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73®

# Amateur Radio's Technical Journal

A Wayne Green Publication

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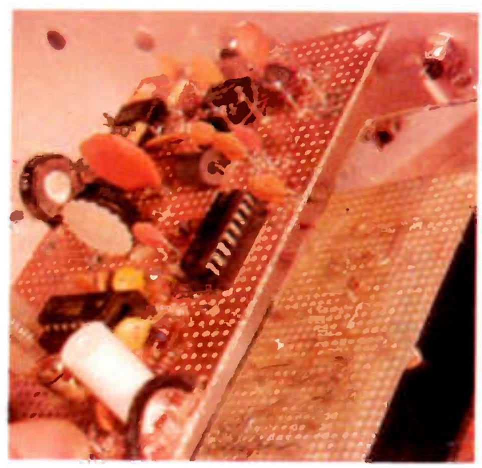

"Cheap Trick" TVRO Receiver—60



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# W2NSD/1 NEVER SAY DIE

*editorial by Wayne Green*

"Wayne, after having read your editorials for many years I feel I know you personally," said Rudolf Aumann HK1ESU the other day in Cartagena, Colombia. Rudolf, hearing that I was in town for a couple of days, came to my hotel to find me after failing to get through by phone. He found Sherry and me just finishing dinner in the garden of the Cartagena Hilton, where they had served an outdoor barbeque cookout.

I found Rudolf a delightful person with many interests, quite wrapped up in his second hobby of collecting pre-Columbian antiquities. Indeed, he has a collection which rivals those of museums. He found, as have many others, that the real Wayne Green, whoever that is, comes through in my editorials.

The Colombians are most friendly. Sherry and I, taking advantage of the Eastern Air system excursion fare, finished off a hectic business trip with a couple of days of relaxation in Cartagena. This gave us a chance to rest a bit and see a new country. It also added to my count of countries visited.

Of course, getting to Cartagena is an adventure in itself. Having arrived with no warning from either friends who had lived there or from the tourist guidebooks, I found myself knee-deep in the barracudas which inhabit many of the third-world airports. Providence was in my favor in that all of the car rental agencies were closed, it being Sunday afternoon. Sherry had tried to reserve a car for us, but fortunately she wasn't able. I'll explain.

The taxi drivers at airports ...and their pimps...start out asking about two to three times the normal fare. This is complicated by their knowing no English and me knowing little Spanish...or Swahili, or whatever the local language. Eager hands reach for your bags, fully expecting to net at least a buck or two for carrying them even the shortest distance. They assure you that all of the official money changers are closed, but they have a friend who will give you a very good rate...sixty pesos to the dollar.

After bargaining the taxi fare to the bus station down from $15 to $10 ($5 turned out to be more like the going fare), we plopped into a taxi...a 1955 Chevy, I think...and were off to Baranquilla. Unless you've been to a poor country, you have no idea of what poverty can be. We really have nothing approaching it anywhere in the United States. Everything is in disrepair...the streets, the sidewalks (where there are any), the buildings, walls...all broken and falling apart.

Colombian buses are about the only means of transportation, so they are usually packed solid with people. Air conditioning of cars and buses is rare, so the windows (if any) are open. It's hot. Remember that the equator goes through Colombia, so it's hot all year around. There are few private cars in Colombia, so the need for buses is great, with the result that they are everywhere, each fighting to pass the others along the narrow streets. Most of them are gaily painted and decorated, reminding one perhaps of the "art" in the New York subways.

The bus depot turned out to be a street corner more than normally infested with buses. We found the place to buy tickets and splurged a big $8.00 for two tickets to Cartagena. The bus was scheduled to leave at 2:30 pm, if we wanted a regular bus. If we waited until 6:30 pm we could take an air-conditioned bus! We really didn't want to stand on a street corner in Baranquilla with our hand luggage and two big suitcases for four hours, so we opted for the 2:30 trip. It wasn't bad at all.

Once out of the city, the bus rolled along the narrow road at around 60 mph, passing just about everything in sight. The countryside consisted of sparsely populated rolling hills, with few towns. We did stop occasionally to let the passengers buy food from roadside vendors...freshly cut pineapple slices, pineapple fritters, shashliks on a stick...things like that. At one point, two children got on the bus and went through a ten-minute recitation in exchange for a few coins, getting off at the next stop for a return on the next bus and another recitation.

