Product Review Column from *QST* Magazine

August 1983

AEA MBA-RC

Cushcraft Corporation 220B 220-MHz "Boomer"

MBA-RO Code Reader

N9CR Contest Radio Operating System

RF Products 5/8 Wavelength 220-MHz And 450-MHz Antennas

Twin Oaks Morse Code Training Programs

Yaesu FT-ONE HF Transceiver

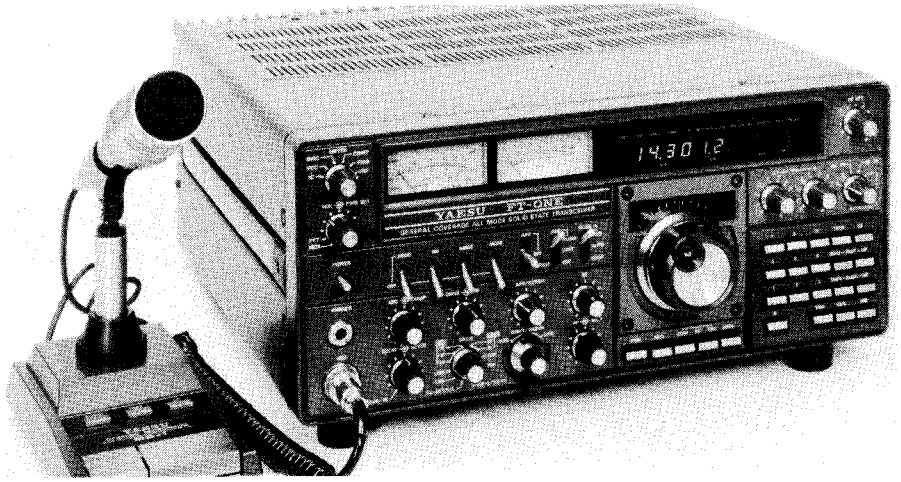
Product Review

Conducted By Paul K. Pagel,* N1FB

Yaesu FT-ONE HF Transceiver

One look at the FT-ONE and you know that it is not the "average" transceiver! There is such an array of buttons, knobs, switches and displays that there is no empty space on the front panel. My first thought upon receiving the review model was to hook up an antenna, plug it in and start tuning around. After a second thought, I decided to read the operating manual instead; I'm glad I did!

The clearly written manual does an excellent job of telling you what you need to know. For example, almost one page is dedicated to the operation of the variable bandwidth and i-f shift features. By studying the large accompanying diagram, one can easily grasp how these controls operate and how to use them to best advantage. I spent about an hour reading and digesting the contents. The time was well spent! I noticed later that people unfamiliar with the FT-ONE were not able to take advantage of the many features that make it a joy to use.



A Peek at the Panel

Two meters are found on the front panel. The one on the right is an S meter during receive; in the transmit mode, it measures alc level. The other meter is controlled by a switch in the upper left corner of the panel; with it you can measure the final amplifier collector supply voltage and current, discriminator voltage (fm mode), compression level of the built-in speech processor, relative forward output power and SWR. Below the meter switch is a pair of concentric controls that set VOX and relative forward power sensitivity.

Below the meters is a row of toggle switches. Those labeled POWER, PROC and NB are used to turn on and off the main power, the rf speech processor and the noise blanker, respectively. The automatic microphone gain control (AMGC) switch enables a microphone gain threshold circuit. This circuit acts as a "microphone squelch" system. The microphone amplifier is not enabled until a minimum input level is present. Speech monitoring and cw sidetone are controlled by the MONI switch. An audio filter is controlled by the APF/NOTCH switch. In the APF position, it behaves as a cw audio filter; in NOTCH, an interfering carrier can be greatly reduced in level. Filter center frequency is controlled in the 300- to 1500-Hz range by a knob just below the switch. The AGC switch selects recovery time for the receiver agc circuit; you can choose fast or slow, or turn off the agc if you desire. The SCAN switch selects the desired stop mode during scanner operation. When this switch is placed in the AUTO mode, the scanner will halt on any signal that is strong enough (S1 or greater) to cause agc action. To stop the scan manually while in the AUTO mode, place the SCAN switch in the STOP position momentarily. Place the SCAN switch in the MAN position for manual scanner operation; the scanner will be activated when the UP or DOWN switches on the keyboard or microphone are pushed. Release the switch to halt the scan.

The lower-left portion of the front panel contains two jacks. When a standard two-conductor phone plug is inserted into the PHONES jack, the internal speaker is disconnected automatically. The headphone impedance should be 4-8 ohms. An eight-pin MIC connector accepts the microphone audio input, as well as the push-to-talk (PTT) and scanning control lines. Nominal microphone impedance is 600 ohms.

To the right of the jacks is a series of knobs. Gain of the microphone amplifier during ssb and a-m operation is set by the MIC control; a concentric control labeled COMP is used to adjust the compression level of the rf speech processor. Another concentric control is used to set the speed of an optional internal electronic KEYER and to adjust VOX hang time DELAY. When the DELAY control is rotated fully counterclockwise into the click-stop, the transceiver is ready for QSK (break-in) cw operation. The DRIVE control is used to set rf levels on a-m, fm, cw, fsk and on ssb when using the rf speech processor. (When the processor is switched out, the MIC control determines rf levels.) When the noise blanker is switched on, turning the NB knob clockwise lowers the threshold, causing the blanker to be more sensitive to impulse noise.

The MODE switch has 11 positions for the selection of operating mode and optional filters.

