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QST Issue: Jul 1979
Title: Ten-Tec 544 HF Transceiver
Author: Doug DeMaw, W1FB

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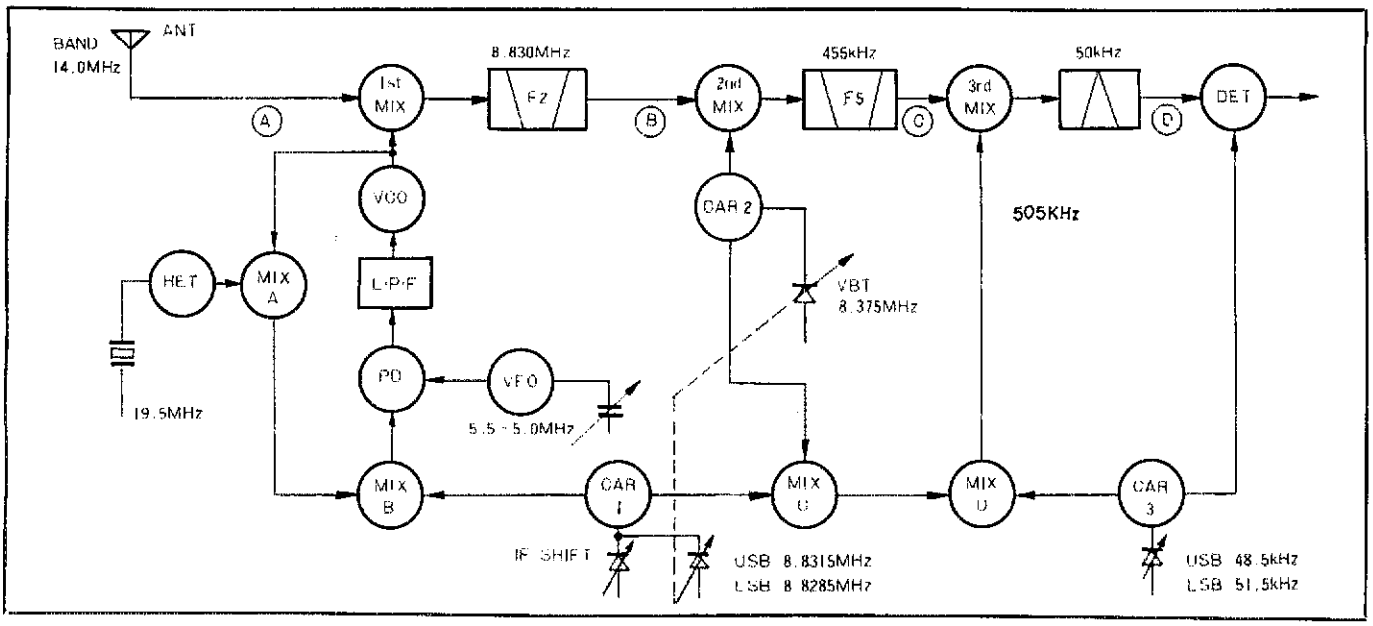


Fig. 2 — Simplified diagram of the conversion system used in the R-820, as shown in the owner's manual.

