113 dBm<br>1.0 MHz –106 dBm / –115 dBm<br>3.5 MHz –129 dBm / –137 dBm<br>14 MHz –129 dBm / –136 dBm<br>50 MHz –125 dBm / –139 dBm |
| Noise figure: Not specified. | 14 MHz, preamp off/on: 18/11 dB |
| AM sensitivity: 6 kHz bandwidth, 10 dB S/N: 2.0 µV (1.8-20, 3.5-30 MHz), 2 µV (50-54 MHz). | 10 dB (S+N)/N, 1-kHz, 30% modulation, 6 kHz bandwidth:<br>*Preamp off* / *Preamp on*<br>1.0 MHz 14.6 µV / 5.62 µV<br>3.8 MHz 1.60 µV / 0.65 µV<br>50.4 MHz 2.66 µV / 0.65 µV |
| FM sensitivity: 15 kHz bandwidth, 12 dB SINAD: 0.5 µV (28-30 MHz), 0.3 µV (50-54 MHz). | For 12 dB SINAD, 5 kHz bandwidth:*<br>*Preamp off* / *Preamp on*<br>29 MHz 0.83 µV / 0.27 µV<br>52 MHz 0.93 µV / 0.24 µV |
| Blocking gain compression: Not specified. | Gain compression, 500 Hz bandwidth:<br>*20 kHz offset* / *5/2 kHz offset*<br>*Preamp off/on* / *Preamp off*<br>3.5 MHz 135/137 dB / 93/87 dB<br>14 MHz 134/136 dB / 93/88 dB<br>50 MHz 128/126 dB / 93/88 dB |
| Reciprocal mixing (500 Hz BW): Not specified. | 20/5/2 kHz offset: –98/–83/–74 dBc. |

ARRL Lab Two-Tone IMD Testing (500 Hz DSP bandwidth)**

| *Band/Preamp* | *Spacing* | *Input Level* | *Measured IMD Level* | *Measured IMD DR* | *Calculated IP3* |
|---|---|---|---|---|---|
| 3.5 MHz/Off | 20 kHz | –28 dBm | –129 dBm | 101 dB | +23 dBm |
| | | –21 dBm | –97 dBm | | +17 dBm |
| 14 MHz/Off | 20 kHz | –32 dBm | –129 dBm | 97 dB | +17 dBm |
| | | –22 dBm | –97 dBm | | +16 dBm |
| | | 0 dBm | –38 dBm | | +19 dBm |
| 14 MHz/On | 20 kHz | –37 dBm | –136 dBm | 99 dB | +13 dBm |
| | | –25 dBm | –97 dBm | | +11 dBm |
| 14 MHz/Off | 5 kHz | –43 dBm | –129 dBm | 86 dB | 0 dBm |
| | | –38 dBm | –97 dBm | | –9 dBm |
| | | 0 dBm | –21 dBm | | +11 dBm |
| 14 MHz/Off | 2 kHz | –53 dBm | –129 dBm | 76 dB | –15 dBm |
| | | –46 dBm | –97 dBm | | –21 dBm |
| | | 0 dBm | –17 dBm | | +9 dBm |
| 50 MHz/Off | 20 kHz | –25 dBm | –125 dBm | 100 dB | +25 dBm |
| | | –18 dBm | –97 dBm | | +22 dBm |

an improvement over the original, I agree with the reviewer of the original FT-450 that widths of 250, 500 and 800 Hz would be even better. I gave this new filter width a try during the Worked All Europe DX CW contest. I found the narrowest setting, 300 Hz, to be adequate. The 500 Hz setting, to me, seemed the best during crowded band conditions. A bandwidth wider than 500 Hz but narrower than 2.4 kHz would be useful for less crowded conditions.

Yaesu now includes an MH-31 hand mic with the FT-450D. This mic has frequency UP/DWN buttons that are useful in a mobile environment. Pressing and holding these buttons starts the scanning process.

