

# PRODUCT REVIEW

## Yaesu FT-450D HF and 6 Meter Transceiver



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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.<sup>1</sup>

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

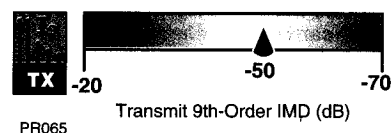
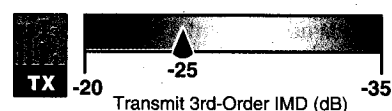
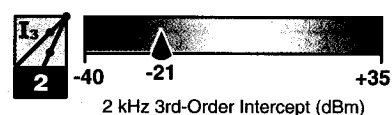
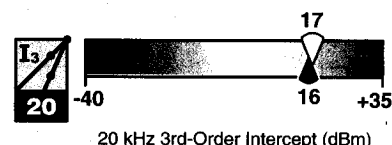
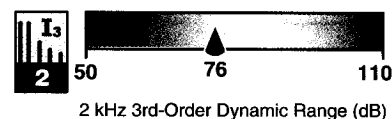
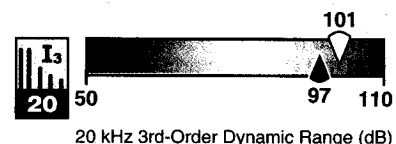
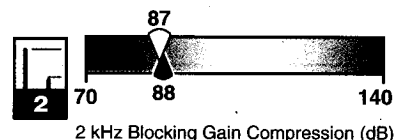
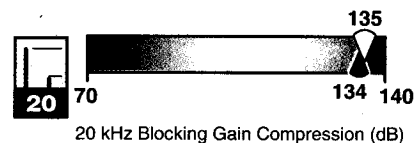
an internal automatic antenna tuner, the ATU-450. The new D model includes an automatic antenna tuner that covers the 6 to 160 meter bands and will, according to the manual, match impedances between 16.7 and 150  $\Omega$ . The manual also cautions that antennas such as non-resonant whips and wire antennas 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

### Key Measurements Summary



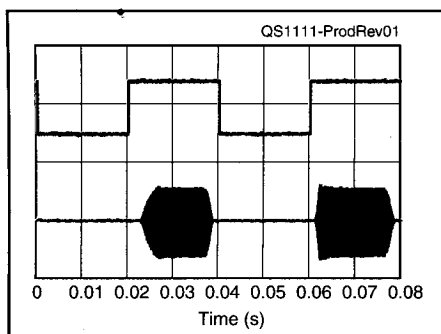
PRO65

Key:  
Dynamic range and intercept values with preamp off.  
Intercept values were determined using -97 dBm reference

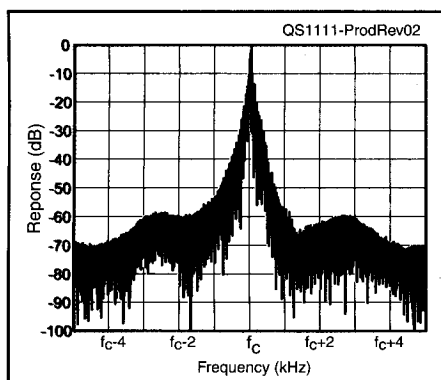
### Bottom Line

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.

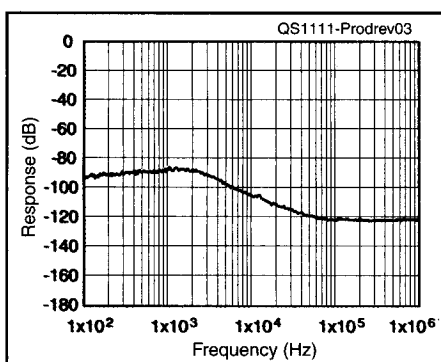
<sup>1</sup>R. Lindquist, N1RL, "Yaesu FT-450 HF and 6 Meter Transceiver," Product Review, *QST*, Dec 2007, pp 53-57. This review is available to ARRL members online at [www.arrl.org/product-review](http://www.arrl.org/product-review).



**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  $\pm 5$  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**

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.

Power requirement: 13.8 V dc  $\pm 10\%$ ; receive, 1.5 A (no signal); transmit, 22 A (100 W).

Modes of operation: SSB, CW, AM, FM.

