Product Review Column from *QST* Magazine

November 1983

Yaesu Electronics Corp. FT-77 HF Transceiver

Yaesu describes the FT-77 as a thrifty hf transceiver. This compact radio is easy to operate and well suited to mobile installations. A microphone or key, an antenna, and a power supply (20 A at 13.5 V) are all that is required to begin operation.

Features

The FT-77 is a solid-state transceiver, and no final amplifier tuning is required. It is rated to produce 100 watts (85 watts on 10 meters) of ssb or cw output power. Output power must be reduced to 50 watts when using the optional fm unit. Operating frequency is controlled by a VFO or a single crystal (not included). A scanning, synthesized, external VFO (FV-700DM or FV-707DM) is optional. Each optional accessory VFO has frequency-storage capability.

The transceiver has a single-conversion receiver section with the i-f at 8987.5 kHz. When the fm unit is operating, the i-f is shifted up 455 kHz and a second conversion is made from 455 kHz. The receiver bandwidth is 2.5 kHz for ssb and cw (wide). Ardent cw operators will probably want the optional, narrow-bandwidth filter (0.6 kHz). There are slow and fast agc settings, but no way to completely stop agc action. Two noise blanker settings are available. Set to the narrow position, the noise blanker will eliminate normal automotive ignition noise. In the wide position, longer noise pulses created by sources such as over-the-horizon radar ("woodpecker") will be reduced. A SQUELCH control is included for use with the fm unit. An optional 25-kHz marker unit is available.

I received the optional scanning microphone (MH-1B8) with the FT-77. The scanning function does not operate without the optional scanning VFO, but the microphone has a switch that allows a choice of frequency response characteristics. I found this microphone helpful with my low and "muddy" voice.

Front Panel Functions

The MIC/CAR control sets the microphone gain in the ssb mode and carrier level in the cw and fm modes. Below the MIC/CAR control is a push-on/push-off power switch. To the right of the power switch, but separate from it, is a row of six more push switches. The rf attenuator is operative when the RF ATT button is pressed. An LED at the upper left of the tuning knob lights when the attenuator is in use. Pressing the next button activates the noise blanker. AGC-F selects fast agc action for reception of cw or fast-fading ssb signals. FIX activates the crystal oscillator as the frequency control for the FT-77. MARK turns on the optional 25-kHz marker for confirmation of the frequency-display accuracy. A press of the CLAR button switches the clarifier (RIT) on; an LED to the upper right of the tuning knob indicates that it is on.

At the lower left of the front panel is an eight-pin jack with connections for audio input, PTT, up-scan, down-scan and fast-scan (up or down) controls. A ¼-inch-diameter PHONES jack allows connection of stereo or monaural
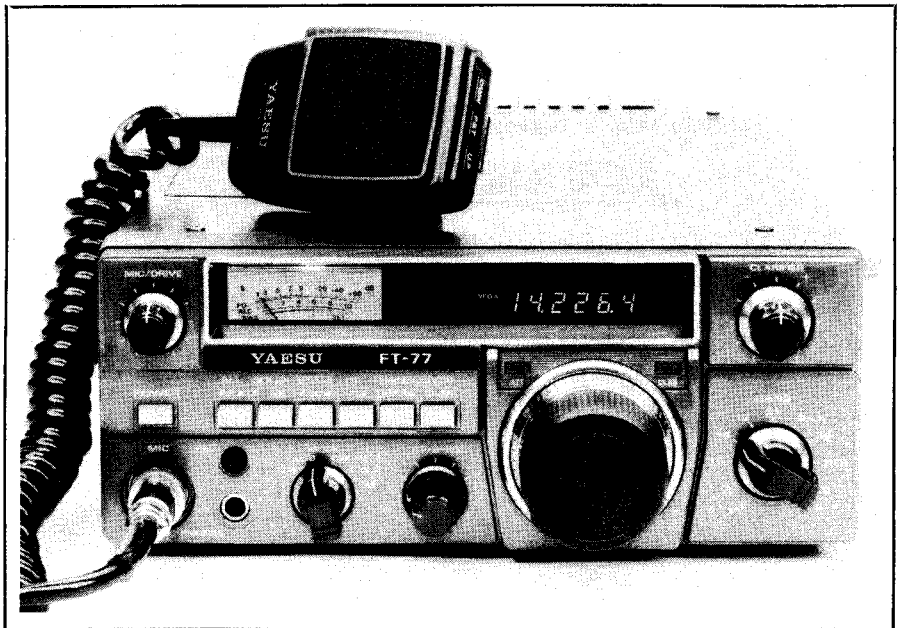
Yaesu Electronics Corp. FT-77 HF Transceiver, Serial No. 2M010010

Manufacturer's Claimed Specifications	Measured in ARRL Lab
Frequency coverage: 3.5 to 4.0, 7.0 to 7.3, 10.10 to 10.15, 14.0 to 14.35, 18.0 to 18.5, 21.0 to 21.45, 24.5 to 25.0, 28.0 to 29.7 MHz.	As specified.
Modes of operation: cw, ssb, (fm optional).	As specified.
Frequency display: 6 digit.	3/8 in. high, 6-digit blue vacuum tube.
kHz/turn of knob: 15.	17.
Frequency resolution: 100 Hz.	As specified.
Backlash: Not specified.	Nil.
S-meter sensitivity (µV/S9 reading): Not specified.	80 m, 24.5; 40 m, 24; 30 m, 35; 20 m, 40; 18 m, 35; 15 m, 28; 12 m, 30; 10 m, 25.
Transmitter output: 80-15 m, 100 W PEP; 10 m, 85 W PEP.	80 - 15 m, 100 W; 10 m, 95 W.
Spurious suppression: Better than 40 dB.	−54 dB (see photo).
Third-order IMD: Not specified.	− 35 dB (see photo).
Receiver sensitivity: Less than 0.15 µV for 10 dB S + N/N.	Receiver dynamics measured with optional 600-Hz filter installed.