## Ergonomic Upgrades

Yaesu made several significant upgrades

| Receiver | Receiver Dynamic Testing |
|---|---|
| Second-order intercept point: Not specified. | Preamp off/on, 14 MHz, +59/+31 dB; 50 MHz, +61/+61 dB. |
| DSP noise reduction: Not specified. | Variable, 12 dB maximum. |
| Notch filter depth: Not specified.<br>Adjacent channel rejection: Not specified. | Manual notch: 50 dB.<br>20 kHz offset, 29 MHz, 82 dB,*<br>52 MHz, 83 dB.* |
| FM two-tone, third-order IMD dynamic range: Not specified. | 20 kHz offset, preamp on:<br>29 MHz, 82 dB,† 52 MHz, 79 dB.<br>10 MHz channel spacing:<br>28 and 52 MHz, 98 dB. |
| S-meter sensitivity: Not specified. | S9 signal at 14.2 MHz: preamp off, 119 μV; preamp on, 38.9 μV. |
| Squelch sensitivity: SSB/ CW/AM, 2.5 μV (1.8-30 MHz), 1 μV (50-54 MHz); FM, 0.32 μV | At threshold, preamp on: SSB, 0.74 μV; FM, 29 MHz, 0.45 μV; 52 MHz, 0.11 μV. (28-30 MHz), 0.16 μV (50-54 MHz). |
| Receiver audio output: >2 W into 8 Ω at 10% THD. | 2 W at 10% THD into 8 Ω.<br>THD at 1 V RMS, 1.6%. |
| IF/audio response: Not specified. | Range at –6 dB points (bandwidth):‡<br>CW (500 Hz): 286-806 Hz (520 Hz);<br>Equivalent Rectangular BW: 450 Hz.<br>USB: (2.4 kHz): 300-1998 (1698) Hz;<br>LSB: (2.4 kHz): 300-2010 (1710) Hz;<br>AM: (6 kHz): 300-1673 (2746) Hz. |
| IF rejection: Not specified. | First IF rejection: 14 MHz, 100 dB; 50 MHz, 54 dB. |
| Image rejection, ≥ 80 dB (HF); ≥ 65 dB (6 m). | Image rejection: 14 MHz, 79 dB; 50 MHz, 74 dB. |
| **Transmitter** | **Transmitter Dynamic Testing** |
| Power output: HF & 50 MHz: SSB, CW, FM, 100 W; AM, 25 W. | HF: CW, SSB, FM, typically 6-105 W; AM, 1.8-25 W. |
| Spurious-signal and harmonic suppression: >60 dB on HF, >70 dB on 50 MHz. | HF, as specified; 50 MHz, 64 dB. Meets FCC requirements. |
| SSB carrier suppression: At least 60 dB. | 68 dB. |
| Undesired sideband suppression: At least 60 dB. | >70 dB. |
| Third-order intermodulation distortion (IMD) products: Not specified. | 3rd/5th/7th/9th order (10 m, worst case):<br>HF, 100 W PEP, –25/–27/–45/–50 dB;<br>50 MHz, 100 W PEP, –20/-30/–39/–45 dB. |
| CW keyer speed range: Not specified. | 4 to 59 WPM. |
| CW keying characteristics: Not specified. | See Figures 1 and 2. |
| Iambic keying mode: Not specified. | Mode B. |
| Transmit-receive turnaround time (PTT release to 50% audio output): Not specified. | S9 signal, AGC fast, 50 ms. |
| Receive-transmit turnaround time ("tx delay"): Not specified. | SSB, 26 ms; FM, 17 ms. |
| Composite transmitted noise: Not specified. | See Figure 3. |

Size (height, width, depth): 3.3 × 9 × 8.5 inches; weight, 8.8 pounds.

Price: $900.

