

Yaesu FT-840 MF/HF Transceiver

Reviewed by Steve Ford, WB8IMY

A new HF radio is a major purchase for most hams. So, the less "major" we can make it, the better. Cutting cost almost always means accepting compromises, but a good design keeps those compromises to a minimum. Yaesu joins the fray with the FT-840, a new entry-level radio with a good selection of features and good radio performance. The FT-840 is a 100-W output (adjustable) AM/CW/SSB (and, optionally, FM) transceiver that covers all ham bands from 160 through 10 meters and has a general-coverage receiver. It offers dual VFOs, 100 memory channels and elaborate scanning features as well.

One of the first things you notice about the FT-840 is its size. Weighing in at only 10 pounds, the 840 is packaged in an enclosure that's barely 4 inches high. Of course you have to add a power supply, but we're still talking about a very compact station. This makes the 840 a good choice for a lightweight traveling companion.

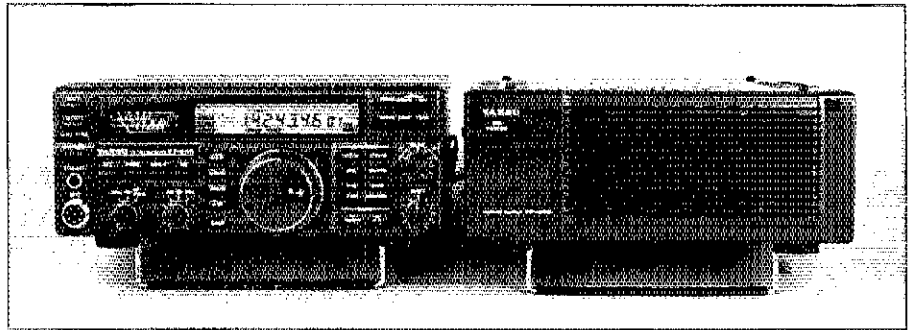
Controls, Displays and Other Goodies

The FT-840 provides enough front-panel control options to enhance operational flexibility, yet it avoids things that I'd consider gratuitous "bells and whistles." It's functional and easy to use, and it gets the job done.

The lightly weighted main tuning knob feels smooth and solid. You can follow some simple instructions in the manual to adjust the drag and make it feel just right for you. The SSB/CW tuning rate is normally a comfortable 10 kHz per knob revolution, but you can easily change it to 5 kHz with a switch accessible through the bottom panel. The slow tuning rate is better for CW operation with the narrow filter.

The easy-to-read front-panel LCD is your window to what's going on with the radio. It displays the operating frequency to 10 Hz (you can turn off the last digit) and shows a host of important operating parameters, including the current VFO or memory selection, mode of operation, IF filter selection, tuning rate, and so on. The analog meter displays signal strength on receive and power output or ALC on transmit.

All of the frequency controls are conveniently grouped to the right of the main tuning knob. From here you can easily switch between ham-band and general-coverage-receive operation, change bands (**UP/DOWN**), control the VFO and memory functions, and activate the **FAST** tuning rate for large frequency excursions. Each band



has two independent VFOs (**A/B**) that store frequency, mode, filter selection, and so on. The FT-840 also offers 100 tunable memory channels that store frequency, mode, filter selection, RIT settings and split-frequency status. Actually, each memory channel stores *two* frequencies and all the related settings, and you toggle between them with the **A/B** button. (The manual calls these the "front half" and "rear half" of the memory channel.) According to the manual, "you can do nearly anything with the two halves of a memory that you can do with the A/B VFOs, except for a few differences in tuning steps, scanning...and special-purpose memories." You can use the **MEM** button to step through the memories manually, or press the **SCAN** button to step through them automatically. When the memory mode is inactive, the **SCAN** switch allows you to scan through the FT-840's complete frequency range.

The 840 also offers a **CLAR**ifier (RIT) and an **IF SHIFT** control. Both are handy tools when you're operating in crowded bands. RIT range is adjustable to ± 2.5 or ± 1.25 kHz, a nice touch. Other receiving aids include a switchable AGC ("normal" and "fast" but no "off"), an effective noise blanker and a 12-dB attenuator. The all-mode squelch is a useful addition, especially if you have the FM option and you want to scan through the 10-meter repeater subband.

