



## Product Review and Short Takes from QST Magazine

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Product Reviews:

Yaesu FT-2000 HF and 6 Meter Transceiver

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Par Electronics 20 Meter End-Fed Dipole Antenna

# PRODUCT REVIEW

## Yaesu FT-2000 HF and 6 Meter Transceiver



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Yaesu's successful FT-1000 series of performance oriented HF transceivers started out with the then top-of-the-line FT-1000D, reviewed in these pages nearly 17 years ago in March 1991. The FT-1000s changed with the times, first to audio digital processing in the FT-1000MP, reviewed in April 1996, then IF DSP with the MARK-V FT-1000MP, reviewed in November 2000. The final version was the FT-1000MP MARK-V Field reviewed in August 2002.<sup>1</sup> It's been quite a run, one that Detroit's automakers would be delighted with.

The first of the series — FT-1000 and '1000D — were large and heavy 200 watt transceivers with internal power supplies. They weighed in at around 50 pounds. The '1000MPs were trimmed down to a smaller table top size that weighted a bit more than 30 pounds. The original 'MP and 'MARK-V Field offered 100 W transmitters and internal power supplies, while the 'MARK-V Field offered 100 W transmitters and internal power supplies, while the 'MARK-V upped that to 200 W with an external supply (13.8 V dc plus 30 V dc for the MOSFET output stage).

The FT-2000 shares the dimensions and weight of the late model FT-1000MP series, a good choice. There is an announced FT-2000D version that is due to arrive at dealers in early January. This will be a 200 W

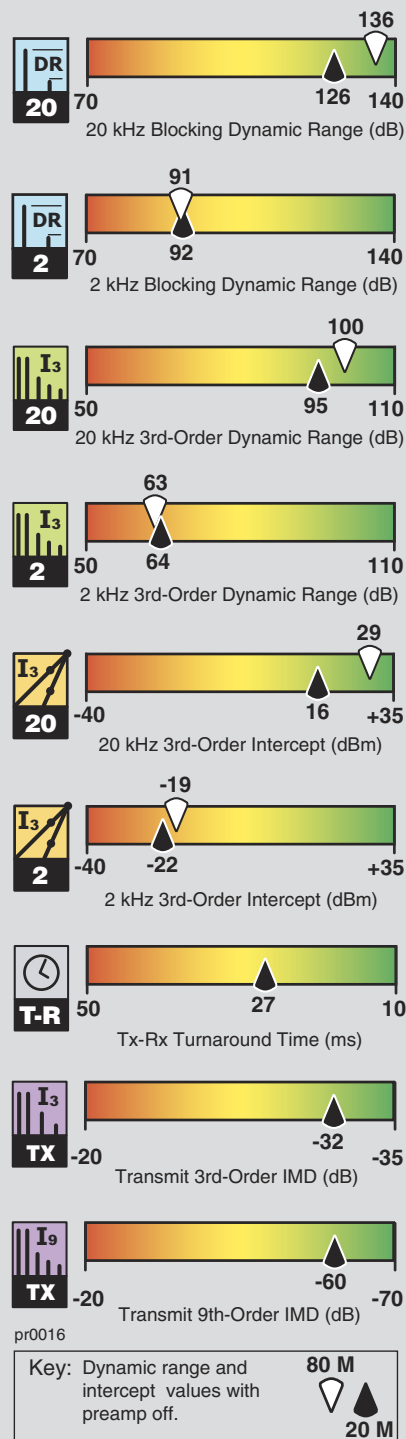
model that will have the power supply outside the radio, continuing the tradition. This seems to me to be a reasonable trade, and I'm sure both configurations will gather a significant following, as was the case with the FT-1000 versions.

### The FT-2000 Configuration

As supplied from the factory, the FT-2000 is a very competent HF and 6 meter transceiver that includes two general coverage capable receivers, a built-in power supply, IF digital signal processing for receive bandwidth selection in the main receiver and analog filter choices in the second receiver. In addition, DSP filtering provides noise reduction and automatic notch filtering on receive. All MF and HF bands are provided, including factory set memory channels for 60 meter operation. A real plus is the addition of full power 6 meter operation, not present on the FT-1000 series.

On the transmit side, you can set the SSB bandwidth you want as well as take advantage of a three band transmit audio equalizer, with different settings depending on whether you have the speech processor engaged or not. Thus there is provision for setting up a "hi-fi" equalization for casual operations when signal are strong and another defined contour for times when conditions are tough and maximum punch is called for. Also provided as standard equipment is an automatic antenna tuner designed to handle an SWR of up to 3:1 and a selection of two antenna connections, in addition to a receive antenna port. The motor-controlled antenna tuner can memorize

### Key Measurements Summary



### Bottom Line

With the FT-2000, Yaesu offers a suitable heir to their FT-1000 dynasty. It offers better performance, more features and adds 6 meters. This combination should make it a popular contender for a long time to come.

<sup>1</sup>QST Product reviews, including all of the FT-1000 series radios mentioned here, are available on the Web at [www.arrl.org/members-only/prodrev/](http://www.arrl.org/members-only/prodrev/).

settings in 10 kHz steps to return to the same settings the next time you're on frequency.

Those of us who operate CW were not forgotten either. Semi or full break-in is provided, as is a built-in memory keyer with automatic contest number sequencing. Switching to CW mode brings in a whole new set of DSP receive filters. In the second receiver, a 1000 Hz filter is standard for narrow CW, but there is also a slot for a second filter — and Yaesu offers optional Collins mechanical filters at 500 or 300 Hz to fill the slot. A version of the CW tuning indicator that had its debut on the FTDX9000 is there on the FT-2000 as well. It allows you to confirm exact zero-beat at a glance — a real asset for those of us without perfect pitch.