As the bus threaded its way through the narrow streets of Baranquilla, none with any route markings that I could see, I was most thankful that the car rental agencies had been closed. Imagine trying to find my way through all *that*! Even once out of the country there were few signs at crossroads. Add to all that the seemingly fatalistic driving attitude of the truck and bus drivers and you can see why, even with the heat, I was glad to be making the trip by bus.

The temperature was in the low 90s and not uncomfortable as long as the bus kept moving. The stops immediately started sweat pouring out of every pore. The trip was a bit over two hours to Cartagena, where the bus terminal was even more primitive than the one in Baranquilla. It was not lacking taxi drivers and hordes of baggage carriers, all with dreams of Yankee gold not well concealed. I got the taxi fare down from $10 to $2.50 and we were on our way through Cartagena to the Hilton, an air-conditioned luxury respite from the heat and poverty everywhere else.

They even had an ice machine on our floor! We unpacked, relaxed, and had a nice buffet dinner at the hotel. The food was superb. I really needed the rest, not so much from the rigors of the taxi and bus rides, but from the tensions of the previous week.

We'd started out Saturday night with a trip to Chicago. Now one thing you should know about Eastern Airlines is that when you go on a trip just about anywhere on Eastern, you go through Atlanta. Just as Federal, I think it is, ships all packages to Memphis and sorts them, Eastern ships all passengers to Atlanta and sorts them out for their destinations.

Over the next few days we flew Boston-Atlanta-Chicago-Atlanta-Houston-San Antonio-Atlanta-Ft. Lauderdale-Atlanta-Miami-Baranquilla-Miami-Boston. We sure got to know the Eastern Ionosphere lounges at Atlanta.

The first stop was Chicago and the summer Consumer Electronics Show (CES). This was at McCormack Place and was huge. While there was little there in the ham field, the two days I spent there were still well invested. I do have to keep up with home computers, the latest in satellite receiving systems, and discover gadgets such as the new Brother $200 dot-matrix typewriter with a 16-character

**$$ HOME-BREW II CONTEST $$**

It is not too late to submit an entry for *73*'s Home-Brew II Contest. Until October 1, we'll be looking for articles describing the best home-brew projects for under $50. The winners will share $500 in cash prizes. For complete details, see page 6 of the June, 1982, issue of *73*.

NEW

# TS-930S

## "DX-traordinary"... superior dynamic range, auto. antenna tuner, QSK, dual NB, 2 VFO's, general coverage receiver.

**A superlative, high-performance, all solid-state HF transceiver, that covers all Amateur HF bands, and incorporates a 150 kHz to 30 MHz general coverage receiver having an excellent dynamic range.**

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- All solid-state 28 volt operated final amplifier. Lowest IM distortion. Power input 250 W on SSB/CW/FSK, 80 W on AM. SWR/ Power meter.
- Available with AT-930 automatic antenna tuner built-in, or as an option. Covers 80-10 meters, including WARC bands.
- CW full break-in. CMOS logic IC, plus reed relay. Switchable to semi break-in.
- Dual digital VFO's, 10-Hz steps, includes band information.
- Eight memory channels. Stores frequency and band data. Internal battery memory back-up, est. 1 yr. life. (Battery not Kenwood supplied.)
- Dual mode noise blanker. NB-1, with threshold control, for "pulse" noise. NB-2 for "woodpecker."
- SSB IF slope tuning, allows independent adjustment of the low and/or high frequency slopes of the IF passband.
- CW VBT and pitch control. VBT tunes out interfering signals. CW pitch control shifts IF pass-band and beat frequency. "Narrow-Wide" filter switch.
- Tuneable, peak-type audio filter for CW.
- AC power supply built-in.
- Fluorescent tube digital display, with digitalized sub-scale, in 20-kHz steps.
- RF speech processor.
- One year limited warranty.
- SSB monitor circuit.

**Optional Accessories:**

- AT-930 Auto. antenna tuner.
- SP-930 External speaker with selectable audio filters.
- YG-455C-1 (500 Hz) or YG-455CN-1 (250 Hz) plug-in CW filters for 455 kHz IF.
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**TR-9130 FEATURES:**

- 25 Watts RF output on all modes, (FM/SSB/CW).
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- Memory scan.
- Internal battery memory back-up, using 9 V Ni-Cd battery, (not KENWOOD supplied). Memories are retained approx. 24 hours, adequate for the typical move from base to mobile. External back-up terminal on the rear.
- Automatic band scan.
- Dual digital VFO's.
- Transmit frequency tuning while transmitting, for OSCAR operations.
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- Covers 143.9 to 148.9999 MHz.
- HI/LOW power switch, 25 or 5 watts on FM or CW.
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- RF gain control. • RIT circuit.