	80 m	20 m
Noise floor (MDS) dBm:	− 139.5	− 139.5
Blocking DR (dB):	99	99
Two-tone, third-order IMD DR (dB):	92	94
Third-order intercept:	− 1.5	− 1.5

Size (HWD): 3.7 × 9.5 × 11.8 inches†	As specified.
Weight: 13.2 lb.	As specified.
Price class: FT-77, $600; FP-700, $135.	

Available from: Yaesu Electronics Corp., 6851 Walthall Way, Paramount, CA 90723.

†mm = in. × 25.4; kg = lb × 0.454.

headphones.[1] The RECORD jack (2-conductor, "mini" phone plug) provides a fixed level (70 mV at 50 kΩ) for a tape recorder (this feature is useful if records of third-party traffic are kept on tape). LSB, USB, CW-W (wide), CW-N (narrow), and FM positions are available on the MODE switch. AF (gain) and SQL (squelch) controls are

[1]mm = in. × 25.4.

on concentric shafts, just left of the tuning knob. A hard-rubber tuning knob (similar to the focus ring of some cameras) covers about 17 kHz per revolution. The BAND switch allows selection of any one of the present hf amateur bands and the future allocations at 18 and 24 MHz. The CLARIFIER (RIT) shifts the receive frequency up to 3.4 kHz above, or 4.0 kHz below, the transmit frequency when the CLAR button is depressed.
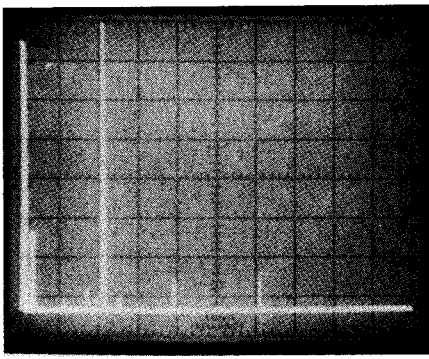
Fig. 1 — Worst-case spectral display of the FT-77. Vertical divisions are each 10 dB; horizontal divisions are each 5 MHz. Output power is approximately 100 W at a frequency of 10.105 MHz. All spurious emissions are approximately 53 dB below peak fundamental output. The FT-77 complies with current FCC specifications for spectral purity.
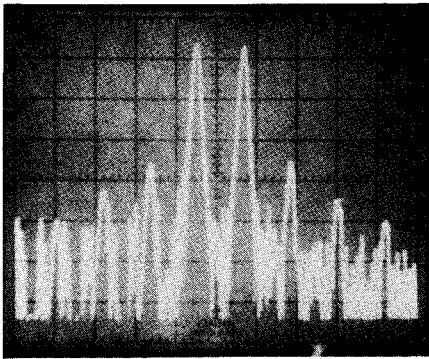

Fig. 2 — Spectral display of the FT-77 output during the transmitter two-tone IMD test. Third-order products are approximately 35 dB below PEP, and fifth-order products are about 44 dB down. Vertical divisions are each 10 dB; horizontal divisions are each 1 kHz. The transceiver was being operated at rated input power on the 20-meter band.

The vacuum-tube frequency display is blue and has 100-Hz resolution. At the left side of the frequency display are frequency control indicators: VFO-A for the internal VFO, VFO-B for the external VFO, or F (fixed). Left of the frequency display is the meter that reads S units on receive, relative forward, power, and reverse power, or alc on transmit. The meter sensitivity and function, sidetone level, cw break-in delay, a crystal socket and a trim control for the crystal frequency are all located under a hatch on top of the FT-77 case.

Rear Panel

Rear panel connections allow for a wide range of operating possibilities. RF OUT provides a low-level (220 mV at 50 ohms) rf source for a transverter (FTV-700 optional). ACC 1 is a six-pin DIN jack with switching and alc signals for a telephone interconnect (phone patch) or power amplifier. A 1/8-inch phone jack is supplied for an external 4- to 16-ohm speaker (EXT SP). There's a dc power connector (DC 13.5 V) for the FT-77 (1 A on receive and 20 A on transmit). ACC 2 is a seven-pin DIN jack with connections for scanning control, transmitter audio input, PTT, and 13.5 V-dc transmit-signals from an external VFO. An eight-pin DIN jack EXT VFO is used for frequency control input from, and power to, an external VFO. The DC 8 V jack pro-
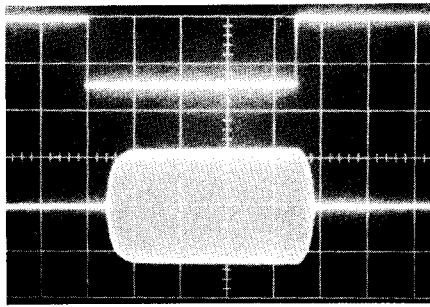

Fig. 3 — Cw keying waveform of the FT-77. Upper trace is the actual key closure; lower trace is the rf envelope. Each horizontal division is 5 ms.

vides power for the optional FC-700 antenna tuner. KEY accepts a ¼-inch phone plug for cw keying (0.4 mA, 1.5 V maximum). Connections are also provided for the antenna (SO-239) and station ground.

Operation

This is simple: Switch on the power, and transmit! I found tuning with the rubber knob awkward at first and the tuning is a little fast for mobile operation. The scanning VFO option will make mobile operation easier. RIT offers a slower tuning rate than the main tuning knob and may be used as a bandspread control for receive only. Since the transceiver is intended for mobile use, no VOX circuit is present for voice operation. Cw operation is semi-break-in with a variable delay. The narrow noise blanker helps fight engine noise when mobile.

