

Product Review Column from QST Magazine

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Yaesu FT-920 MF/HF/6 Meter Transceiver

Tune in the World for Less Than \$300: Drake SW1 and Radio Shack DX-394

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Product Review

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Yaesu FT-920 MF/HF/6 Meter Transceiver

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The Amateur Radio transceiver has changed substantially since its advent in the 1950s. Each generation has provided new features that have gone from option to standard. Some of these, though revolutionary for their time, have become commonplace.

The latest generation of transceivers feature expanded band coverage. Where once 80 through 10 meter coverage was standard (with only a few offering 160 meters), most manufacturers now offer at least one transceiver that at least covers 160 through 6, and nearly all with general-coverage receivers.

The expanded coverage coincides nicely with the beginnings of a new sunspot cycle, and more countries of the world allow 6 meter operation than ever before. Extended coverage plus more availability will increase activity on 6 meters throughout the world. The new generation of transceivers will be ready for this upsurge and may even drive it.

This leads us to the FT-920, Yaesu's latest entry in the current generation and its first "HF" transceiver to include 6 meters. The '920, which replaces the FT-990 in the Yaesu lineup, packs in a lot of features per dollar and couples them with great performance to boot. Some standard features, such as its digital voice recorder, are ones not found on other units in this price class. *Shuttle jog* tuning, which allows for rapid band excursions, is another (it debuted on Yaesu's more upscale FT-1000MP, which the FT-920 somewhat resembles). One standard feature we had not seen before is the *linear tuning pulse* system. This menu option provides a pulsed signal (pulse and space times are menu-settable) for low-duty cycle (ie, 15% or 20%) linear amplifier tuneup with full-power pulses! It's also possible to adjust power output and duration of the tuning signal.

The FT-920 provides 100 W output on all bands, including 6 meters. It has MOSFET power amplifiers in the transmitter's final stage.

Other standard features, such as the automatic antenna tuner and the CW keyer, have come to be considered almost necessities. With the exceptions of FM and transmit on AM (both require optional boards), the FT-920 offers a pretty complete package. Little remained on my "wish list" once I'd had a chance to get familiar with it.

This brings up one point that should be made about this transceiver: you need to read the instruction manual *first*, not only to get



optimum performance, but to get it on the air. It's entirely possible for a new owner to manipulate this radio to the point where you won't hear anything at all if enough knobs are turned the wrong way!

Up Front

This is a pretty busy panel, with 79 buttons or controls to contend with (all the more reason to study the manual). Once you get the gist of it, however, it's not as intimidating as it might first appear. Pushing the power switch brings forth the orange light of the *Omni-Glow* LCD display, which indicates most of the radio's functions. In some cases, the only way you can be sure a particular function is engaged is to check the display. The FT-920's display features nice, big numbers—approximately 3/8-inch high—for the VFO A and VFO B readouts. I found the display could be seen from any angle in any room lighting condition, including bright sunlight.

The main **VFO A** tuning knob dominates the center of the radio. The outer part of the concentric main tuning knob includes the shuttle jog control, a feature we first saw on the FT-1000MP. You simply twist the ring to one side or the other for rapid frequency excursions, and the tuning speed depends upon

how far you turn it. This is great for getting from one end of a band to the other for contest search-and-ponce operation, but it does take a little practice. Additionally, the main tuning knob may be set to a fast, normal or fine tuning rate, depending upon operator preference, by pressing the **STEP** button to the left of the tuning knob. The display shows the rate. The **STEP** button can control the tuning rate of either of the radio's two VFOs.

Front-panel buttons set VOX or (MOX) manual transmission mode. You must use the menu to set VOX delay and gain or CW semi or full-break-in. Both the headphone and key jacks are stereo types. I got adequate headphone output with either the Heil ProSet or the Yaesu YH-55 headsets.

The **MIC GAIN**, **AF GAIN**, **RF GAIN** and **RF PWR** controls are clustered on the panel's lefthand side. A set of four stem controls are along the bottom of the front panel: **SQL** (squelch), **COMP** (speech processor compression level) **GAIN** (for the speech monitor) and **LEVEL** (for the noise blander). Pushbutton switches interspersed in the same row let you turn the processor, speech monitor and noise blander on or off. While the controls are small, these are functions that don't have to be set very often, so their size is not necessarily a disadvantage.

Meter selection is via a pushbutton switch. You can step through ALC, SWR, COMP (compression level), VOLT and AMP (and back to ALC). Being able to monitor the supply voltage is great if you're operating from a storage battery in the field. The **IPO** switch controls the *Intercept Point Optimization*, which essentially allows the operator to switch out the receiver RF preamplifier. Actually, the FT-920 has *two* preamps. One is a JFET, which defaults for use on 160

BOTTOM LINE

The FT-920 offers lots of standard features per dollar for a radio in this price class, including a digital voice recorder and terrific DSP—plus excellent receiver performance. Many of its best features can be found in its extensive menu system.

Table 1**Yaesu FT-920, serial number 7F020059****Manufacturer's Claimed Specifications**

Frequency coverage: Receive, 100 kHz-30 MHz; 48-56 MHz. transmit, 1.8-2; 3.5-4; 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.

Modes of operation: USB, LSB, CW, AM, FM, FSK, AFSK

Power requirement: Receive, 2.0 A (no audio); transmit, 22 A (max), 13.5 V ($\pm 10\%$).

Size (height, width, depth): 5.4x16.4x12.6 inches; weight, 25.3 pounds.

Receiver

SSB/CW sensitivity, 2.4 kHz bandwidth, default preamp on, 10 dB (S+N)/N: 150-250 kHz, -84 dBm; 250-500 kHz, -95 dBm; 0.5-1.8 MHz, -101 dBm; 1.8-24.5 MHz, -121 dBm; 24.5-54 MHz, -125 dBm.

AM sensitivity, default preamp on, 6-kHz bandwidth, 10 dB (S+N)/N: 150-250 kHz, 40 μ V; 250-500 kHz, 32 μ V; 0.5-1.8 MHz, 16 μ V; 1.8-24.5 MHz, 2.0 μ V; 24.5-54 MHz, 1.3 μ V.

FM sensitivity, 12 dB SINAD, default preamp on: 28-29.7 MHz and 50-54 MHz, 0.25 μ V.

Blocking dynamic range: Not specified.

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

Third-order input intercept: Not specified

Second-order intercept point: Not specified

First IF rejection: > 70 dB on HF; >50 dB on VHF.

First IF image rejection: >70 dB on HF.

FM adjacent channel rejection: Not specified

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

S-meter sensitivity: Not specified

Squelch sensitivity: SSB, CW, RTTY, AM, preamp on, less than 2.0 μ V; FM, preamp on, less than 0.32 μ V.

Receiver audio output: 1.5 W at <10% THD into 4 Ω .

IF/audio response: Not specified.

Notch filter depth: >35 dB.