This radio has a well thought out front panel with most commonly used controls available via real sized knobs, far enough apart to use without moving other ones. The display includes a helpful “block diagram” of the receiver front end, showing antenna in use, the attenuator, preselector, preamp, roofing filter and AGC settings employed, all at a glance. This is a very helpful feature.

Infrequently needed adjustments and configuration settings are relegated to the 147 menus. The menus are clustered and described by mode or function to make it easy to set up the parameters the way you want for a particular operating mode. These are readily accessed while operating without losing your place. If there is one menu item you use frequently, it can be programmed for immediate access by a special front panel button. I think Yaesu did a good job of apportioning functions between the front panel and menus. If I could have had one menu item on the front panel, I think it would have been the receiver filter slope selection, but otherwise they are right on.

A nice feature of the FT-2000 configuration is that, while it has a built-in ac (120 or 240 V) power supply, making for easy self-contained portability, it can be unplugged from a connector on the rear and 13.8 V dc can be connected directly to allow emergency operation when ac is not available. While a myriad of jacks on the rear allow for all manner of interconnection flexibility, this can also be used as a single box station. Just hook up a mic or key and an antenna, add ac or dc power and you're ready for emergency or portable operation without a hitch. There's even a carrying handle on the side. The FT-2000D will operate from a 50 V supply, so this flexibility will likely not be available in the higher powered version.

## A Radio with Good Genes

The FT-2000 takes advantage of some of the work done to develop its earlier, and much more expensive siblings, the FTDX9000 family of high-end transceivers. Most noticeable are the selectable roofing filters at 3, 6

and 15 kHz, allowing near optimum early bandwidth selection for most modes.

In addition, the optional DMU-2000 data management unit can be plugged into the back at any time to generate video displays described in the review of the original FTDX9000D.<sup>2</sup> The FT-2000 version requires an external computer monitor and keyboard — there's no option for a front panel video display as offered on the '9000 series.

Other notable options are the  $\mu$ -Tuning high-Q narrow bandwidth preselectors as provided on the FTDX9000D and MP. The FTDX9000 Contest also lists  $\mu$ -Tune units as options, but they must be factory installed when you order the radio.<sup>3</sup> With the FT-2000 these can be added at any time, not just at original order, and just for the bands you want. Since these are expensive options, this flexibility can be helpful for those of us who need to spread out radio expenses.

The FT-2000 could be said to be something of an amalgam of features from both the FT-1000 and FTDX9000 lines, but with a distinct personality of its own.

## So How's She Play?

As with other major HF radio reviews, we have gathered the collective impressions of a number of amateurs. I will kick it off with general operating impressions. Then we will hear from ARRL staffers Norm Fusaro, W3IZ, and Rick Lindquist, N1RL, about their experiences with the FT-2000 in the Fall contests.

### Starting Up

My first experience using the FT-2000 was during my weekly schedule with former boss, long-time friend and mentor, George Randig, W1WO, on 80 CW. We've been doing this most weeks since 1974, so I didn't want to miss our time just because I had a new radio in position. I had to decide to rip out the usual radio, put the '2000 in its place and see if I could be up and running in the 30 minutes I had available. Well, I made the sked, and all went well. This doesn't exactly pass the Steve Ford test of getting on the air without looking at the manual, but basic operation doesn't take many looks. For a regular FT-1000 family user, it's probably duck soup!

### Receiver Performance

One of the primary considerations in the purchase of a new transceiver for serious contest or DX operation is receiver performance, particularly dynamic performance as represented by the critical third order

IMD and blocking dynamic range evaluations at close-in signal separation. The ARRL Lab test results are in Table 1 and are shown graphically in the Key Measurements Summary. Perhaps not surprisingly, if you pay more, either with Yaesu or its competitors, you can achieve even better performance. Still, the FT-2000 performance sits comfortably between that of the FT-1000 line and the FTDX9000 radios, competitive with others in its price range, and somewhat better in some areas, perhaps due to the use of multiple roofing filters.

Other important features include the fact that with the FT-2000, we have *two* receivers to consider. The second one is a quite competent analog design that meets its intended purposes quite nicely although it's not quite up to the level of the main receiver. Convenient controls allow the push of a button to command switching between receivers, bringing them both to the same frequency, or switching to transmit on the frequency either receiver is tuned to. Turning both on can put the headphone audio from each into separate ears with real size controls to set the level of either to the right intensity to help keep track of what's happening. Very nice.

### Getting to Know Your Radio

This is a radio that you need to spend time getting to know and love. It seems easy to get going and make contacts quickly, but that's just the beginning! There are many subtle operating skills that will be gained over time as you carefully note how this radio plays. Yaesu has tried to make the transition easy by providing knobs for digital controls, for example, but don't expect them to all act like your kitchen radio VOLUME control!

A good example is the digital noise reduction (DNR). There is a DNR button and a DNR knob. Pushing the button engages the noise reduction function at whatever position the knob is turned to. The farther clockwise, the more the noise reduction and the longer the processing time. If you turn the DNR knob to change the level, you are actually selecting a modification of the parameters used in the algorithm, and they won't reach full effect for a fraction of a second (longer the farther clockwise you turn it). This is a very different feel than the usual analog control and it can be easy to think it's not working properly. You will need to program your fingers to turn and wait, not to expect to observe an immediate response.

Plan to grow with this radio for a long time before you will be able to make use of all its features and you are likely not to be disappointed.