**Receiver**

SSB sensitivity (2.4 kHz bandwidth, 10 dB S+N/N): SSB, 0.25  $\mu$ V (1.8-2.0, 3.5-30, 50-54 MHz).

Noise figure: Not specified.

AM sensitivity: 6 kHz bandwidth, 10 dB S/N: 2.0  $\mu$ V (1.8-20, 3.5-30 MHz), 2  $\mu$ V (50-54 MHz).

FM sensitivity: 15 kHz bandwidth, 12 dB SINAD: 0.5  $\mu$ V (28-30 MHz), 0.3  $\mu$ V (50-54 MHz).

Blocking gain compression: Not specified.

Reciprocal mixing (500 Hz BW): Not specified.

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

**Measured in the ARRL Lab**

Receive and transmit, as specified.

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).

As specified.

**Receiver Dynamic Testing**

Noise floor (MDS), 500 Hz bandwidth:

	Preamp off	Preamp on
0.137 MHz	-90 dBm	-93 dBm
0.505 MHz	-103 dBm	-113 dBm
1.0 MHz	-106 dBm	-115 dBm
3.5 MHz	-129 dBm	-137 dBm
14 MHz	-129 dBm	-136 dBm
50 MHz	-125 dBm	-139 dBm

14 MHz, preamp off/on: 18/11 dB

10 dB (S+N)/N, 1-kHz, 30% modulation, 6 kHz bandwidth:

	Preamp off	Preamp on
1.0 MHz	14.6 $\mu$ V	5.62 $\mu$ V
3.8 MHz	1.60 $\mu$ V	0.65 $\mu$ V
50.4 MHz	2.66 $\mu$ V	0.65 $\mu$ V

For 12 dB SINAD, 5 kHz bandwidth:\*

	Preamp off	Preamp on
29 MHz	0.83 $\mu$ V	0.27 $\mu$ V
52 MHz	0.93 $\mu$ V	0.24 $\mu$ V

Gain compression, 500 Hz bandwidth:

	20 kHz offset	5/2 kHz offset
	Preamp off/on	Preamp off
3.5 MHz	135/137 dB	93/87 dB
14 MHz	134/136 dB	93/88 dB
50 MHz	128/126 dB	93/88 dB

20/5/2 kHz offset: -98/-83/-74 dBc.

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

Second-order intercept point: Not specified.

DSP noise reduction: Not specified.

Notch filter depth: Not specified.

Adjacent channel rejection: Not specified.

FM two-tone, third-order IMD dynamic range: Not specified.

S-meter sensitivity: Not specified.

Squelch sensitivity: SSB/ CW/AM, 2.5  $\mu$ V (1.8-30 MHz), 1  $\mu$ V (50-54 MHz); FM, 0.32  $\mu$ V

Receiver audio output: >2 W into 8  $\Omega$  at 10% THD.

IF/audio response: Not specified.

IF rejection: Not specified.

Image rejection,  $\geq 80$  dB (HF);  $\geq 65$  dB (6 m).

## Transmitter

Power output: HF & 50 MHz: SSB, CW, FM, 100 W; AM, 25 W.

Spurious-signal and harmonic suppression: >60 dB on HF, >70 dB on 50 MHz.

SSB carrier suppression: At least 60 dB.

Undesired sideband suppression: At least 60 dB.

Third-order intermodulation distortion (IMD) products: Not specified.

CW keyer speed range: Not specified.

CW keying characteristics: Not specified.

lambic keying mode: Not specified.

Transmit-receive turnaround time (PTT release to 50% audio output): Not specified.

Receive-transmit turnaround time ("tx delay"): Not specified.

Composite transmitted noise: Not specified.

Size (height, width, depth): 3.3  $\times$  9  $\times$  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.

## Receiver Dynamic Testing

Preamp off/on, 14 MHz, +59/+31 dB; 50 MHz, +61/+61 dB.

Variable, 12 dB maximum.

Manual notch: 50 dB.

20 kHz offset, 29 MHz, 82 dB,\* 52 MHz, 83 dB.\*

20 kHz offset, preamp on: 29 MHz, 82 dB,† 52 MHz, 79 dB.