**Optional accessories:**

- KPS-7 Fixed station power supply.
- PS-20 Fixed station power supply (TR-9500 only).
- SP-120 External speaker.
- TK-1 AC adapter for memory back-up.


# TR-9500

## 70 CM SSB/CW/FM transceiver

- Covers 430-440 MHz, in steps of 100-Hz, 1-kHz, 5-kHz, 25-kHz or 1-MHz.
- CW-FM Hi—10 W, Low—1 W. SSB 10 W.
- Automatic band/memory scan. Search of selected 10-kHz segments on SSB/CW.
- 6 memory channels.

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LCD readout which permits some rough editing of the material before it is printed. The new Sony pocket TV was interesting, too. And I was pleased to see our book of programs for the Casio 702P on display in the Casio exhibit.

Atari had one hell of a press party to announce their relationship with Spielberg. Fresh oysters, escargots . . . it was a fantastic buffet. The way to my heart is definitely through my taste buds.

For some reason, both the CES and the NCC (National Computer Conference) were running concurrently, so Sherry and I had to see as much of CES as we could in two days and then get aboard Eastern for another trip to Atlanta and then to Houston.

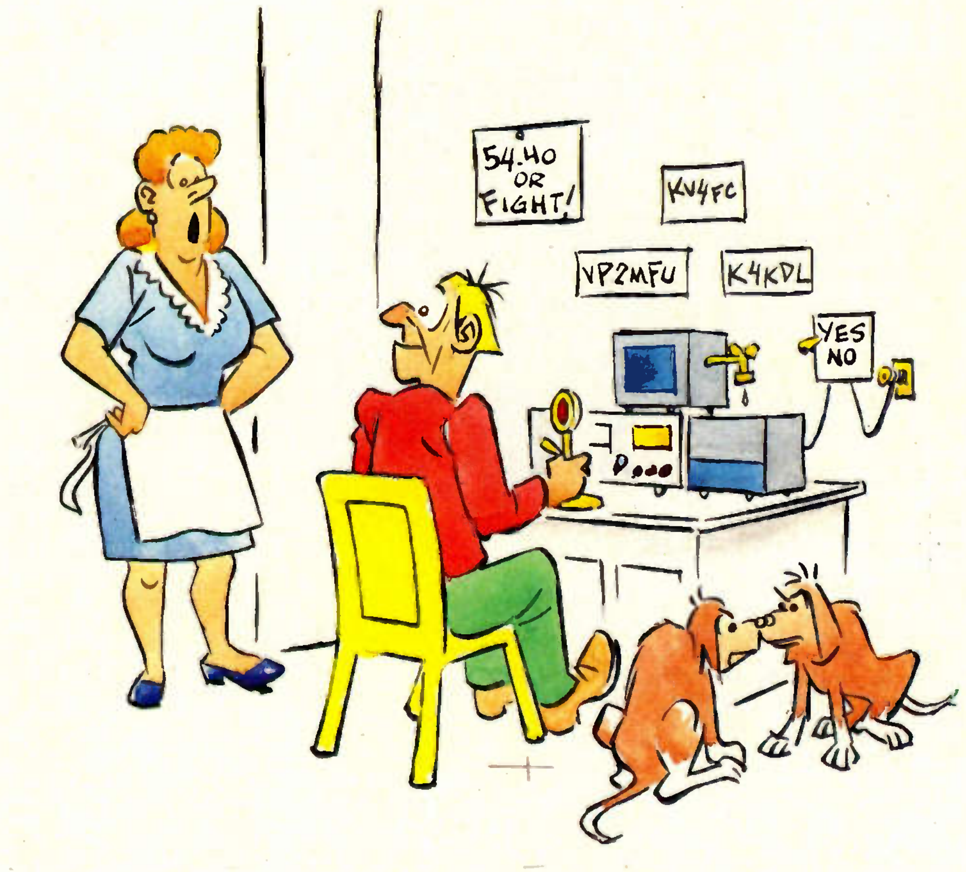
NCC, like CES, was a madhouse. The attendance was probably about the same, somewhere in the 80,000 or so range. Like CES, I could easily have spent the four days of the show seeing it, meeting old friends, and catching up on new products. I did spend a good solid two days looking over perhaps twenty or more new microcomputers, a wide variety of new hard-disk drives, and enough