If you're using a manual antenna tuner (as I was during this review), **MOX** is a button you'll reach for often. It allows you to

manually activate the transmitter for quick antenna system tune-ups. If the SWR is high, the FT-840's protection circuitry decreases output power to about 5 W. This is still enough RF to get a usable reading on most antenna-tuner meters. Of course, output increases as you tweak your antenna tuner closer to the match point.

The FT-840 is compatible with the Yaesu FC-10 and FC-800 automatic antenna tuners. There's a separate DIN jack on the rear panel for each of these tuners. The front-panel **START** switch activates the tuner and *Wait* appears on the display while the tuner finds the best match (this happens within 30 seconds, according to the manual). We didn't test either tuner for this review.

The vertical row of buttons to the left of the main tuning knob is dedicated to selecting the various operating modes. You have your choice of SSB (press once for USB, again for LSB), CW (wide or narrow), AM (wide or narrow) and FM (optional). A speech processor is available for SSB or AM.

Yaesu offers two optional crystal filters for the FT-840: a 500-Hz CW filter and a 6-kHz AM filter. If you plan to do much shortwave broadcast listening, get the AM filter. Without it, you have to listen to AM with the standard 2.4-kHz SSB filter, which doesn't offer much fidelity for music. CW enthusiasts will probably want the narrow CW filter. I was grateful to have it when I was roaming through the low end of 40 meters at night. ARRL Lab Engineer Mike Gruber, WAISVF, reports that it takes less than 10 minutes to install the CW filter. Just remove the cabinet top and press the filter into its connector socket on the board. You don't have to change jumpers or cut any wires. This is a dramatic improvement to filter installation in the last Yaesu MF/HF transceiver we reviewed (see the FT-890 review in September 1992 *QST*). *Good job!*

The FT-840's speaker is located in the

The Bottom Line

Yaesu's newest entry-level MF/HF transceiver offers more features and performance than we would have expected in a "starter" radio just a few years ago. Its compact size and light weight make it a good choice for portable and mobile operation, too.

Table 1**Yaesu FT-840 MF/HF Transceiver, serial no. 3I010272****Manufacturer's Claimed Specifications**

Frequency coverage: Transmitter: 160- through 10-meter amateur bands. Receiver: 100 kHz to 30 MHz.

Modes of operation: CW, LSB, USB, AM, FM (optional).

Power requirement: 13.5-V dc, $\pm 10\%$; 1.2 A on receive, 2.0 A on transmit.

Receiver

SSB/CW receiver sensitivity (2.4 kHz bandwidth, 10 dB S/N): 0.5 to 1.8 MHz, $< 1 \mu\text{V}$ (-107 dBm); 1.8 to 30 MHz, $< 0.25 \mu\text{V}$ (-119 dBm).

AM (10 dB S/N, 6-kHz filter): 0.5 to 1.8 MHz, $< 8 \mu\text{V}$; 1.8 to 30 MHz, $< 1 \mu\text{V}$.

Blocking dynamic range: Not specified.

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

Third-order input intercept: Not specified.

S-meter sensitivity: Not specified.

CW/SSB squelch sensitivity: $< 2 \mu\text{V}$.

Receiver audio output: > 1.5 W into 4 Ω with $< 10\%$ THD.

IF/audio response: Not specified.

Image rejection (1.8 to 30 MHz): 70 dB or better.

Transmitter

Power output: SSB, CW, FM, adjustable up to 100 W; AM, 25 W carrier.

Spurious-signal and harmonic suppression: > 40 dB spurious radiation; > 50 dB harmonic radiation; 45 dB harmonic radiation (10, 18 MHz).

Third-order intermodulation distortion products: 25 dB at 100 W PEP output at 14.2 MHz.

CW keying characteristics: Not specified.

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

Composite transmitted noise: Not specified

Size (height, width, depth): 3.75 \times 9.5 \times 9.75 inches; weight, 10 lb.

*Dynamic-range measurements were made at the ARRL Lab standard signal spacing of 20 kHz. Blocking dynamic range measurements were noise limited at the values shown. AGC could not be defeated.

Measured in the ARRL Lab

As specified. Transmitter range: 1.8-2, 3.5-4, 7-7.5, 10-10.5, 14-14.5, 18-18.5, 21-21.5, 24.5-25, 28-30 MHz.

As specified. FM not tested.