Transmitter

Power output: SSB, CW, RTTY, and FM, 100 W maximum, AM, 25 W, continuously adjustable in all modes.

Spurious-emission suppression: 50 dB (HF bands); 60 dB (50 MHz band).

SSB carrier suppression: 40 dB.

Undesired sideband suppression: 50 dB

Third-order intermodulation distortion (IMD) products: -31 dB or better at 100 W output.

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.

Note: Unless noted otherwise, all dynamic range measurements were taken at the ARRL Lab standard of 20 kHz.

*Measurement was noise-limited at the value indicated. †Third-order intercept point was determined using S5 reference.

Measured in the ARRL Lab

Receive and transmit, as specified.

As specified.

Receive, as specified; transmit, 18.5 A, tested at 13.8 V.

Receiver Dynamic Testing

Minimum discernible signal (MDS), 500 Hz IF filter at 8.2 MHz:

Freq	Preamp off	Preamp on
1.0 MHz	-114 dBm	-121 dBm
3.5 MHz	-132 dBm	-139 dBm
14 MHz	-131 dBm	-138 dBm
50 MHz	-131 dBm	-137 dBm

10 dB (S+N)/N, signal 30% modulated with a 1-kHz tone, 6-kHz filter: 1.0 MHz, preamp off, 2.7 μ V, preamp on, 1.1 μ V; 3.5 MHz, preamp off, 0.36 μ V, preamp on, 0.18 μ V; 52 MHz, preamp off, 1.51 μ V, preamp on, 0.52 μ V.

For 12 dB SINAD, preamp on, 12-kHz bandwidth: 29 MHz, 0.30 μ V, 52 MHz, 0.16 μ V.

Blocking dynamic range, 500 Hz filter at 8.2 MHz default preamp selection.

Freq	Preamp off	Preamp on
1.0 MHz	133 dB	129 dB
3.5 MHz	134 dB	129 dB
14 MHz	131 dB	129 dB
50 MHz	137 dB	120 dB

Two-tone, third-order IMD dynamic range, 500 Hz IF filter at 8.2 MHz, default preamp selection:

Freq	Preamp off	Preamp on
1.0 MHz	95 dB	83 dB
3.5 MHz	99 dB	96 dB
14 MHz	98 dB	97 dB
50 MHz	101 dB*	99 dB

Default preamp selection:

Freq	Preamp off	Preamp on†
1.0 MHz	+25.3 dBm	+9.6 dBm
3.5 MHz	+17.7 dBm	+5.3 dBm
14 MHz	+17.2 dBm	+8.9 dBm
50 MHz	+21.2 dBm	-2.5 dBm

14 MHz, tuner off, preamp off, +69 dBm, preamp on, +68 dBm; 14 MHz, tuner on, preamp off, +70 dBm, preamp on, +72 dBm.

14 MHz, preamp off, 73 dB, preamp on, 106 dB.

14 MHz, preamp off, 67 dB; preamp on, 80.2 dB.

At 20-kHz spacing, 29 MHz, preamp off, 77 dB, preamp on, 71 dB; 52 MHz, preamp off, 75 dB, preamp on, 69 dB.

At 20-kHz spacing, 29 MHz, preamp off, 80 dB, preamp on, 70 dB; 52 MHz, preamp off, 78 dB, preamp on, 70 dB.

S9 signal at 14 MHz: preamp on, 50 μ V.

At threshold, FM, 29 MHz, preamp on, 0.12 μ V; 50.2 MHz, preamp on, 0.07 μ V; SSB, 14.2 MHz, preamp on, 1.36 V.

2.7 W at <10% THD into 4 Ω .

Range at -6 dB points, (bandwidth): CW-N (500 Hz IF filter): 309-933 Hz (624 Hz); CW-W (2.4 kHz IF filter): 219-1888 Hz (1669 Hz); USB (2.4 kHz IF filter): 270-1930 Hz, (1660 Hz); LSB (2.4 kHz IF filter): 279-2007 Hz (1728 Hz).

As specified.

Transmitter Dynamic Testing

SSB, CW, RTTY, and FM, as specified (1.2-107 W); AM, as specified.

53 dB or greater on HF; greater than 60 dB on 50 MHz. Meets FCC requirements for equipment in its power output class and frequency range.

50 dB or greater.

As specified.

See Figures 1 and 2.

Approximately 6-62 WPM.

See Figure 3.

PTT release to 50% audio output, S9 signal, 18 ms.

SSB: 50% delay on, 15 ms; FM: 50% delay on, 47 ms.

See Figures 4 and 5.

Expanded Product Review Report Available

The ARRL Laboratory offers a detailed test result report on the FT-920 that gives in-depth, technical data on the transceiver's performance, outlines our test methods and helps you interpret the numbers and charts. The report even includes a summary of how this radio stacks up with similar previously tested units.

Request the FT-920 Test Result Report from the ARRL Technical Department, 860-594-0278. It's \$7.50 for ARRL members and \$12.50 for nonmembers, postpaid.

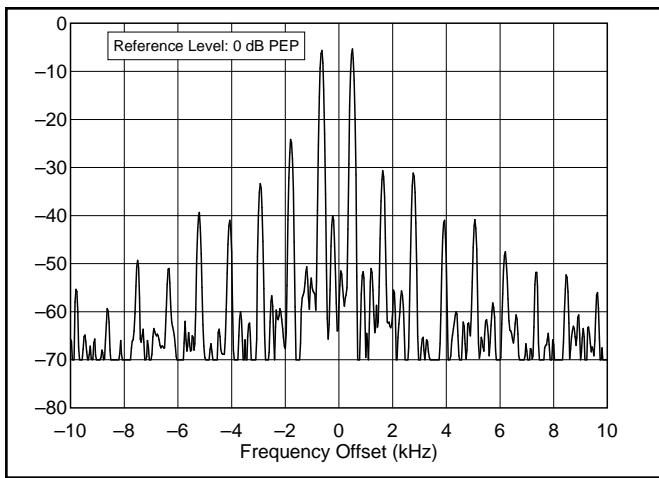


Figure 1—Worst-case spectral display of the FT-920 transmitter during two-tone intermodulation distortion (IMD) testing on HF. The worst-case third-order product is approximately 25 dB below PEP output, and the worst-case fifth-order product is approximately 31 dB down. The transceiver was being operated at 100 W output at 24.950 MHz.

