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Elecraft KX3 HF and 6 Meter QRP Transceiver

A small self-contained transceiver with big features and performance.

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The Elecraft KX3 is a nominal 10 W HF and 6 meter transceiver intended primarily for portable use. With its internal battery compartment and available miniature keyer paddles, it is ready to go from a campsite or picnic table with just the addition of an antenna (see Figure 1). Unlike many low power radios, in addition to CW, this transceiver can operate SSB, AM, FM and digital modes. As we will discuss, unlike many compact portables, it doesn't give up much in terms of features or performance in comparison to full-size high-end radios.

Honey, I Shrunk The K3!

Based on the photo, you could easily be forgiven for thinking that this is a miniature K3. The KX3's front panel is ⅔ the width of the K3's and about ⅞ the height, but the radio is only 16% of the depth of its bigger sibling. Interestingly, the display is exactly the same size and includes the same indicators as that of the K3. The KX3 is somewhat larger than the latest crop of CW-only portable transceivers, but it offers so much more.

Figure 1 — The KX3's small size makes it a natural for camping or picnic table use. Here the author uses the KX3 in "minimalist" mode, using the internal battery and speaker with the optional paddles attached. Just the connection of an antenna has him on the air.

What's In The Box?

To say that the KX3 is a direct conversion radio misses the point. It would probably be more descriptive to say that the KX3 is a high performance software defined radio (SDR) with a 0 Hz IF and quadrature component receiver processing that provides single-signal reception. The quadrature outputs are also directly available on a jack. Those signals allow a PC running your favorite SDR software to display the spectrum without the need for an accessory IF-to-quadrature transistor.

The box also includes multiple power supply options. The standard KX3 includes AA size battery compartments for eight cells, all within the box. There is also a connector that can be used to power the radio from a storage battery or a 13.8 V station supply. The radio includes special low voltage drop diodes that power the radio from whichever source has the higher voltage. An optional internal battery charger for NiMH batteries was not available at the time of the review, but is now shipping.

DSP Features Abound

The quadrature components allow the KX3 DSP (digital signal processor) to demodulate all modes on receive, and the processor also generates the required waveforms on transmit. The DSP also provides most of the other functions that you would expect on a high end transceiver.

The receiver DSP offers K3 style special effects if you listen with stereo headphones or a pair of speakers. A big surprise to me — while a separate subreceiver isn't available, the *dual watch* function allows listening to the signals from VFO A and B on different frequencies in each ear, just as if you had two receivers. The catch is that both frequencies have to be within the passband of the roofing filter, which can be opened as wide as 15 kHz — enough for most CW, and many SSB, DX split operations. For wider splits, you can toggle between the A and B, or reverse (REV) mode can be selected.

The receiver can drive its single internal 1 inch speaker, but I would consider that mainly a backup or trail solution. You will want the stereo capability of at least a pair of ear buds to appreciate the DSP features described above. For base or mobile applica-

Bottom Line

The KX3 offers a large measure of performance and features in a compact but workable enclosure. While it's a wonderful addition to a campsite or picnic table, the KX3 can also form the basis of a competent home or mobile station with the addition of the appropriate accessories.

tions Elecraft suggests the use of external amplified speakers to provide sufficient output. Another mobile option is to use the KX3 audio to drive the AUX AUDIO INPUT jack available in most recent vehicles.

The KX3 is transverter friendly. Up to nine transverter bands can be defined, each with different IF frequency range and output RF power level. The KX3 will then display the transverter's operating frequency on the main tuning dial with the capability to adjust the offset to compensate for transverter local oscillator error. The KX3 does not have separate transverter input and output connections, so the KX3 ANTENNA jack must be used.

Computer Connectivity

The KX3 connects to a computer through a serial connection via a 3.5 mm stereo socket. Elecraft provides your choice of a cable that connects to a computer USB port or an RS-232 socket. If you want both, you can have the other for an additional $29.95.

As with most of their products, the folks at Elecraft keep up with improvements in the feature set and bug fixes as often as needed. Downloading new firmware is easy from an Internet connected computer. The computer connection can also be used with the usual rig control, memory management and logging software. The logging program I tried didn't have a choice for KX3, but seemed to work fine by selecting K3 as the radio. It is possible to control a network connected KX3 from a PC running control software at a different location.

What's Not In The Box?