Trio-Kenwood R-820 Receiver Claimed Specifications

Frequency coverage:
1.8-23 MHz, 3.5-4.0 MHz, 7.0-7.5 MHz, 14.0-14.5 MHz, 21.0-21.5 MHz, 28.0-30.0 MHz.
Shortwave bands:
5.9-6.4 MHz, 9.4-9.9 MHz, 11.5-12.0 MHz, 15.0-15.5 MHz, 17.7-18.2 MHz.
Modes: Ssb, cw, a-m, RTTY.
Image rejection: More than 80 dB (SW bands more than 50 dB).
I-f rejection: More than 90 dB (SW bands more than 40 dB).
Selectivity: Cw (250 Hz) less than 250 Hz (−6 dB). less than 500 Hz (−60 dB) (Note 1);
cw (500 Hz) less than 500 Hz (−6 dB), less than 850 Hz (−60 dB) (Note 2);
ssb (2.4 kHz) less than 2.4 kHz (−6 dB), less than 3.9 kHz (−60 dB);
a-m (6 kHz) less than 6 kHz (−6 dB), less than 12 kHz (−60 dB).
Variable bandwidth: Cw (500 Hz) 150-500 Hz (−6 dB) (Note 3);
ssb (2.4 kHz) 600 Hz-2.4 kHz (−6 dB);
a-m (6 kHz) 4.3-6 kHz (−6 dB) (Note 4);
Note 1: optional filter YG-455CN installed;
Note 2: optional filter YG-455C installed;
Note 3: optional filters YG-88C and YG-455C installed;
Note 4: optional filter YG-88A installed.
Notch filter attenuation: Greater than 50 dB.
Frequency stability: Within 100 Hz during any 30-minute period after warm-up. Within 1 kHz during the first hour after 1-minute warm-up and within 100 Hz every 30 minutes thereafter.
Antenna impedance: 50-75 ohm unbalanced.
Af output: More than 1.5 W (8-ohm load, 10 percent distortion).
Af load impedance: 4-16 ohms for both speaker and headphone.
Power consumption: 120 V, 30 W ac; 13.8 V, 1.6 A dc.
Semiconductors: ICs: 40, FETs: 34, transistors: 89, diodes: 170.
Dimensions (HWD): 6 × 13-1/8 × 13-3/16 inches (152 × 333 × 335 mm) projections not included.
Weight: 26.4 lbs (12 kg).
Price class: $1100.

bands. On the contrary, we could count only four and that was with no antenna connected to the receiver! With the antenna connected, the spurious signals didn't move the S meter and were virtually undetectable. By the way, the S meter is calibrated in both S units and dB in terms of μV. This is particularly handy for giving out comparison reports since the dB scale of the meter is very linear and accurate.

Other features not mentioned thus far include the following: blue LED digital readout with accurate analog backup, transmit signal monitor, front-panel transceive/separate function switch, 25-kHz marker, standby switch, RIT control and RIT indicator, and connecting terminals for a tape recorder, phone patch, headphones and speaker. Also included are outputs for two i-fs (8.83 MHz for a panoramic display and 50 kHz).

Receiver performance tests, as outlined by Hayward,[1] were performed on the R-820 and yielded the following numbers: noise floor, −138 dBm; blocking dynamic range, 115 dB; and IMD dynamic range 84 dB. These tests were performed at 14 MHz. An additional set of tests completed at 3.5 MHz did not produce any significant differences. In actual use, the receiver performed every bit as good as the numbers suggest. In fact, the receiver appeared to be considerably "tighter" than the receiver in the TS-820 transceiver. This is no doubt attributable to the extra filters used in two different i-fs. Using the TS-820/R-820 combination hooked up for full-transceive operation results in a most flexible system. Operating the two units side-by-side left no doubt in this reviewer's mind which receiver he would reach for when the going gets rough. The difference is practically like night and day, as one would probably expect . . . the receiver alone sells for more than the transceiver!

For additional information on the R-820 contact Trio-Kenwood Communications Inc., 1111 West Walnut, Compton, CA 90220. — *Jay Rusgrove, W1VD*

[1]Hayward, "Defining and Measuring Receiver Dynamic Range," *QST*, July 1975.

TEN-TEC 544 HF TRANSCEIVER

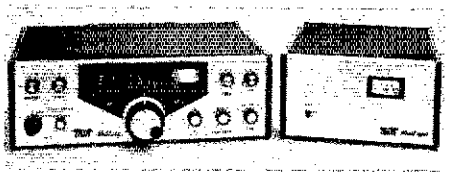
Here's a lightweight, reasonably compact, solid-state transceiver with digital display that is a model of simplicity in design and operation. Covering 80 through 10 meters (160-meter converter optional), the 544 has an output of 85 to 100 watts and features full cw break-in.

Transmitter adjustment is quick and easy because the conventional "dipping and peaking" technique is eliminated through the use of broadband networks. The one-step operation consists of increasing transmitter drive until an LED indicator begins to glow. This feature should be an important asset to the handicapped amateur. The panel meter serves a dual-purpose: It measures SWR on transmit and functions as an S-meter on receive.

Receiver incremental tuning (RIT) adds versatility to the 544. Actuation is indicated by an LED. This switch-activated circuit provides up to plus or minus 5 kHz in receiver tuning relative to the transmit frequency. This feature is beneficial when you are working several stations not exactly on the same frequency, or when a station responds to your CQ slightly off frequency.