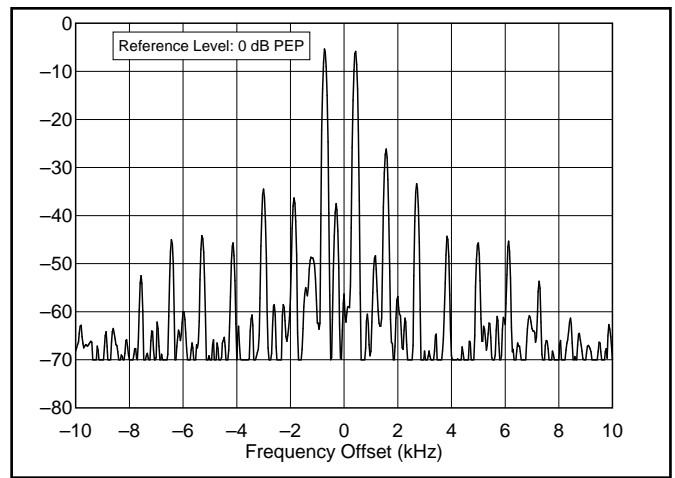


Figure 2—Spectral display of the FT-920 transmitter during two-tone intermodulation distortion (IMD) testing on 6 meters. Third-order product is approximately 27 dB below PEP output, and fifth-order product is approximately 33 dB down. The transceiver was being operated at 100 W output at 50.2 MHz.

through 15 meters. The other is a lower-noise, dual-gate MOSFET which defaults for use on 12 through 6 meters. (You can select which preamp you want via the menu system.) An **ATTenuator** has 6, 12 or 18 dB steps, a big improvement on the 20-dB fixed attenuators of the past. The **AGC** switch is also a step switch, and successive pushes go through fast, slow, and off.

One nice touch a lot of operators will appreciate is the front-panel **ANTENNA** switch to switch between two antennas. Antenna selection stays in the radio's band memory, too. For example, connect antenna A for 20 meters and antenna B for 6 meters. As you switch back and forth between the two bands, the antennas change automatically. Even better: a separate **RX** (receive) antenna switch lets you choose a separate receive antenna (or, alternatively, a VHF or UHF transverter, receiving converter or other accessory) via a rear-panel phono jack. This

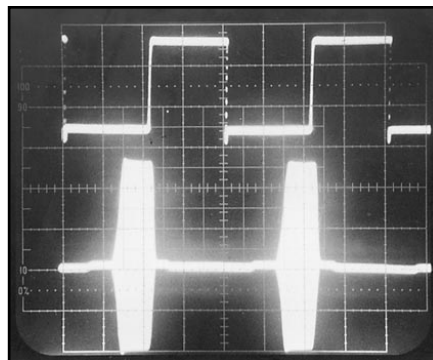


Figure 3—CW keying waveform for the FT-920 showing the first two dits in full-break-in (QSK) mode. The equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transceiver was being operated at 100 W output at 14.2 MHz. Note that both dits are somewhat shortened. This does not occur in semi-break-in (VOX) mode.

separate receive antenna function is especially well-executed. A menu option lets you choose to protect the transceiver's front end against pickup of stray RF from the transmitter by switching the receiving antenna out of the line during transmit.

The radio has separate switches for each mode: **SSB**, **CW**, **AM** (optional board required for transmit), **FM** (available with the optional FM-1 board), and **DATA** (FSK or AFSK). The **SSB** and **CW** buttons also let you toggle between the desired sideband for those modes.

The **LOCK** switch to the right of the VFO knob allows locking the VFO A frequency—a handy feature when youngsters walk into the shack (there's another **LOCK** button for the **VFO B** knob).

The **A→B** button moves the frequency of VFO A to VFO B. The **A↔B** knob swaps the contents of the two VFOs. The **RPT** button allows the operator to set a repeater offset (by menu) for 29 or 52 MHz FM operation. If you need a CTCSS tone, you set this

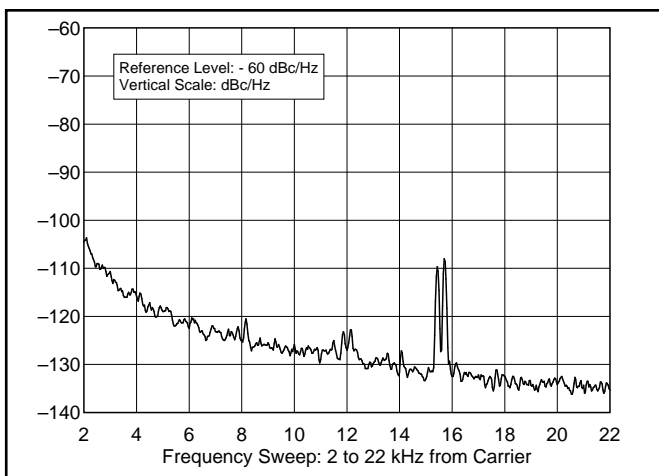


Figure 4—Worst-case tested spectral display of the FT-920 transmitter output during composite-noise testing on HF. Power output is 100 W at 3.5 MHz. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 2 to 22 kHz from the carrier.

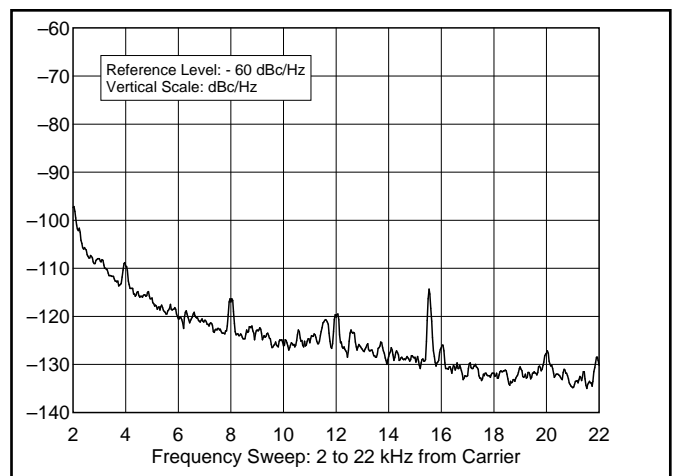


Figure 5—Spectral display of the FT-920 transmitter output during composite-noise testing on 6 meters. Power output is 100 W at 50.2 MHz. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 2 to 22 kHz from the carrier.

via the menu.

The **DW** button activates the *Dual Watch* function. Dual watch sets the radio up to periodically check the VFO B frequency for activity while you're tuned to VFO A. In theory, this sounds great. In practice, using dual watch requires enabling the squelch. This means that you hear *nothing* on either frequency unless there's a signal. When the radio hears a signal on the VFO B frequency, it breaks the squelch and goes to that frequency. Some users were disappointed to find out that this was not a true dual-receive function, but more like a priority scanning system. Since it works only while the receiver is squelched, it might be useful for times when the operator is otherwise occupied.

A keypad dominates the area to the immediate right of the VFO A (main tuning) knob. It's used primarily for one-touch band selection. The FT-920 stacks the last two sets of parameters for each band into memory registers. You also can use it for direct frequency entry on either VFO, and it controls memory selection for the digital voice recorder and the CW memory keyer. For FM, the keypad serves as a DTMF keyboard.

The **REC** and **PLAY** buttons work for both the digital voice recorder and the CW memory keyer. The radio has **UP** and **DOWN** keys for rapid frequency excursions or to step through the memories—which ever is selected.