At 13.8-V dc: 1.2 A on receive (no signal); 15.7 A max on transmit.

Receiver Dynamic Testing

Minimum discernible signal (noise floor) with 500-Hz IF filter:

1.0 MHz -133 dBm

3.5 MHz -137 dBm

14 MHz -138 dBm

10 dB S+N/N (signal 30% modulated with a 1-kHz tone, 2.4-kHz filter):

1.0 MHz $1.0 \mu\text{V}$

3.8 MHz $0.6 \mu\text{V}$

Blocking dynamic range with 500-Hz IF filter:*

1.0 MHz 106 dB

3.5 MHz 108 dB

14 MHz 113 dB

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

1.0 MHz 88 dB

3.5 MHz 90 dB

14 MHz 90 dB

1.0 MHz -0.9 dBm

3.5 MHz -1.9 dBm

14 MHz -1.7 dBm

S9 signal at 14 MHz: 28 μV .

0.5 μV .

2.4 W at 10% THD into 4 Ω .

At 6 dB: CW-N, 446-1018 Hz (572 Hz); CW-W, 250-1320 Hz (1070 Hz); USB, 255-2656 Hz (2401 Hz); LSB, 165-2422 Hz (2257 Hz); AM-N, 84-2100 Hz (2016 Hz).

105 dB.

Transmitter Dynamic Testing

Maximum power output typically 105 W, minimum power typically 3 W; varies slightly from band to band.

As specified. Worst case, 50 dB at 18 MHz. Meets FCC specifications for equipment in its power output class and frequency range.

See Figure 1.

See Figure 2.

S9 signal, 32 ms.

See Figure 3.

top of the radio. Despite its small size, there is more than enough audio for all but the noisiest environments. When the background noise becomes too much, you can always plug in an external speaker or resort to the front-panel headphone jack.

The rear-panel layout is straightforward. A fixed-level audio output is available for digital operating with multimode TNCs, but there is no corresponding audio input jack. This means that you must route the audio from your TNC to the front-panel microphone jack. The FT-840 has no FSK provision.

There are access holes for screwdriver-adjust trimmers to set the CW keying delay, CW sidetone level and speech-processing compression level. Having the sidetone control on the rear panel is fine. Once I set

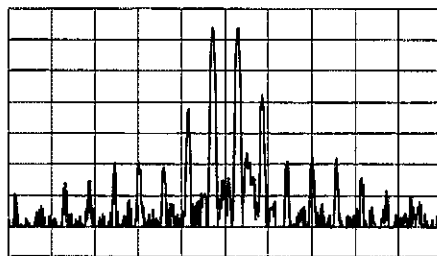
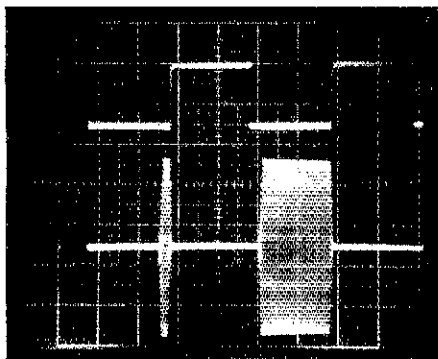


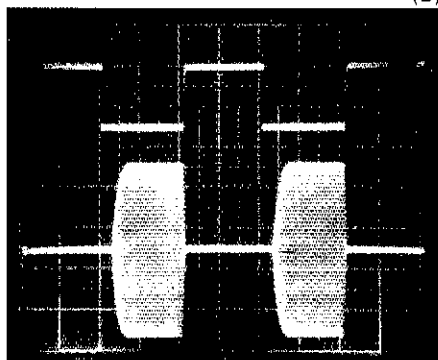
Figure 1—Worst-case spectral display of the Yaesu FT-840 transmitter during two-tone intermodulation distortion (IMD) testing. Worst-case third-order product is approximately 28 dB below PEP output, and the fifth-order product is approximately 49 dB down. Vertical divisions are 10 dB; horizontal divisions are 2 kHz. The transceiver was being operated at 100 W PEP output at 14 MHz.

my sidetone level, I rarely change it. And a set-and-forget speech processing control is fine as long as you don't change microphones often. The CW keying delay is another matter, though. Most CW operators like to adjust the delay for changes in sending speed and operating style (short delay for contesting or DXing, longer delay for ragchewing).