*Continued on page 126*


**QSL OF THE MONTH: W7VZ**

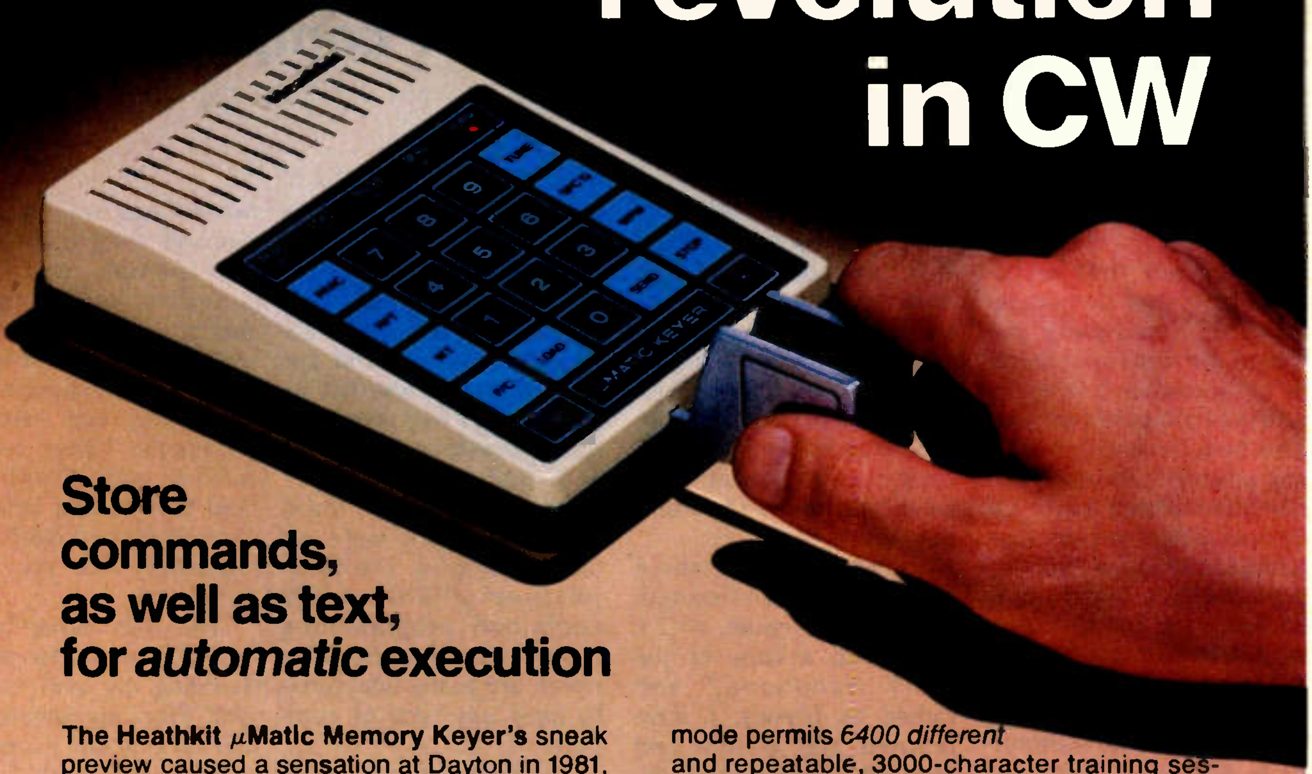
If this innovative eye-grabber makes you thirsty, it's no accident. Send *your* QSL entry, in an envelope, to QSL of the Month Contest, Editorial Offices, *73 Magazine*, Peterborough NH 03458. Be sure to include your choice of book from *73*'s Radio Bookshop.

## Well . . . I Can Dream, Can't I? by Bandel Linn K4PP




**"I know you need the extra space for ham radio, so my mother is moving out!"**

# The Memory Keyer that started a revolution in CW



## Store commands, as well as text, for *automatic* execution

**The Heathkit μMatic Memory Keyer's** sneak preview caused a sensation at Dayton in 1981, and the excitement is still running high. *Ask about it on the air.* Those who own one will tell you it revolutionized their operating practices, eased their hand fatigue, multiplied QSOs – and increased the number of incoming QSLs. In contest, you can prove it's the best every time,

**Inside, a custom microprocessor** stores up to 240 characters of text or commands. *Variable-length buffers* eliminate wasted memory space. *Command strings* let you sequence speed, weight and repetition alterations or text in any order you desire. Choose the speed (1-99), any of 11 weight settings, plus spacing and message repeat count, then sit back and collect contacts...