10 MHz channel spacing: 28 and 52 MHz, 98 dB.

S9 signal at 14.2 MHz: preamp off, 119  $\mu$ V; preamp on, 38.9  $\mu$ V.

At threshold, preamp on: SSB, 0.74  $\mu$ V; FM, 29 MHz, 0.45  $\mu$ V; 52 MHz, 0.11  $\mu$ V. (28-30 MHz), 0.16  $\mu$ V (50-54 MHz).

2 W at 10% THD into 8  $\Omega$ . THD at 1 V RMS, 1.6%.

Range at -6 dB points (bandwidth):‡ CW (500 Hz): 286-806 Hz (520 Hz); Equivalent Rectangular BW: 450 Hz. USB: (2.4 kHz): 300-1998 (1698) Hz; LSB: (2.4 kHz): 300-2010 (1710) Hz; AM: (6 kHz): 300-1673 (2746) Hz.

First IF rejection: 14 MHz, 100 dB; 50 MHz, 54 dB.

Image rejection: 14 MHz, 79 dB; 50 MHz, 74 dB.

## Transmitter Dynamic Testing

HF: CW, SSB, FM, typically 6-105 W; AM, 1.8-25 W.

HF, as specified; 50 MHz, 64 dB. Meets FCC requirements.

68 dB.

>70 dB.

3rd/5th/7th/9th order (10 m, worst case): HF, 100 W PEP, -25/-27/-45/-50 dB; 50 MHz, 100 W PEP, -20/-30/-39/-45 dB. 4 to 59 WPM.

See Figures 1 and 2.

Mode B.

S9 signal, AGC fast, 50 ms.

SSB, 26 ms; FM, 17 ms.

See Figure 3.

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

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

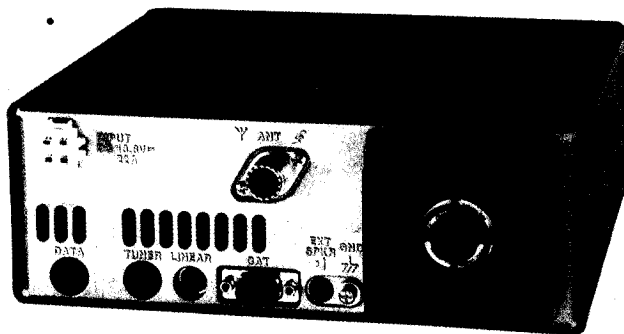


Figure 4 —  
The rear  
panel of the  
FT-450D.

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



### 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](https://youtube.com/watch?v=xenOt9jSK7I)

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](http://www.yaesu.com).

## Elecraft XG3 RF Signal Source

Reviewed by Bob Allison, WB1GCM  
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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 micro-

volts ( $\mu$ V) or, with stronger signals, millivolts (mV). A 0 dBm signal equals about 225 mV into a 50  $\Omega$  terminated system.

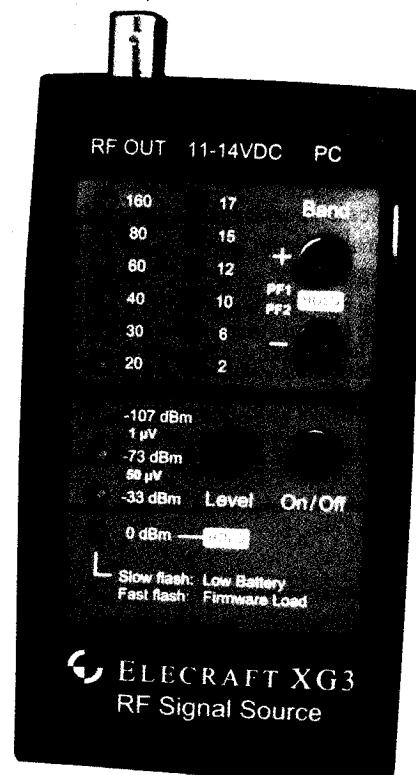
Another common signal reference level radio amateurs use is S9. Many receiver manufacturers align the S meter to read S9 with a 50  $\mu$ V (-73 dBm) signal level at the antenna jack, though not all do this. A signal level of 1  $\mu$ V is equivalent to -107 dBm, which is also the point at which a receiver's 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.<sup>2</sup> The XG3 is significantly more sophisticated.

### 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  $\mu$ V). 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



### 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.