Other rear-panel jacks are standard fare: external ALC (for use with a linear amplifier), remote PTT, external speaker, auxiliary dc output and so on. TR control for a linear amplifier is available from the 8-pin BAND DATA jack. Maximum ratings are 1.5 A and 150 V dc, which should be sufficient to switch just about any modern amplifier. I would have preferred the convenience of a separate phono jack for



(A)



(B)

Figure 2—CW-keying waveform for the Yaesu FT-840 in the semi-break-in mode. 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 MHz. The photo at A shows noticeable shortening of the first transmitted character during semi-break-in operation; the photo at B shows the CW waveform with the radio locked in transmit.

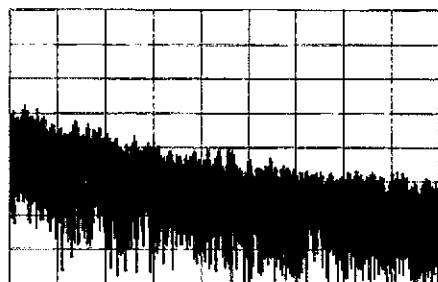


Figure 3—Spectral display of the Yaesu FT-840 transmitter output during composite-noise testing. Power output is 100 W at 3.5 MHz. Vertical divisions are 10 dB; horizontal divisions are 2 kHz. The log reference level (the top horizontal line on the scale) represents -60 dBc/Hz and the baseline is -140 dBc/Hz. The carrier, off the left edge of the photograph, is not shown. This plot shows composite transmitted noise 2 to 20 kHz from the carrier.

amplifier switching, though.

The **CAT**—Computer Aided Transceiver—jack permits computer control of many of the FT-840's functions. Many transceiver-control, logging and contesting software packages understand how to communicate with Yaesu's CAT interface, and to use the computer-controlled features you'll need an optional TTL to RS-232-C level converter such as the Yaesu FIF-232.

The FT-840 manual provides plenty of information for those who want to write their own control software. All of the CAT control commands are described along with their corresponding decimal and hexadecimal operating codes. The manual even offers examples of BASIC code to implement various functions. Yaesu does *not* offer software for the FT-840.

We used the FT-840 with Yaesu's matching FP-800 power supply. During this review I used the FP-800 power supply, but I also operated briefly from my own 30-A home-brew unit. Any 20-A (continuous) 13.8-V dc supply should do the job as long as it provides good filtering and regulation.

So, How does it Work?

One of the first things we look for in a new radio is receiver performance. Did Yaesu leave out receiver performance in designing a radio for this price class? At one time, less money meant less receiver performance—low dynamic range, wide filters, noisy synthesizers—that rendered the radios unusable with strong nearby signals and in crowded band conditions. ARRL Lab testing (Table 1) shows that Yaesu considered receiver performance a priority in the FT-840. It is sensitive and offers very acceptable dynamic range. We do have one nit to pick, though: Copy in the FT-840 manual and FT-840 advertising refers to the radio's receiver RF amplifier, but the 840 doesn't have one. This is good engineering—leaving out an RF gain stage you don't really need leads to better strong-signal performance, and the FT-840 is plenty sensitive without it—but inaccurate reporting.

In previous reviews of Yaesu's FRG-100 and FT-747GX, we complained about heavy-handed high-end-audio rolloff, which resulted in muffled-sounding audio on SSB and AM. As the IF/audio response numbers in Table 1 show, however, the FT-840's audio-amplifier chain includes thoughtful, *appropriate* audio rolloff. The audio circuitry in the 840 preserves its solid receive sound on CW and SSB while usefully minimizing high-frequency AF and IF hiss, as well as minimizing the high-pitched audio that results from IF-filter blow-by. The 840's circuitry reduces the radio's high-end IF/AF response less in SSB than in CW wide—even though the same IF filter is used in both cases. (A switchable bypass capacitor in the 840's

first audio amplifier/filter makes the difference.) Higher-priced MF/HF transceivers from a number of manufacturers include mode/filter linked AF filtering, but we applaud Yaesu's inclusion of this feature in a *low-end* radio.