Every transceiver design is a compromise. With the KX3 offering so much, an obvious question is, "What is it giving up by being so small?" Of course, the first parameter is transmit power, but that's easy to fix. Similarly, the audio output power is low, but it's even easier to fix if circumstances require it. As noted in Table 1, there is not much that could be said to be missing in the performance area.

The most significant limitation that I could see in comparison to my K3 is the connectivity flexibility. Few external connections will be needed for operating on the trail. In fact, if you're operating CW with the optional paddles and have the internal batteries installed, ear buds and an antenna should be all you need. At home, it is a very different story, and the left side panel is likely to be fully utilized (see Figure 2).

Fortunately, during our review, the wizards at Elecraft figured out that they had a potential

Table 1
Elecraft KX3, serial number 0496

Manufacturer's Specifications	Measured in the ARRL Lab
Frequency coverage: 0.31-32, 44-54 MHz; transmit excluded in some ranges (varies by country).	As specified. Transmit frequencies on unit tested, 1.7 to 2.7, 3-32, 44-54 MHz; watch band edges.
Power requirement: 8-15 V dc, 1-2 A typical in transmit; receive, 150 mA minimum typical (back lights off, preamp off, no signal).	Transmit, 2.35 A (10 W) at 13.8 V dc, 1.35 A 11.1 V dc (internal battery power); receive, 220 mA (no signal, max audio, maximum lights), 186 mA (no signal, max audio, no lights).
Modes of operation: SSB, CW, AM, FM, DATA.	As specified.
Receiver	**Receiver Dynamic Testing**
Sensitivity (MDS): –138 dBm typical (20 dB preamp); –140 dBm typical on 6 meters (30 dB preamp). Sensitivity decreases gradually below 1.5 MHz due to protective high pass filtering.	Noise floor (MDS), 500 Hz BW, 500 Hz roofing filter: *Preamp off/1/2/3* 0.475 MHz –81/–88/–98/–102 dBm 1.0 MHz –92/–98/–110/–113 dBm 3.5 MHz –121/–126/–137/–139 dBm 14 MHz –120/–125/–137/–139 dBm 50 MHz –120/–126/–137/–141 dBm
Noise figure: Not specified.	Preamp off/1/2/3: 14 MHz, 27/22/10/8 dB; 50 MHz, 27/21/10/6 dB.
AM sensitivity: Not specified.	10 dB (S+N)/N, 1 kHz tone, 30% modulation, 6 kHz bandwidth: *Preamp off/1/2/3* 3.8 MHz 8.70/4.21/1.27/1.00 µV 50.4 MHz 8.12/4.16/1.29/0.90 µV
FM sensitivity: Not specified.	For 12 dB SINAD, 3 kHz deviation, 15 kHz bandwidth: *Preamp off/1/2/3* 29 MHz 1.82/1.12//0.35/0.27 µV 52 MHz 2.51/1.24/0.40/0.29 µV
Blocking gain compression dynamic range: Not specified.	Blocking gain compression dynamic range, 500 Hz BW, 500 Hz roofing filter: *20 kHz offset, Preamp off/1/2/3* 3.5 MHz >131/>136/131/131 dB 14 MHz >130/>135/131/130 dB 50 MHz >130/135/131/132 dB *5/2 kHz offset, Preamp off* 3.5 MHz >131/131 dB 14 MHz >130/128 dB 50 MHz 130/129 dB
Reciprocal mixing dynamic range (500 Hz BW): Not specified.	14 MHz, 20/5/2 kHz offset: 120/119/114 dB.

ARRL Lab Two-Tone IMD Testing (500 Hz BW, 500 Hz roofing filter)*

Band/Preamp	*Spacing*	*Input Level*	*Measured IMD Level*	*Measured IMD DR*	*Calculated IP3*
3.5 MHz/Off	20 kHz	–20 dBm	–121 dBm	101 dB	+31 dBm
		–11 dBm	–97 dBm		+32 dBm
14 MHz/Off	20 kHz	–17 dBm	–120 dBm	103 dB	+35 dBm
		–10 dBm	–97 dBm		+34 dBm
		0 dBm	–73 dBm		+37 dBm
14 MHz/One	20 kHz	–25 dBm	–125 dBm	100 dB	+25 dBm
		–16 dBm	–97 dBm		+25 dBm
14 MHz/Two	20 kHz	–41 dBm	–137 dBm	96 dB	+7 dBm
		–29 dBm	–97 dBm		+5 dBm
14 MHz/Three	20 kHz	–44 dBm	–139 dBm	95 dB	+4 dBm
		–30 dBm	–97 dBm		+4 dBm
14 MHz/Off	5 kHz	–17 dBm	–120 dBm	103 dB	+35 dBm
		–10 dBm	–97 dBm		+34 dBm
		0 dBm	–73 dBm		+37 dBm

*ARRL Product Review testing now includes Two-Tone IMD results at several signal levels. Two-Tone, Third-Order Dynamic Range figures comparable to previous reviews are shown on the first line in each group. The "IP3" column is the calculated Third-Order Intercept Point. Second-order intercept points were determined using –97 dBm reference.
**Default values; bandwidth and cutoff frequencies are adjustable via DSP.