### CW Operation

The FT-2000 is a fine CW radio. The folks at Yaesu were clearly talking to CW

<sup>2</sup>J. Hallas, “Yaesu FTDX9000D HF and 6 Meter Transceiver,” Product Review, *QST*, Aug 2005, pp 53-59.

<sup>3</sup>R. Lindquist, “Yaesu FTDX9000 Contest HF and 6 Meter Transceiver,” Product Review, *QST*, Mar 2006, pp 61-66.

operators when they designed this radio. There are ¼ inch key connectors at both front and back and either can be independently menu configured to use the internal keyer or allow an external keying system to transmit. They both can be enabled at the same time so that a manual system can be used in between transmissions from an automated system, for example. A menu selection allows keying to also enter via the data port — useful for some forms of computer controlled operation.

The built-in electronic keyer works well, with handy full size speed and monitor level knobs on the front panel, where they should be. There are four CW memories, easily programmed and then callable via the small buttons on the bottom of the left side of the front panel. The messages can be entered with a key or the built-in keyer, or can be entered in textual form. There is also provision for auto number sequencing for contest use.

Full break-in (QSK) is supported, and it's every bit as smooth as I'm used to with my regular CW focused radio. I even managed to tie in the other manufacturer's linear amplifier keying loop by connecting an external keyer to the amplifier enable line and then from the amplifier to the rear '2000 key input. High power QSK worked fine with this combination.

A menu is provided to set the keying rise and fall time. I received good reports with the default 4 ms setting. Menus can also be called upon to select the type of keying — manual (or external) semi or full automatic as well as to set the dot-dash weight for the internal keyer.

On receive in CW mode, the bandwidth is adjustable using the WIDTH control from 25 Hz to 2.4 kHz in what feels like about a dozen steps. One wish I had was that I could tell what the bandwidth actually was. On the other hand, you crank down the WIDTH and adjust the SHIFT until you eliminate the interference. I found the narrowest bandwidths, 25 and 50 Hz, not particularly usable. I even tried listening to W1AW 5 WPM code practice and couldn't copy code through them. Perhaps there are some very low data rate modes that will make use of the very narrow bandwidths.

The skirt slope and corner sharpness are adjustable through menu settings. The manual indicates that the narrow (NAR) button sets the bandwidth to a menu adjustable value, perhaps 300 or 500 Hz and the WIDTH control can be used to make further adjustments. (On SSB, the WIDTH control is disabled with the NAR filter in line.)

One caution while operating CW — make sure that the digital notch filter (DNF) is off! I accidentally had left it enabled following a 40 meter SSB net and thought the receiver had lost its mind when I jumped into the CQ WW CW contest! The DNF is surprisingly effective at eliminating CW signals, but only

**Table 1**  
**Yaesu FT-2000, serial number 6J030197**

**Manufacturer's Specifications**

Frequency coverage: Receive, 0.03-60 MHz; transmit, 1.8-2, 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: 90-132, 180-264 V ac; receive, 80 VA (typical); transmit, 450 VA (100 W out).

Operating modes: SSB, CW, AM, FM, FSK, AFSK.

**Receiver**

SSB/CW sensitivity, 2.4 kHz bandwidth, 10 dB S+N/N: 0.1-1.8 MHz, 2.0 µV; 1.8-30 MHz, 0.15 µV; 50-54 MHz, 0.12 µV.

AM sensitivity, 6 kHz bandwidth, 10 dB S+N/N: 0.1-1.8 MHz, 3.2 µV; 1.8-30 MHz, 2 µV; 50-54 MHz, 1 µV.

FM sensitivity, 15 kHz bandwidth, 12 dB SINAD: 28-30 MHz, 0.5 µV; 50-54 MHz, 0.35 µV.

Blocking dynamic range: Not specified.

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

Third-order intercept: Not specified.

Second-order intercept: Not specified.

FM adjacent channel rejection: Not specified.

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

**Measured in the ARRL Lab**

Receive, as specified (sensitivity degrades below 1 MHz); transmit, as specified.

As specified.

As specified.

**Receiver Dynamic Testing**

Noise Floor (MDS), 500 Hz bandwidth:

	Preamp off	Preamp 1/2
1.0 MHz	-112 dBm	-122/-128 dBm
3.5 MHz	-124 dBm	-133/-137 dBm
14 MHz	-127 dBm	-138/-141 dBm
50 MHz	-121 dBm	-133/-139 dBm

10 dB (S+N)/N, 1-kHz tone, 30% mod:

	Preamp off	Preamp 1/2
1.0 MHz	12 µV	3.9/2.0 µV
3.8 MHz	2.5 µV	1.1/0.94 µV
50 MHz	4.6 µV	1.3/0.66 µV

For 12 dB SINAD:

	Preamp off	Preamp 1/2
29 MHz	1.6 µV	0.47/0.22 µV
52 MHz	2.0 µV	0.58/0.29 µV

Blocking dynamic range, 500 Hz filter:

	20 kHz Preamp off/1/2	5/2 kHz Preamp off
3.5 MHz	136/132/128 dB	107/91 dB
14 MHz	126/126/120 dB	108/92 dB
50 MHz	135*/131*/129* dB	105/88 dB

Two-tone, third-order IMD dynamic range, 500 Hz filter:

	20 kHz Preamp off/1/2	5/2 kHz Preamp off
3.5 MHz	100/95*/92 dB	84/63 dB
14 MHz	95/94/91 dB	85*/64 dB
50 MHz	85/92/96 dB	83*/65 dB

	20 kHz Preamp off/1/2	5/2 kHz Preamp off
3.5 MHz	+29/+15/+6 dBm	+20/-19 dBm
14 MHz	+16/+5/-5 dBm	+11/-22 dBm
50 MHz	+15/+9/+8 dBm	+11/-16 dBm

Preamp off/1/2, +75/+74/+71 dBm.