Green **RX** and red **TX** light/button combinations flank both VFO knobs. Pressing one or the other sets the VFO in use for either transmitting or receiving. These replace the "split" buttons on many other transceivers and are very intuitive. Just touch the one you want for transmit or receive. This should minimize use of the wrong VFO in pileups and contests!

Beneath the **VFO B** tuning knob are the clarifier (RIT) and keyer controls. **RX** and **TX** clarifier may be selected independently, and the **CLEAR** button lets you return to the original frequency. Clarifier tuning is via the **VFO B** tuning knob; users were split on whether they liked this doubling up.

Momentarily pressing the **TUNER** switch activates the automatic antenna tuner, which can be enabled via the menu to work on receive, if desired. Holding the button in for a half second activates the *automatic matching* mode. The tuner works on all bands, including 6 meters. It operates very quickly and quietly.

Yaesu says the tuner can match from approximately 17 to 150 Ω . Power is automatically reduced to 50 W while tuning. The LCD display indicates the tuner's operation, and mode (TX, RX or both). The tuner automatically stores settings of less than 1.5:1 SWR, but does not store those above that level. This prevents storing an undesirable setting, such as inadvertently trying to tune your 20 meter antenna on 10 meters.

The FT-920 also has **IF SHIFT**. The control has a range of ± 1.2 kHz.

Controls involved with CW operation are clustered along the lower right apron. A **SPOT** switch activates a spotting tone to zero beat CW signals (set the level using the **SIDETONE** knob). Having the sidetone level

on the front panel was a nice touch; too often, this is hidden away inside or on a menu somewhere. A **PITCH** control adjusts CW offset in 50-Hz steps between approximately 300 and 1050 Hz. Switches control the CW keyer and selection of full CW break-in operation, and there's a small pot for keyer speed control. Most users felt the **VFO B** and **DSP** knobs obscured the clarifier and keyer controls, making them harder to use.

Thanks for the Memories

The FT-920 has 99 *standard* memories, five *quick memory bank* (QMB) memories, 10 *split-frequency* channels, 11 *call* channels and a set of *band-edge* memories for program-mable memory scanning. In addition to operating frequency and mode, standard and split memory channels can store filter bandwidth, clarifier (RIT) information, antenna selection, antenna tuner status, repeater shift, CTCSS tone, alphanumeric labels and lock switch status (some restrictions apply on what can be stored in QMB and band-edge memories).

Press the **QMB STO** button to store up to five "quick memories," which are stacked as they are entered and recalled by pressing the **QMB RCL** button until the desired memory appears. This is great for contesting or for the DXer who wants to check multiple pileups. A few reviewers cited the **QMB** memories among those features they liked most. It's a feature I also found handy.

The **MEM CH** switch changes the **VFO B** knob from VFO operation to memory channel selection. You can divide the standard memory area into as many as four groups, if you like. The **MEM GROUP** switch accesses memory channels within a designated group, to reduce selection time if you only need to keep an eye on a few particular channels.

You can apply seven character alphanumeric names to all memory channels except the quick memory bank channels. The **DISPLAY** button lets you swap the VFO B frequency display for alphanumeric memory names the operator may have plugged into memory.

DSP Delights

The DSP works at audio frequencies rather than at a low-frequency IF, as it does in some other transceivers (including big brother FT-1000MP). Execution of the DSP functions was excellent.

The heart of the radio's DSP features is a prominent set of concentric **LOW CUT/HIGH CUT** controls on the righthand side of the panel. You activate this part of the DSP by pushing the **DSP** button, then use the **LOW CUT/HIGH CUT** to set your passband cutoff frequencies. Many users found this implementation very convenient, and the DSP worked so well you had to remind yourself that it was only working at audio and after the AGC. As Yaesu points out in the FT-920 manual, strong signals outside the DSP passband still can pump the AGC. The **LOW CUT/HIGH CUT** controls are designed to move through half rotation for best results, and I preferred the **HIGH CUT** control at 12 o'clock and the **LOW CUT** control at 8 o'clock. These settings conformed the passband to my tastes,

both on CW and SSB.

Through a menu setting, you can have the display provide a graphical representation of the relative audio passband. The **NOTCH** button activates the automatic DSP notch, handy for nulling out those pesky carriers on SSB. You don't have to push the DSP button to use it. The notch captures the offending heterodynes and lowers them to a tolerable level—in most cases totally eliminating them. Touching up the **LOW CUT/HIGH CUT** controls can eliminate any residual heterodynes in most cases. The lack of an IF notch may be a problem on CW for some operators.

The **NR** knob adjusts the level of the DSP-based noise reduction—super for cutting down on "background" noise. Again, you don't have to press the **DSP** button to enable noise reduction. Simply rotating the front panel control brings it into play, and the receiver is most comfortable to listen to with at least a little bit cranked in. The DSP NR can help reduce operator fatigue during long operating periods.

Digital Voices

It was a pleasant surprise to find a digital voice recorder as a standard feature of this midrange radio. It's something you'd certainly expect to find only in a top-of-the-line set. The DVR records both incoming audio (16 seconds worth) plus four outgoing messages. To record incoming audio, you touch the **REC** button, then the **50 MHz** key on the keypad. The received audio plays through the monitor—so you can bask in the glow of hearing that rare DX station you just worked come back to you again and again.

Recording outgoing messages is easy, but the instructions in our FT-920 manual were incorrect, and when we'd attempt to air the message, it would hang up for several seconds in transmit. After Yaesu told us that the correct way to stop recording was to press the **REC** button again, the message would play back properly. The manual indicates that outgoing message buffers are 16 seconds apiece. We timed two buffers at approximately 8 seconds each and two at approximately 4 seconds each, however.

Some users did not like the fact that you had to first momentarily press the **PLAY** button, then quickly select the proper memory buffer to air your message. If you don't press the memory key (1-4) fast enough, the memory key will revert to its original function, and you'll probably find yourself on another band altogether.

It is not possible to control the digital voice recorder via computer.

For audio processing, the FT-920 uses a digital speech compressor at audio level. This is a break with Yaesu tradition, as most past offerings have used RF clipping. Activating the **PROC** switch and adjusting the compression level is all that is necessary for adjustment. We found that turning the **COMP** control to around 3 o'clock yielded optimum results.

In addition to the audio processor, you can use the menu to select four different DSP *voice pattern contours*. On the air reviews were mixed on how well the four digital con-

tours did their job in tailoring transmit audio. Consensus was that audio level appeared to drop off on all four settings; you had to compensate with higher gain level or by using a bit more compression. The high-emphasis selection successfully produced “contest” type audio to cut through QRM; the changes wrought by the other settings were more subtle. But several stations said they thought the audio sounded “best” in the default position, with the digital equalization turned off. The manual seems to say that you have to enable the DSP system via the front panel in order to take advantage of this feature, but we found this to be incorrect.

The speech monitor comes in handy while using the digital voice recorder during contests. The clarity of audio through the FT-920 monitor was excellent.