Receiver	Receiver Dynamic Testing
ARRL Lab Two-Tone IMD Testing (500 Hz BW, 500 Hz roofing filter)* (continued) *Band/Preamp* — *Spacing* — *Input Level* — *Measured IMD Level* — *Measured IMD DR* — *Calculated IP3* 14 MHz/Off — 2 kHz — –20 dBm — –120 dBm — 100 dB — +30 dBm — — –10 dBm — –97 dBm — — +34 dBm — — 0 dBm — –72 dBm — — +36 dBm 50 MHz/Off — 20 kHz — –17 dBm — –120 dBm — 103 dB — +35 dBm — — –11 dBm — –97 dBm — — +32 dBm	
Second-order intercept point: Not specified.	*Preamp off/1/2/3* 14 MHz +75/+75/+69/+69 dBm; 50 MHz +69/+69/+49/+49 dBm.
DSP noise reduction: Not specified.	15 dB.
Notch filter depth: Not specified.	Manual notch: >70 dB. Auto notch: >70 dB, two tones, 55 dB. Attack time: 50 ms.
FM adjacent channel rejection: Not specified.	Preamp 3: 29 MHz, 85 dB; 52 MHz, 89 dB.
FM two-tone, third-order IMD dynamic range: Not specified.	20 kHz offset, preamp 3: 29 MHz, 84 dB; 52 MHz, 84 dB. 10 MHz offset, preamp 3: 29 MHz, 99 dB; 52 MHz, 99 dB.
S-meter sensitivity: Not specified.	S9 signal, preamp off/1/2/3: 14.2 MHz, 242/87/29.6/9.76 µV; 50 MHz, 278/116/33.1/13.8 µV.
Squelch sensitivity: Not specified.	At threshold, FM, preamp 3: 29 MHz, 0.75 µV, 50 MHz, 0.33 µV.
IF/audio response: Not specified.	Range at –6 dB points, (bandwidth)**: CW (500 Hz): 322-788 Hz (466 Hz); Equivalent rectangular BW: 472 Hz; USB: (2.7 kHz): 125-2865 Hz (2740 Hz); LSB: (2.7 kHz): 125-2865 Hz (2740 Hz); AM: (8.4 kHz): 75-4059 Hz (7950 Hz).
Spurious and image rejection: Not specified.	Direct conversion, image of opposite sideband rejection, 72 dB.
Transmitter	**Transmitter Dynamic Testing**
Power output: 10 W PEP (160-15 meters), 8 W PEP (12-6 meters).	With 11-15 V dc, HF: CW, SSB, DATA, FM, 0-12 W (HF), 9 W (6 meters) typical; AM, 0-4 W (HF), 0-3 W (6 meters). With internal batteries (8.8-11 V dc), 0-5.5 W typical.
Spurious-signal and harmonic suppression: >50 dB.	HF, 48 dB (worst case, 1.8 MHz), typically >60 dB; 50 MHz, 65 dB.
SSB carrier suppression: > 50 dB typical.	53 dB.
Undesired sideband suppression: >55 dB.	66 dB (HF). 59 dB (50 MHz).
Third-order intermodulation distortion (IMD) products: Not specified.	3rd/5th/7th/9th order: HF, 10 W PEP, –30/–40/–51/–55 dBc (worst case, 12 meters), typically better than –36/–42/–54/–60 dBc. 50 MHz, 8 W PEP, –32/–54/–52/–51 dBc.
CW keyer speed range: Not specified.	9 to 52 WPM; iambic mode A and B.
CW keying characteristics: Not specified.	See Figures 3 and 4.
Transmit-receive turn-around time (PTT release to 50% audio output): Not specified.	S9 signal, 44 ms.
Receive-transmit turn-around time (tx delay): Not specified.	SSB, 30 ms; FM, 8 ms.
Composite transmitted noise: Not specified.	See Figure 5.
Size (height, width, depth): 3.5 × 7.4 × 1.7 inches; weight, 1.5 lbs (less options and batteries).	
Price: KX3, $899.95 (kit), $999.95 (assembled); KXFL3 dual passband roofing filter, $129.95; KXAT3 internal antenna tuner, $169.95; KXPD3 iambic paddle, $129.95; MH3 mic, $59.95.	