20 kHz offset, preamps on:  
29 MHz, 78 dB; 52 MHz, 76 dB.

20 kHz offset, preamps on:  
29 MHz, 78 dB\*; 52 MHz, 76 dB\*;  
10 MHz offset: 52 MHz, 96 dB.

after you think you have them tuned in! There are some digital notch filters that don't filter out CW, and some that do. It would be better if the FT-2000 either changed the algorithm when in CW mode, or just disabled the function when in CW.

**SSB Operation**

At its heart, the FT-2000 is a classic single sideband (SSB) transceiver. The narrow 3 kHz roofing filter is almost optimum for that mode, although the default selection is the 6 kHz unit, to allow for up to 4 kHz SSB bandwidth. For contesting or DXing, you will want to hit the R.FLT button to switch from

AUTO mode to 3 kHz to take advantage of the improved near-in dynamic performance. The difference won't likely be noticeable — until the band fills with strong signals, then the "buck shot" and "popcorn" from near-in IMD should be reduced.

Single sideband voice operation is well defined and laid out. The eight-pin mic connector is directly compatible with earlier Yaesu microphones (rant — why have all transceiver manufacturers now standardized on the same eight-pin connector, but no two manufacturers wire them the same way?). The voice operated transmit (VOX) operates smoothly and doesn't trip from receive audio

## Manufacturer's Specifications

S-meter sensitivity: Not specified.

Squelch sensitivity: SSB, 2.0  $\mu$ V;  
FM, 1.0  $\mu$ V.

Audio output power: 2 W into 4  $\Omega$  at  
10% THD.

IF/audio response: Not specified.

Spurious and image rejection: HF, 70 dB;  
50 MHz, 60 dB.

## Transmitter

Power output: HF & 50 MHz: SSB, CW, FM,  
100 W (high), 5 W (low); AM, 25 W (high),  
2 W (low).

Spurious and harmonic suppression: >60 dB  
on HF, >70 dB on VHF.

SSB carrier suppression: >60 dB.

Undesired sideband suppression: >60 dB.

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

CW keyer speed range: Not specified.

CW keying characteristics: 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): 5.3  $\times$  16.1  $\times$  13.8 inches; weight, 32 pounds.

Price: FT-2000, \$2675; DMU-2000 data management unit, \$1000; Microtune module kit A (160),  
B (80/40) or C (30/20 meters), \$500 each; FH-2 remote keypad, \$100; YF-122C 500 Hz or  
YF-122CN 300 Hz Collins CW filter, \$170.

Third-order intercept points were determined using S5 reference.

\*Measurement was noise-limited at the value indicated.

\*\*Varies with pitch control setting.

at the speaker (but don't forget to turn off the MONI if you use the speaker, or the howl will be heard around the globe!). The VOX GAIN and DELAY controls are handy knobs on the front panel, where they should be. The delay is adjustable from not perceptible to ridiculously long, so there's a setting for every operator and type of operating.

I used the FT-2000 with three different Yaesu mics, the MH-31 hand mic that is supplied with the unit, an early MD-1 that was in a dark corner of the ARRL Lab and an MD-100 that we had purchased to use for FTDX9000 testing. The first two worked great, both straight through and with the speech

## Measured in the ARRL Lab

S9 signal at 14.2 MHz: preamp off, 160  $\mu$ V;  
preamp 1, 45  $\mu$ V; preamp 2, 19  $\mu$ V;  
50 MHz, preamp off, 160  $\mu$ V; preamp 1,  
45  $\mu$ V; preamp 2, 20  $\mu$ V.

At threshold, preamp on: SSB, 14 MHz,  
1.3  $\mu$ V; FM, 29 MHz, 0.23  $\mu$ V;  
52 MHz, 0.14  $\mu$ V; 146 MHz, 0.15  $\mu$ V;  
430 MHz, 0.15  $\mu$ V.

4.2 W at 8.5% THD into 4  $\Omega$   
(max volume).

Range at -6 dB points, (bandwidth):  
CW (500 Hz): 450-955 Hz (505 Hz)\*\*;  
USB: 260-2380 Hz (2120 Hz);  
LSB: 267-2000 Hz (1733 Hz);  
AM: 48-1682 Hz (1634 Hz).

First IF rejection, 14 MHz, 108 dB;  
50 MHz, 98 dB; image rejection,  
14 MHz, 98 dB; 50 MHz, 90 dB.

## Transmitter Dynamic Testing

HF: CW, SSB, FM, typically 110 W high,  
4 W low; AM, typ 20 W high, <1 W low;  
50 MHz: CW, SSB, FM, typ 100 W high,  
4 W low; AM, typ 42 W high, 1 W low.

HF, 60 dB; VHF, 64 dB.  
Meets FCC requirements.

63 dB.

67 dB.

3rd/5th/7th/9th order (worst case band):  
HF, -32/-40/-53/-60 dB PEP;  
VHF, -32/-43/-51/-62 dB PEP.

4 to 56 WPM.

See Figures 1 and 2.

S9 signal, 27 ms.

SSB, 35 ms; FM, 35 ms.

Unit is suitable for use on AMTOR.

See Figure 3.

processor, when set up as described in the manual. I received a number of good reports on the audio. When I switched to the newer mic, I found that I had to take advantage of the built-in parametric equalizer to make it balance properly. Then I found the filter selection on the bottom of the mic, and that worked too. While talking to a bunch of local and expatriate club members, I received good reports without the processor and "processed" reports while on the processor. Rich Roznoy, K1OF, perhaps summed it up best: "When the processor is off, it sounds like you — when the processor is on, it sounds like processed audio, right for DX and contests." What could be better?