Comments

The FT-77 is a fine transceiver, but there is always room for improvement. The meter-function control and noise-blanker-selection control locations are awkward. To operate the controls, one must remove a hatch cover and reach inside the case to manipulate slide-switch settings. This procedure is troublesome at home, difficult and maybe impossible (dependent upon mounting location) while mobile. I am pleased to find a transceiver with an SWR meter and selectable noise blanker built in, but the controls should be on the case exterior.

The receiver "hears" the frequency counter, faintly, all across the 80-meter band. There are 20 spurious responses that are strong enough to compete with a weak cw signal in the hf bands.

The first time I used the FT-77 in my vehicle I had a problem. Each time I pressed the PTT button, the meter dropped to zero — no power at all! After an hour of searching, I found that a jumper wire had been omitted from the power connector. I installed the jumper, as shown in the manual, and when I again pressed the PTT button, the meter needle climbed the scale — and immediately fell to zero again! The fuse supplied in the dc power cord was rated for 2 A, but a 20-A fuse is required. With the proper fuse installed, the set works well. A quick QSO with a station in southern Indiana confirmed the successful installation.

The FT-77 is easy to operate. I can switch on and transmit in a few seconds. The radio is easily portable and installation goes quickly. Reports indicated a clean transmitted signal and good audio quality. Receiver performance is excellent.

Conclusion

I am happy with the FT-77. Through most of

the trial period I used a mobile whip antenna. Eastern Europe and South America were worked easily. I erected a ground-mounted vertical antenna near the end of the review period and Israel was contacted the first afternoon. The FT-77 gave me many hours of enjoyable operating. The radio is fun! — *Bob Schetgen, KU7G*

ICOM IC-45A 450-MHz FM TRANSCEIVER

□ The ICOM IC-45A is a small 450-MHz fm radio with big-rig performance. Packed with just about every feature, the IC-45A follows in the footsteps of the 2-meter IC-25A. In fact, they're matching units, and can be stacked neatly.

Not on 450 yet? The IC-45A could be your ticket to blissful solitude and quiet, away from the masses on 2 meters. Enjoy longer QSOs, and radio radio silence in the monitoring mode when you wish.

"Versatility" describes the IC-45A: a microcomputer provides many operating capabilities. Multipurpose scanning, dual VFOs, a continuous tuning system with protection against out-of-band operation, and priority/memory channel capabilities all add up to give the fm fan all he or she can handle.

Thanks for the Memories ...

Up to five frequencies can be programmed easily into the memory channels. I found this memory capability handy. A click of the switch, and you're on the next programmed frequency — simple.

Scanning is a particularly useful function on any rig operating in the sparsely populated 450-MHz band. Multipurpose scanning capability is a feature of the IC-45A. The memory scan allows monitoring of the five memory channels and the two VFO frequencies *alone* — you don't have to wade through 10 MHz of spectrum to find a busy spot. (But, you *can* if you so desire). The program scan provides scanning between two programmed frequencies. Thus, you can search for a busy (or clear) frequency just about anywhere, with maximum efficiency.

Two VFOs can be used independently. Oddball splits can be implemented easily. VFO A changes frequency in 5-kHz steps; VFO B in 25-kHz steps. The dual VFOs allow you to set a certain frequency with one VFO, work up and down the band with the other VFO, and periodically check the set frequency simply by switching between VFOs A and B.

Another neat feature is instant monitoring of a repeater's input frequency (your transmit frequency) to determine if your friend is within simplex range. When the SIMP/DUP switch is in the "DUP" position and the memory W/CK button is pushed, you can receive the repeater's input frequency instantly.

A priority channel allows you to check your favorite channel, such as a local repeater or simplex frequency stored in a memory channel while operating on a VFO frequency. Every few seconds, the dial (receive) frequency will change to the priority channel to see if it's busy: five seconds of VFO frequency, then one second of priority channel check.

One thoughtful feature is the IM UP switch. By pressing this switch, the dial frequency is raised by one MHz. This saves a good deal of arm-wrenching, and finger-twisting when traveling from the low end of the band to the high end.
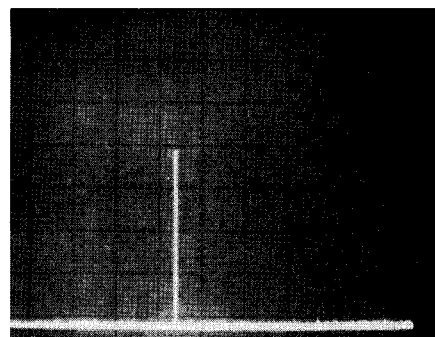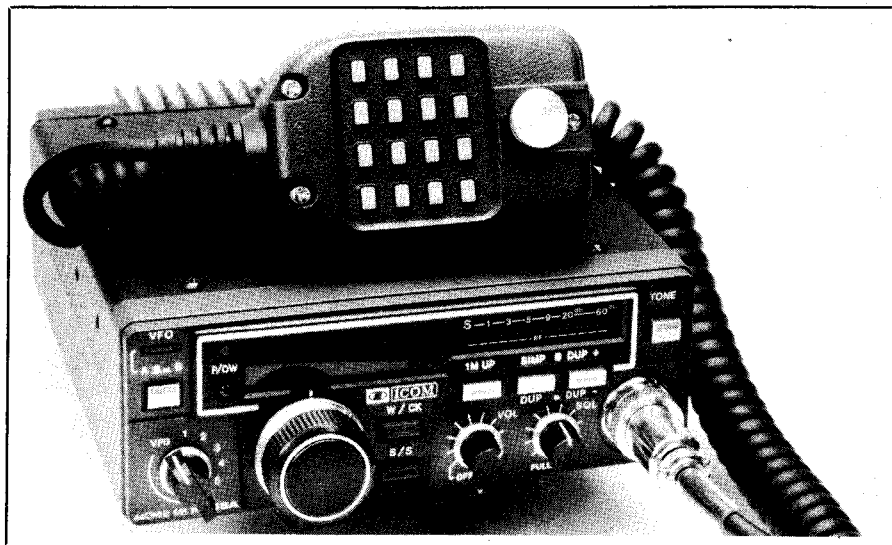
Fig. 4 — Spectral display of the IC-45A. Vertical divisions are each 10 dB; horizontal divisions are each 100 MHz. Output power is approximately 16 W at a frequency of 444.0 MHz. Spurious emissions are all greater than 68 dB below peak fundamental output. The fundamental has been reduced in amplitude approximately 31 dB by means of notch cavities; this prevents analyzer overload.