*Widest FM DSP filter setting is 5 kHz.
**ARRL Product Review testing now includes Two-Tone IMD results at several signal levels. Two-Tone, 3rd-Order Dynamic Range figures comparable to previous reviews are shown on the first line in each group. The "IP3" column is the calculated third-order intercept point. Second-order intercept points were determined using –97 dBm reference.
†Measurement was noise-limited at the value indicated.
‡Default values. Bandwidth and cutoff frequencies are adjustable via DSP. CW bandwidth varies with PBT and pitch control settings.

to the external design of the FT-450, so let's start with the one that was considered by many to be the biggest oversight in the original design…the feet.

The original FT-450 lacked one basic feature found not only on just about every transceiver on the market, but just about any type of personal electronics you may encounter — adjustable feet. The new D model features flip down feet so the face of the radio may be angled up for easier viewing. It's not an earth shattering upgrade but it sure beats propping up your radio with an old *ARRL Repeater Directory*. The new style feet are available separately to retrofit original FT-450 models.

Speaking of display there are some changes to the radio's front panel as well. The first thing one would notice in comparing the '450 to the '450D is the change in the tuning knob. The D model has done away with the finger dimple on the knob and instead simply uses a rubberized grip that makes it fairly easy to tune. Reviews of the original FT-450 pointed out that the finger dimple on the knob was generally useless due to its small size.

The D model also features four other knobs on the front panel, the same as the original '450. The redesigned knobs are attractive and for the most part they have a sturdier feel to them. The one exception is the DSP/SEL knob. Other users have noted that this knob seems a little loose. This may present a problem further down the road since this knob will likely see regular use.

A big improvement to the front panel is backlighting for the buttons. There are 24 buttons on the front panel that control a wide range of functions and features. The new backlighting is strong enough that buttons can be seen from several feet away in a dark room. The backlighting is linked to the display brightness setting in the menu and you cannot switch the backlighting off.

There are eight different display brightness levels, an improvement over four in the original '450. I found that settings 5 to 8 worked best in a well lit room. The lowest settings were really not usable.

Some literature shows 60 meter coverage as one of the improvements. The original '450 had 60 meter capability included. To access 60 meters, enter into the memory mode where the five 60 meter channels and the Alaska Emergency Channel (5167.5 kHz) are found. This is the same in the D model.

## Anything New Under the Hood?

As the lab numbers indicate, the receiver performance on the FT-450D is about the same as the original '450. There are some slight differences in sensitivity on AM.

The new model has eliminated a strange problem noted with the original. The reviewer of the original FT-450 noted that when the early radio was first powered on there was a noticeable popping noise coming from the speaker. The cause was determined to be a DSP artifact present when the radio's attenuator and preamp were off and the bandwidth was at the narrowest setting.

## Original Nits to Pick

The original review of the FT-450 found a few nits to pick that weren't addressed in the upgrade to a D model. As with the original FT-450, the D version lacks an automatic notch filter. It does include a manual notch that is, as in the original, quite effective.

The clarifier (Yaesu's term for *receiver incremental tuning*, RIT) is somewhat awkward to operate. There is no separate RIT knob. To use the clarifier, you press the CLAR

**Figure 4 — The rear panel of the FT-450D.**

button and adjust the receive frequency with the main tuning knob. I had some difficulty getting used to this. Although other HF transceivers have used this RIT scheme, current radios tend to have a prominent RIT knob.

I also agree with other users that a second antenna jack for 6 meters would be nice. I also found the fan to be quite noisy. It activates each time you transmit, so perhaps with enough operating you may get used to it. And finally, like the '450, the D version has an optional, not standard, carrying handle that would be useful for portable or emergency operation.

During the review I noticed that audio quality from the internal speaker left something to be desired. I would recommend using an external speaker or good quality headphones with this radio.

### Conclusions

As was the earlier version, the FT-450D is a solid transceiver that is easy to use and offers many features for a radio in its price class. New operators, as well as seasoned operators, will find it enjoyable to use.

The upgrades on the D model add to an already good radio. While other radios in Yaesu's lineup are better choices for the serious contester or DXer, the FT-450D is definitely suitable for those new to HF, casual operators, emergency communications use, camping/RVing or as a backup radio.

