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May 1994

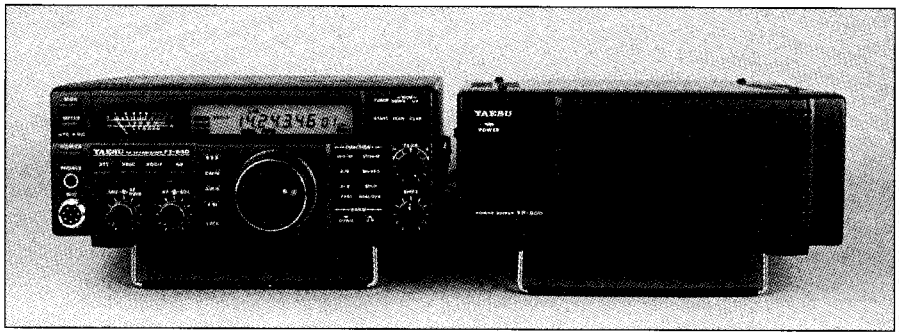
Yaesu FT-840 MF/HF Transceiver

S & S Engineering ARK 40 CW QRP Transceiver Kit

Conducted by Mark Wilson, AA2Z
Editor, *QST*

Yaesu FT-840 MF/HF Transceiver

Reviewed by Steve Ford, WB8IMY


KIRK KLEINSCHMIDT, NT0Z

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, WA1SVF, 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	*Measured in the ARRL Lab*
Frequency coverage: Transmitter: 160- through 10-meter amateur bands. Receiver: 100 kHz to 30 MHz.	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.
Modes of operation: CW, LSB, USB, AM, FM (optional).	As specified. FM not tested.
Power requirement: 13.5-V dc, ±10%; 1.2 A on receive, 20 A on transmit.	At 13.8-V dc: 1.2 A on receive (no signal); 15.7 A max on transmit.
Receiver	*Receiver Dynamic Testing*
SSB/CW receiver sensitivity (2.4 kHz bandwidth, 10 dB S/N): 0.5 to 1.8 MHz, <1 μV (–107 dBm); 1.8 to 30 MHz, <0.25 μV (–119 dBm).	Minimum discernible signal (noise floor) with 500-Hz IF filter: 1.0 MHz –133 dBm 3.5 MHz –137 dBm 14 MHz –138 dBm
AM (10 dB S/N, 6-kHz filter): 0.5 to 1.8 MHz, <8 μV; 1.8 to 30 MHz, <1 μV.	10 dB S+N/N (signal 30% modulated with a 1-kHz tone, 2.4-kHz filter): 1.0 MHz 1.0 μV 3.8 MHz 0.6 μV
Blocking dynamic range: Not specified.	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: Not specified.	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
Third-order input intercept: Not specified.	1.0 MHz –0.9 dBm 3.5 MHz –1.9 dBm 14 MHz –1.7 dBm
S-meter sensitivity: Not specified.	S9 signal at 14 MHz: 28 μV.
CW/SSB squelch sensitivity: <2 μV.	0.5 μV.
Receiver audio output: >1.5 W into 4 Ω with <10% THD.	2.4 W at 10% THD into 4 Ω.
IF/audio response: Not specified.	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).
Image rejection (1.8 to 30 MHz): 70 dB or better.	105 dB.
Transmitter	*Transmitter Dynamic Testing*
Power output: SSB, CW, FM, adjustable up to 100 W; AM, 25 W carrier.	Maximum power output typically 105 W, minimum power typically 3 W; varies slightly from band to band.
Spurious-signal and harmonic suppression: >40 dB spurious radiation; >50 dB harmonic radiation; 45 dB harmonic radiation (10, 18 MHz).	As specified. Worst case, 50 dB at 18 MHz. Meets FCC specifications for equipment in its power output class and frequency range.
Third-order intermodulation distortion products: 25 dB at 100 W PEP output at 14.2 MHz.	See Figure 1.
CW keying characteristics: Not specified.	See Figure 2.
Transmit-receive turnaround time (PTT release to 50% audio output): Not specified.	S9 signal, 32 ms.
Composite transmitted noise: Not specified	See Figure 3.
Size (height, width, depth): 3.75×9.5×9.75 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.

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 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).