ICOM IC-45A 450 MHz FM Transceiver Serial No. 01311

Manufacturer's Claimed Specifications	Measured in ARRL Lab
Frequency range: 440.000-449.995 MHz.	Same.
Operating mode: 16F3	
RF Output Power: 10 W HI; 1 W LOW	16 W HI; 1.5 W LOW
Spurious emissions: − 60 dB or better.	Better than − 60 dB
Power requirements: 13.8-V dc ± 15%.	Same.
Current drain: at 13.8-V dc:	
rx 0.5 A (squelched).	Same.
0.7 A (full audio output).	Same.
tx 3.5 A (10 W).	3.4 A.
1.7 A (1 W).	1.6 A.
Receiver type: Double-conversion superheterodyne	
1st i-f — 21.8 MHz.	
2nd i-f — 455 kHz.	
S-meter sensitivity: Not specified.	4 μV/S9.
Sensitivity: Better than 0.3 μV for 12 dB	
SINAD; better than 0.4 μV for 20 dB noise quieting.	− 119 dBm/20 dBq.
Squelch sensitivity:	0.1 μV (min) 0.5 μV (max).
Audio output power: More than 2 W.	
Dimensions (HWD): 2 × 5.5 × 7 in.†	
Weight: 3.3 lb.	
Color: Black.	

†mm = in. × 25.4   kg = lb. × 0.454

Remember, the IC-45A covers *10 MHz* of spectrum!

General

The IC-45A is durable, compact and easy to use. I found that the two power levels afforded fine performance for my mobile applications; an outboard amplifier was never required. Frequency choice is determined by the tuning control knob. Depending upon which VFO is employed, one complete rotation of the tuning knob results in a frequency change of 250 kHz or 1,250 kHz.

For home/base use, you'll need at least a 4-A power supply. The microphone has a convenient up and down switch arrangement for ease of frequency selection. A 16-key DTMF pad is also incorporated on the PTT mike.

Performance

I installed the review unit in my pick-up truck. A standard ¼-wavelength whip antenna was chosen for use with the rig. Pick-up trucks are not known for smooth rides. But this did not bother the IC-45A. It survived bumps and jolts on some of New England's ruttiest back roads.

Audio output is of sufficient level to be heard over the ambient noise in my truck. This is quite a feat considering the rig was mounted *behind* my seat. Reports of my transmitted audio were excellent — full and crisp. ICOM's reputation for good quality audio is manifested in their IC-45A.
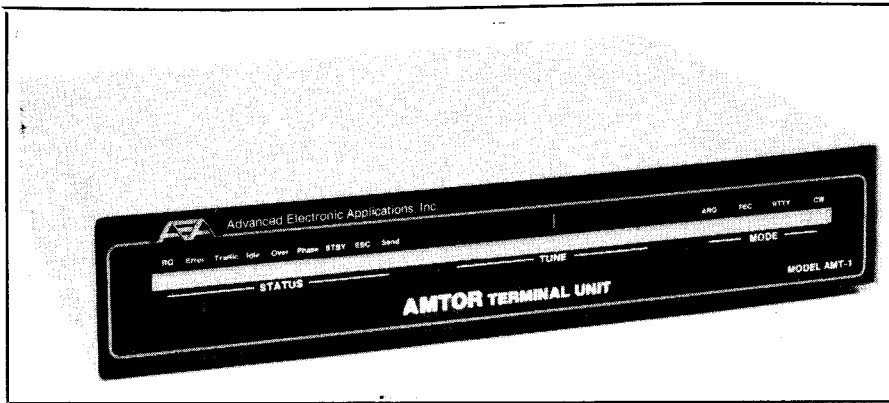
The green color of the LEDs seemed to contribute to their readability in high ambient light situations, although LCD displays are still superior in these applications. But at night, they glowed clearly, providing for ease of reading.

I liked the feature of the low and high power option. When the truck engine was turned off, I could continue to operate at low power to avoid excessive battery drain.

The LED S-meter is easy to read even in high ambient light conditions. I also found the meter to be aesthetically pleasing to the eye. In fact, the entire rig is attractive with its avionics look. I had many admiring comments from both hams and non-amateurs alike.

The receiver is sensitive, and performs well. I experienced no difficulties with desensitization. The IC-45A worked well in cold temperatures as well as in direct sunlight and heat. Frequency stability was never a problem.