The six easy-to-read 0.4-inch (10.16-mm) LED frequency readout digits are complemented by 1-kHz markers on the dial skirt. One revolution of the main tuning dial provides 25 kHz of frequency change.

The Ten-Tec 544 has an aluminum chassis and sub-panels. A lightweight aluminum case with cyolac (plastic) side panels encloses the rig.



The Ten-Tec model 544 shown here with power supply model 252M.

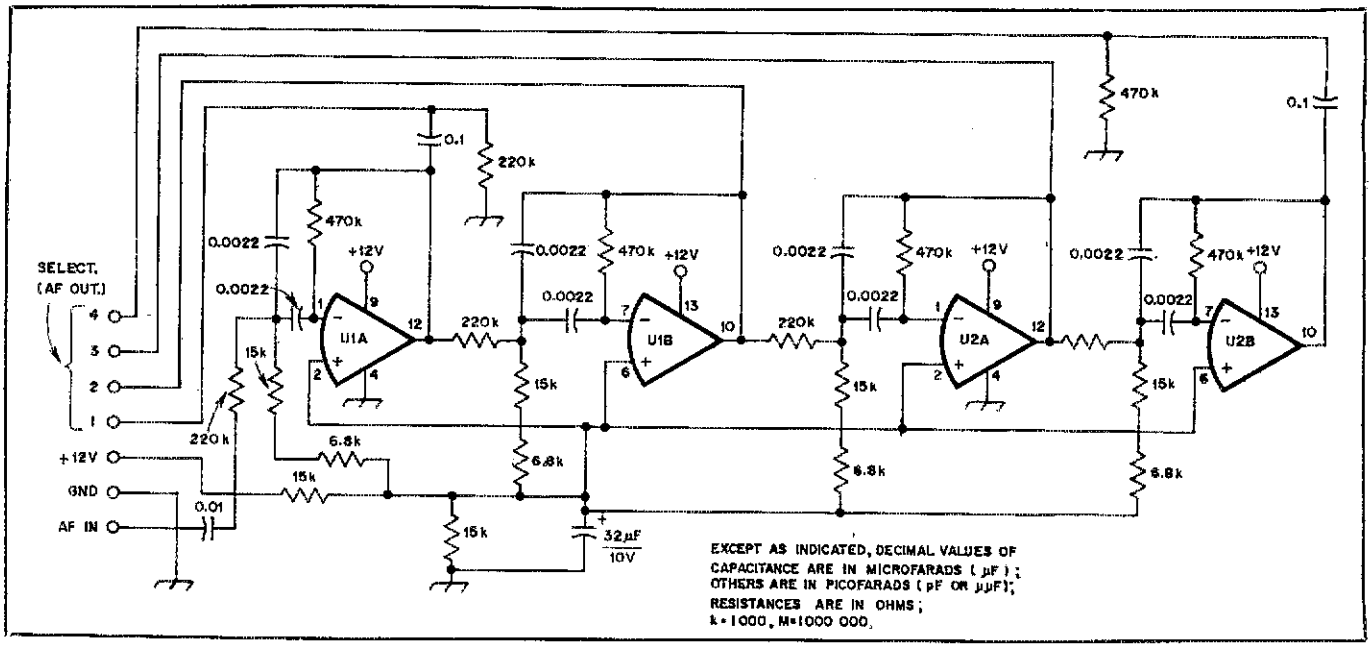
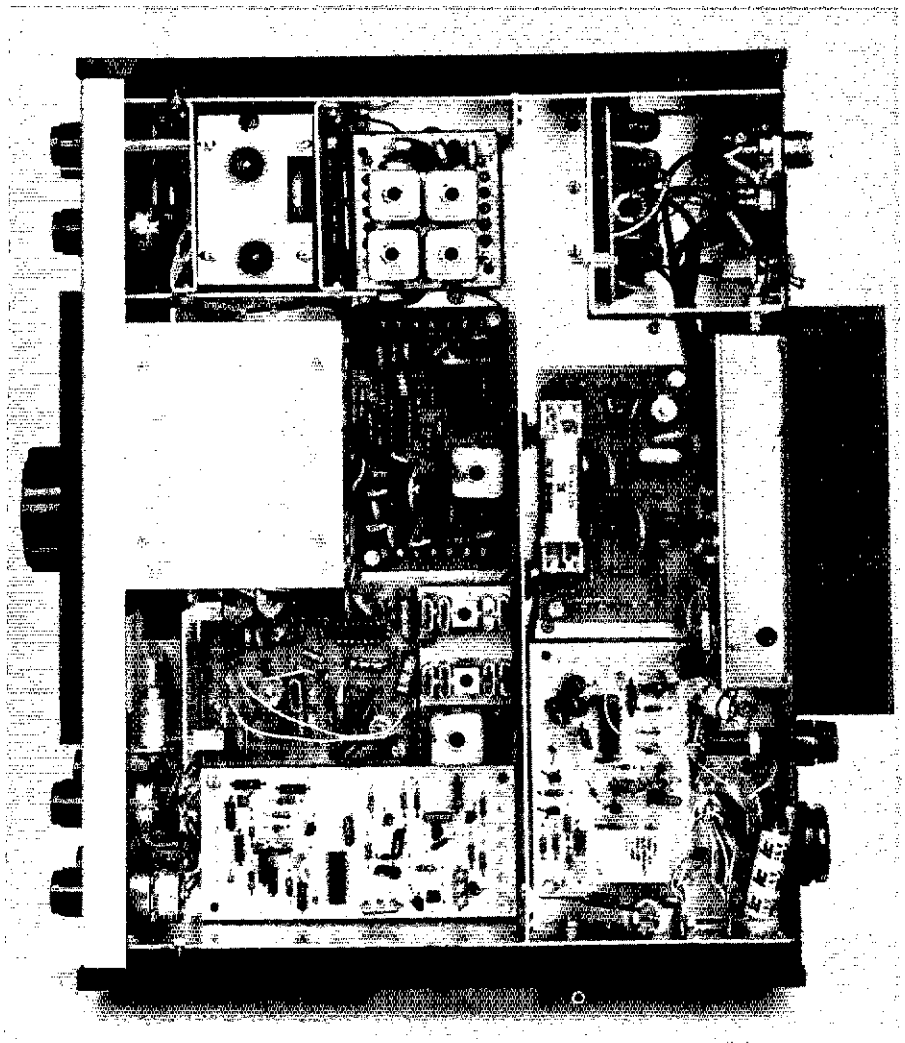