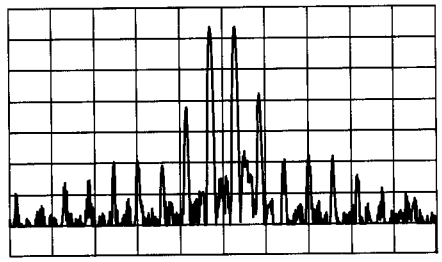
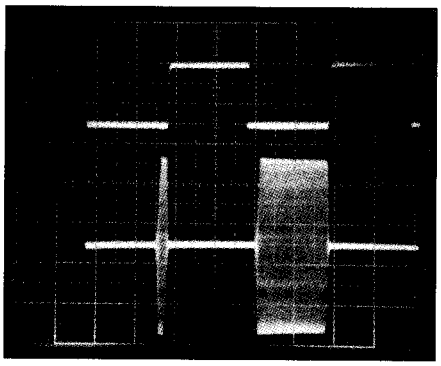


Figure 1—Worst-case spectral display of the Yaesu FT-840 transmitter during two-tone intermodulation distortion (IMD) testing. Worst-case third-order product is approximately 28 dB below PEP output, and the fifth-order product is approximately 49 dB down. Vertical divisions are 10 dB; horizontal divisions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

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)

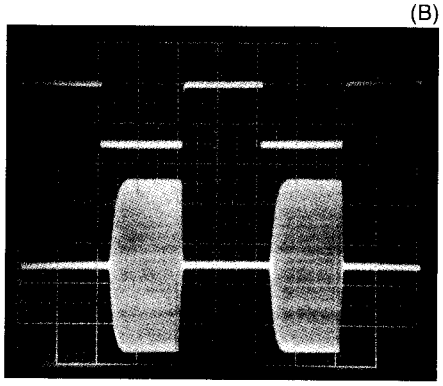


Figure 2—CW-keying waveform for the Yaesu FT-840 in the semi-break-in mode. The upper trace is the actual key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transceiver was being operated at 100 W output at 14 MHz. The photo at A shows noticeable shortening of the first transmitted character during semi-break-in operation; the photo at B shows the CW waveform with the radio locked in transmit.

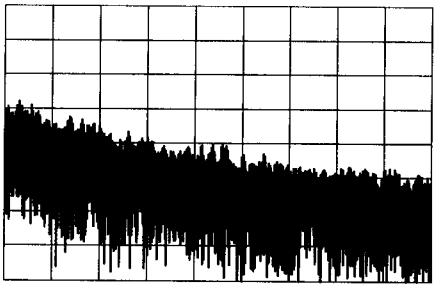


Figure 3—Spectral display of the Yaesu FT-840 transmitter output during composite-noise testing. Power output is 100 W at 3.5 MHz. Vertical divisions are 10 dB; horizontal divisions are 2 kHz. The log reference level (the top horizontal line on the scale) represents –60 dBc/Hz and the baseline is –140 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 timing 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, WJ1Z, 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 mechanical 4-digit counter, which resolves frequencies to 100 Hz. Tuning is in 100-Hz steps.

The Bottom Line

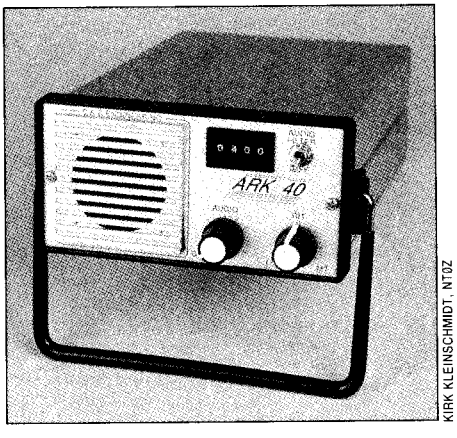
Quality components, a thorough manual and good basic radio performance make this kit a good choice for the intermediate or experienced builder.

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



KIRK KLEINSCHMIDT, N1DZ

Table 2
S & S Engineering ARK 40 40-Meter CW Transceiver

Manufacturer's Claimed Specifications	*Measured in the ARRL Lab*
Frequency coverage: 7 to 7.15 MHz, 100-Hz tuning steps.	As specified.
Mode of operation: CW.	As specified.
Power requirement: 10 to 13.8-V dc; 0.4 A on receive, 1 A on transmit.	At 13.8-V dc: 0.4 A on receive (no signal); 1 A at 4 W RF output on transmit.
Receiver	*Receiver Dynamic Testing*
CW receiver sensitivity (bandwidth not specified, 10 dB (S+N)/N): 0.3 μV (–117 dBm).	Minimum discernible signal (noise floor) with 600-Hz IF filter: –127 dBm.
Blocking dynamic range: >75 dB at 20-kHz signal spacing.	Blocking dynamic range with 600-Hz IF filter:* 95 dB.
Two-tone, third-order IMD dynamic range: >90 dB at 20-kHz signal spacing.	Two-tone, third-order IMD dynamic range with 600-Hz IF filter:* 94 dB.
Third-order input intercept: >10 dBm.	14.2 dBm
Receiver audio output: 1 W.	0.7 W at 1% THD into 4 Ω.
IF/audio response: Not specified.	At –6 dB: Audio filter off, 696-1304 Hz (608 Hz); audio filter on, 647-880 Hz (233 Hz).
Image rejection: >60 dB.	62 dB.
Transmitter	*Transmitter Dynamic Testing*
Power output: 3 to 4 W typ, 5 W at 13.8 V dc.	Maximum power output, 5.9 W at 13.8 V dc.
Spurious-signal and harmonic suppression: Not specified.	41 dB. Meets FCC specifications for equipment in its power output class and frequency range.
CW keying characteristics: Not specified.	See Figure 4.
Composite transmitted noise: Not specified	See Figure 5.
Size (height, width, depth): 2.75×5.5×8 inches, weight 4 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.