*Manufacturer:* Vertex Standard, 6125 Phyllis Dr, Cypress, CA 90630; tel 714-827-7600; **www.yaesu.com**.

**YAESU FT-450D**

If you own a tablet or smartphone with the appropriate application, scan this QR Code to see a video overview of the FT-450D. You can also watch this video on your computer by going to:

**youtube.com/watch?v=xenOt9jSK7I**

# Elecraft XG3 RF Signal Source

*Reviewed by Bob Allison, WB1GCM*
*ARRL Test Engineer*
**wb1gcm@arrl.org**

A signal generator is an important instrument to have on hand while testing receivers. Whether it's an old vacuum tube receiver or a brand new top-of-the-line model, a radio technician can use an RF signal generator to quickly determine a receiver's sensitivity.

Readers of *QST* Product Reviews know that sensitivity is a key measurement included with all receiver reviews. Noise floor, or equivalently *minimum discernible signal* (MDS), is measured in dBm (decibels referenced to a milliwatt). The value 0 dBm, or 1 mW, is the reference used for the measurement of signal levels. Noise floors of some current receivers have achieved sensitivities better than –140 dBm.

Sensitivity can also be measured in microvolts (μV) or, with stronger signals, millivolts (mV). A 0 dBm signal equals about 225 mV into a 50 Ω terminated system.

Another common signal reference level radio amateurs use is S9. Many receiver manufacturers align the S meter to read S9 with a 50 μV (–73 dBm) signal level at the antenna jack, though not all do this. A signal level of 1 μV is equivalent to –107 dBm, which is also the point at which a receiver's AGC is likely to kick in.

With this brief introduction out of the way, let's take a look at the subject of this review — Elecraft's XG3 Signal Source. *QST* previously reviewed the Elecraft XG1 Receiver Test Oscillator, a simple and inexpensive kit whose main use was S meter calibration.[2] The XG3 is significantly more sophisticated.

**Bottom Line**

The Elecraft XG3 is a compact, accurate signal source with a variety of uses in the Amateur Radio station or on the workbench.

### Features

The XG3 is a programmable, pocket sized RF signal generator that provides output from 1.5 to 1400 MHz. Four commonly used selectable output levels provide test signals at 0 dBm, –33 dBm (40 dB over S9), –73 dBm (S9) and –107 dBm (1 μV). Each output is calibrated from 1.5 to 200 MHz.

The XG3 has 12 output memory channels; each can be programmed to a particular frequency within a ham band. Elecraft has

**Table 2**

**Elecraft XG3 Signal Source**

| *Manufacturer's Specifications* | *Measured in the ARRL Lab* |
|---|---|
| Frequency range: 1-200 MHz fundamental; up to 1400 MHz via harmonics. | As specified. |
| Frequency resolution: 1.5-66 MHz, 1-10 Hz; 67-159 MHz, 1-12 Hz; 160-200 MHz, 1-24 Hz. | As specified. |
| Frequency stability: ±50 ppm, maximum. | As specified. |
| Frequency accuracy: not specified. | See Table 3. |
| Output level: 0 dBm (±3 dB), –33 dBm, –73 dBm, –107 dBm (±1 dB typ). | As specified. |
| Power requirements: 9 V battery or external 11-14 V supply; 60 mA max at 0 dBm output | At 13.8 V dc, 64 mA with 0 dBm output, 28 mA at other output levels. |

Size (height, width, depth): 4.8 × 2.6 ×1 inches; weight, 4 oz with internal battery.

Price: $169.95.