Figure 2 — The side panel of the KX3 is the location of all the external interconnection points, except for the antenna. By using the optional KX3-PCKT Accessory Cable Set, all the connections except the power cable terminate in right angle plugs allowing neat routing of the accessory cables.

problem and addressed it. They announced the availability of a set of special interface cables, the KX3-PCKT Accessory Cable Set ($19.95) that includes four cables that have right angle plugs and fit into the left side panel of the KX3. Not only do these make it easy to dress the cables by running them to the rear, but they also break out the ACC2 connections into two separate connectors, an RCA for amplifier keying and a 3.5 mm phono jack for other selected functions. In addition to making for a neater operating environment, this option reduces the likelihood that undue pressure on the connectors or cables will damage the KX3's side panel jacks.

KX3 On the Bench

As shown in Table 1, the KX3 is an excellent performing transceiver on both receive and transmit. The KX3 can be powered in a number of ways, and the test results reflect the voltage levels of some of the power supply options. With the latest firmware, the radio will operate with a supply as low as 7.5 V.

Receiver Performance

The receiver dynamic performance is top drawer. In terms of the critical third-order IMD dynamic range, blocking gain compression dynamic range and reciprocal mixing dynamic range it is at the top of the heap.

There are a couple of caveats, however. The first is a limitation particular to its architecture — *image rejection*. In a superhet, the image is twice the IF frequency from the desired signal. This is usually many megahertz from the signal of interest and easy to filter in the front end. In the direct conversion architecture with an IF of dc (0 Hz), the image is just twice the beat note away. The KX3 does an admirable job of reducing that response (we measured

72 dB down), but it will still result in a stronger signal than a third-order IMD signal. Image response is thus the limiting parameter, but only for signals that happen to be at the image frequency (there are many frequency combinations that can result in third-order signals).

Elecraft does have a solution for this. The menu item RX SHIFT can be used to move the receive IF up to 8 kHz from the normal 0 kHz. This moves the image signal up to 16 kHz away. This also can be used to eliminate other audio artifacts and is worth trying if reception is impaired. The downside is that neither dual watch nor the narrow roofing filters can be used if this is selected. The selection is per band, so it will only affect the band with the problem.

The second caveat is that our initial lab measurements indicated that the dynamic performance on 160 and 80 meters was about 10 dB worse than on the higher bands. While this is still better than most radios and should not be noticeable in most operations, metro contesters frequently have trouble on these bands with strong local interference so this may be significant for them. Elecraft was surprised to hear this, but confirmed it with a radio at their lab and made a design change that resulted in the uniform performance across the bands shown in Table 1. The design change will be in all production radios with boards made after October 1, 2012. If you have an older radio and would like to upgrade, contact Elecraft Customer Service to get the details.

Another change that occurred as a result of our testing was poor adjacent channel rejection in FM mode. Elecraft confirmed this and took care of it with a firmware upgrade to MCU rev 1.22/DSP rev 0.99. The results in Table 1 are after the upgrade.