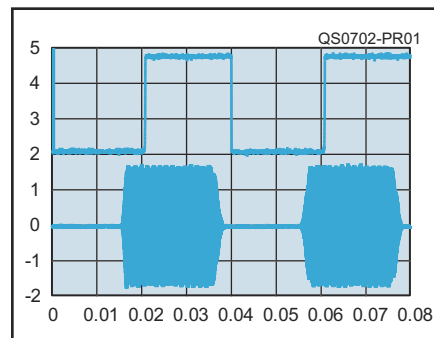


Figure 1—CW keying waveform for the Yaesu FT-2000 showing the first two dits in full-break-in (QSK) mode using external keying. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. (Note that the first key closure starts at the left edge of the figure.) Horizontal divisions are 10 ms. The transceiver was being operated at 100 W output at 14.2 MHz at the default 4 ms setting.

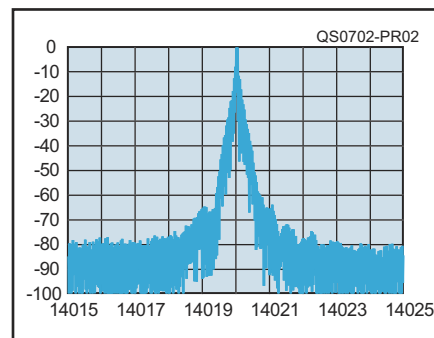


Figure 2 — Worst-case spectral display of the Yaesu FT-2000 transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 100 W PEP output at 14.2 MHz at the default 4 ms setting.

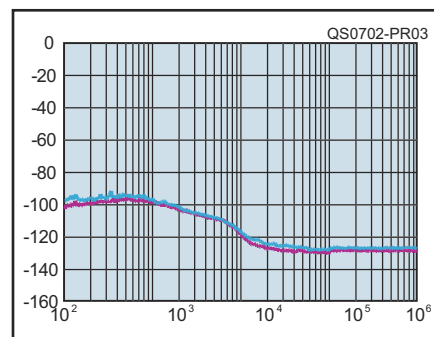


Figure 3 — Worst-case spectral display of the Yaesu FT-2000 transmitter output during composite-noise testing. For the red trace, power output is 100 W at 14.2 MHz; the blue trace is 100 W at 50 MHz. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 100 Hz to 1 MHz from the carrier.

## An SSB Contest Operator's View of the FT-2000

As noted previously, there are two sets of transmit audio parametric equalizer settings. Menu items 123 to 131 set equalizer parameters when the speech processor is off, while 132 to 140 are effective when the processor is on. According to Yaesu, the default settings of 132 to 140 are intended to provide maximum punch for DX and contest operation. If more natural sounding voice is desired with the processor on, they suggest setting menus 132 and 135 to OFF. Operator voice characteristics and type of microphone may make other settings optimum for a particular user. To be certain, listen to the results in another receiver.

The monitor function, switch selectable and with MONI level set from the front panel, makes it easy to preview the sound you will get. Be prepared to take some time with the equalizer. There are six adjustments (three with, and three without, the speech processor) for each of the three equalizing bands, so maximum flexibility is provided. Don't expect to find a simple TONE control!

The FT-2000 has a manual notch filter that provides a depth of more than 60 dB and is very effective in all modes. The digital notch filter (DNF) is designed to automatically notch out multiple interfering tones in the passband. The DNF notched a single tone by 60 dB when nothing else is in the passband, but its effectiveness is reduced with noise or signals in the passband (as there would be during on-air SSB operation when you really need the filter). We also noticed that the reduction is greater with stronger tones. The DNF didn't behave well with more than one tone. It adds audible distortion products and notches the upper tone only 5 dB.

The SSB receive bandwidth is smoothly adjustable from 200 Hz (perhaps thinking of digital sound card modes) to 4 kHz, in the same manner as for CW. On SSB the narrow (NAR) button brings in a fixed 1.8 kHz (menu settable) bandwidth and disables the WIDTH adjustment, but not the SHIFT or CONTOUR controls. Of course, if you don't like the one-button approach, you can manually set the WIDTH to whatever suits you best.

There are four voice memories that reuse the same buttons (but not the memory spaces) that are used for CW memory.

### AM Operation

One of my radio interests is older amateur equipment and I maintain a station or two with vacuum tube "boat anchor" gear. From time to time, I check into the Antique Wireless Association ([www.antiquewireless.org](http://www.antiquewireless.org)) AM net on 75 meters on Sunday afternoons. The group, centered around Rochester, New York, tolerates my occasional lapses into solid state gear, and said that my signal from the FT-2000 (25 W) amplified by my 500 W linear sounded about like my usual '50s era Johnson Viking II. I had to go into the menu system to modify the mic gain from the AM

Contesters and DXers are continuously searching for ways to improve their station's performance, especially when it comes to pulling a weak station out of the noise or holding a frequency in crowded band conditions. I have an FT-1000MP in my station and had high hopes for the FT-2000.

My first impression when unpacking the rig was the family resemblance to its big brother, the FTDX9000. The oversized main VFO knob and the proliferation of control knobs and buttons on the face of the '2000 may be intimidating to some operators, but basic operation is quickly accomplished by using a few clearly marked controls. The radio's large display and analog meter are easy to view. Menu settings for brightness of the display and meter are independent of each other, making several hours in front of the radio comfortable on the eyes.

When I turned on the FT-2000 for the first time, I wanted to check to see if I had an antenna connected because the receiver is so quiet. Don't be fooled into thinking that the rig is asleep because even weak signals jump out of the speaker when you tune through a band.