Overall, I enjoyed reliable performance with the review unit. The manual is complete, easy to read and understand. Try the "wilderness" approach to radio, and get on 450 MHz. You'll

be glad you did! The IC-45A is available from ICOM America, Inc., 2112 116th Ave. NE, Bellevue, WA 98004. Price Class: $400. — *Rick Palm, K1CE*

AEA AMT-1 AMTOR TERMINAL UNIT

☐ AMTOR (Amateur Teletype Over Radio) is an almost error-free mode of RTTY operation. Although it has been used for years commercially as SITOR, it is relatively new to the U.S. amateur fraternity. It has been in use on the amateur bands, primarily in Europe, but has just recently been authorized by the FCC for use on the hf bands where F1 emission is permitted. (For a complete explanation of the system, see the articles by Martinez and Newland in the June 1981 and July 1983 issues of *QST*, respectively.)

The AEA AMTOR Terminal Unit will get you on AMTOR quickly and easily if you have a home computer or an RTTY/ASCII terminal unit with RS-232-C compatible output. In addition to your regular transceiver you need a 12-V dc source, a five-wire cable to the terminal and a 4-wire cable to your transceiver. Connections to the terminal provide for serial data transmission to and from the AMT-1, ground and, for full interfacing, CTS (clear-to-send) and RTS (ready-to-send) lines. Connections to the transceiver are audio in/out, PTT and ground. The transceiver is used in the usb mode, and 1275- and 1445-Hz tones from the AMT-1 are fed into the audio input to produce the fsk signal. Be sure you have sufficient carrier rejection so your signal is really F1. If you desire to use the AMT-1 with an existing loop circuit, an audio tone to 20- or 60-mA loop interface will be required. In addition to AMTOR, the AMT-1 will receive and send Baudot RTTY up to 100 bauds and will send cw up to 100 wpm. The AMT-1 will not receive cw and will not receive or send ASCII. It can be bypassed for ASCII operation, but then must be switched off and on again for normal operation. The manual includes programs for adapting some of the more common home computers to the AMT-1.

The AMT-1 contains no external controls and, in normal use, no internal adjustments should be required. 110-baud ASCII data from the terminal ESC and CTRL functions is used to control the AMT-1. The front panel contains a 16-LED tuning display, a 4-LED mode indicator and a 9-LED status indicator. A properly tuned-in Baudot RTTY or AMTOR signal will result in

a two-green-LED display, with the dots being spaced equidistantly from the center line of the display. A red LED will indicate whether the AMT-1 is in the ARQ, FEC, RTTY or CW mode. In the status display, white LEDs are the indicators. ERROR is lit when a received block contains an error, RQ when a distant station requests a repeat, TRAFFIC when text is being sent or received, IDLE when no traffic is being sent, OVER when a change of direction of an ARQ contact is occurring, PHASE when the AMT-1 is trying to synchronize with another station, STBY when the unit is waiting to be used, ESC when the AMT-1 is in the escape mode and the next signal from the terminal will be a command. A red LED lights in the transmit mode. Parameters such as SELCAL, AMTOR time-out, RTTY baud rate, cw speed, echo on-off and automatic new line on-off may be programmed and will remain as long as the unit is not turned off. ESC Q will list the current settings of these parameters.

You will find operating AMTOR to be different from anything you have done before. When you first turn on the AMT-1 and tune in an ARQ signal you will probably find that the copy is anything but perfect. The slave may call for repeats while you are copying perfectly and your copy will show many blocks repeated. Conversely, you may get errors when the slave doesn't and those blocks will not be repeated. However, when you are in synchronization with another station you will receive almost completely error-free copy despite fading and interference.

Another AMTOR feature is SELCAL. A self-assigned four-letter group is entered into your AMT-1, the letters usually being derived from your call. For example, W1AW uses WWAW and G3PLX is GPLX. When another station calls using your SELCAL group, your station will automatically respond. The normal way to end a transmission is with +? which automatically reverses the master/slave relationship. The last station to transmit at the end of a contact finishes with CTRL D, which switches both stations to the standby mode.

The AMT-1 has a 960-character buffer so you can enter text in advance. However, when the data rate slows down because of QRM you must be careful not to exceed the buffer's capacity. This is where the RTS connection comes in handy; the text will be held in your terminal until there is room for it. An interesting characteristic of AMTOR is that the maximum range is governed by the speed of your transceiver change-over relay. With a change-over delay of less than 15-ms, contacts almost half-way around the world are possible. Slower relay action will shorten the range.

The manual is well-written with respect to the setup and operation of the AMT-1 itself, but I

found it a bit vague concerning operating procedures. Fortunately, a contact or two straightened out the confusion. At the present time, almost all AMTOR activity is near the calling frequency of 14075 kHz. Undoubtedly, when there is sufficient activity, calling frequencies will be established on the other bands as well. The AMT-1 measures 2½ × 12¼ × 9¼ inches (HWD). It is distributed by Advanced Electronic Applications, Inc., Bldg. O & P, 2006 196th SW, Lynwood, WA 98036. Price class: $590. — *Chuck Bender, W1WPR*

SUPER-RATT RTTY/CW SOFTWARE

☐ Super-RATT is a popular RTTY/cw software package designed to be used with an Apple® II (or //e) computer with 48 K of RAM, Applesoft BASIC in RAM and at least one disk drive using DOS 3.3. If you've got a clock card and another disk drive, you'll find them useful, but they're not absolutely necessary to use the software effectively.

The Super-RATT package consists of a 5¼-inch floppy disk containing several programs and a 70-page manual describing their functions. The RTTY software allows the computer to send and receive Baudot or ASCII (upper and lower case) RTTY at the popular speeds from 40 to 300 bauds. Speeds of from 5 to 100 wpm are accommodated for the reception and transmission of cw.

How quickly you become familiar with the software is dependent upon how much RTTY experience you've had and how well you know your computer. Don't expect to shove the disk into the drive, push a couple of keys and be on the air in five minutes! You've got to take some off-the-air time to become acquainted with the system operation.