Transmitter Performance

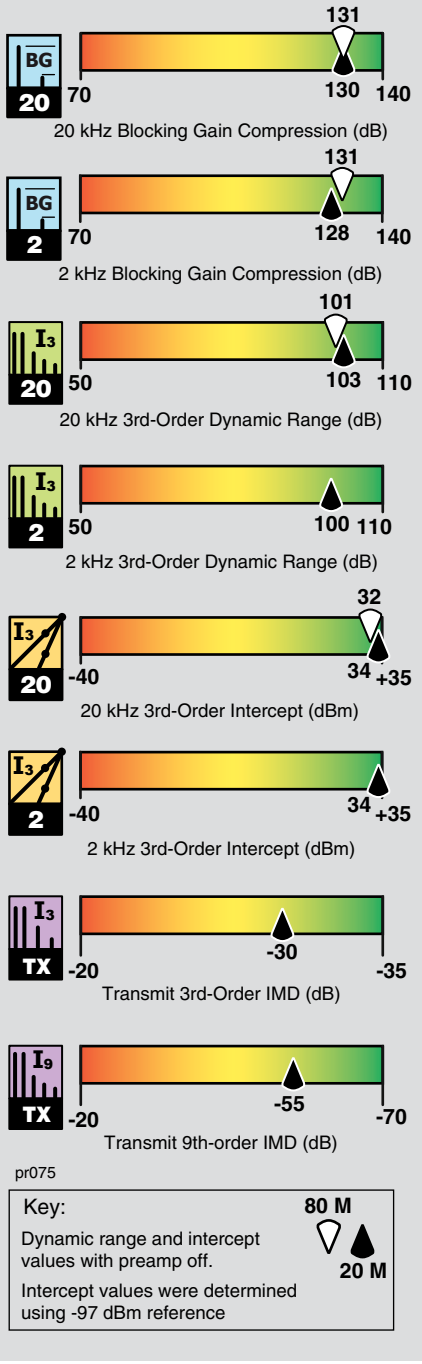
While low power radios don't have to be quite as clean on transmit as their full power brethren, the KX3 needs to make no apologies and can be used with a high power linear without being a noisy neighbor. The CW waveform and resulting spectrum are some of the best we've seen. See Figures 3-5.

While the transmitter's nominal power output is, as noted above, 10 W (8 W on 12, 10 and 6 meters, 50% power suggested on data modes), it does automatically adapt to different supply voltages. Above 13 V, power can be set as high as 12 W on all bands but 6 meters, where the limit is 10 W. If the supply voltage drops below 13 V, the maximum power is 10 W on all bands while if the supply voltage drops below 11 V, as is often the case with internal battery operation, the maximum power is 5 W on all bands. The radio will operate down to at least 8 V with an adjustable warning level (default 10 V) BAT LOW alarm. The lower power output preserves both battery life and transmit linearity.

KX3 On the Air

I don't spend a lot of time using low power, and when I do it's usually on CW. My first

Key Measurements Summary



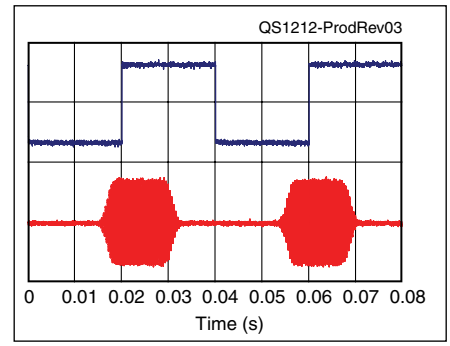


Figure 3 — CW keying waveform for the KX3 showing the first two dits in full break-in (QSK) mode using external keying. Equivalent keying speed is 60 WPM. The upper trace is the actual key closure; the lower trace is the RF envelope. (Note that the first key closure starts at the left edge of the figure.) Horizontal divisions are 10 ms. The transceiver was being operated at 10 W output on the 14 MHz band.

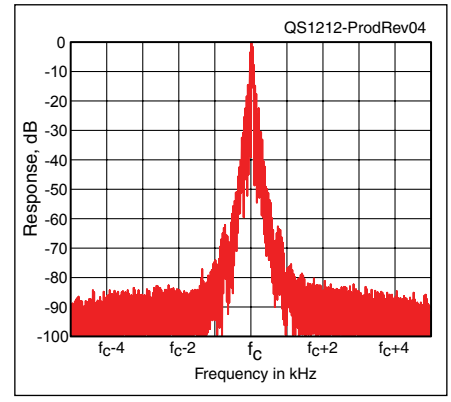


Figure 4 — Spectral display of the KX3 transmitter during keying sideband testing. Equivalent keying speed is 60 WPM using external keying. Spectrum analyzer resolution bandwidth is 10 Hz, and the sweep time is 30 seconds. The transmitter was being operated at 10 W PEP output on the 14 MHz band, and this plot shows the transmitter output ±5 kHz from the carrier. The reference level is 0 dBc, and the vertical scale is in dB.

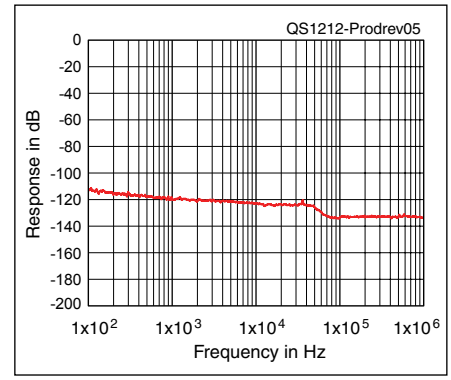


Figure 5 — Spectral display of the KX3 transmitter output during composite-noise testing. Power output is 10 W on the 14 MHz band. The carrier, off the left edge of the plot, is not shown. This plot shows composite transmitted noise 100 Hz to 1 MHz from the carrier. The reference level is 0 dBc, and the vertical scale is in dB.