To the Rear

The back panel is where the FT-920 shows its practical side. Most connections use standard phono (RCA) connectors, so many setups can avoid having to solder those dreaded DIN connectors (one DIN jack provides TX/RX switching and band data for use with a Yaesu FL-7000 linear). SO-239 connectors are provided for both **ANT A** and **ANT B**.

For computer control, you make the connection to the **CAT** port via a standard DB-9 female connector (cables with the proper connectors are available at most Radio Shack stores). The rear panel also provides an additional (stereo) **KEY** jack, used in conjunction with the rear-panel **PDL-KEY** switch, which lets you use an external keying device (a hand key or computer, for example) and the built-in keyer at the same time—a great idea and something that contest operators certainly will appreciate. This allows use of the popular contest programs for keying contest exchanges, while the internal electronic keyer itself may be left on, and paddles connected through the front jack, for sending fills by key—a boon for the non-typists among us.

The rear panel also provides a **PTT** jack for use with a foot switch or other type of remote switching plus a **TX GND** jack for amplifier switching. There are two possibilities for its use: With the **TR-RY** switch set in the “RY” (relay) position, a relay capable of switching 125 V at 500 mA is used, so you can safely switch your old SB-220. For break-in use with some amplifiers, the “TR” position employs a quiet transistor switch, rated at 50 V dc at 500 mA.

Another jack provides 13.5 V at up to 200 mA for accessories. You’ll also find an **EXT SPEAKER** jack (3.5 mm, two-conductor) and an **AF OUT** jack for low-level audio recording, TNC, or WEFAX. It provides 100 mV into a 600- Ω and the level is not controlled by the front panel **AF GAIN** control. A similar jack for **PATCH** input is independent of the **MIC GAIN** control.

There’s an **FSK-AFSK** switch for digital operation. A five-pin DIN connector (the only other one, thankfully) is available for data input.

The **ALC** connection is provided via an RCA jack.

We already mentioned the separate receive antenna jack. While the FT-920 does not offer a transverter port as such, the *Operating Manual* includes information on how to use the **RX** jack and/or one of the SO-239 antenna connectors to accommodate a transverter.

Overall, the back panel offers ample flexibility. The only drawback is that, except for the antenna and power connections, nothing on the rear panel is marked. A legend affixed to the top panel of the radio provides a map to all connections, but it’s difficult to refer to this chart when the radio is beneath a shelf and the operator is behind it!

May I see the Menu?

Overall, operation is straightforward. Some users got the hang of the FT-920 without spending a whole lot of time with the manual, which, as we’ve already noted, contained a few errors (Yaesu says it’s working on these). But some features are not terribly obvious, and many of the radio’s best features only are accessible through the menu (shades of the FT-1000MP). For best results, it’s wise to pay special attention to the section of the manual that describes the 73 menu functions.

The **MENU** switch activates the menu mode and allows customization of many parameters. *Normal menu* operation is simple. Just press the **MENU** button, dial up the desired function with the VFO B knob, press the **ENT** key on the keypad, use the VFO B knob to set the desired parameter, press **ENT** again, and **MENU** to exit.

A handy *panel menu* feature retains five frequently used menu items for quick recall, including the display dimmer, VOX hang time in CW, multi-panel display choice, enhanced tuning scale display, and CTCSS tone frequency. In addition, the FT-920 has a *quick menu* option that lets the user pick out certain menu items for quick and easy access. This quick menu bank operates almost identically to the *normal menu* mode except it only gives you the menu items you’ve asked to make available. To get to the *quick menu*, you press the **MENU** button momentarily; to access the *normal menu*, you hold in the **MENU** button for one-half second. Pretty nifty.

On the Air

While the profusion of knobs and buttons on the front panel might suggest a steep learning curve, the FT-920 is really pretty simple to use.

For instance, for SSB operation, just touch the **SSB** button. The LCD display shows which sideband has been selected. While the default is according to convention (LSB below 10 MHz, USB above), you can swap sidebands by pressing the **ENT** button again. Adjust the **MIC GAIN** control for proper ALC metering, and you’re all ready to go.

VOX operation is smooth. There are two different menu settings available, one for voice, the other for semi-break-in CW.

The FT-920 provides effortless CW operation, both semi-break-in and full-break-in (QSK). Full-break-in CW was free of the

pops found in some radios, and it was possible to hear between dits at 35 WPM or so. When using a non-QSK linear amplifier, you’ll want to use semi-break-in with the proper VOX adjustment. It’s easy to adjust the delay for just the right balance between fast transition to receive and absence of relay chatter.

We did notice we could still hear a very strong CW signal on the opposite side of zero beat, even with the 500-Hz filter enabled. The opposite side signal was down by more than 50 dB, however.

Receiving with the radio was a pleasure. It handled strong signals well, but the combination of a good basic receiver with DSP resulted in excellent overall performance for a radio in this price class (see Table 1). Two filters are available as options: a 500-Hz CW filter and a 6-kHz AM filter. The radio can only accommodate these filters, and Yaesu does *not* offer an optional narrow SSB filter.

We found out that you must install the AM filter in order to *transmit* on AM (Yaesu now offers a free “pass-through” board that enables AM transmit). Our unit had both filters installed, and filtering was very good, although the AM filter is too narrow for suitable AM broadcast reception. On CW, you can further reduce the bandwidth by using the DSP, and the combination of the two provided excellent single-signal CW reception.

By the way, the FT-920 receiver is double conversion on HF (68.985 MHz and 8.215 MHz). The accessory filters are in the 8.2 MHz IF. The radio is triple conversion only on FM, where the lowest IF is at 455 kHz.

The CW memory keyer works well, but some users felt its two-button operation was less than convenient. The keyer allows for automatic character spacing to be enabled or disabled, or use as an electronic “bug” type key. Especially noteworthy was the fact that you can adjust dot and dash lengths (ie, weighting) separately, not just the dot-to-dash ratio. The keyer has six memories, and it permits sequential contest serial numbering. The primary drawback is that, as with the digital voice keyer, you have to press the **PLAY** button, then (quickly) the memory number to air a message. On the other hand, the CW memories may be controlled by a computer program.

The noise blanker worked well against electric motor noise. At my place, there is usually no noise, so I generated some S9 noise by turning on a vacuum cleaner. The blanker reduced the noise to a negligible level. Other users also found the noise blanker to be very effective, especially in combination with the DSP noise reduction.

When our unit first arrived, it exhibited a strange hissing or buzzing sound (sort of like a small nest of tiny hornets) whenever the noise blanker was engaged and the **MONI LEVEL** control was turned up (it made no difference if the monitor was engaged or not). We returned our unit to Yaesu, which determined that some earlier production units like ours suffered a crosstalk problem. Yaesu fixed our FT-920 and says it has corrected this problem in subsequent production units.