The FT-840's stock 2.4-kHz IF filter provides quite good SSB and "wide CW" selectivity. The review transceiver included the optional 500-Hz CW filter. This filter pair, operating in conjunction with the FT-840's IF shift and mode/filter-linked AF filtering, does a good job of sorting out signals in crowded bands and presenting you with audio that's noticeably free of audio/IF hiss. I could hear some high-pitched filter blow-by when tuning adjacent to very strong signals with the 500-Hz filter switched in, but the AF rolloff keeps this effect very much under control.

One selectivity no-no that really compromises the FT-840's usefulness for data communication is its inability to let you use the narrow-CW filter in SSB mode—a trait shared by the higher-priced FT-890, but not by the FRG-100 receiver. There is a workaround. The FT-840 allows you to set its CW offset (discussed later), and it allows you to switch between the upper or lower sideband for CW reception. Through some control acrobatics you can use the narrow filters in the data modes. (It's necessary to operate split, transmit in SSB and receive in CW, and set your offset. CW "sideband" and **IF SHIFT** *just so*.)

To Yaesu's credit, the manual devotes nearly two manual pages to the dance steps necessary to do this, but it seems like some of the effort that went into the control programming for the elaborate memory and scanning features might have been better spent on developing a simple way to make the narrow filters available for data operation. We simply *must* be able to use our radios' "CW" filters in SSB mode, at BFO-to-IF offsets appropriate for data modes!

SSB is the first mode I tried after getting the FT-840 home. Everyone reported that my audio sounded crisp and clean. I'm loath to use speech processing, but I gave it shot one evening on 17 meters. The band was fading fast and I had just started a conversation with a fellow in Arizona. When he commented that my signal strength was slipping, I switched in the processor. To my surprise he said that it made an audible difference. According to him, I immediately jumped from difficult copy to "adequate" copy. A notable omission is the lack of a VOX for SSB operation. I think that VOX should be standard on any MF/HF transceiver.

CW operating was a breeze—despite the fact that I had to set the keying delay and leave it. (There was no way I was going to fiddle around behind the rig every time I was unhappy with the timing.) Previous *QST* Product Reviews have called for adjustable CW offset on all MF/HF transceiv-

ers, and the FT-840 includes it. The CW pitch/receiving offset/sidetone pitch are easily changed from the front panel (400 to 1000 Hz in 100-Hz steps, 700-Hz default). This is a welcome feature.

My AM air time was brief, but educational. The dedicated AMers thought the FT-840's audio lacked "authority." It was perfectly clear and understandable, but it wasn't the booming, full-bodied sound that many AM enthusiasts demand. The FT-840's AM characteristics are more than adequate for those few times I venture onto the AM frequencies.

I didn't test the FT-840's FM option, but it has a couple of features worth mentioning: built-in CTCSS encoding and programming for the standard repeater frequency offset. Many 10-meter FM repeaters use CTCSS to prevent distant stations on the same frequency from inadvertently keying up the machines. If you can't transmit the proper subaudible tone, you won't be able to use the repeater.

On the digital modes (RTTY, AMTOR and PacTOR), I found that the 80-mV audio level at the rear-panel **AF OUT** jack was not enough to "plug and play" with my Kantronics KAM multimode TNC. Audio requirements vary from TNC to TNC, so

your experience may be different.

Once the KAM was up and running, I tried the FT-840 on RTTY. I enjoyed several QSOs—both domestic and international—and received excellent reports. The manual cautions you to reduce the output to about 50 W for extended operation. On a couple of occasions I cranked the output up to 100% and the rig held up nicely. Regardless of the power output, keep an eye on the ALC meter to avoid overdriving the FT-840's mike input on the digital modes. A slight adjustment of the **MIC** knob is all that's needed to keep the transmitter drive at the proper level to keep your signal from unnecessarily interfering with other stations on the band.

ARRL Lab testing indicated that our FT-840's TR turnaround time was overly long—120 ms or so—too long for AMTOR and PacTOR. Consultation with Yaesu netted the response that the radio was defective, so Yaesu shipped us another radio to try while they fixed ours. The replacement radio worked fine (32 ms turnaround), as did the review unit after repair. It turns out that Yaesu made some circuit modifications that weren't included in our early-production unit. If you have early FT-840, are using it on AMTOR, and are having a tim-

ing problem, contact Yaesu for a warranty repair.