Assembling the KX3 Kit

The Elecraft KX3 "kit" is a no-solder, mechanical assembly only kit, similar in that regard to the K3 kit version. The KX3 is, however, a smaller radio with fewer parts and thus is quicker and easier to assemble. The whole process took me just 4 hours of a leisurely Sunday afternoon, with much of the first hour dedicated to unpacking and taking inventory.

Opening the Box

The radio is nicely packed in two inner boxes within the compact outer box. The major parts are all identified with name and number. The bags of small parts are organized by the PC board and assembly they go with. The inventory checklist is organized the same way, so keep them separate for easy checking, as well as to make it easier for you to find the right part for each step.

I took my usual step of sorting the small parts into the compartments of a muffin as shown in Figure A. As shown, there aren't all that many parts to deal with, although many are quite similar and most of the hardware is 2-56 or 4-40, so a magnifier and a scale or digital caliper can be handy to tell one size from another.

Building Your KX3

The KX3 is constructed as two halves of a clamshell that are brought together only at almost the end of the process. Each half of the basic KX3 has a single top or bottom cover and a single PC board. This makes for easy handling since only one handful-sized subassembly is operated on at a time. The first half is the control panel (CP) PC board and top cover. In almost no time, you have a recognizable start to your transceiver (see Figure B) that provides motivation to finish it up and make it play.

Everything went together without much of a hitch. There were just a few spots that delayed me a bit. The back of the CP board has some rather long pins that will connect to the speaker cable. These are easy to bend, if you don't notice them. I found they will straighten at least once after I finally did notice them. A few parts (ANTENNA and MIC connector in my kit) came with extra mounting hardware already on them. After trying to fit them, I realized that the hardware was surplus and needed to be removed (reportedly resolved in current production). A close look at the photos in the *Kit Assembly Manual* would have saved me that trouble. I also had to assemble the RF board into the bottom cover a few times before I got all the holes to line up. Be sure to heed the manual's advice to keep all screws loose at an assembly step until they are all started.

In the last few steps, final chassis hardware is assembled, a ribbon cable is put between the two halves and they are joined with a connection that allows access to the battery compartment.

Figure A — The KX3's parts are sorted into the cups of a muffin pan for easy identification as called out in the instructions.

Figure B — After just a few steps, the KX3 starts to take recognizable shape.

Documentation

The *Kit Assembly Manual*, a spiral-bound volume separate from the similar looking *KX3 Operating Manual*, is excellent. The assembly process is divided into small easy-to-take steps, each accompanied by a photograph with arrows showing the locations and details of each type of hardware required for that step. A list of the required tools — all normal hand tools — is provided, so you can have them at the ready.

The manuals and errata are available on the Elecraft website and I suggest looking them over before you commit to the project, so you'll know what you will need to be able to do and can gather the required tools. You also should check in to the website just before you begin assembly and print out any errata sheets reflecting changes made since your manual version was printed.

contacts were on a very noisy summer evening with poor propagation just after I finished building the transceiver — but who could wait! My first contact was on 40 meter CW using an 80 meter center fed antenna fed with window line and a balun at the bottom. It loaded up fine with the optional internal antenna tuner and I quickly connected with VA1MM in Nova Scotia, 535 miles away. Al was running 500 W and putting in a respectable signal here. He was amazed to find I was running only 10 W, and had solid copy for the whole contact with a report of 579 with higher peaks.

I next tried 75 meter SSB. I joined in a roundtable with folk extending from Boston to Eastern Pennsylvania. They were all running significantly higher power than I was and were also amazed how well I was competing with the heavy static. No one had trouble copying and all thought that the audio from the optional MH3 hand mic sounded great. The MH3 supports PTT and also has UP/DOWN frequency control. They were particularly impressed with the audio quality after I mentioned that I hadn't optimized the transmit audio equalizer yet. Perhaps they were kidding, but a few were talking about selling their big box rigs and replacing them with KX3s.