Somewhat disconcerting were the results of the transmit intermodulation distortion (IMD) tests (see Figures 1 and 2). Almost as disturbing as the prominence of third and fifth-order products was the prominence of higher-order (ie, seventh, ninth, eleventh) products. Yaesu specified a third-order IMD figure of -31 dBc (see Table 1), a specification it met on 15, 17, 20, 40, 80 and 160 meters, where IMD performance was much better but not spectacular. For comparison, the *best* case was 40 meters, where third-order products were 32 dB down, and fifth-order were 45 dB down, and higher-order products were almost non-existent.

On HF, the ARRL Lab measured worst-case performance on 12 meters, where third-order products were just 25 dB down and fifth-order 31 dB down. That's marginal in comparison to other transceivers in this price class that we've looked at recently. Exacerbating this performance was the fact that higher-order products do not drop below 50 dB until the 13th order!

The worst-case performance on 50 MHz was only a shade better. Third-order products were down by 27 dB and fifth-order products by 33 dB, but, once again, higher-order products remain prominent through the 13th order.

As we've said in past reviews, this is the kind of IMD performance that may lead to problems with splatter and "wide" signals, especially when the transceiver is used with an amplifier.

The ARRL Lab measured comparable IMD performance on a second FT-920. This marginal IMD performance was the only serious problem we encountered with this transceiver.

Yaesu advised that its production units as of mid-August were "displaying less variation in performance, due to tightening of production part tolerances." Yaesu supplied one of these units for us to test. The unit barely met its third-order IMD specification on the HF bands but not on 6 meters; higher-order products overall were less prominent, however.

Additional Observations

The reactions of several users appear to prove out the proverbial notion that "you can't please all of the people all the time." Take the radio's ergonomics, for example. One user called the ergonomics "some of the best of the radios I have recently used," while another called the front panel "awkwardly laid out" and the radio "not as comfortable to operate" as others he'd used. For my part, I tend to feel that the rig is generally comfortable, ex-

cept for the location of the clarifier and keyer controls.

Users were ambivalent about the double-duty **VFO B** knob for the VFO and for RIT. One tester found that this scheme "worked out much better than I would have thought," while another said it was "awkwardly shared with the VFO."

Overall, I enjoyed using this radio. In comparison to what was available 10 or 15 years ago in price and performance, the FT-920 shows that it's possible to increase value in greater proportion to price. The '920 offers lots of standard features and performance, and it's a worthy contender among the other offerings in this price category.

Many thanks to Randy Thompson, K5ZD; Emil Pocock, W3EP; Larry Wolfgang, WR1B; Rick Lindquist, N1RL; and Mike Tracy, KC1SX, and Ed Hare, W1RFI, of the ARRL Lab for their contributions to this review.

Manufacturer: Yaesu USA, 17210 Edwards Rd, Cerritos, CA 90703; tel 310-404-2700. Manufacturer's suggested retail price, \$2300; 500-Hz YF-116C CW filter, \$127; 6-kHz YF-116A AM filter, \$127; FM-1 FM board, \$62; TCXO-7 temperature-compensated oscillator, \$99.

Tune in the World for Less Than \$300! Drake SW1 and Radio Shack DX-394



*Reviewed by Rick Lindquist, N1RL
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One of the surest routes to ham radio over the years has been shortwave listening (SWLing) and broadcast listening (BCLing). Very often, the fascination of listening to broadcasts and other transmissions from far-off places has led to a desire on the part of listeners to put a signal of their own on the air. We looked at a couple of economical receivers for the beginning SWL or BCL to consider that won't put you in hock but can offer hours of listening fun, the Drake SW-1 Shortwave Receiver and the Radio Shack DX-394 Communications Receiver.

Drake and Radio Shack have been making receivers for novice and veteran SWLs and BCLs for years (decades in the case of Drake, which recently re-entered the Ama-

teur Radio market). In the past, we've looked at the Radio Shack DX-302 receiver (see "Product Review" *QST* Aug 1981) and the Drake R7, R8 and SW8 receivers (see "Product Review", *QST*, Jan 1980, Mar 1992, and Oct 1994, respectively).

Both of these receivers are tabletop sets designed primarily for installing in a home listening post. Both are equipped to operate from 120 V ac, have built-in speakers and digital displays. Both cover the standard broadcast (530-1710 kHz) and shortwave bands—and then some. But perhaps the best part is that each receiver sells for less than \$300.

Drake SW1

The SW1 designation says it all. This is Drake's entry-level receiver, and these days, you won't find a set much more basic and down-to-earth than the Drake SW1. This is a

fairly compact, utilitarian, lightweight box (except for the plastic front panel, the cabinet is steel) with a front-firing speaker on the left and a big green LED display on the right above the **TUNING** knob. The radio continuously covers from 100 kHz to 30 MHz. It's double conversion, with IFs at 45 MHz and 455 kHz. There are controls for **RF GAIN** and **VOLUME**, plus a 16-button keypad (that includes the power and display dimmer buttons) and big up and down buttons labeled with arrows. AGC is fixed. You'll find the mini-phone jack on the lefthand panel for headphones. Drake did not provide a signal-strength indicator of on the SW1. That's unfortunate, since an S meter is a staple for hobby listeners.

The US-made SW1 receives one mode—AM. It has 32 programmable memories to save frequency settings (it comes from the factory pre-programmed with SW stations), and you can enter frequencies directly from the keypad. Hook your antenna to the rear panel (the SW1 has an SO-239 for a coaxial-fed connector or a set of screw terminals for a wire antenna and a ground connection), and apply power and you're all set. To help get you started, Drake supplies a little wire antenna with the SW1 that's suitable for a temporary indoor setup. The SW1 can operate from 12 V dc into the coaxial power connector on the rear panel. An ac "wall cube" adapter is supplied for typical home use, but the dc capability makes it handy for use away from home (or even in an emergency).

As an AM-only receiver, the fact that the smallest tuning increment is 1 kHz is not necessarily a hardship (the radio tunes in 5-kHz steps using the up/down keys). The synthe-

Table 2**Drake SW1, serial number 6H12910064**

<i>Manufacturer's Specifications</i>	<i>Measured in ARRL Lab</i>
Frequency coverage: 100 kHz-30 MHz.	As specified
Modes of operation: AM.	As specified.
Power requirements: 120 V ac; 12 V dc at 400 mA.	As specified.
Size (HWD): 4.4×10.9×7.6 in; weight, 4.7 lb.	
Sensitivity (bandwidth not specified): 2.0 μV or less (typical).	AM, test signal modulated 30% with a 1-kHz tone. 10 dB (S+N)/N: 100 kHz, 10.5 μV; otherwise, as specified.
Blocking dynamic range: Not specified.	14 MHz, 87 dB (noise-limited) at 100-kHz spacing.
Two-tone, third-order IMD dynamic range: Not specified.	14 MHz, 72 dB (noise-limited) at 100-kHz spacing.
First IF rejection: Not specified.	58 dB.
First IF image rejection: Not specified.	67 dB.
IF/audio response: Not specified.	Bandwidth at -6 dB points: 4500 Hz.
Audio power output: Not specified.	245 mW @ 10% THD into 8 Ω.
NOTE: All dynamic range measurements were taken at 100 kHz, instead of at the ARRL Lab standard of 20 kHz.	

sized SW1 does exhibit some “synthesizer chuffing” when tuning manually, but getting where you want to go is extremely simple via the **TUNING** knob, up/down buttons or direct entry. A nice feature was the automatic frequency entry. Punch in a frequency and the SW1 will automatically enter the frequency (after a slight pause if the frequency has fewer than five digits)—or you can just press the **ENTER** key if you’re in a hurry.