**Capacitive-touch Iambic paddles** unplug and store inside the keyer when not in use. Left handed? A two-key function will reverse the paddles! Or a socket will connect to your favorite keyer. To boost copy, a 4-level random 'practice' mode permits *6400 different* and repeatable, 3000-character training sessions at any speed you like.

**Other features** include a built-in sidetone oscillator and speaker with volume/tone controls, phone jack and earphone, message editing, entry error alarm, self-diagnostics, battery back-up and a unique auto-shutoff should you forget. Complete details on the revolutionary μMatic Memory Keyer are in the new Heathkit Catalog and at your nearby Heathkit Electronic Center.*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AM-422R1

*Albert D. Hearn WA4GKQ*
*98 SW 13th Avenue*
*Boca Raton FL 33432*

# Micro Modem

## —a RTTY TU designed for computers

This article describes an easy-to-build AFSK (audio frequency shift keyed) modulator and demodulator unit specifically designed for microcomputer RTTY operation. I take the liberty of using the term *modem* here in describing this unit since it is the common computer-related term for devices which perform digital-to-audio signal conversions [mo'dem (mō'dəm) η. an acronym for the term *mo*dulator-*dem*odulator. A device used for communicating digital information over analog transmission systems, such as telephone or radio]. Conventional RTTY terminology defines this as a terminal unit.

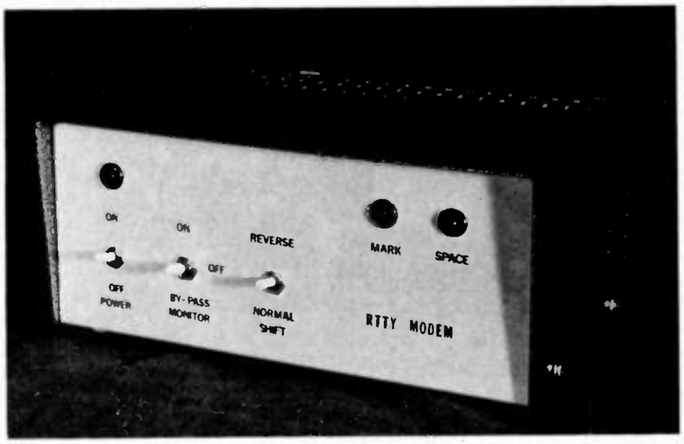
I would like to start by telling you a little about how and why I decided on the particular design I chose. I don't know about you, but I frequently find it frustrating to read a construction article and not have the author tell me how his design is different from other similar designs, in what ways it is better, and what led him to take his approach. I believe you can appreciate the result more when you know the rationale for its being.

I knew very little about RTTY mode when I started. I read back issues of *73*, picked up a copy of the *RTTY Handbook*,[1] and talked to friends. I soon learned the basics and realized that there were only two things preventing me from getting on the air—a program for my microcomputer and a modem to convert RTTY AFSK tones to digital TTL-level signals, and vice versa.

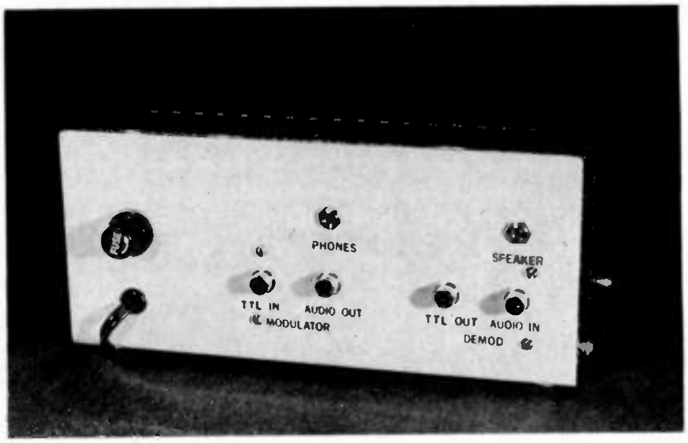
Writing the send-receive computer program to translate serial Baudot data to parallel ASCII (for the video display), translate parallel ASCII (from the keyboard) to serial Baudot, and manage the keyboard and display operation was not as difficult as I had imagined. Again, previous *73* articles and the monthly RTTY Loop column by Marc Leavey WA3AJR were extremely helpful. The June-July issues of 1978 and 1979 contained programming flowcharts and descriptions which are easily adaptable to most any type of computer.