Summary

Yaesu's FT-840 offers features and performance beyond what I would have expected in a "starter" rig just a few short years ago. Although it's missing a few things like VOX and an easy means of using the narrow filter in the data modes, it's the type of radio you'll enjoy for years before you feel the need to upgrade. And it isn't just a radio to leave at home, either. I suspect we'll see FT-840s cropping up in many mobile applications—and more than a few Field Day operations.

Thanks to Dave Newkirk, W1JZ, Senior Assistant Technical Editor, for lending his critical ear and providing comments on the FT-840's receive characteristics.

Manufacturer's suggested retail prices: FT-840, \$999; YF-112C 500-Hz CW filter, \$124; YF-112A 6-kHz AM filter, \$124; FC-10 automatic antenna tuner, \$379; FC-800 automatic antenna tuner, \$499; FP-800 dc power supply, \$309; SP-6 speaker/audio filter, \$160; FIF-232 CAT System Interface, \$109; 747 FM unit, \$70; TCXO-4 master reference oscillator, \$42. Manufacturer: Yaesu USA, 17210 Edwards Rd., Cerritos, CA 90701, tel 310-404-2700.

S & S Engineering ARK 40 CW QRP Transceiver Kit

Reviewed by Jeff Gold, AC4HF

If you're looking for something different in a QRP transceiver kit, S & S Engineering may have just the product for you. The ARK 40 is a single-band, 40-meter CW transceiver that covers 7 to 7.150 MHz; 20- and 30-meter versions are available, too. It features a superheterodyne receiver and 5-W transmitter. The rig offers full break-in (QSK) keying, a diode-ring mixer and 600-Hz crystal filter. Other standard features include RIT, AGC, a front-panel speaker and a narrow (200-Hz) audio filter.

A big difference between the ARK 40 and other low-cost QRP kits is that it uses a frequency synthesizer instead of a conventional VFO. Tuning is accomplished with pushbutton switches. They're like thumbwheel switches, but you push a button to increment or decrement the mechani-

cal 4-digit counter, which resolves frequencies to 100 Hz. Tuning is in 100-Hz steps.

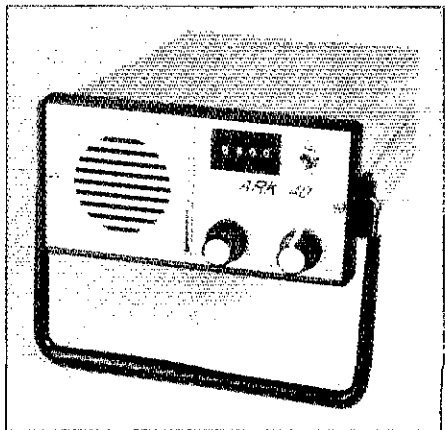
The ARK 40's frequency synthesizer uses two phase-locked loops. The signal from the first, which tunes from 4 to 7 MHz in 2-kHz steps, is divided by 20, giving 100-Hz steps. An image-reject mixer consisting of two 1496s combines the resultant 0.2 to 0.35-MHz signal with energy from an 18.8-MHz crystal oscillator to produce the ARK 40's receiver-LO range of 19 to 19.15 MHz. (The ARK 40's RIT control varies this oscillator.) A second PLL, operating as a "cleanup" loop, filters the 19 to 19.15-MHz signal for improved image and spur rejection. Its output drives the ARK 40's receive mixer directly or is converted to 7 MHz by the transmit mixer and a 12-MHz crystal oscillator.

As the test results in Table 2 show, the ARK 40 meets or exceeds its specifications and offers solid receiver and transmitter performance. ARRL Lab Supervisor Ed Hare, KA1CV, even pointed to a couple of areas (blocking dynamic range, for example) where he thought S & S Engineering should revise the performance specifications—*upward*. (He doesn't get to say this very often.) The receiver is plenty sensitive, and the dynamic range is excellent

for a receiver in this class. The transmitter effortlessly delivers a clean 5 W. The keying waveform is excellent, with no appreciable shortening of the first transmitted dit.

The Manual

One of the keys to an enjoyable and successful kit-building experience is the manual. Previous kits I've built range from those supplied as basically a bag of parts and a schematic, to Heathkits with manuals that told you in minute, step-by-step detail



The Bottom Line

Quality components, a thorough manual and good basic radio performance make this kit a good choice for the intermediate or experienced builder.