Yaesu FT-ONE HF Transceiver, Serial No. 040145

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency coverage: Receive — 150 kHz to 29.9999 MHz; transmit — 1.8 to 2.0, 3.0 to 4.0, 7.0 to 8.0, 10.0 to 11.0, 14.0 to 15.0, 18.0 to 19.0, 21.0 to 22.0, 24.0 to 25.0, 28.0 to 29.99 MHz.	As specified.
Modes of operation: cw, ssb, a-m (fm optional).	As specified.
Frequency display: Six digit.	3/8-inch high, six-digit yellow LED.†
kHz/turn of knob: 10 MHz/20/2.	As specified.
Frequency resolution: 100 Hz.	As specified.
Backlash: Not specified.	Nil.
S-meter sensitivity (μV/S9 reading): Not specified.	160 m, 9; 80 m, 8.5; 40 m, 8.5; 30 m, 8.4; 20 m, 10; 17 m, 8.8; 15 m, 9.1; 12 m, 9.0; 10 m, 9.1.
Transmitter output: 160-15 m, 100-W PEP; 10 m, 90 W.	160 m, 120; 80 m, 125; 40 m, 120; 20 m, 120; 15 m, 125; 10 m, 110.
Harmonic suppression: Better than 50 dB.	−53 dB (see photo).
Spurious suppression; Better than 40 dB.	−65 dB (see photo).
3rd-order IMD: Better than 31 dB.	−38 dB (see photo).
Receiver sensitivity: Less than 0.3 μV for 10-dB S + N/N.	Receiver dynamics measured with optional 300-Hz filter installed: *80 m* *20 m* Noise floor (MDS) dBm: −133 −138 Blocking DR (dB): noise limited Two-tone 3rd-order IMD DR (dB): noise limited 3rd-order intercept: noise limited
Size (HWD): 6.2 × 14.6 × 13.8 in.	As specified.
Weight: 37.5 lb.††	As specified.

†mm = in. × 25.4. ††kg = lb × 0.4536.

*Assistant Technical Editor

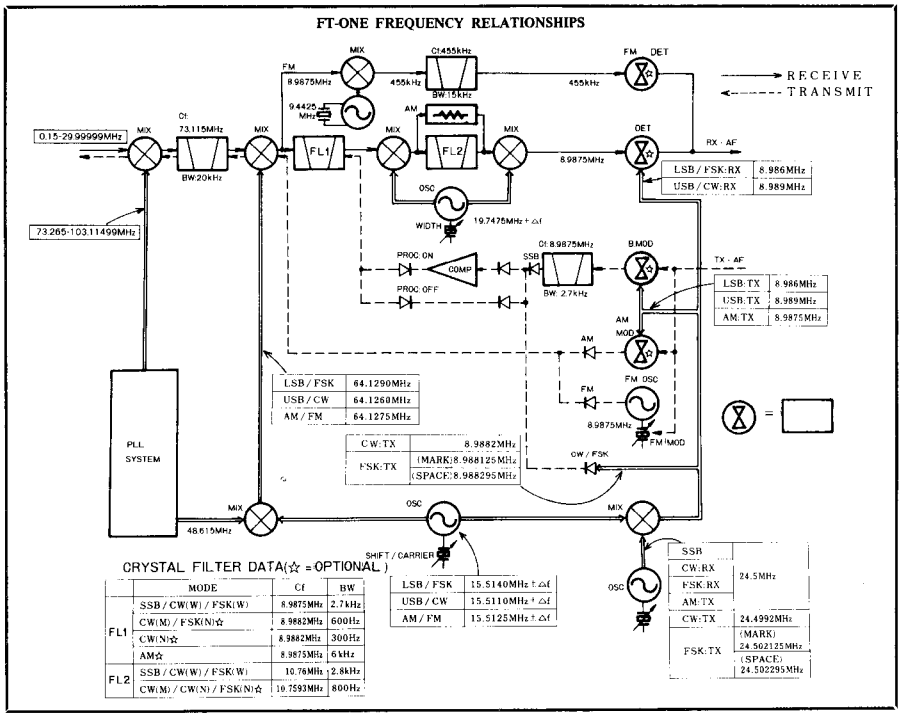


Fig. 1 — Block diagram of the FT-ONE showing frequency relationships.

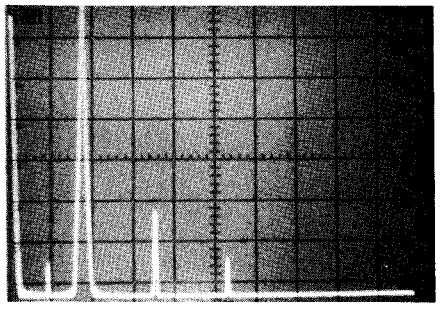


Fig. 2 — Worst-case spectral display of the FT-ONE. Vertical divisions are each 10 dB; horizontal divisions are each 2 MHz. Output power is 120 W at 1.8 MHz. All spurious emissions are at least 53 dB below the fundamental output. The FT-ONE complies with current FCC specifications for spectral purity.

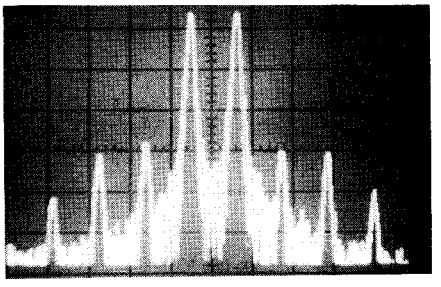


Fig. 3 — Spectral display of the FT-ONE during transmitter two-tone IMD test. Third-order products are 38 dB below PEP output, and the fifth-order products are 40 dB down. Vertical divisions are each 10 dB; horizontal divisions are each 1 kHz. The transceiver was operated at rated output power on the 160-meter band.

You can even choose RX-U/TX-L (receive usb, transmit lsb) or RX-L/TX-U. The value of that feature may not be obvious unless you plan to operate through the AMSAT Phase IIIB satellite (OSCAR 10). What goes up on usb (Mode J or L) comes down as lsb. A tip of the hat to the folks at Yaesu for that little extra that will add much to the value of the FT-ONE.

The SHIFT and WIDTH controls are mounted on concentric shafts. Moderate friction between them allows fingertip adjustment of the i-f shift and variable bandwidth features. The controls are normally aligned so that the black zone on the inner dial is fully within the cutout area of the outer (paddle) control. If interference is heard on ssb, narrow the bandwidth by holding the center knob and rotating the paddle control. A narrower bandwidth has now been set. Use the paddle to align the passband for optimum reception and interference reduction.