### Tailoring the Transmit Audio

The first adjustment I explored was the built in parametric equalizer for the transmitted audio. Normally I set up my transmitted audio by listening to my signal on an external receiver. Using the transceiver's monitor, which samples the transmitter's IF signal, proved to be very effective in setting up the audio menus.

I received outstanding transmitted audio reports with the FT-2000 and a Heil Goldline microphone. Proper set up of the parametric equalizer, speech processor and audio bandwidth produced a full-bodied, warm, flat response for those nice armchair ragchew type QSOs. I changed the microphone to a Heil headset and after a few tweaks to add some midrange punch the radio was ready for contesting.

Yaesu included a digital voice keyer (DVK) for contesting, eliminating the need for an outboard box like the DVS-2 used with the FT-1000 series. While there is no need for an outboard unit to play back recorded messages, it's convenient to have the optional FH-2 keypad to control the internal DVK. I used the FH-1 keypad from my FT-1000MP and it worked fine. Without the keypad you control the DVK with front panel pushbuttons.

The DVK falls just short of what I wanted for contesting. It's easy to record and play back messages ("CQ Contest" for example), but on playback there is about half a second of dead air at the tail end before the radio returns to receive. This may not seem like much of a delay, but I found it very frustrating because I missed the beginning of a lot of calls, requiring fills and slowing down the QSO rate.

### The Learning Curve

Operating an HF transceiver is like driving an automobile in that the basic operation is the same for almost every model. Beyond basic operation, it's a good idea to read the manual. Understanding the controls and their functions can greatly enhance your operating pleasure. Improper use of some of the controls can yield undesirable performance.

Imagine sitting in a new high performance car with no foot pedals or steering wheel. Instead you are in a captain's chair with joysticks on the arms and several buttons at your fingertips. Surely it will take you some time to familiarize yourself with the new controls and become proficient at driving such a machine. The FT-2000 is not *that* big a departure from current radios, but I can't emphasize

default, but managed to get good signal reports, with and without the speech processor. The manual could use a bit more detail about how to set the AM levels, but listening on a second receiver can get you very close.

The receiver did a fine job on AM, but many of the DSP functions are not available there. The IF bandwidth choices are 9 kHz or 7 kHz with NAR pressed. The WIDTH control doesn't work on AM.

Lab testing showed that the audio frequency response is quite limited — around

2 kHz. This is suitable for communications quality work, but it limits AM or "hi-fi" SSB listening.

### Other Modes

In addition to CW, SSB and AM, described above, the FT-2000 is also set up for easy operation on other modes.

### FM

With the FT-2000, Yaesu has crossed the divide between HF and VHF. The FT-2000

enough that this radio has a lot to offer the operator who takes the time to understand its features and controls. The best way to really get to know the FT-2000 is to sit down with the radio and manual and play with it.

### Fighting Interference

The FT-2000's filters and QRM busting features helped me to pick out signals in crowded band conditions. Most of them performed as expected, but I wasn't impressed with the digital notch filter (DNF). This autonotch feature does not have the "seek and destroy" performance of the autonotch in my FT-1000MP. The manual suggests using the manual notch filter first for strong interference, and then the DNF, and that really works well. So, if I have to make manual adjustments to make the autonotch most effective... well, you get the idea.

I was impressed with the digital noise reduction (DNR). The manual does not provide a thorough description of the use of this feature, but it really helps pull out a signal from the noise. For normal operating conditions, the DNR can make the station you are talking to sound like the only signal on the band.

### Contest Operation

Having spent several evenings with the radio, I was ready to run it in the CQ World Wide SSB DX Contest. Other than the previously mentioned DVK issue, the FT-2000 really performed well. Selectivity is excellent. Each slight movement of the VFO knob was like turning a page in a book and uncovering a new station.

The FT-2000 has plenty of audio punch. Running stations on a crowded band was painless. When I called CQ, stations started calling and I found it very comfortable to pick out call signs in the pile up. After picking off the loud stations, a twist of a knob or push of a button was all it took to clean up the pile up of weaker stations calling me. On several occasions I was able to maintain a rate of over 225 QSOs per hour.

My contest logging software didn't have drivers for such a new radio, so I didn't try rig control during the contest. With my everyday logging and station control software (*LOGic 8*) I was able to select the FTDX9000 drivers and take advantage of most of the transceiver's computer controlled features.

Split operation on 40 meters was quick and easy with the push of a single button. The SUB VFO-B knob is unobtrusive but large enough to allow smooth quick tuning to the DX station's listening frequency on the second VFO. The FT-2000's dual receive feature lets the operator monitor the DX transmit and receive frequencies simultaneously. Menu selections allow you to tailor the style in which you monitor the sub receiver. I prefer to have the sub receiver at a slightly lower volume in the background of both ears but others may wish to listen to one receiver in the left ear and the other receiver in the right ear. The FT-2000 can accommodate any preference.

### Overall

The FT-2000 performed well in crowded band conditions and did not require a lot of adjusting of controls. Running stations was as simple as putting the pedal to the metal and calling CQ. Search and pounce operation yielded nice results. After collecting the low hanging fruit, the FT-2000's receiver uncovered several layers of stations and several new multipliers. Being familiar with the radio's operating characteristics made operating the contest fun in spite of the less than optimum band conditions for the contest weekend. — *Norm Fusaro, W3IZ, Affiliated Club/Mentor Program Manager*

supports all usual VHF modes including full FM operation. This includes CTCSS tone generation and decode capabilities and automatic repeater spacing for the usual 6 and 10 meter offsets. A transverter output at the 10 dBm level is provided to extend operation to higher bands.