**Table 3**

**Elecraft XG3 Signal Source versus HP 5351 GPS Locked Frequency Counter**

| *Elecraft XG3 Frequency (MHz)* | *HP 5351 Frequency (MHz)* | *Frequency Difference (Hz)* |
|---|---|---|
| 10.120000 | 10.120001 | 1 |
| 14.020000 | 14.019999 | 1 |
| 18.200000 | 18.199998 | 2 |
| 21.020000 | 21.020004 | 4 |
| 24.900000 | 24.900004 | 4 |
| 28.020000 | 28.020000 | 0 |
| 50.120000 | 50.120013 | 13 |
| 144.220000 | 144.220030 | 30 |

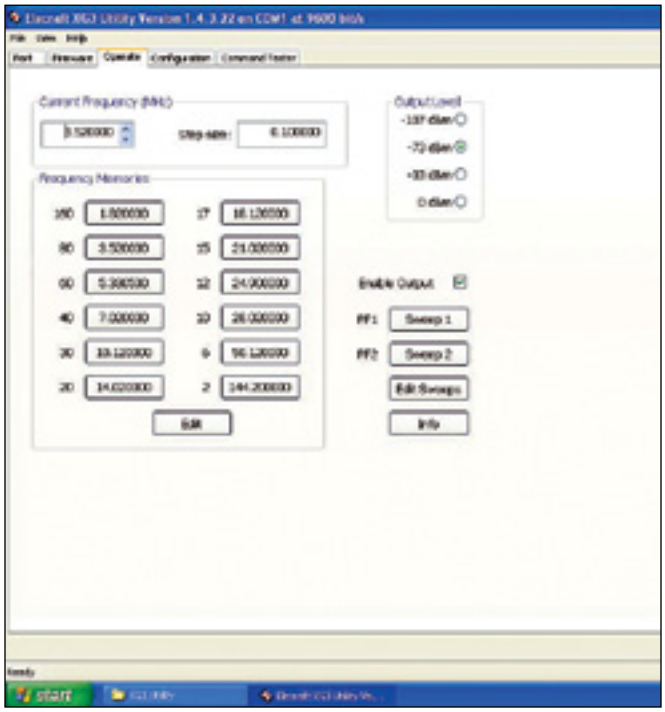


**Figure 5 — The XG3 utility software may be used to set a variety of parameters as well as to update firmware. This screen allows the user to program specific test frequencies for each amateur band from 160 through 2 meters, set output level and perform swept frequency tests.**

labeled each channel as a ham band, starting with 160 meters, all the way up to 2 meters. Using the XG3's utility program (Figure 5), the user can program any memory channel for an output frequency of 1.5 to 1400 MHz. Elecraft provides an RS-232 interface for connecting the XG3 to a PC.

The unit can be powered by an internal 9 V battery or with an external power supply of 11 to 14 V dc. The XG3 is quite small and light so you can use it in your home station or in the field. The plastic case is stronger than it looks. Though drop testing equipment is not (yet) in our ARRL Procedure Manual, the manufacturer performed this test repeatedly for us onto cement with no damage reported to the case or electronics.

The XG3 controls are minimal. There are four momentary contact push buttons: the BAND (+) and BAND (–) buttons, the ON/OFF power button and the output LEVEL button. The BAND (+) and BAND (–) buttons change the output to different fixed frequencies that have been preprogrammed at the factory or programmed by the user. When pressed and held for one second, each of these buttons selects a sweep frequency range that is chosen by the user, with selectable sweep step size and a sweep rate as little as 1 ms.

There is an LED indicator for each channel (ham band) that illuminates when selected. There is also an LED indicator for each output level, making a total of 16 indicators. The brightness of the LEDs is adjustable with the utility software.

The 0 dBm indicator will flash when the internal 9 V battery falls below a measured 7.6 V, or if an external supply falls below 11 V. A BNC type connector is used at the RF output.

Before using this or any other signal generator, be sure there is no possibility that RF from a transceiver under test is transmitted into the XG3's RF OUT jack — a real possibility if you have connected the XG3 to a transceiver's antenna jack. Transmitting into the XG3, even briefly, will damage the unit and will not be covered under Elecraft's warranty. A fusible link at the XG3's RF OUT jack provides a little protection from such incidents. It will open and will stop the frying process, but the degree of damage depends on the amount and duration of RF power applied to the RF output of the XG3. It's best to disable the test transceiver's transmit function if possible, or unplug any CW key or keyer, microphone or other keying lines before using any signal generator. At the ARRL Laboratory, I must always be mindful of these safety steps! I also turn the RF output and the microphone gain to minimum with any transceiver I test as an added precaution.