It’s also very easy to save stations to memories—too easy, in fact, because the SW1 does not warn you that you’re overwriting a given memory channel—but we sometimes found ourselves wishing for a few more memories. You could quickly fill up all 32 in a single sitting on the broadcast or shortwave bands. An 11-page *Owner’s Manual* comes with the SW1, but the radio is quite intuitive. We had the whole thing figured out even before we looked at the book—including how to program the memories.

The sound from the SW1 was pretty astounding for such a little set, although it delivers less than 1 W to the speaker. The audio had a nice rich balance especially suited for AM broadcasts, but AM operators on the ham bands sounded terrific on the SW1, too. On the AM broadcast band, the 5-kHz steps on the SW1’s up/down keys made tuning across the standard 10-kHz channels very convenient, yet you still could listen for those stations in other countries that are sandwiched in between our 10-kHz channels. With a fairly large antenna attached, the receiver did a creditable job of separating the AM channels and keeping splatter or adjacent-channel spillover to a minimum, even in the neighborhood of strong local stations. On shortwave, there was an undercurrent of noise that likely was the result of various mixing products developed in the receiver and just plain poor dynamic range (see Table 2). For example, even in the vicinity of 29 MHz—relatively quiet at this point in the solar cycle—we could detect various shortwave broadcasting signals that were

elsewhere in reality. Connecting a resonant antenna reduced this effect significantly. Using an antenna tuner might also help.

We found the **RF GAIN** and **VOLUME** knobs a bit wobbly. Also, the **RF GAIN** control did not seem to have the expected effect. It appeared to be more of an attenuator than an actual RF gain control.

Manufacturer: R. L. Drake Co, 230 Industrial Dr, Franklin, OH 45005; tel 513-746-4556; fax 513-743-4510. *Manufacturer’s suggested retail price, \$299.*

Radio Shack DX-394

This is Tandy’s top-of-the-line general-coverage receiver, the latest of its type in Radio Shack’s consumer electronics lineup. Since it debuted on the market, the DX-394 has gone through two updates, identified by an A or B suffix after the model number on the back panel. When we purchased our DX-394, our local Radio Shack store still had A-suffix models in stock, and that’s what we tested. The A-suffix units include decreased gain of the second mixer, extended AGC release time, and modified audio compensation for SSB.

The DX-394 touts lots of features, especially considering its price class: continuous coverage from 150 kHz to 30 MHz; AM, SSB, and CW modes; 160 frequency memories; digital readout; dual clocks; a mike-level tape-recorder output; search and scan; and direct frequency entry from its front-panel keypad.

This is a compact set in a charcoal-gray plastic cabinet with two fold-down front legs. It features a large LCD display, five front-panel controls, plus a bunch of push buttons—including a keypad. Like the SW1, this set is a dual-conversion superhet (the IFs also are 45 MHz and 455 kHz) with PLL synthesized tuning. You can dim the green-background display but you won’t want to. The DX-394 has a built-in power supply, so you can plug it right into the wall outlet. It also can run off 13.8 V dc, and it has a little built-

in telescoping whip antenna on top of the case, making it fairly portable.

Front-panel push buttons let you jump immediately to any of the international shortwave broadcasting bands—from 120 to 11 meters (the 11-meter BC band is right below the 11-meter Citizens Band). The display clearly shows which BC band you’re listening to (ie, 41 m, 19 m). There’s a front-panel mini-jack for headphones.

You can set the tuning step size (100 Hz, 1 kHz, 5 kHz or 10 kHz) using two front-panel **STEP** keys, and it displays the selection on the front panel (9-kHz AM channel spacing used in some parts of the world is available as a power-up option). Programmable timers let you store frequencies and on/off times. The front panel also includes a digital replication of an analog S meter. AGC is not adjustable.

Using the manual tuning knob can be a little squirrely, since the actual tuning rate varies with the speed with which the knob is spun (something the *Owner’s Manual* did not explain). Tune very slowly and carefully, and it covers approximately 2.5 kHz per rotation when you’re set to the smallest tuning step (100 Hz). Spin it very rapidly and you’ll move up or down 15 or 20 kHz or more in short order. A continuous-tuning **FINE TUNE** control gives you somewhat greater control, covering approximately 2 kHz per rotation, independent of step size.

The rear panel includes connections for a high- or low-impedance antenna, an extension speaker, tape out, and external dc power. It also has a recessed button to perform a hard microprocessor reset. The set also has a rear-panel 20-dB **ATTENUATOR** switch, which we left on when the set was connected to an external antenna; it engages a passive attenuator. Hooking it up to an external antenna is neither necessary nor especially desirable, except that an external antenna might be less prone to pick up household interference. The noise blanker was not very effective in reducing interference from an oil-burner igniter.

The DX-394 is ultra-simple to use. Just plug it in, extend the little antenna on top, turn it on, set the **MODE** switch, **VOLUME** and **RF GAIN** controls and tune away. The DX-394 gives you several ways to tune in stations. You can manually tune them in using the main tuning knob, reading the frequency right off the display. Manual tuning was accompanied by synthesizer “chuffing” typical of inexpensive sets like this. You also can directly enter a frequency via the keypad on the front panel. Or you can use the unlabeled arrow keys. In addition, the radio’s search mode will automatically look for the next strong signal, although you probably will want to first turn down the **RF GAIN** control, as the *Owner’s Manual* suggests. Otherwise, the radio might mistake whatever noise it’s hearing for a signal and not start searching.