### RTTY

The FT-2000 has a dedicated four-pin rear panel RTTY jack similar to the FT-1000 and other Yaesu radios. The RTTY jack provides

inputs for frequency shift keying (FSK) and PTT transmitter control plus a fixed level audio output from the receiver. You can use the RTTY jack with a dedicated terminal unit or with a computer based setup with FSK keying through a serial or USB port and a sound card for receive.

### Packet and Sound Card Modes

A dedicated five-pin rear panel PKT jack is designed to accept audio frequency shift (AFSK) tones and a PTT line from a standard

terminal node controller (TNC) for packet operation. Many TNCs provide for operation in other modes such as Pactor or RTTY through the same interface.

The PKT label is actually a bit misleading. Using a computer sound card to generate and decode various modes of operation from a computer is very popular these days. Software is available from multiple sources to allow slow-scan television (SSTV), packet, AFSK RTTY, PSK31 and many other operating modes. Use the PKT connector to get audio into and out of the FT-2000 for any of these modes. In addition, the rear panel offers fixed level audio out and (phone patch) microphone and PTT line connections that can be used for this purpose.

### Documentation

Yaesu has provided a 128 page manual with the FT-2000. It is organized for someone who is learning how to operate the radio, guiding a new owner through installation and setup, then receiving, including the various DSP and analog receive enhancements. Next the reader is led through various modes starting with SSB and progressing through CW and FM. The manual concludes with a description of each of the menu settings including an indication of their default values.

The documentation would be more useful if it were also indexed by function and control. Once you have worked your way through the initial familiarity, which the current manual structure is designed for, it would be nice to be able to look up a control function without having to know if it were described in the SSB or CW section.

The documentation seems to run behind the production. The unit we received came with a manual that described 138 menu items, while the radio had 147. The added menu items are for adjusting the microphone equalizer while using the speech processor — a welcome addition. Unfortunately, the addition of these menu items changed other menu numbers. As a consequence, some of the menu numbers in the printed manual were not correct and in those cases our printed manual was not too useful.

Fortunately, Yaesu provides the up to date manual on their Web site, [www.yaesu.com](http://www.yaesu.com). Click on FT-2000 and then FILES and you will have a selection of all their newest documentation. One advantage of downloading the PDF version of the manual is that you can use Adobe *Acrobat's* search features to locate information.

Since I didn't know all that had changed, I printed all 128 pages and put them in a loose leaf notebook and used that. It would be very handy if they indicated which pages have been updated so you would only have to print changed ones going forward. For example, I'm sure that they will fix pages 104 and 105 to get the correct figures on each

## N1RL's ARRL 160 Meter Contest Observations

Anyone who's operated the ARRL 160 Meter Contest in early December knows what genuine CW QRM can sound like, not to mention the challenge of trying to pick out weaker (sometimes much weaker) signals in the midst of the horde. With hundreds of signals packed into some 60 to 70 kHz of spectrum, and the band's propensity to get noisy at times, it goes without saying you'll need a top-notch receiver to sort things out. Overall, the FT-2000 proved to be an able performer.

In much of the Eastern US, severe thunderstorms generated waves of raucous static crashes to greet participants right out of the gate. While the FT-2000 couldn't put up much of a defense against *that* sort of assault, the radio's DSP noise reduction, VRF and CONTOUR features, coupled with up to 18 dB of attenuation, made it possible at least to work *many* of the more obvious stations in the early going. Given the challenging conditions, the FT-2000 remained reasonably quiet once the static crashes subsided. This was true whether I used the wide or the narrow roofing filter selections.

Integrating the FT-2000 into my station was painless, although since I was operating in the low-power category (150 W or less), amplifier switching was not a concern. (I'd considered going QRP until I heard the carnival of atmospherics.)

The DSP filtering is competent but not quite as flexible as other implementations I've seen. I found the WIDTH adjustment, on the outer ring of a concentric control, awkward to adjust. More important: The user has only a vague notion of the actual bandwidth setting, since there's no readout, only a *very* rough LED-segment approximation. Apparently, the number of actual bandwidth choices exceeds the ability of the LED segments to represent them more distinctively.

In performance terms, only the two narrowest filter settings (50 and 25 Hz) exhibited considerable ringing. After

some use, CW notes I was hearing would acquire an unpleasant rough tone, especially at narrow filter settings. This seemed related to aliasing in the DSP noise reduction system, something I've heard in other radios. Turning the radio off and on again reduced it somewhat. Backing down the DNR control or turning DNR off and on again also reduced the effect.

The sub-receiver is a terrific addition. It's great to be able to listen two places in the band at the same time at the press of a button to, say, keep an ear on the high-power crowd going after that rare multiplier while you're waiting for the throng to thin a bit.

While the FT-2000's quality fit and finish impressed me, its front-panel and, especially, its menu design still harkens back to the 1990s. I much prefer a menu system that doesn't demand consulting the manual to decipher. Yaesu included a daunting number of front-panel controls and buttons, so it's pretty easy to inadvertently hit something you didn't intend to. State-of-the-art menus could eliminate some of these by farming out a few lesser-used functions.

### Additional Nits, Puffs and Pans

- I found the zero-beat indicator helpful, even though I possess a pretty decent sense of pitch.
- Even at its loosest setting, the dial tension was too tight for my taste and the tuning rate was too fast. The finest you can get is 1 kHz per turn.
- The NOTCH control makes an annoying crackling noise, as if it were dirty.
- The receiver audio sounded quite good.
- The analog meter does not provide for peak reading.
- The QSK is decent but I thought a bit on the "poppy" side while listening to the monitor. — *Rick Lindquist, N1RL, Senior News Editor*



Figure 4 — The FT-2000 shows the status of many feature settings at a glance.