## Applications

Elecraft's instruction manual for the XG3 is very thorough. If the reader is new to signal generators, they will soon discover the many uses of this test instrument. The "Applications" section starts off with a good explanation of how to measure receiver sensitivity with a step by step test procedure. Using the –107 dBm output, an ac voltmeter and some basic math, the user can determine the noise floor of a receiver. You can also determine the noise floor without the math if a step attenuator is used between the XG3 and receiver.

Another useful application that is explained in the manual is S-meter calibration, in which the user selects the –73 dBm output and manually adjusts the receiver's S-meter

[1]M. Tracy, KC1SX, "Elecraft XG1 Receiver Test Oscillator," Product Review, *QST*, Apr 2005, pp 78-79. This review is available to ARRL members online at **www.arrl.org/product-review**.

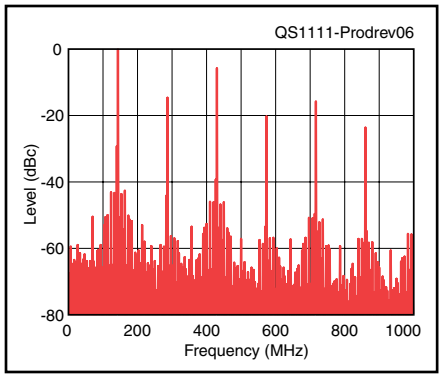



**Figure 6 — The XG3 relies on harmonics to generate test signals above 200 MHz. Here, the XG3 is programmed for 440 MHz and shows 440 MHz on the display, but the synthesizer is actually programmed for 146.666667 MHz.**

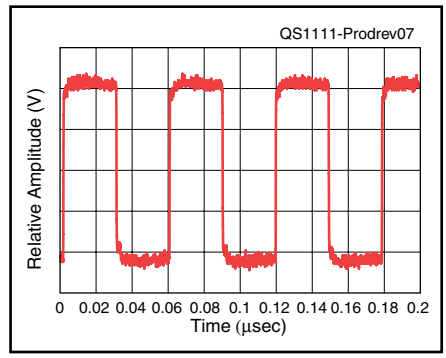



**Figure 7 — The XG3's output is a classic square wave. Here the output level is –33 dBm.**

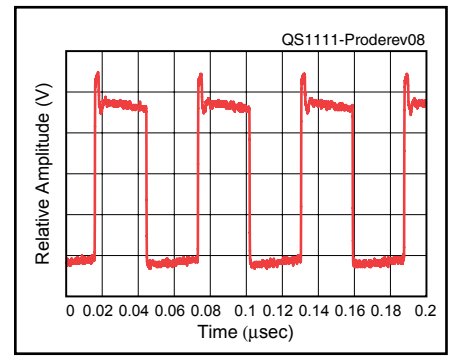



**Figure 8 — At 0 dBm (maximum output), the XG3's waveform shows a little distortion.**

sensitivity to read S9. Other applications of this test instrument are receiver alignment and using the XG3 as a VFO or local oscillator. The XG3 is a handy tool for tracing coax cables. On more than one occasion I've run bundles of coax cables and forgotten to mark each cable!

The XG3 can also be used as a signal tracer for testing each RF stage of a receiver. One word of caution, as the manual explains: Make certain there are no voltages present where the RF output jack connects to the test circuit. You must use a capacitor to block dc voltages found at various stages of a receiver.