Makeup

You probably can't think of more for an RTTY program to do than what is already contained within Super-RATT. There are three programs and a text file of importance: Super-RATT (the operating program); Super-RATT. UTL, used to maintain and edit the system directory, add message titles, create new indices and logbooks, etc.; Super-RATT. CONFIG, used to set up program options that meet with your particular system needs, and Super-RATT. EXEC, a file created by the previous program. This file is used to insert new information into several of the main program lines. In order to modify the main program to suit different system setups and modes, several such files may be kept on the disk. It all serves to make your operation flexible. You can have things configured so that you can use more than one TU.

An RBBS (Radio Bulletin Board System) is an integral part of the software. This subsystem has

over 34 commands that a user can access. All message-handling functions and log-keeping routines are included.

If you have a 16 K RAM card installed or own an Apple //e, you have at your disposal 10 K of receive and 10 K of transmit text buffer. With the receive buffer you can elect to save off-the-air copy. At 50 bauds, an empty, initialized disk will hold over five hours of copy. The receive/transmit buffers may be independently erased and full-screen display of the transmit or receive buffer is operator selectable.

When transmitting, you can elect the fill ("diddle") character (letters, figures, blank or none), word- or character-mode transmission and carriage return position. The latter permits you to select automatic carriage return (CR) at 40- or 72-character intervals or to disable the CR function entirely.

The BREAK feature is a welcome part of the transmit section of the program. It allows you to respond to a question asked by the station being received or to answer a breaking station without losing text entered into the normal transmit buffer. If you've ever been on RTTY without such a feature, you can appreciate what this addition means! When you use the BREAK feature to answer a station, you will see the break transmission text appear on the screen immediately after the last transmit buffer information. Only the break transmission information will be output. After returning to receive, you can resume filling the transmit buffer. Although the screen shows the break transmission information lodged between the interrupted transmit buffer information, the break data will not be retransmitted.

Using QUICK LOAD files, you can store messages on disk for later transmission. It is a method of message storage that is conservative of machine memory space, as opposed to the use of stored message strings in RAM. File access is rapid.

Super-RATT offers an on-line LOGBOOK, and a feature called VERIFIED FILE TRANSFER. The latter is to be used with other Super-RATT-equipped stations. It is a method of file transmission that provides for two-way handshaking and checksum computation. Once contact has been established between the two stations and the process begun, the rest of the operation is fully automatic. The system is still under development, and the program developer welcomes input from Super-RATT users who will improve the process.

The software contains a copyrighted feature known as RATT-SOFT. It is a method of using the Apple ampersand jump routine for a number of different command functions. RATT-SOFT may be called by any Applesoft® program or directly from the keyboard. Over 30 different commands are at your beck and call.

The screen display is divided into five sections, if you count the top status line and the bottom command and status line. Below the top status line is a 13-line area reserved for incoming text. That is followed by a single-line "Times Square" scrolling area that displays the transmitted text as it is being output. This single-line area is separated from the sections above and below it by screen-wide dotted lines. Beneath the "Times Square" line is a four-line transmit-buffer-text area. Transmitted text (and received text) scroll once the bottom line of the respective area is reached. Both texts can be displayed using a full-screen format, if desired.

The bottom command/status area is the place to look for help when you can't remember which keys to push to accomplish your intended pur-

pose. The upper status line tells you your mode and speed of operation, T-R status (whether you're in receive or transmit mode), the receive buffer status, and whether or not you're saving incoming text to disk. There are also relay status and mark/space indicators. The mark/space symbols (letters M and S) flicker with incoming and outgoing text, acting as tuning/status indicators. Relay status informs you when you are re-transmitting just-received text or repeating your last transmission.

The status indicators on the top line are enclosed in brackets. This makes the line look rather busy, as far as I'm concerned. I opted to delete the brackets, and I find the line easier to read. You can modify program lines 2660 to 2880 to suit your personal tastes.

CW Software

I am somewhat disappointed with the cw section of the program. The plus it has (inclusion of most of the prosigns) is outweighed by its inflexibility. The speed algorithm is good, but it can stand some improvement. At higher transmission speeds, the weighting becomes too light and I couldn't find a way to vary it easily.

The operator must key in a cw speed for transmission. This keyed-in speed also sets up the cw receiving speed. Because I (and others) had trouble getting the program to respond properly during receive, I was told to try setting the receive speed at a figure about twice that expected. It does help, but not that much and because the receiving and transmitting speeds are interlocked, if the transmit and receive speeds differ appreciably, you'll have to change speeds as you go between transmit and receive. Ideally, the cw-receiving algorithm should be self-adjusting and adapt itself independently to the speed of the incoming code.

I would like to be able to alter the weighting of the cw characters by simply using a couple of keystrokes. It would also be nice to be able to use the computer speaker for monitoring sent cw. This feature could also be turned on and off by simple commands. As it stands, you must rely on the transmitter cw-monitor signal when transmitting.

General Comments

As I understand it, earlier versions of Super-RATT were composed of several smaller programs. The present version is, essentially, one big program. I would like to see the big program broken down into a few "bite-sized" chunks. While this would lead to code duplication, it would make the system more appealing to some, I'm sure.

One nice part of Super-RATT is that the programmer has enabled the user to modify much of what is available according to his or her tastes. When making changes to the program, ensure you make them to the operating version (Super-RATT) and not to Super•RATT REMarked. The latter version of the program is filled with REM statements that help explain the program to the user.

By all means, do as the program author suggests: Make a copy of the program disk and stick the original disk in your archives! Don't take a chance on losing the original copy. As you make changes to your backup disk, back that disk up with yet another in case something "crashes." Otherwise, you'll have to do all that work over again.