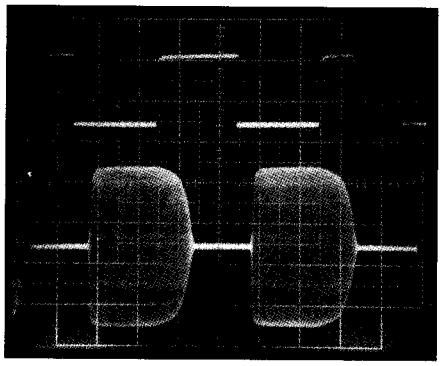


Figure 4—CW-keying waveform for the S & S Engineering ARK 40. The upper trace is the actual key closure; the lower trace is the RF envelope. Horizontal divisions are 10 ms. The transceiver was being operated at 5 W output at 7 MHz.

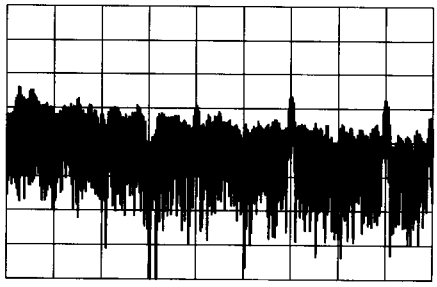


Figure 5—Spectral display of the S & S Engineering ARK 40 transmitter output during composite-noise testing. Power output is 3.6 W at 7 MHz. Vertical divisions are 10 dB; horizontal divisions are 2 kHz. The log reference level (the top horizontal line on the scale) represents 60 dBc/Hz and the baseline 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.

how to assemble the rig. The 118-page S & S instruction manual is a work of art. It is professionally written, with excellent production quality, good schematics and clear photos. This is by far the most complete and well done manual I have come across since building my Heath HW-9.

There is a master list of parts that has complete descriptions of each part (including details such as the color code for the resistors). This makes part placement a lot surer. One of the biggest problems builders experience is incorrectly identifying parts and putting them in the wrong place on the board.

The manual offers a second parts list, this one with two checkoff boxes for each part, as an aid during construction. The parts list is in the back of the manual, separate from the assembly instructions. At first I wasn't sure I liked this approach, but found it worked fine as I built the boards. There are separate assembly instructions for each board, and then sections for final assembly and alignment.

The manual was very easy to follow until the final assembly and alignment section. I found it easier to look at the pictures of the assembly and the schematic for this part. I also found the alignment procedures to be somewhat confusing. During initial testing, the ARRL Lab engineers found that I had missed some of the alignment steps and were able to realign it to specifications. S & S said they are revising the manual to make the alignment instructions clearer.

S & S offers a guarantee that the rig will work as specified or you can send it back and they will fix it promptly. If the problem is their fault (bad component, etc), they'll fix it free (you pay postage one way). If you've done something wrong (like put a part in the wrong place), they'll fix it for less than $25. Although I didn't have to test the service, this seems like a very reasonable arrangement to me.

Building the Kit

Most of the ARK 40's components fit on three printed-circuit boards. There are over 1000 solder connections in all, and S & S Engineering clearly states that this is not a beginner's kit. Although this shouldn't be your first kit, I think that someone with a little kit-building experience could tackle this project with help from an experienced builder. There are a lot of parts, but the way the kit is packaged and the quality manual make it easy to assemble.

The boards and their corresponding parts are each packaged separately. If there are a lot of the same value resistors or capacitors, they are put in separate packages. If there is any chance of a part being identified incorrectly, it is in a separate wrap and clearly labeled. The coils are all pre-wound. Some of the capacitors are tiny

surface-mount devices; the kit includes extras in case you goof. (It turned out that I managed to crunch one with a pair of surgical forceps. No problem: I just used a different tool and the spare capacitor.)