Among the best features of the DX-394 is its memory system. It’s very easy to store a frequency (and only a frequency) in one of the memories. The DX-394 sets aside 10 memories for each of the bands (LW, MW and SW), plus 10 apiece in each of the “meter” bands,

Table 3**Radio Shack DX-394, serial number, C004541**

<i>Manufacturer's Specifications</i>	<i>Measured in ARRL Lab</i>
Frequency coverage: 0.15-30 MHz.	As specified.
Modes of operation: LSB, USB, AM, CW.	As specified.
Power requirements: 120 V ac, 13 W; 13.8 V dc, 300 mA.	
Size (height, width, depth): 3.8x9.2x9 inches; weight, 4.6 lb.	
SSB sensitivity, bandwidth not specified, 10 dB (S+N)/N, 1.7-30 MHz, 0.3 μ V.	As specified.
CW sensitivity, bandwidth not specified, 10 dB (S+N)/N, 1.7-30 MHz, 0.1 μ V.	As specified.
AM sensitivity, bandwidth not specified, 10 dB (S+N)/N: 150-510 kHz, 10 μ V; 510-1730 kHz, 7 μ V; 1.7-30 MHz, 1 μ V.	10 dB (S+N)/N, signal 30% modulated with a 1-kHz tone: As specified.
Blocking dynamic range: Not specified.	14 MHz, CW1 position, 104 dB at 100-kHz spacing.
Two-tone, third-order IMD dynamic range: Not specified.	14 MHz, CW1 position, 84 dB at 100-kHz spacing.
First IF rejection: 80 dB (50- Ω antenna).	67 dB.
First IF image rejection: 80 dB (50- Ω antenna).	70 dB.
IF/audio response: Not specified.	Bandwidth at -6 dB points: CW1, 333 Hz; CW2, 328 Hz; USB, 2059 Hz; LSB, 2111 Hz; AM, 9520 Hz.
Audio output: 0.8 W at 10% THD into 8 Ω .	1.1 W at 10% THD into 8 Ω .

NOTE: All dynamic range measurements were taken at 100 kHz, instead of at the ARRL Lab standard of 20 kHz.

like 49 or 31 meters—160 memories in all. Of course, this can make for a little confusion when you're trying to recall which set of 10 memories you're operating with at any given moment. A separate **MON** button lets you store and recall a frequency in a "scratchpad" memory. An internal, rechargeable cell backs up memories a month or more, when power is removed from the receiver.

On any given evening—especially here in the Northeast—the 40-meter amateur phone band (41-meter SW BC band) can be a radio listener's nightmare, particularly for a receiver lacking in dynamic range. Of course, we put the DX-394 to that test. While the needle-pinning AM broadcast stations dominated the band (and the DX-394's front end and/or AGC), we still were able to locate and copy some of the amateur SSB stations that had shoehorned their way among the BC behemoths. We pulled out several stations in a crowded 75-meter band as well. CW and SSB share the same IF filter, but additional audio filtering is switched in when you move to the CW position. In actual use, we even were able to hear weaker CW signals, but also lots of other stations at the same time—and some of them overloaded the front end, reducing sensitivity. Backing off on the **RF GAIN** control was a big help. The rear-panel ATT switch was a necessity. ARRL Lab testing also determined that the radio's noise floor varies considerably with frequency.

The DX-394 did a decent job of receiving AM signals, and we were able to copy many international broadcasters with no problem, even using the built-in whip antenna. AM stations on the DX-394 had a

comfortable sound—especially on the standard AM broadcast band. We also were able to monitor some AM activity on the amateur bands, and, of course, we eavesdropped on some local 11-meter CB chatter. For those demanding narrower, more consistent filtering, a 6.5-kHz AM filter, model LFH-4S, is available for \$15, shipping included, from Kiwa Electronics, 612 South 14th Ave, Yakima, WA 98902; tel 509-453-5492 or (orders only) 800-398-1146; e-mail kiwa@wolfe.net; <http://www.wolfe.net/~kiwa/index.html>.

The 31-page DX-394 *Owner's Manual* included nice tables of the international broadcasting bands and even pointed out that both 3900-4000 and 7100-7300 kHz are shared between hams and international broadcasters and "interference is heavy in this range." It has a useful troubleshooting table, too.

Manufacturer: Tandy Corp, 1900 One Tandy Center, Ft Worth, TX 76102; tel 817-390-3700. The DX-394 is available from Radio Shack retail outlets. Manufacturer's suggested retail price, \$249.99; optional DC adapter model 270-1533, \$4.49.

SOLICITATION FOR PRODUCT REVIEW EQUIPMENT BIDS

[In order to present the most objective reviews, ARRL purchases equipment off the shelf from dealers. ARRL receives no remuneration from anyone involved with the sale or manufacture of items presented in the Product Review or New Products columns.—*Ed.*]

The ARRL-purchased Product Review equipment listed below is for sale to the highest bidder. Prices quoted are minimum accept-

able bids, and are discounted from the purchase prices. All equipment is sold without warranty.

Alinco DJ-G5TH dual-band hand-held VHF/UHF transceiver (see "Product Review," Jul 1997 *QST*). Minimum bid: \$244.

AOR AR7030 communications receiver, (see "Product Review," Jun 1997 *QST*). Minimum bid: \$758.

Grundig Yacht Boy 400 BC/SW/FM portable receiver, (see "Product Review," Jul 1997 *QST*). Minimum bid: \$112.

ICOM IC-T7A dual-band hand-held VHF/UHF transceiver (see "Product Review," Jul 1997 *QST*). Minimum bid: \$198.

ICOM IC-W32A dual-band hand-held VHF/UHF transceiver (see "Product Review," Jul 1997 *QST*). Minimum bid: \$251.

Japan Radio Corp NRD-535 HF receiver (see "Product Review," May 1997 *QST*). Minimum bid: \$1122.

Panasonic RF-B45 BC/SW/FM portable receiver, (see "Product Review," Jul 1997 *QST*). Minimum bid: \$112.

Radio Shack Model 21-527 digital SWR/power meter, (see "Product Review," Jun 1997 *QST*). Minimum bid: \$40.

Radio Shack Probe-Style Oscilloscope (see "Product Review," Aug 1997 *QST*). Minimum bid: \$66.

Sangean AT5-909 BC/SW/FM portable receiver, (see "Product Review," Jul 1997 *QST*). Minimum bid: \$178.

Sony ICF-2010 BC/SW/FM portable receiver, (see "Product Review," Jul 1997 *QST*). Minimum bid: \$238.

Standard C508A dual-band hand-held VHF/UHF transceiver (see "Product Review," Jul 1997 *QST*). Minimum bid: \$188.

Ten-Tec Centaur Model 411 HF linear amplifier, (see "Product Review," Jun 1997 *QST*). Minimum bid: \$495.

Yaesu FT-50R dual-band hand-held VHF/UHF transceiver (see "Product Review," Jul 1997 *QST*). Minimum bid: \$218.

Sealed bids must be submitted by mail and must be postmarked on or before November 1, 1997. Bids postmarked after the closing date will not be considered. Bids will be opened seven days after the closing postmark date. In the case of equal high bids, the high bid bearing the earliest postmark will be declared the successful bidder.

In your bid, clearly identify the item you are bidding on, using the manufacturer's name and model number, or other identification number, if specified. Each item requires a separate bid and envelope. Shipping charges will be paid by ARRL. Please include a daytime telephone number. The successful bidder will be advised by telephone with a confirmation by mail. No other notifications will be made, and no information will be given to anyone other than successful bidders regarding final price or identity of the successful bidder. If you include a self-addressed, stamped postcard with your bid and you are not the high bidder on that item, we will return the postcard to you when the unit has been shipped to the successful bidder.

Please send bids to Bob Boucher, Product Review Bids, ARRL, 225 Main St, Newington, CT 06111-1494. 