If you intend to LOAD and LIST the REMarked version of Super-RATT, you'll probably have to set MAXFILES to 1 or 2. Without doing that, I got a PROGRAM TOO LARGE error indication.

After five transmit-receive toggles, the program automatically sends a cw i-d whether or not text has been transmitted. The program purchaser's call sign is buried within the bowels of the program.

Unfortunately, Super-RATT (at this time) does not support the 80-column display capabilities of the Apple IIe. Perhaps someday this will become part of Super-RATT. The program is under constant improvement and users are kept in touch with the program developer by means of a newsletter.

I've only touched on the highlights in this review. There are other program features that are sure to be of interest to some. If you're looking for a comprehensive RTTY program for your Apple computer, you may find it in Super-RATT. The package does have some weak areas, but I've not used a piece of RTTY/cw software yet that doesn't. I hope these areas will be strengthened in the near future. Super-RATT is available from Universal Software, Inc., 9 Shields Lane, Ridgefield, CT 06877. Price class: $60. — *Paul K. Pagel, N1FB*

AEA HOT ROD ANTENNA FOR 2-METER HAND-HELD TRANSCEIVERS

☐ Fm operators have seemingly fallen in love with gain antennas for 2-meter hand-held transceivers ("HTs"), if brisk sales and high visibility can be used to judge such things. There are good reasons for this — compared to the "rubber duckie," the gain antennas (when properly designed) provide as much increase in effective transmitter power as a small amplifier. The gain antennas show the same improvement on the receiving end of things, too.

Previous efforts in this area have been limited to models designed around a 5/8-λ radiator. AEA has broken with this tradition by designing the Hot Rod around a 1/2-λ radiator. Fully extended the Hot Rod measures 39-5/8 inches, and it weighs in at a little under two ounces.[2] This makes it shorter and lighter than any of the other (5/8-λ) gain antennas on the market. This should add up to a longer life for the Hot Rod and for the BNC connector on the radio.

Does it work? Fully extended, the antenna works like a charm. I observed the same general improvement in transmitted and received signal that I've seen with the 5/8-λ variety antennas.

Collapsed, the antenna measures 8½ inches long. Although some of the AEA promotional literature suggests using the antenna in the collapsed position, you may want to check the VSWR safety rating of your rig first. VSWR measurements across the 2-meter band for the collapsed mode are included in Table 1.

If you are in the market for a gain antenna for that new 2-meter rig, you might want to give serious consideration to the AEA Hot Rod. Price class: $25. Additional information can be obtained from AEA, P.O. Box C-2160, Lynwood, WA 98036. — *Peter O'Dell, KB1N*

HEATH HL-2200 AMPLIFIER KIT

☐ I'm sure many readers have at least a nodding acquaintance with the popular Heath SB-220 and SB-221 amplifiers.[3,4] Therefore, a look at the exterior of the HL2200 might prompt

[2]g = oz × 28.35.
[3]Recent Equipment, *QST*, Aug. 1970, p. 45.
[4]Product Review, *QST*, March 1980, p. 43.

**Table 1
Frequency Vs. SWR for AEA Hot Rod**

Frequency (MHz)	Extended	Collapsed
144.0	1.0	10.8
144.4	1.0	11.2
144.8	1.0	12.7
145.2	1.0	14.9
145.6	1.0	13.9
146.0	1.0	12.9
146.4	1.25	13.9
146.8	1.35	15.9
147.2	1.47	17.9
147.6	1.55	17.14
148.0	1.70	19.9

SWR values expressed are in relationship to unity. Measurements performed in ARRL lab with an IC-2AT, a Sola Basic Directional Wattmeter and a 5-W element.

one to ask, "How different is the '2200?" The exterior is quite a bit different. A warm brown finish has replaced the familiar green cabinet color, and other facial changes, such as the use of different styles of knobs, meters, switches and a new logo, are obvious. A couple of the exterior changes reflect modifications that have been made to the control and SWR monitoring circuits, but for the most part, the physical interior and electrical designs are identical to those of the earlier amplifiers.

Kit Assembly (and Some Hints to Avoid Kinks)

It took me approximately 22 hours to assemble the '2200. A few additions and changes to the assembly manual from supplied errata sheets are required before work is started. I found one additional minor error on page 32: The color code for R29 is given as red-violet-orange when it should be yellow-violet-orange for the 47-kΩ resistor. One assembly procedure, the installation of the pilot lamp, caused me a bit of grief. I could not get the grain-of-wheat lamp and diffuser combination to fit properly into the body of the lens. After several attempts to mate the two units, one of the lamp leads broke off. I substituted a Radio Shack 272-1140 lamp for the original bulb, and the fit is perfect.

When separating the line-cord leads, don't attempt to make two cuts of the length required, as you're bound to nick the insulation on one of the wires. A much easier method is to make a small cut either side of the green center wire and simultaneously pull the two heavy conductors away from the center wire; they'll separate easily, and no insulation will be damaged.

If you're going to operate the amplifier from a 234-V line, you'll have to purchase the proper line-cord plug. The molded plug supplied is for use only on 117-V circuits.

When installing the high-voltage transformer, I'd recommend leaving the red-yellow lead uncut until the transformer has been set in place. Once you've determined that the lead will comfortably reach the required point of attachment, you can cut it to the proper length.

Controls and Metering

One welcome addition to the new amplifier is the addition of an AMPLIFIER IN/OUT switch that allows the HL-2200 to be placed in standby. A red pilot lamp (located immediately above the POWER ON/OFF switch) illuminates when power is applied to the amplifier; it replaces that function of the lighted meters on the older amplifiers. The '2200 meters are not illuminated types.