Fig. 3 — Schematic diagram of the Ten-Tec 245 RC active audio filter. All resistors are 1/4-and 1/2-watt close-tolerance composition types. All capacitors and resistors in the frequency-determining parts of the circuit are 5-percent tolerance. The 5-percent capacitors are polystyrene. The others are disk ceramic. The polarized capacitor is electrolytic. U1, U2 — 747 dual op amp.



When the top cover is removed, you can see much of the modular construction used inside the Ten-Tec 544.

Of the 18 pc boards, 10 are the plug-in variety. This should greatly facilitate any maintenance that might be necessary.

In order to prevent damage to the output transistors, the external power supply will shut down in excessive current situations, or when the SWR is higher than the recommended maximum of 3:1. This safety factor was inadvertently tested when the reviewers were tuning a home-built antenna for minimum SWR. Happily, no damage to the equipment resulted.

Transmitter spectral purity was tested in the ARRL laboratory with a spectrum analyzer. The results of the tests are displayed in the spectral photo.

Many positive comments concerning the quality of the signal were received while we were running the rig through its paces. It did not exhibit the audio "fuzziness" sometimes associated with commercial receivers. The transmitted ssb signal has "presence" and excellent quality, according to numerous reports received by W1FB while using the transceiver. A clean, well-shaped, chirp-free signal was reported during cw QSOs.

The rig was used for several days without the optional RC active audio cw filter, but QRM was often difficult to work through. The audio filter is a compact plug-in module which required only 10 minutes to install. It features a 150-Hz bandwidth centered at 750 Hz. It especially proved its worth during operation on the noisy Novice portion of 40 meters. It also reduces wide-band noise during receive. The circuit for the Ten-Tec RC active filter is presented in Fig. 3. One of the interesting features of this filter is the availability of four selectivity levels, even though the 544 provides only a "full in" or "out" choice.