Receiver rf and i-f amplifier gain is varied by the RF GAIN control. Audio output level is set by the AF control. In the fm mode, the SQL control keeps the receiver silent until a signal is present.

Frequency Control

The transceiver main tuning knob can be used to control the VFO or the clarifier (RIT) frequency. Five push buttons, located directly below, are used in conjunction with the main tuning knob. When the alternate-action FINE switch is in, the main tuning knob will vary the transceiver frequency at a rate of 2 kHz per revolution; in the out position, the rate is 20 kHz per revolution. When the MHZ switch is held depressed and the main tuning knob is turned, the tuning rate is 10 MHz per revolution.

Pressing the CLAR switch activates the clarifier, allowing an offset in receive frequency of up to ± 9.9 kHz. Once the clarifier is activated, the transmit frequency cannot be changed. My first impression was that I did not like that feature. After using the FT-ONE for a few weeks, I changed my mind. While this feature can be used for split-frequency operation, it is not the best way to operate "split" — but more on that later. When the clarifier is operating, pressing the RX-TRX button causes both the transmit and the receive frequencies to offset. A second button depression causes only the receive frequency to offset. Pressing the button marked LOCK disables frequency changes by the main tuning knob.

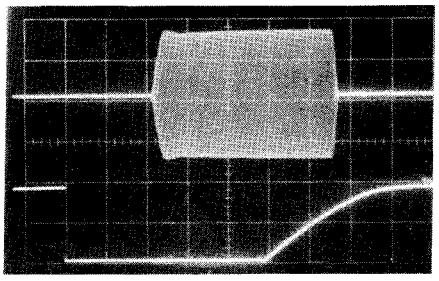


Fig. 4 — FT-ONE cw keying waveform. Upper trace is the rf envelope; lower trace is the dc level at the key jack. Each horizontal division is 5 ms.

To the right of the tuning knob is the keyboard and three VFO switches. This combination makes a versatile and powerful frequency-selection system. Fig. 5, taken from the FT-ONE operating manual, will give you an idea of how many ways you can select a given frequency. Once you become familiar with the equipment, you will be surprised at how quickly and easily you can change frequency, set up a split or scan a portion of a band.

The RF ATT control, located in the upper-right corner of the front panel, adjusts the receiver front end attenuation. PIN diodes are used in the attenuator. This control is particularly useful on crowded and noisy bands.

A yellow LED display directly over the tuning knob shows the operating frequency. A smaller red LED display to the right shows which of the 10 VFO memories is in use and the amount of clarifier offset (when the clarifier is switched in).

A set of 10 yellow LED indicators is located above the frequency displays. These indicators provide quick verification of various operating functions. When a particular LED is illuminated, the respective function is in operation. The functions include PROC (speech processor), NB (noise blanker), AMGC (automatic microphone gain control), MONI (ssb voice monitor/cw sidetone), APF (audio peak filter), NOTCH (audio notch filter), A. SCAN (automatic scan), RX (receiver clarifier), TRX (receive/transmit clarifier), D. LOCK (dial lock), TRCV (Transceive mode) and TX. DIS (transmitter disabled — lights when attempting to transmit outside an amateur band).

Versatility is the word that describes the front panel; it also describes the rear panel. Antenna connections are designed so you can use an external receiver, a separate receive antenna, a vhf transverter or other external equipment (see Fig. 6).

Other rear-panel jacks can be used to connect an external speaker, an fsk terminal (170-Hz shift), a tape recorder (400 mV at 50 kΩ, fixed level), anti-trip audio (from external receiver), a phone patch, a PTT switch (I use a foot

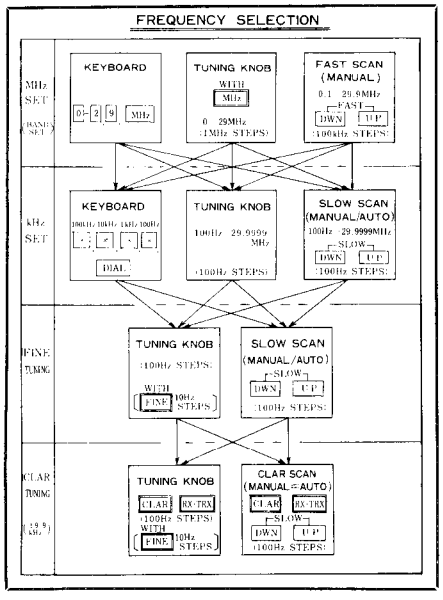


Fig. 5 — This diagram is used in the FT-ONE operating manual to explain the various ways of tuning to a given frequency.

switch), an i-f signal waveform monitor or sidetone (for external receiver). A pair of key jacks are used to key the transmitter directly (KEY-1) or to operate the optional internal electronic keyer unit (KEY-2). Two DIN-type jacks are used for making interconnections to linear amplifiers, transverters or other accessories.

Personal Observations

I wanted to change the cw offset on the FT-ONE. With other transceivers it has been as simple as setting the RIT control for the desired offset. That won't work with the FT-ONE! A telephone call confirmed the proper procedure; VR 3005 (TX CW) on the LO board sets the cw offset. Complete the job by adjusting the sidetone frequency as described on page 26 of the operating manual.

My linear amplifier has an electronic bias switch. When no rf energy is applied, the tubes are biased to cut off. When rf is first applied, it takes a couple of cycles for the switch to activate. The FT-ONE did not "like" that. When I tried to send a series of dots, the first few were severely level-limited by the transceiver alc. It took a bit of pondering to solve the problem (the FT-ONE worked fine with other amplifiers!). When I disabled the electronic bias switch, the transceiver and amplifier worked together nicely.

I have had the FT-ONE on the air for several weeks, and in a couple of contests. I am pleased with the results. Most reports have been complimentary (twice I was told that the keying was slightly harsh). The speech processor and AMGC help deliver clean, crisp ssb that is clear of background clutter. The joys of QSK must be experienced to be fully appreciated. When I need the amplifier (not very often!), it is only necessary to insert the appropriate delay — my amplifier is not equipped for QSK.