Two meters monitor the vital amplifier functions. The left-hand panel meter measures tube plate current in increments of 50 mA to a maximum value of 1 A. To the right of the PLATE CURRENT meter is the PLATE VOLTS meter, which actually is a multifunction indicator used in conjunction with the FUNCTION switch. In the HIGH VOLTAGE position, the meter reads dc plate voltage in 400-V increments to a maximum of 4 kV. Grid current, in 25-mA increments and with a scale maximum of 400 mA, is measured with the FUNCTION switch in the GRID CURRENT position. The RELATIVE LOW and RELATIVE HIGH switch positions select taps on a voltage divider/detector network attached to the RF OUTPUT jack. In either position, relative forward power is measured, the full-scale reading dependent on the tap selected. These switch positions replace the SENSITIVITY control function present on the SB-220/221 amplifiers.

Some Observations

To comply with current FCC regulations, the '2200 has no provisions for operating on 10 meters. (At the time this review is being written, Heath has no 10-meter modification kit available for the HL-2200). The 15-meter input tuned circuit now consists of three series-connected pi matching sections, and acts as the 27-MHz filter; the main-chassis-mounted 27-MHz filter is no longer used.

The large front-panel paddle switches don't fit tightly and exhibit a small amount of front-to-back movement. These switches are snap-in types, unlike those on the older amplifiers that were bolted to the chassis. But this should not pose any problem other than one of aesthetics.

A "plug-in" high-voltage transformer arrangement is now used. Late SB-221 models have this feature. Of the eight high-voltage transformer leads, six are wired to a Molex plug. Only two easily reached wires need be unsoldered, and the Molex plug and transformer mounting screws removed, to take out the transformer for amplifier shipment or transformer replacement or substitution. Should you need to remove the front panel for any reason, taking out four screws will free the assembly.

In the past, some concern had been expressed about filament inrush-current protection for the 3-500Z tubes.[5-8] I spoke with representatives of Heath and Eimac/Varian about this subject. I was told that filament inrush current poses no problem with this amplifier because of the filament transformer design. There is enough sag produced by the transformer during turn-on that the tube ratings are not exceeded. The more important consideration regarding the tubes is one of installation. When the tubes are being inserted into their sockets, they should be pushed straight down until seated properly. No rocking motion should be applied! Such action may crack the glass beads around the tube pins creating small air leaks that will prematurely destroy the tube(s). If the socket fingers are too tight to permit the tube to seat properly, bend the socket fingers

[5]K. M. Gleszer, "Upgrading Your SB-220 Linear Amplifier," QST, Feb. 1979, p. 20; also, Feedback, QST, April 1979, p. 27.
[6]Hints and Kinks, "On Upgrading Your SB-220 Linear Amplifier," QST, Nov. 1979, p. 57.
[7]Hints and Kinks, "Comments On SB-220 Modification," QST, Feb. 1980, p. 44.
[8]Hints and Kinks, "Filament Inrush-Current Limiter For Linear Amplifiers," QST, Nov. 1982, p. 49.

Heath HL-2200 Linear Amplifier

| Manufacturer's Claimed Specifications	ARRL Lab Test Results
Frequency coverage: 80, 40, 20 and 15 meters.	Confirmed.
Maximum power input: Ssb, 2-kW PEP; cw, 1 kW; RTTY, 1 kW.	Confirmed.
Maximum recommended key-down time at full power input 10 minutes.	Confirmed.
Third-order IMD (dB): −30 or better.	See text.
Power requirements: 117-V ac at 50/60 Hz. (20 A max.), or 234-V ac at 50/60 Hz. (10 A max.).	
Driving power required: 100 W max.	Confirmed.
Color: Medium brown.	
Size (HWD): 8-1/4 × 14-7/8 × 14-1/2 in.†	
Weight: 50 lb.	
Price class: $850.	
Manufacturer: Heath Company, Benton Harbor, MI 49022.	

†mm = in. × 25.4; kg = lb × 2.2.
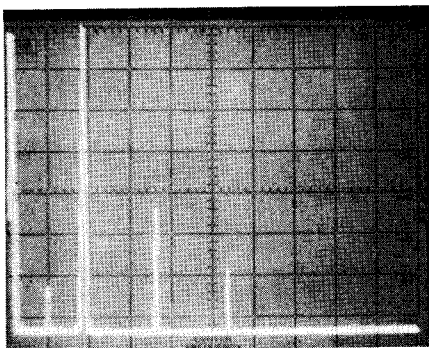
Fig. 5 — Worst-case spectral display of the HL-2200 amplifier. Vertical divisions are each 10 dB; horizontal divisions are each 2 MHz. Output power is approximately 680 W at a frequency of 3.6 MHz.

Table 2
HL-2200 HF Amplifier Performance

Band (meters)	P_{in} (W)	P_{out} (W)	Input SWR	Drive Power (W)	Efficiency (%)
80	1000	680	1.4:1	68	61
40	1000	720	1:1	70	65
20	1000	680	1.8:1	68	62
15	1000	680	1.9:1	100	59

Table 2. No difficulties were encountered when the 10-minute key-down test was run.

The −30 dB third-order IMD performance of the HL-2200 is met easily. At present, the transceivers used in the ARRL lab to drive amplifiers such as the '2200 are the limiting factor when it comes to making this measurement. Because of this, new equipment is being ordered that will permit more-telling third-order IMD measurements to be made.

The HL-2200 looks like a perfect mate for the HW-5400 and SS-9000 transceivers, and should be a welcome addition to almost any amateur station. The HL-2200 is available from Heath Company, Benton Harbor, MI 49022. Price class: $850. — *Paul K. Pagel, N1FB*

slightly until the tube pins fit firmly, but don't rock the tubes!

Amplifier Testing

Results of the amplifier tests are shown in