The filter has four active poles, U1A, U1B, U2A and U2B, as shown. The pc board is set up with four end terminals to which a suitable switch can be connected for obtaining the various degrees of audio selectivity desired. Each of the solder terminals is connected to the

Ten-Tec 544 Specifications

Dimensions (HWD): 4.5 × 13.6 × 13 inches (114 × 346 × 330 mm).
Weight: 12 lbs (5.44 kg).
Power requirements: 12 to 14 V dc at 1 A on receive, 2 A on standby-transmit, 18.5 A maximum transmit.
Receiver audio power: 1 watt at less than 2 percent distortion.
Semiconductors: 65 transistors, 38 diodes, 14 ICs.
Price class: $875 (transceiver), $150 (power supply).
Manufacturer: Ten-Tec, Inc., Sevierville, TN 37862.

output of a different filter pole. Those who aren't fearful of degrading the resale value of the 544 may wish to add a switch to permit the use of all four selectivity levels.

Two 747 dual op amps are used as the active devices in the filter. Good stability is assured by virtue of the polystyrene capacitors used in the frequency-determining portions of the circuit. These capacitors also provide the high Q needed for proper filter performance. There is no reason why this Ten-Tec accessory cannot be used with other types of receivers, provided it is installed at some low-level point in the audio channel, and that 12 volts at a few milliamperes is available.

RC active audio filters are a worthwhile addition to any receiver, even if a narrowband i-f type of cw filter is employed. The audio filter helps to eliminate the wide-band noise which originates after the i-f filter, thereby enhancing the receiver signal-to-noise ratio.

Available as accessories are the following: ac power supplies (model 262M with VOX and 252M without VOX), dc circuit breaker for mobile operation (model 1140), noise blanker (model 249), remote VFO (model 242), crystal oscillator for six fixed frequencies (model 241), 160-meter converter (model 240), 10-meter crystals for 29.0-29.5 MHz (model 212) and 29.5-30.0 MHz (model 213), RC active audio cw filter (model 245), and ceramic microphone (model 215P).

An overall impression of the Ten-Tec 544 transceiver is good. It is functional, easy to operate, lightweight and performs well. Because of its size and weight it should make an excellent portable rig. A carrying handle is not provided, but would be a welcome addition. — *Dave DeMaw, KA1BUQ and Doug DeMaw, W1FB*

CUSHCRAFT ATV VERTICAL HF ANTENNAS

With the increasing urbanization throughout the world, limited-space antennas are receiving a great deal of attention. For ease of assembly, erection and operation, it's hard to beat a trap vertical. After a couple of months on the air with the ATV-5, this reviewer concluded that trap verticals can be very effective performers, too.

Cushcraft manufactures three hf verticals: the ATV-3 covering 20, 15 and 10 meters, the ATV-4 covering 40, 20, 15 and 10, and the ATV-5, which features at least partial coverage of 80 through 10 meters. Designed for roof, mast or ground mounting, these antennas are constructed of telescoping aluminum tubing and weather-resistant traps. The traps are prewound of heavy-gauge copper wire on fiberglass forms for maximum efficiency. The antennas operate as electrical quarter-wavelength monopoles on all bands. The traps isolate the radiating sections, and also provide distributed loading on the lower bands, resulting in a maximum antenna height of only 28 feet (8.6 m) on 80 meters. The trade-off, of course, is reduced frequency coverage on that band. About 75 kHz may be covered within the 2:1 VSWR specification. This should not be construed to mean the antenna isn't *useable* over the entire band, for it certainly is. If one has a Transmatch or a transmitter with a flexible output network, good results can be had over all of 75 and 80 meters. If this type of operation is contemplated, we recommend assembling the antenna to resonate at the low end of the band. In the phone segment, the small extra loss from standing waves on the transmission line will be at least partially offset by the reduced ground system loss with the higher radiation resistance associated with the greater length. (See Gibilisco, "What Does Your SWR Cost You?" *QST*, January 1979.) A capacitance hat provides top loading for increased bandwidth on 40 meters.