My original CW contacts were with the optional Elecraft KXPD3 iambic keyer paddles that attach to the front of the unit, as shown in the photos. I adjusted to these quickly and they worked fine. The physical attachment to the radio kept everything in place while sending, often a problem with lightweight portable paddles. The KX3 also has a key jack that can be configured via MENU settings to operate with a straight key or with external paddles. Menu settings also accommodate iambic A or B operation.

In a similar manner, on SSB I started out with the optional compact MH3 mic, perfect for the trail, but couldn't resist trying out my Yamaha CM-500 headset with electret boom mic. By making a few menu changes to the PTT settings, I was able to plug my mono mic plug into the three circuit MIC jack without problems. Again, audio reports were good without resorting to the use of the equalizer. Without the hand mic's PTT function, I made use of the internal voice operated transmit switching (VOX) and it worked fine as well.

I found the front panel intuitive and easy to navigate, once you get past the two-button (BAND-ATU TUNE) power on and off arrangement, designed to avoid inadvertent battery rundown. All the basic controls are readily available and spaced in a similar manner to those on the K3 (but just a bit tighter) — compact, but not hard to use. The TUNING knob at 1.5 inches is a bit smaller (the K3's is 2 inches in diameter), but with its finger dimple is easy to move across the band. There are three front panel accessible tuning speeds that make this easy. The RATE button toggles between two tuning rates with a tap, the default being at 2500 or 250 Hz/revolution for CW, just right for finding and then fine tuning a station. Push it for half a second and it speeds up to 12.5 kHz/revolution — handy for moving around the band. Other modes have different rates selected to be most useful. The display shows one, two or three digits to the right of the decimal point depending on the selection.

The KX3 provides 100 frequency memories as well as message storage buffers for CW and voice modes. On CW six message buffers are provided, each holding up to 250 characters. On voice there are two message memories provided as standard equipment.

A dedicated PBT I/II (passband tuning) knob controls the DSP bandwidth. On CW it toggles with a push between center frequency and width — smoothly down to 50 Hz without ringing and automatically selecting appropriate roofing filter if the option is installed. On voice modes, the same control toggles between high and low filter limits, just as you would want. If operating in frequency shift keying (FSK) data modes such as RTTY, a dual passband is provided, centered on each of the two frequencies.

As with the K3, the KX3 supports RTTY and PSK31 without the need for a PC. Data sent using Morse with the built-in keyer is translated to the appropriate mode for transmission. Reception of those modes, along with CW, can be displayed on the second line of the main display. If you have a PC connected, the *KX3 Utility* software offers a terminal function that will allow looking at a full page of decoded data at a time.

As with the K3, a quick tap of the display (DISP) button changes the lower line of the display to a multifunction meter that can be set with the RIT knob to measure battery voltage, current, operating time, received audio level and a few internal temperature readings — very handy. Speaking of meters, the S meter is calibrated and can be set via a menu item to be absolute so that the reading is just reflective of the signal strength at the antenna terminals — not a function of the preamp (PRE) or attenuator (ATT) settings — in my opinion the most meaningful way to use an S meter.

In addition to the front panel controls, there are a total of 65 menu items, but most are set-and-forget configuration or calibration items that won't need frequent attention. There are two assignable programmable function buttons (PF1/PF2) that can be used to directly access two menu items if desired.
I found it helpful to have the dual watch/virtual second receiver on one. For an on-off function of this sort, the PF button toggles the function each time it is pushed.

Yet to Come

There are a number of options that have been announced for the KX3, but weren't available while we were conducting this review (check the Elecraft website for details). These will serve to make the KX3 even more flexible. The combination of these items with the KX3 will make for a very usable 100 W HF and 6 meter mobile setup or home station.

Manufacturer: Elecraft, PO Box 69, Aptos, CA 95001-0069; tel 831-763-4211, fax 831-763-4218; **www.elecraft.com**.

See the Digital Edition of *QST* for a video overview of the Elecraft KX3 transceiver.

Steve Ford, WB8IMY, wb8imy@arrl.org

Glowbug Kits AC-1 Junior Transmitter

There is nothing quite like the fragrance of hot vacuum tubes. It is a distinctive aroma that's almost impossible to describe. I caught my first whiff more than four decades ago, but it had been years since I'd owned a tube radio. That warm, dusty scent had become a fading memory — until I applied power to the Glowbug AC-1 Junior transmitter.

At the heart of the AC-1 is a single 6AQ5 tube. In the AC-1 it functions as a crystal controlled oscillator that generates 1 W output on 40 meter CW. The AC-1 relies on cathode keying, although only about 9 V appears at the key jack so it is safe to use with most modern keyers, if that is your preference.