Split-frequency operation is handled with ease by using the VFO select switch in the RA-TB position. Set the A and B VFO channel selector switches for different channels. Tune in the station you want to contact. Set the VFO select switch in the B position. Tune in the frequency

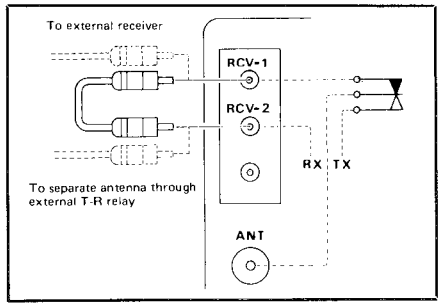


Fig. 6 — Antenna and rf connections on the rear panel of the FT-ONE. In normal operation, a jumper connects RCV-1 to RCV-2. The RF OUT jack provides transmitter output at −6 dBm into 50 ohms for use with a transverter or other accessory equipment.

you want to transmit on. Return the VFO select switch to the RA-TB position and you are ready to call.

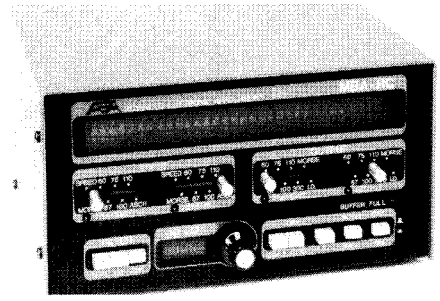
From my rural location, I noticed reciprocal mixing problems only a couple of times — and then not bad. In this regard, the FT-ONE is no different than most of the frequency-synthesized, hf transceivers that have been tested in the ARRL lab.

At the end of the review period, the FT-ONE developed a malady: It would not transmit in the low end of the cw bands. The transceiver was returned to the Yaesu service center. The problem, a bad solder joint on the PLL board, was repaired under warranty.

It is easy to summarize my opinion of the FT-ONE — I like it! It has the flexibility and features that appeal to DXers and contesters alike. Those same features make net and casual operating fun, too. The FT-ONE deserves to be called "top of the line."

Yaesu has two modification kits available for the FT-ONE. The NB-ONE is a noise blanker modification that the manufacturer says will eliminate the "woodpecker." A second kit, the FAN-ONE, changes the operation of the PA heat-sink fan from continuously running to on-demand. That is, the fan operates only during transmit periods or when the heat-sink temperature has risen beyond a specific point.

Price class of the FT-ONE with the 300-Hz cw filter, the 600-Hz cw filter, the 6-kHz a-m filter, the 3rd i-f cw filter, a memory back-up board and the fm board: $2900; KY-ONE keyer price class: $45; dc cable, $15. Price class of the NB-ONE is $10; FAN-ONE, $5.40. — *Chuck Hutchinson, K8CH*



AEA MBA-RC

☐ Probably the best word to describe this μP-based unit is "multifaceted." With it, you can receive and transmit Morse code and Baudot/ASCII RTTY. So, what makes this unit any different from many others on the market? The fact that it can perform code conversions and allow cross-mode operation. You can transmit in any of the modes and speeds available on the 'RC and receive a station using a different mode or speed. You cannot input 300-baud ASCII from your keyboard to the 'RC, but the unit can transmit 300-baud ASCII. (It speed converts 110 baud to 300 baud to do this.) The Baudot speed range is 60, 67, 75 and 100 wpm, while Morse speeds of from 2 to over 80 wpm can be handled.

At the top of the front panel is a 32-character vacuum fluorescent-blue display that offers a built-in monitoring system for reception and transmission. Input and output mode/speed selection switches occupy left and right positions immediately below the display. The bottom row of controls includes RTTY/cw filter selecton switches, a signal-tuning LED bar graph, a variable shift control, carriage return/line feed control switches, an i-d/cw speed set switch, mark/space inversion controls and a power ON/OFF switch. A BUFFER FULL LED sits just above these last switches.

All I/O connections are made at the rear panel. These include power, audio, speaker, tape, scope, keying and printer ports. TTL level output, parallel ASCII, 20/60 mA current loop keyer and an optional RS-232 hookup are available. Some less-often-used controls, such as the speaker and afsk output level potentiometers, and selection switches for downshift on space, printer lockup and 170/850-Hz shift, are there, too. A required external power supply delivering 13-V dc (±3 V) at about 1.2 A connects to the 'RC by means of a miniature coaxial power plug.

Two 3870 single-chip, 8-bit microcomputers are at the core of the MBA-RC. A pair of 74150 16-input multiplexers handle the speed/mode selector switch decoding, and a pair of 2114s provide 1K of RAM. An XR-2206 generates the afsk tones.

Positive and negative key lines are controlled by high-voltage transistors (MPSA42, MPSA92). Speaker tones are created by the ever-faithful 555 IC. Current-loop input and output circuits are optoisolated.

The demodulator section decodes both mark and space tones using op-amp filters. Demodulator performance is good. While there are frequency adjustment potentiometers to set the filters to their proper frequency, the manual contains no maintenance or alignment instructions. It does have three schematic diagrams and three board layout drawings, but that's it.

Three pc boards (including the display board) hold the circuit components. The boards are glass-epoxy types, double-sided and solder masked. Component quality is excellent.

A complete account of the multitude of control functions is beyond the scope of this review. With this machine, you'll want to read the instruction manual first. It's well written and contains plenty of drawings to aid you in equipment setup and operation.

Perhaps I'm spoiled by 24-line, 40- and 80-character displays, but I found I needed some time to get used to the "Times Square" scroll and the character style of the display. Along with the incoming text to be read, there are the special characters used for carriage returns, line feeds, etc. After a while, I learned to disregard (for the most part) those irrelevant characters. The 32-character display certainly makes for an all-in-one unit, and it has its applications, but my

eyes found the display difficult to follow except at slower speeds. Reading the display at rates of up to the commonly used 60-wpm Baudot speed was tolerable, but anything higher than that was a bit too fast for comfort.