Assembly is very simple, thanks to the clear, well-illustrated instructions. One would have to be extremely slow to take more than 30 minutes putting one of these together. The instruction booklet has a table of dimensions for the various segments of each band. By interpolating, one can scale the antenna for the cw section of one band and the phone section of another. The "center" dimension is adequate for full coverage of all bands except 40 and 80 meters on the ATV-5. Cushcraft claims 240-kHz bandwidth on 40 meters with the ATV-4. Unlike some other verticals, the ATV series features slotted tubing sections with circumferential clamping. This method of joining provides the low-resistance connections necessary for high radiation efficiency, as well as allowing repeated length adjustments. Although it appears several times in the instruction booklet, the following warning bears repetition: *Never erect an antenna where there is a possibility of it contacting the utility wires.*

The performance of the ATV-5 is surprisingly good. The antenna was ground mounted on an image plane of 11 radials. One of these was 60 feet long and the others were 25 to 30 feet long. No doubt a proper ground system would have enhanced the efficiency and low-angle radiation, but parting the New England soil in the dead of winter is no small feat. Parachute-cord guys provided additional stability in high winds. Using 100 watts of output power, we received good signal reports on 20 meters from Australia, Japan and Siberia. St. Helena was worked on 40. Much to our amazement, considering the marginal ground system, even 80 meters produced DX. Several contacts were made with eastern Europe on this band. We didn't spend too much time on 15, but the antenna was reliable for contacts with Europe and the U.S. West Coast. The results on 10 meters were less impressive, with Texas representing the hottest DX worked. We attribute this to the generally poor antenna location. There are numerous automobiles and concrete and steel buildings within a few wavelengths of the radiator. On the lower bands, at least some of the radiation emanated from the higher sections. Also, the comparison is a little unfair, because ssb was used exclusively on 10 meters. Our activity on the other bands was mostly cw, which has a significant DXing advantage at the 100-watt power level. We are confident that the high-band performance would have been superior if the antenna had been roof mounted. The proximity of the utility wires precluded erecting the full 28 feet on the roof. Later on, we intend to mount the 20-, 15- and 10-meter section on the roof where it can do the most good.

Cushcraft ATV-5 Vertical Antenna Manufacturer's Claimed Specifications

Overall height — cw: 28' 4" (8.64 m), phone: 24' 9" (7.54 m).
Wind surface area: 1.49 sq ft (0.139 sq m).
Assembled weight: 8.5 lbs (3.9 kg).
Maximum mast diameter: 1-3/4" (44 mm).
Frequency coverage (MHz): 28.0-29.2, 21.0-21.5 14.0-14.4, 7.0-7.3, 3.5-4.0.
SWR bandwidth (2:1): 80 m — 75 kHz*, 40 m — 160 kHz,* 20 m — 500 kHz,* 15 m — 500 kHz,* 10 m — 1.0 MHz.*
Input impedance (nominal): 50 ohms (takes PL-259 connector).
SWR (at resonance): 1.5:1 or less.*
Power handling capacity: 2000 watts PEP.
Element material: Hard-drawn aluminum tubing.
Trap materials: 1/8-inch (32-mm) wall fiberglass tubing with enameled copper wire coils.
Price class: $110.
Manufacturer: Cushcraft Corporation, P. O. Box 4680, Manchester, NH 03108.
*Confirmed by ARRL measurements.

Vertical antennas tend to pick up more man-made noise than horizontal ones. It is unfortunate that the urban environment which dictates the use of limited-space antennas such as verticals also generates more noise. In extremely noisy areas it may be advantageous to use a miniature low-noise antenna for receiving (see DeMaw, "Beat the Noise with a Scoop Loop," *QST*, July 1977, and "Low-Noise Receiving Antennas," *QST*, December 1977) and restrict the vertical to transmitting duty.

The radiating elements of the ATV series have no rf chokes in the bases, so the user may want to install one for lightning protection. Such a choke could be wound on a large ferrite toroid core, and should have about 500 ohms of reactance at the lowest working frequency. Use the heaviest possible wire for the winding. Hose clamps can be used to attach the choke across the base insulator. No choke was used in the reviewer's installation because there are several grounded structures nearby which are taller than the antenna. In any case, the feed line should be disconnected from the station equipment when the antenna is not in use.

One final word of caution: Like all multiband antennas, trap verticals have little inherent rejection of harmonics. With modern transmitters of good design, the harmonic suppression should be sufficient, but it is wise to make tests with other competent amateurs to ensure compliance with FCC regulations.

The ATV-5 is an important part of the modest antenna farm at W1RN, where a horizontal directive array at an effective height is out of the question. Where economics are concerned, it may be a most cost-effective system at any location. — *George Woodward, W1RN*

ACCU-CIRCUITS ACCU-MEMORY II KEYER

A few years ago, the Accu-Keyer was introduced to Amateur Radio and it soon became one of the most popular keyers on the air. Later, memory capability was added and we