The AC-1 is a kit, but putting it together is straightforward. Just two hours elapsed from the time I plugged in my soldering iron until the moment I tightened the last cabinet screw and pressed the POWER button.

Building the AC-1

The kit arrived as a collection of small boxes containing the silkscreened enclosure, the hardware and electronic components (including the 6AQ5), a power transformer and what appeared to be an ordinary "wall wart" dc power supply, albeit a rather heavy one.

Upon further inspection I realized that the wall wart was not what it seemed. Rather than being a power supply, it was a hefty transformer designed to convert 120 V ac at the wall outlet to 12 V ac. The 12 V ac is fed to the power transformer within the AC-1. The transformer primary windings are center tapped to provide the 6 V ac for the 6AQ5 filaments. At the transformer secondary the voltage is stepped up to 140 V and converted to dc.

I'm a slow kit builder; I prefer to take my time and do it right. The AC-1 is not a complex kit by any means, but it pays to proceed gradually. Start by identifying and sorting the parts. The parts list consists of a handful of capacitors, several resistors, three chokes, a bridge rectifier, two diodes, an antenna switching relay and a single toroid core that you have to wind. The kit includes two crystals for 7030 and 7040 kHz.

To assemble the kit you need only a soldering iron and a pair of wire cutters. The components are all through-hole; there are no surface-mount parts. Some amateurs find toroid winding intimidating, but with the AC-1 you're only dealing with a single 29 turn toroid required for the Pi-network output circuit. As long as you remember that the first pass of the wire through the "donut" counts as the first turn, the rest is simple.

The AC-1 is intended to be used with a separate receiver or transceiver. You connect your antenna to the AC-1 antenna jack and the receiver or transceiver to the adjacent "receiver" jack. Both are RCA phono jacks.

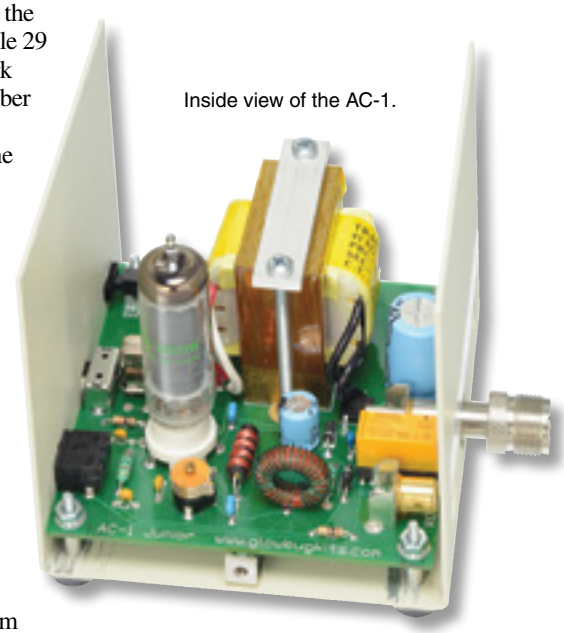
On the Air

After carefully checking my work I attached the 12 V ac line and pressed the POWER button. I couldn't help but smile as I watched (and smelled) the 6AQ5 come to life. After giving the tube a minute to warm up, I plugged in a straight key and selected the 7030 kHz crystal with the front panel slide switch.

When I keyed the AC-1 for the first time, I didn't hear a peep from my monitor receiver. Okay, it was time to tweak the trimmer capacitor in the tank circuit. A slight twist with a screwdriver was all it took to kick the 6AQ5 into oscillation. The output peaked up nicely and the CW note sounded pure. Minutes later I made my first contact and by the end of the night I put several more in the log. Not bad for 1 W to a vertical antenna.

The ARRL Lab later confirmed that my AC-1 was indeed producing a full watt of RF as specified. They also checked for spectral purity and verified that the AC-1 met all FCC requirements.

Because of the high voltage present in the AC-1, I wouldn't recommend this kit for a beginner without an experienced amateur on hand to supervise. That said, building the AC-1 is one of the more satisfying ways to spend an hour or two this weekend. It generates clean RF without a transistor in sight...and you can't beat the aroma!



Inside view of the AC-1.

Manufacturer: Glowbug Kits, PO Box 10366, Jackson, TN 38308; **www.glowbugkits.com**. *$99.97 plus $15 shipping.*