After a bit of practice, tuning in a signal using the bar graph tuning indicator becomes easy. Of course, there is the option of using the scope outputs to provide the familiar RTTY cross pattern used for tuning.

The most fun I had with the 'RC was using it with my newly acquired (old) model 33 110-baud ASCII printer. The 'RC built-in current loop keyer provided a means of hooking up the '33 and getting some "hard copy." Because of the conversion abilities of the 'RC, I could print anything from cw to 110-baud ASCII. I got a kick out of tuning in a cw signal at, say, 15 wpm and seeing the copy placed on paper as if by a slow (very slow!) typist. Copying RTTY signals at any of the available speeds was no problem for the 'RC. For the more affluent, there's a Centronics compatible parallel printer port for use with the more modern printers. (That sort of printer is on my "wish list.")

At the other end of the copying spectrum, I tried receiving 60-wpm Baudot and 110-baud ASCII while using Morse code output. Sure it works, but the limitations of operating this way should be obvious. You can also reverse the roles, and input Morse while transmitting RTTY. If you're entertaining that idea, remember that if your Morse transmission is slow the receiving operator is going to have to exercise a lot of patience! On the other hand, if you can rattle the keys of a keyboard fairly well, you can make the transition more palatable.

Selecting the VAR position of the filter selection switch permits using the TUNE control to vary the space tone filter frequency from about 2225 to 3125 Hz. This provides a received frequency-shift range of approximately 100 Hz to 1 kHz to allow reception of other than standard RTTY shifts. The TUNE control also adjusts the cw filter center frequency within a range of 900 to 950 Hz.

Cw reception suffers from the same maladies that affect most other automated cw receiving machines, the primary problem being sloppy fists. As is said, "garbage in, garbage out." During Morse operation, the operator can monitor received and sending speeds. The speed indicator appears in the extreme right side of the display.

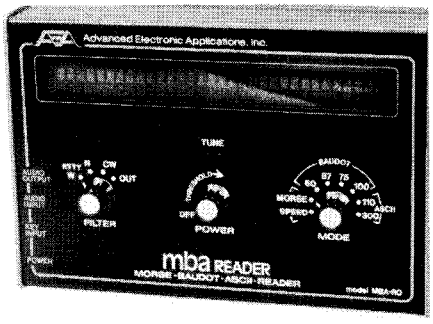
Cw transmission is best accomplished with a Baudot or ASCII keyboard. I tried using a hand key and a keyer to input Morse, but the buffered delay makes this type of operation confusing.

The I-D function performs two tasks: It is used to load an i-d message and to change the cw output speed. Unless you select a different speed, the 'RC will default to 20 wpm. I-d message length is limited to 40 characters. When that limit is reached, the BUFFER FULL LED will light and no more characters are accepted.

During transmission, the i-d message is sent by depressing the appropriate control button; it is not an automatic function. During reception, the BUFFER FULL LED illuminates when 25 characters are left in the 1024-character block. Should the buffer be forced into overflow, the display will extinguish, but data in the buffer at the time will not be lost. A.E.A. recommends using the 300-baud ASCII position of the receive output selector to avoid display blanking.

Manual and automatic control of the carriage return/line feed functions are switch selectable. In the automatic mode, a CR/LF is generated at the first space following the 60th received character or at the end of a 71-character line. Most operations will use the automatic mode.

The MBA-RC measures (HWD) 5 × 9-1/4 × 7-1/4 in. and weighs in at 4 lb 6 oz.[1] The price class is $470. It is available from Advanced Electronics Applications, Inc., 2006-196th SW, Lynwood, WA 98036. — *Paul K. Pagel, N1FB*



MBA-RO CODE READER

☐ I certainly found the AEA MBA-RO to be an interesting "appliance." It provided many hours of observing how poorly most of our cw operators handle the Morse, and it also showed the telltale evidence of my own lack of proper (cw) character formation!

One might wonder how effective a code reader can be in a crowded amateur band. Well, the circuit depends on being fed properly formed characters. It does not "like" to copy fists that are erratic or those with a "Lake Erie" or "banana boat" swing. But then, not many of us enjoy listening to that kind of sending, either! Generally, the MBA-RO will display gibberish if it is locked onto a signal that contains poor cw sending. Similarly, if the operator uses incorrect spacing between letters and words, the code reader will display exactly what is being fed into it — assuming the individual code characters are sent properly. It is distracting to have a cw message run together as though it were a horrendously long word, or to have enormous gaps between some letters or words. In practice, the human ear and mind can copy rotten cw much better than a machine can (I found myself taking my eyes off the digital readout of the code reader and relying on the coherence that my brain and ears could supply after so many years of cw copying).

This does not mean that the AEA product is deficient or poorly designed. Rather, it suggests that there aren't too many fists that such a device can copy. Indeed, it's a sad testimonial for the quality of the cw we find in our amateur bands, but it's a reality we must accept. QRM and heavy QSB tend to negate the good qualities of the instrument as well, despite the selectable built-in audio filter.

In a more positive vein, the MBA-RO does a fine job of copying keyboard-generated cw (allowing for the poor typing ability of some ops). Similarly, the RTTY copy was a delight. W1AW bulletins came through in perfect shape on both the cw and RTTY modes.

I would not recommend this device to beginners. It takes a fair amount of practice to be able to tune in a signal for reliable copy. It is not a casual operation, and one that could easily frustrate a newcomer to Amateur Radio. Conversely, I would recommend the system to anyone who hangs out on the keyboard frequencies or who works RTTY and ASCII. It would also be a suitable accessory for those who work stations that send proper keyer-generated Morse. If the operator uses his or her paddle correctly, the code reader will copy the data perfectly (I did run across a number of operators who were properly acquainted with the business end of their paddles or bug keys).

For many years, I fancied myself as a reasonable cw operator while using a quality paddle and keyer. I was gripped with despair when I hooked the MBA-RO to the sidetone output of my keyer and perceived what was being printed out on the display! My spacing wasn't all that bad, but there were a few letters that the code reader just couldn't digest. A few hours of practice, while monitoring my sending on the digital display, helped me to correct my not-so-good character formation. The code reader may be well worth the price for that application alone. If you want to be proud of your fist, you may want to give the MBA-RO a try.