The next step was deciding what to do about a modem, or terminal unit. There seemed to be an abundance of TU gear available from various manufacturers, but there were a couple of problems with nearly everything I saw. First, the prices were out of line with what I was willing to pay. Second, most had features (for example, loop power supplies and autostart) which were for users who were operating conventional electromechanical TTY terminals, not computer terminals. Other features such as wide (850-Hz) shift and CRT tuning indicators were likewise judged as not necessary for my initial system.

The only other avenue open to me was to consider building my own terminal unit. From my research into the various ham magazines, I found numerous TU construction articles. Some described only modulators, others only demodulators, and still others described complete units. I was looking for something that was relatively simple, inexpensive, and yet would give me good operational perfor-




*Front view of RTTY modem.*




*Rear view of RTTY modem.*

mance under typical HF RTTY conditions—and would work with my microcomputer.

Selection of an AFSK modulator was settled when I saw the article in *73* entitled "Experimenting with Tones."[2] The Exar XR2206 function generator IC can be easily connected as a very stable two-tone oscillator and can be keyed using a TTL-level input. A breadboard version of a 170-Hz shift generator confirmed my feeling that this was the circuit I was looking for. More on this later.

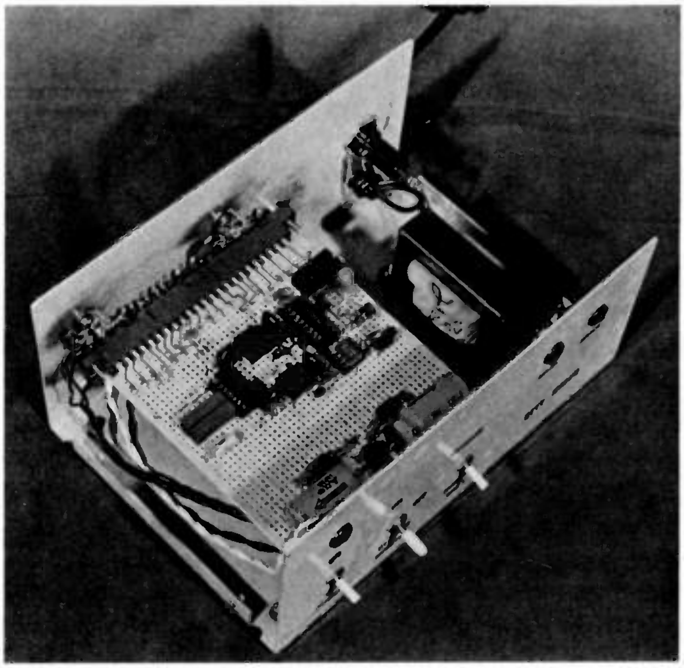
Selection of a demodulator circuit was a different and more difficult matter. The designs based on phase-locked loops (PLLs) like the 565 and the 567 appealed to me because they are inherently frequency selective, relatively immune to noise, and are specifically intended to perform FSK demodulation. Furthermore, they are simple to work with and are inexpensive.

I first breadboarded a circuit based on the 565. This worked fairly well but seemed much more sensitive to noise and QRM than I was comfortable with. Too, it required a relatively large number of components external to the IC for filtering, signal conditioning, and TTL-level conversion. After a while I realized that the same functions could be accomplished using the more comprehensive capabilities of the 567 tone detector IC and could be done with considerably fewer external components. The 567 also operates on a 5-volt supply which means that no TTL-level conversion is required on its output.

Most published designs of 567-based demodulators use the single tone detect technique in which only one 567 is set up to detect only one half of a RTTY signal—either mark (2125 Hz) or space (2295 Hz). Absence of the desired tone is interpreted to mean presence of the opposite tone. In other words, if the detector is set to look for mark, any time a mark is not being received, it is assumed that a space is being received. Obviously this assumption can be all wrong under conditions where fading and noise are causing signal outages. Also, it makes tuning difficult because CW signals look like RTTY to the detector. You must actually listen to the signal to determine the difference.