Figure 5 — Jacks on the FT-2000's rear panel are easy to get to and well marked.

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page. When they do, will those be the only changes, or do I have to just print the whole thing again to be sure?

### My Wish List

This is a fine radio out of the box, but I could appreciate just a couple of enhancements for the next revision. First, the DNF needs to be set so that it isn't able to be turned on for CW, or its algorithm is fixed so that it is effective in that mode. Second, I expect that this radio will evolve over time. My wish is that Yaesu finds a way to update the firmware remotely so that all users will be able to take advantage of all the improvements.

*Manufacturer:* Vertex Standard, 10900 Walker St, Cypress, CA 90630; tel 714-827-7600; [www.yaesu.com](http://www.yaesu.com).

### Correction

In the December 2006 Product Review we printed an incorrect phone number for ACOM. The correct number is 508-533-7765. **QST**



# SHORT TAKES

## Par Electronics 20-Meter End-Fed Dipole Antenna



On the face of it, an “end fed dipole antenna” seems to defy common sense. It looks like nothing more than a simple end-fed piece of wire. The difference is apparent when you dig a little deeper.

A traditional  $\frac{1}{2}$ -wavelength dipole antenna is fed in the center because that is where the impedance is closest to 50  $\Omega$ , which is a nice match to 50- $\Omega$  coaxial cable. But nothing prohibits you from feeding a  $\frac{1}{2}$ -wavelength antenna at any other point, so long as you are willing to deal with the impedance mismatch. If you attempt to feed the antenna at one of the ends, you’re looking at an impedance of thousands of ohms (4 to 5 k $\Omega$  is typical).

End feeding offers advantages for people like me who have limited space and few antenna supports. An end-fed antenna requires only one support, which any convenient tree will provide, and it doesn’t need a network of ground radials.

Of course, there are disadvantages to end feeding. End-fed dipoles can be inefficient and subject to problems with common-mode currents on the feed line. At 100-W power levels used by most hams, common-mode currents don’t usually pose a serious problem, though.

### The EF-20

For this review I decided to try one of the Par Electronics designs—the model EF-20 for 20 meters. As with most end-fed antennas (or “End-Fedz” as Par calls them), the EF-20 is a  $\frac{1}{2}$  wavelength of wire. Specifically, it is 33 feet of black polyethylene jacketed stranded copper wire. At the business end you find the matching unit with an SO-239 coaxial connector. The EF-20 comes completely assembled and ready to go.

Fifteen minutes after removing the EF-20 from its box, the antenna was dangling from a convenient tree branch. The EF-20 wasn’t installed vertically, but instead sloped at about a 60° angle. This is quite a stealthy antenna. Even in late autumn the wire was difficult to see among the bare branches. If the tree were in bloom, it would be invisible.

The first test involved a sweep with an antenna analyzer. Initially, the 2:1 SWR bandwidth was somewhat sharp, but end-fed antennas can be affected by nearby objects and my EF-20 was relatively close

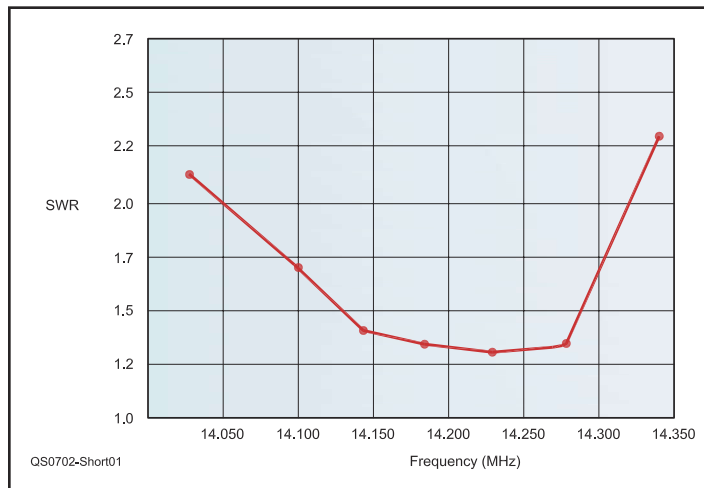


Figure 1—The 2:1 SWR bandwidth of the Par Electronics EF-20 end-fed dipole after I moved the antenna into the clear.



The Par Electronics EF-20 arrives pre-assembled and ready to go.

to not only a tree, but also my Fluidmotion SteppIR vertical antenna. When I moved the EF-20 into the clear, the curve flattened considerably. See Figure 1.

### On the Air with the EF-20

I used an antenna switch for A/B comparisons between the EF-20 and my SteppIR vertical. The difference was noticeable with the SteppIR having a definite edge over the EF-20. In terms of received signal strength, the “edge” amounted to about one to two S units in most cases.

I received good signal reports with the Par EF-20. In fact, my test stations noticed only a slight difference when I switched between the SteppIR and the EF-20. In addition, I had no problems with RF getting back into the shack.

### Conclusion

An end-fed dipole is not a panacea, but



The EF-20 matching unit converts the high impedance at the end of the antenna to 50  $\Omega$  for the transmission line.

the Par Electronics EF-20 did a decent job considering the fact that it doesn’t require radials or a counterpoise. The EF-20 is an attractive option for antenna-restricted environments, and for portable operation. The antenna only weighs about 8 ounces, so you can roll it up in a bag and take it anywhere. In addition to the EF-20, Par manufactures end-fed models for 40 through 2 meters.

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