The digital display has 3/8-in. characters (32 in all), and the color of the illuminated display is blue. The mode switch provides for straight Morse readout, or Morse plus the cw speed of the incoming message. In the speed-indicating mode the last two right-hand digits are used to display the sending rate of the other station. There are four Baudot positions: 60, 67, 75 and 100. The ASCII position takes care of 110 and 300 rates. Another panel switch permits wide or narrow RTTY selectivity; likewise for standard cw. The MBA-RO measures (HWD) 5-3/4 × 9 × 2-1/2 in. It is powered by a small external dc supply. The price class is $300. — *Doug DeMaw, W1FB*

CUSHCRAFT CORPORATION 220B 220-MHz "BOOMER"

☐ During the past few years, growing interest in vhf and uhf operation among amateurs in the U.S. and Canada has led manufacturers to develop high-performance antennas for the bands above 50 MHz. High performance is usually equated with forward gain, and forward gain is directly related to boom length. Cushcraft's entry in the high-performance antenna market is the "Boomer" line, aptly named in light of their relatively long booms. In addition to the 220B reviewed here, Cushcraft also markets "Boomers" for 50, 144 and 432 MHz.[2,3]

The 220B is based on the gain-optimized 4.2-λ NBS design.[4] This design calls for 15 elements on an 18-ft 9-in. boom.[5] The 220B is designated a 17-element antenna because of Cushcraft's "Trigon" reflector assembly, which employs two additional reflector elements for some additional gain. A T-match is used to feed the driven element, and the antenna is designed to be used with 50-ohm cable.

The 220B is made from high-quality aluminum stock. The machine work on the review anten-

[1]mm = in. × 25.4; kg = lb × 0.4536.

[2]G. Hull, "Cushcraft 617-6B 'Boomer' 6-Meter Yagi," *QST*, Sept. 1982, p. 41.

[3]D. Sumner, "Cushcraft 32-19 'Boomer' and 324-QK Stacking Kit," *QST*, Nov. 1980, pp. 48-49.

[4]P. Viezbicke, "Yagi Antenna Design," *NBS Technical Note 688*, U.S. Department of Commerce, Washington, DC, Dec. 1976. A discussion of NBS antennas also appears in D. Lusis, "Go for the Gain, NBS Style," *QST*, Aug. 1982, pp. 34-38.

[5]m = ft × 0.3048.

na was generally good, although some of the drilled holes were not deburred (causing one minor flesh wound).

The main portion of the boom is made from two 6-ft sections of 1-1/8 in. tubing joined by a 1-ft section of 1-1/4 in. tubing. Two pieces of 1-in. tubing complete the boom. The various boom sections are secured with worm-gear clamps and machine screws. Masts of up to 2-in OD will fit the boom-to-mast bracket. A rigid brace made from 3/4-in. tubing supports the boom. This brace may be mounted above or below the boom with no effect on antenna performance.

All elements are made from 3/16-in. aluminum rod, except for the driven element, which is made from 1/2-in. tubing. Elements are mounted to the boom by machine screws, which go through holes in the elements, then through small aluminum brackets to keep the elements from moving, and then through holes in the boom.

Cushcraft supplies first-rate hardware. All bolts, screws, washers and nuts (including the boom-to-mast U bolts and hardware) are stainless steel. Plastic end caps are provided for the boom and driven-element assemblies. Silicon grease and vinyl boots are supplied to waterproof the balun and feed-line connectors. It's obvious that Cushcraft has taken great care to provide the right parts for long and reliable antenna life.

Assembly took about one hour. The hardest part is making sure each of the 17 elements is in the correct spot along the boom. Cushcraft helps by bundling together directors number 8 through 13; they are all the same length. The instruction manual is brief and to the point. Using a minimum of text, the manual relies on clear, detailed drawings to guide you through assembly. Parts shown in the illustrations are numbered according to the parts list, leaving no questions about where each piece goes. The manual also gives instructions on stacking two or four of these antennas to provide additional gain.

Upon completion of assembly, care should be taken to align the elements. Because of the light weight of the 220B, installation can be a solo job. Remember to keep a watchful eye on the elements (especially the Trigon reflector elements) so they don't get caught in the tower. They will bend if pushed hard enough.

Chances are good that if you're reading this review you're a hard-core vhfer, or at least interested in vhf contesting. I fall into the latter category. The review 220B was originally set up at WA2OMY/3 in the Philadelphia area for the ARRL January VHF Sweepstakes contest. We mounted the antenna on a 50-ft self-supporting tower and fed it with about 70 feet of high-quality foam-type RG-8/U. Hardline is highly recommended at this frequency, but the coaxial cable was all we had available.

The antenna proved to be a real performer,

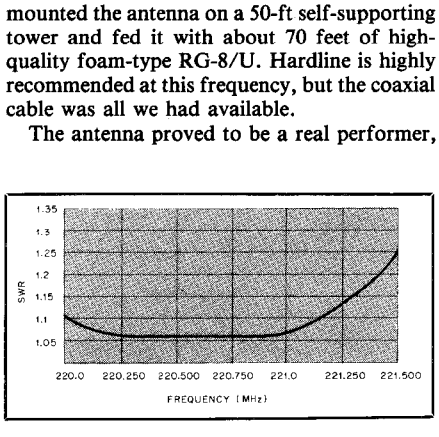


Fig. 7 — SWR curve of the Cushcraft 220B measured at the antenna with a Bird model 4410 wattmeter.

Cushcraft Corporation 220B 220-MHz "Boomer"

Manufacturer's Claimed Specifications	*ARRL Evaluation*
Boom length: 18 ft 9 in.	As specified.
Longest element: 26-1/16 in.	As specified.
Turning radius: 8 ft 8 in.	As specified.
Assembled weight: 10.5 lbs (4.77 kg).	As specified.
Windload: 2.6 sq. ft.	Not measured.
Frequency coverage: 220-223 MHz.	Confirmed.
VSWR: Less than 1.2:1 at 220.100 MHz.	Confirmed.