My approach to building a kit is to take all the parts out of the box, check them off and separate them. I usually take a big piece of paper, label the components (R1, C34 and so on), and put the leads through the paper. This helps me keep track of everything when I'm soldering the parts on the board. It also alerts me ahead of time if anything is missing so I can call for a replacement. This tedious process is usually my least favorite part of building a kit, and I found that I didn't need to do it with the ARK 40 because the parts were so well packaged. I just took a number of small plastic bins and just dumped each of the packages into each one. There was nothing missing.

The boards are double-sided with plated-through holes. The down side to this type of board is that if you put a part in the wrong place, it is harder to remove it from the boards—so watch what you're doing. Silk-screened component numbers make parts placement much easier. The parts in the kit were also all top-quality. The case is fantastic and should stand up to about any type of use.

I still get real nervous when I first power up a rig, especially one with so many parts. When I flipped the switch on the ARK 40, the power came on and no smoke billowed out. Boy, was I happy!

Testing and alignment requires a multimeter, a receiver with an accurate digital display (or a frequency counter), and an oscilloscope or power meter capable of measuring QRP levels. After you complete each board, you are asked to make some simple resistance checks with an ohmmeter. Most of the alignment procedures are typical of QRP transceivers. There are two coils and a couple of variable capacitors to adjust in the receiver section and two transformers for the transmitter. If you run into problems during alignment, the troubleshooting section should help point you in the right direction to localize the problem. If you need to take advantage of the service, you will find the people at S & S Engineering knowledgeable and helpful.

On the Air

Building the rig is only half the fun. Putting a rig I just have built on the air is always an exciting experience for me. I plugged in the antenna and key and turned on the power. The 40-meter band was not in very good condition. I tuned around a little and heard someone calling CQ. I answered and he came back with a QRZ? This was a good sign as far as I was concerned. I answered back with my call twice and turned it over. Ralph, N3QF, in Washington, DC, came right back. We had a nice 40-minute ragchew. He said my signal had a very nice sound to it. I listened to the ARK 40's keying on my Kenwood TS-850, and it sure sounds sweet.

At first I had serious reservations about the use of push buttons to tune around the band. I found that after a few minutes I didn't mind this method at all. The QSK works as expected, and my only (minor) complaint is that the TR relay sounds a little squeaky. The rig sounds great, is very sensitive, has great full break-in keying, and is extremely rugged. It even acquitted itself well during the ARRL November Sweepstakes, when 40 meters is packed with contest stations. The size is about right for backpacking or portable operation. I am impressed!

I was little surprised when I first saw the $270 price tag; many of the other QRP transceiver kits I'm familiar with are in the $160 to $200 range. As I finished building and testing the rig, though, I came to the conclusion that the quality of the components and manual, combined with the impressive radio performance, make this kit a good value.

Manufacturer's suggested retail price: ARK 40, $270 (20- and 30-meter versions also available); optional keyer kit, $40. Manufacturer: S & S Engineering, 14102 Brown Rd, Smithburg, MD 21783; tel 301-416-0661; fax 301-416-0963.

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

Alinco DJ-580T dual-band H-T with EMS-8 speaker/mike, EDC-36 dc cable and EDH-6 battery case (sold as a package only; see Product Review, March 1994 *QST*). Minimum bid: $316.

Down East Microwave SHF-2400B Mode S downconverter (see Product Review, February 1994 *QST*). Minimum bid: $158.

ICOM IC-707 MF/HF transceiver with FL-52A CW filter (sold as a package only; see Product Review, April 1994 *QST*). Minimum bid: $665.

ICOM IC-W21AT dual-band H-T with HM-75 speaker/mike, CP-13 dc cable and BP-130 battery case (sold as a package only; see Product Review, March 1994 *QST*). Minimum bid: $404.

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Kenwood TH-78A dual-band H-T with SMC-33 speaker/mike, PG-2W dc cable and BT-8 battery case (sold as a package only; see Product Review, March 1994 *QST*). Minimum bid: $364.

SSB Electronic UEK-2000 Mode S downconverter (see Product Review, February 1994 *QST*). Minimum bid: $260.

Standard C558A dual-band H-T with CMP-111 speaker/mike, CAW-150 dc cable and CBT-151 battery case (sold as a package only; see Product Review, March 1994 *QST*). Minimum bid: $422.

Yaesu FT-530 dual-band H-T with MH-29A2B speaker/mike, E-DC-5B dc cable and FBA-12 battery case (sold as a package only; see Product Review, March 1994 *QST*). Minimum bid: $407.

Sealed bids must be submitted by mail and must be postmarked on or before May 27, 1994. 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.

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