Besides being a steady state signal generator, the XG3 can be used as a sweep generator, useful for checking filter or amplifier frequency response, and a programmable Morse and RTTY sender that can store up to 60 characters. I observed the sweep generator function using the swept frequency display of a software defined radio. Elecraft also provides a list of command control words for the technically savvy who wish to write their own custom control software. The sweep generator would be even more useful if a connection were provided to synchronize an oscilloscope sweep to the start of each generator sweep.

## Utility Software

Elecraft allows for the firmware to be updated using the computer interface cable and the XG3 utility program. The latest firmware and software are available for free download on the Elecraft website, **www.elecraft.com**. Downloading and launching of the provided software went smoothly for me. Using the TEST COMMUNICATIONS SOFTWARE tab, I choose the only com port listed, COM 1, to get the program to run the XG3 with my computer. The software instructions in the manual are very good; they will not leave the user guessing.

## Lab Testing

Tables 2 and 3 show the results of testing in the ARRL Lab. One software feature I appreciated was the ability to calibrate the RF output frequency so that it was close to the ARRL Lab's GPS locked HP 5351B frequency counter. I did this by using the EDIT OTHER SETTINGS tab and adjusting the calibration number while monitoring the frequency counter. Our counter's lower frequency limit is 10 MHz, so I selected the output frequency to be 10.120 MHz, the factory default. The XG3 uses a synthesizer and multiplier to create the desired output frequency from a stable, crystal controlled 10 MHz clock. Table 3 shows the actual output frequency error.

I discovered that when the low battery indicator is flashing, modulation is added to the signal, creating an audible tone in the test receiver's speaker. At this low voltage threshold, I found that the RF output dropped by only 1 dB or less. Frequency stability was rock steady within the normal operating voltages.

Using the XG3 during long periods at the 0 dBm output will definitely drain the battery quickly. A fresh generic alkaline battery I used lasted less than an hour during frequency measurement and calibration. There is an automatic power off feature in case the user forgets to shut off the unit. The default setting shuts off the XG3 after 10 minutes of inactivity; the time is adjustable with the utility program. A dc jack is provided for external power.

Output level accuracy was dead-on at all four output levels with the internal battery on all bands. With an external 13.8 V dc applied, accuracy was as good, except at the 0 dBm level, which increased to +2.5 dBm.

The RF output is a square wave and generates strong odd harmonics at the output. This is how the XG3 generates a signal higher than 200 MHz. While you can program any frequency up to 1400 MHz into the XG3's memories, for frequencies above 200 MHz, it will automatically program the XG3 synthesizer for the appropriate subharmonic. For example, if you program 440 MHz into the memory, it will show 440 MHz on the display, but the synthesizer will be automatically programmed for 146.666667 MHz (see Figure 6).

Above 200 MHz, accuracy of the RF output level is off, but a signal is generated nonetheless. If the user intends to operate this unit as a VFO, the RF output must be followed by a driver stage with shaped keying, a power amplifier and harmonic filters. Figure 7 shows the output waveform at –33 dBm and Figure 8 at 0 dBm.

## Conclusion

Elecraft has built a very handy, reasonably priced signal generator with stability and accuracy normally seen only on more expensive units. This versatile test instrument is great for the bench technician, radio restorer and experimenter. The XG3 Signal Source's small size allows it to be an excellent addition to any modern emergency "'go kit."

A video about this product review is available via the QR code to the left, or at **www.youtube.com/watch?v=vhrW4UkJ2_U**.

*Manufacturer*: Elecraft, PO Box 69, Aptos, CA 95001-0069; tel 831-763-4211; fax 831-763-4218; **www.elecraft.com**.