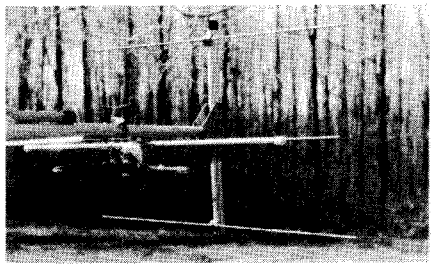


Fig. 8 — Close-up of the Cushcraft 220B Trigon reflector assembly.

despite the marginal feed line. With fair-to-average conditions, we were able to work every station we heard. Contacts north into New England and south into Maryland and Virginia were easy, whether we ran the 500-W amplifier or just the 10-W exciter. We ended the contest with the highest 220-MHz score among the Pack Rats. There was simply no comparison between the Boomer and an old-style 11-element Yagi we used previously.

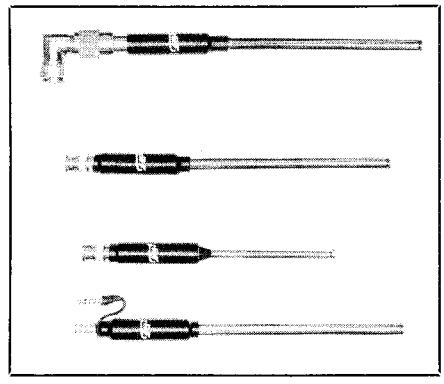
If you are looking for a reliable, well-built, high-performance antenna for the low end of 220 MHz, the 220B is worth serious consideration. It lists for $110. Manufacturer: Cushcraft Corporation, P.O. Box 4680, Manchester, NH 03108. — *Mark Wilson, AA2Z*

RF PRODUCTS 5/8-λ 220-MHz AND 450-MHz ANTENNAS

☐ In the last couple of years, 5/8-λ antennas for 2-meter "hand-helds" have proved their worth. With the increasing number of 220-MHz and 450-MHz hand-held transceivers in use each day, it was only a matter of time before someone began manufacturing similar antennas for these bands. RF Products, a manufacturer of antennas for the commercial services, has met the challenge.

Fully extended, the 220-MHz version measures slightly over 33 inches; collapsed, just under 8 inches. It (as well as the 144-MHz and 450-MHz versions) is available with BNC, PL-259 and no. 5/16-32 thread fittings. A heat-shrink-covered, copper-clad-steel spring between the whip and connector serves as a shock absorber and as part of the matching network. SWR is less than 1.5:1 across the 220-MHz band.

Using the 220-MHz 5/8-λ antenna, I am able to put a full-quieting signal into my favorite repeater from my living room with a hand-held unit, which I cannot do with a standard 1/4-λ whip. In fact, with the 1/4-λ whip, my received signal is noisy and will "drop out" when I move the whip a fraction of an inch. I am very pleased with the performance.



Diversity is the name of the game at RF Products. In addition to making gain antennas for portable equipment with a wide variety of base connectors, RF Products makes these antennas for 220, 450 MHz and 144 MHz.

Tests on the 450-MHz antenna indicated the SWR to be less than 2.5:1 across the fm band (440 to 450 MHz). Although we were unable to subject this unit to as extensive field tests as we did for the 220-MHz version, our experiments did show it to be a good performer. Most users should find a significant improvement over a 1/4-λ whip or "duck." Overall length ranges from 6-1/4 inches collapsed to 17 inches fully extended.

Price class for each antenna is $20. Additional information can be obtained from RF Products, P.O. Box 33, Rockledge, FL 32955, tel. 305-631-0775. — *Peter O'Dell, KB1N*

TWIN OAKS MORSE CODE TRAINING PROGRAMS

☐ A new series of tapes for learning Morse code, incorporating modern psychological theories, is being offered by Twin Oaks Associates. The firm, a partnership of amateurs who are also mental-health professionals, claims that its systems "represent careful interfacing of clinical psychology and Amateur Radio."

Twin Oaks markets three Morse code training programs: the System 12 Alphabet Book (designed to take the student to over 5 wpm), the System 12 (for speeds to over 13 wpm) and the System 24 (to take the student over 20 wpm). Each system has several common denominators. Emphasis is placed on learning through auditory processing — listening then mentally or verbally recognizing what was sent. The student must be willing to commit at least *30* minutes each day to code practice. The goal is to enable the student to recognize/process ever-increasing amounts of auditory material at an automatic level.

Each system asks that the student never rewind a tape to pick up something that was missed. Just listen to the first side and then the second side, repeating this process until everything on the tape is readily understood. After comfortably mastering the first tape, the student may proceed to the next tape, and use the same study method. Succeeding tapes are increasingly demanding. A written study guide details the methods and theories used to design the tapes. According to Twin Oaks, "this method has been proven under many test situations. It works if used as directed."

As the saying goes, "The proof is in the pudding." ARRL staff member Andrew Tripp tested the System 12 Alphabet Book (and is now

KA1JGG, as a result!). Here's what he had to say about it:

"Like many methods of teaching Morse code, the Alphabet Book uses an ear-training system. That is, it teaches one's brain to associate the sounds of code with the number of dots and dashes. This system, however, has a few interesting twists.

"First, one is instructed to go through all 12 sides *without* writing anything down. Only after students have mastered all the material aurally should they practice writing down what is heard. By doing this, the system's author says, you allow your brain and ear to work together without also having to be concerned with writing.

"Another interesting feature is the use of reinforcement, a technique no doubt gleaned from the author's vocation, psychology. After each character is sounded, it is identified by a narrator. This helps shorten the learning process, as well as giving the student an immediate progress report. Side 2 of each tape reviews all previous material without the narrator, simulating on-the-air conditions more closely.

"The material is presented in a unique way. Groups of characters are presented according to the number of dots and dashes they have, instead of at random. For example, Tape A introduces letters E, T, I, A, M and N, which have one or two dots/dashes. This builds, with the addition of a dot/dash per tape, to Tape E and the presentation of numerals and punctuation, which have the longest code equivalents. Again, this method helps cut down the time needed to master the material, as the repetition of sounds has a cadence to which the ear can easily become accustomed. However, this technique falls somewhat short of preparing one for on-the-air conditions, in which code is far more random in nature.