**Elecraft XG3 vs HP 5351**

If you own a tablet or smartphone with the appropriate application, scan this QR Code to see a video overview of the XG3 vs HP 5351. You can also watch this video on your computer by going to

**youtube.com/watch?v=vhrW4UkJ2_U**

# West Mountain Radio RIGblaster Advantage

If you plan to try your hand at PSK31, RTTY, JT65 or any of the other sound-card-based digital modes available today, chances are you're going to need some means to connect your computer (and its sound card) to your transceiver. Many amateurs rely on simple interfaces that merely provide transmit/receive switching and audio signal isolation. They are fine as far as they go, but the trend among more "deluxe" interfaces has been to incorporate the sound device within the interface itself. The advantage of this approach is that it frees the computer sound card for other applications (along with the need to readjust its settings between ham and family uses), and it eliminates the rat's nest of wires between the computer and the transceiver. Having an interface with an internal sound device makes life easier for the digitally active ham, especially if you want the convenience of being able to use the interface anywhere, and with just about any computer.



**The Advantage rear panel.**

West Mountain Radio has been making their famous RIGblaster interfaces almost since the day hams began using sound cards to create new digital modes. It was only recently, however, that they introduced an interface with a built-in sound device: the RIGblaster Advantage.

## Unique Design

The RIGblaster Advantage is designed to be a flexible hub for your entire station, regardless of whether you intend to operate phone, CW or digital. For example, you may want to use the microphone jack of your transceiver for regular SSB, AM or FM operation *and* as the input for digitally modulated audio for PSK31. Normally this would be a bit of a hassle since you'd have to swap the microphone and interface plugs each time you wanted to switch from voice to digital. With the RIGblaster Advantage, you simply plug your microphone into the interface and connect the interface to the radio's microphone jack. The Advantage switches between the microphone and the internal sound device automatically.

Another perennial headache with sound-card interfaces has been configuring the transmit/receive switching connections and transmit audio lines to correspond to the wiring of the transceiver's microphone jack. This often involves the tedious use of tiny jumper blocks or wires that you must place in the correct positions according to which signals need to go on which lines. The odds of success are usually not in your favor.

West Mountain's solution is to streamline the process with what they call "Instant Setup Connectors." You just choose the connector that matches your particular transceiver brand and pop it into place. It takes all of 10 seconds and you're good to go.

The Advantage connects to your computer through a USB cable. It obtains its power through the same cable, so there is no need to hook up an external power supply. The USB connection creates a virtual COM port for your computer operating system and the Advantage user manual steps you through the process of figuring out the designation (COM 6, for instance) so that you can set up your software accordingly. The Advantage appears to your computer as a sound device, so you also need to "tell" your software to chose it as the default. As with the COM port setup, this is a one-time operation. I was able to easily configure the Advantage in *Windows 7* for use with *DigiPan* for PSK31 operation and *Ham Radio Deluxe* for multimode applications. I also was able to get it working with *Fldigi* under *Ubuntu Linux*. In each case it was a matter of a few mouse clicks within the appropriate menus.

Speaking of *Ham Radio Deluxe*, the RIGblaster Advantage also includes transceiver control interfacing. Through *Ham Radio Deluxe* the Advantage gave me full access to control of all the functions of my radio.

CW and FSK keying are achieved with relay switching through a dedicated jack on the Advantage rear panel. The Advantage has the ability to perform transmit/receive keying in response to sound alone, such as when your sound card sends AFSK RTTY or modulated CW (MCW) tones, but "hard" COM port keying is almost always the best choice. The Advantage gives you the option — VOX or COM keying — through a front-panel toggle switch.

## Smooth Operation

The RIGblaster Advantage is one of the easiest interfaces I've ever used in terms of initial setup and overall operation. They've clearly put a lot of thought into making this product as simple to use as reasonably possible. The only glitch I encountered wasn't the fault of the Advantage. When I attempted to use *JT65-HF* software for *Windows*, the program had difficulty accessing the audio streams from the Advantage and generated errors as a result. Apparently this is a known issue with similar interface designs and will probably be resolved by the software author soon. With all other applications I tried, the Advantage was flawless.

*Manufacturer: West Mountain Radio, 1020 Spring City Dr, Waukesha, WI 53186; tel 262-522-6503;* **www.westmountainradio.com**. *$200.* QST

Steve Ford, WB8IMY ♦ *QST* Editor ♦ sford@arrl.org