"Any problems encountered were with the audio quality of the tapes, not with the actual mechanics of the code course, which succeeded in preparing me for the Novice code test. For instance, at a couple of points in the program a microphone "thump" is heard, or the narrator's voice fades out. Also, one of the tapes had an irritating tendency to slow down, causing the code to be slurred. Gaps, created by missing code or narration, and a misplaced letter (K in with H) occurred, but were not prevalent. But these problems were minor, and could be remedied easily."

Others used the System 12 and System 24 to sharpen their cw skills after having been away from code for a while. The consensus agrees with Andrew's opinion: The only minor problems were with audio quality on the tapes. All agree that by following directions and being committed to practicing 30 minutes each day, success is *inevitable.* This is no magical path to conquering cw, but it is a viable, realistic method for success.

The Systems are produced by Twin Oaks Associates, Rte. 5, Box 37, Knoxville, IA 50138. Price class: System 12 Alphabet Book, $15; Systems 12 and 24, $30 each — *Carol L. Smith, AJ2I*

N9CR CONTEST RADIO OPERATING SYSTEM

☐ I am a contester, but I hate to shuffle paperwork. Operating a contest with an arsenal of aluminum of the "death-ray" variety can be a very enjoyable experience, but compiling the paperwork associated with a 24- or 48-hour operating stint makes me feel more like a *victim* than a *victor.* I shudder when I think of how many times I've put a serious effort into a contest operation, then haven't bothered to submit an entry for fear of the drudgery of duplicate checking.

I've often thought that it would be nice to operate a contest, push a few keys on a computer keyboard and be left with legible, *error-free* log and dupe sheet printouts! A foolish dream? A few years ago, perhaps, but with modern microcomputer technology, a very reasonable one.

With this idea in mind, N9CR has developed a real-time program for the APPLE® II microcomputer that puts *all* contest paperwork where it belongs — in the closet with your old vacuum tube handbooks! The system not only compiles a running log and checksheet while you operate, it *sends cw contest exchanges as well!*

Computer Requirements

To use the Contest Radio Operating System, an APPLE II Plus or APPLE II microcomputer with 48K of Random Access Memory (RAM) and at least one 16-sector disk drive are needed. With the APPLE II (Integer BASIC), Ramcard APPLESOFT® is an additional requirement.

Log and checksheet printout is accomplished with any of the available Apple-compatible printers. For log printout, a 67-column printer is required, but a unit capable of printing a 92-column line is necessary for dupe sheets.

N9CR lists a clock card as an option but I would have listed it as a definite requirement if a serious effort is planned. Without such a clock card, it is necessary to input a four-digit time entry with each QSO. Depending on the contest and exchange, this could slow the operator down considerably. After approximately 20 entries without the clock card, I chose to borrow one from a friend to complete the review.

System Operation

Operating-system software is supplied on a single 5-1/4 inch diskette. To utilize the program for logging and duping duties, it is necessary to use the supplied software diskette to format another, on which the log and duplicate check sheet(s) are maintained. A single log diskette formatted with the software diskette can store up to 2350 QSOs, or the results of 17 contests, whichever occurs first.

When the user first runs the program, the software requests contest-rules information. System provisions enable a consecutive serial number to be sent and incremented (for ARRL SS, for instance). The software can also be used to keep a dupe sheet for each band/mode; for Field Day or IARU Radiosport competitions, this is a must.

While the system is in operation, the dupe-search function performs almost as quickly as I can type in the call sign. I've seen many programs that have taken as much as a minute or two before completing a single check! In addition, provisions have been made to allow editing of the call sign and received report during operation. A call sign or report can be edited after the contest, also.

The software contains approximately 20 abbreviated commands, all designed to speed up the system and virtually eliminate operator-generated "cockpit" errors. An example of one such command is used to change cw transmitting speed. Instead of being forced to "break" the program and restart, the keystrokes CTRL-S, a numeric input between 4 and 100 (WPM), and the "RETURN"(ENTER) will instantly change the cw routine speed.

Documentation

With each software diskette, the manufacturer supplies 14 pages of information. A detailed, 13-page instruction manual presents the prospective user with information on software usage as well as interfacing instructions. In addition, valuable information on user modification of the software is given. This information enables the user to modify several functions, such as logging in local time (instead of UTC), or to locate the real-time clock in a slot other than 4.

While the program is in operation, the software writes information to the disk every four QSOs. This could cause a few QSOs to be "lost" if shack power should ever fail. If this possible loss of information annoys you, the software can be modified to force a "write to disk" after every QSO. Modification provisions for control of various printers is also addressed.

For the operator (like myself) who has difficulty remembering his or her *own* call at 3 A.M., a single-page, quick-reference guide is provided. Posted near the machine, this sheet will remind the user to achieve the desired system function.

Comments

I found the software a joy to use after becoming familiar with the numerous commands. My first attempt was to use the operation on an old contest log. Just as with a new electronic keyer, I would suggest several off-the-air practice sessions before using the system on the air, as one slip of the keys can confuse the unskilled user.

I would prefer an optional two-digit time input format to the required one. This would allow entry of the time every five minutes or so, and allow a four-digit input at the change of the hour. This would eliminate the added expense of a clock card.

Overall, I would recommend this operating system for anyone who really loves to contest, but hates paperwork. Think of it — no more nasty letters from the ARRL Contest Branch about dupes or sloppy logs!

The N9CR Contest Radio Operating system is available from CR Software, 2512 James Dr., Dyer, IN 46311. Price class: $35. — *Michael B. Kaczynski, W1OD*

Strays

Visitors to the Eastern India Science Camp in Calcutta pause to watch and listen as VU2MKI makes a contact. Members of the Amateur Radio Department of the Birla Industrial and Technological Museum (curator VU2BMT) manned a booth at the Camp for a week last February/March.