Even though I felt that some of the designs I had seen were less than ideal, I also felt that I wanted to use the PLL approach—specifically the 567. Basically, it seemed that a demodulator based on two PLLs, one for mark and another for space, would be the most significant improvement. I would discover later (after having breadboarded a version of this type of circuit) that there were other improvements which could be made.

One of the things I learned about the 567 is that its detection bandwidth is extremely dependent upon the level of its input signal. Most designs I have seen do not attempt to manage the bandwidth, but rather attempt to simply keep input level below the



*Interior view. 22-pin PC board plugs into socket mounted on rear panel.*

maximum at which the device will still function. Below that maximum, varying input levels cause bandwidth also to vary over a wide range. A consistently small bandwidth would be preferable in order to reduce the effects of QRM. This meant that I would want some type of limiter in my design which would maintain a minimum input to the 567.

Another characteristic of the 567 that caused me concern was the fact that the output will "chatter," or bounce, briefly when turning on. This is somewhat dependent upon certain combinations of input level, component values, and how far off center frequency it is operating. This apparently causes no problems when this type of circuit is used to drive conventional electromechanical TTY gear because of the relatively long response time of its components. It can be a problem, however, when used to drive a computer terminal or other digital logic devices. This problem also would have to be solved in my demodulator design.

Let's take a look now at an overview of the circuit I finally decided upon.

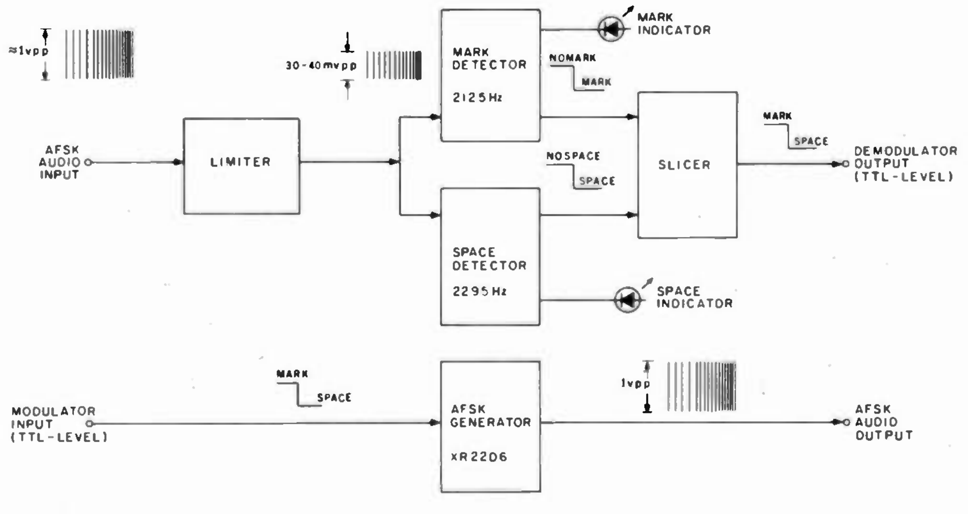



*Fig. 1. Block diagram of RTTY modem. Top is demodulator; bottom is modulator.*

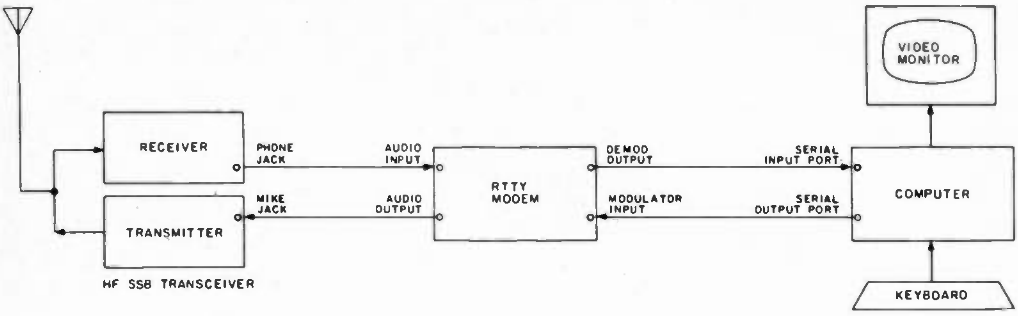



*Fig. 2. RTTY modem and computer in an amateur station.*

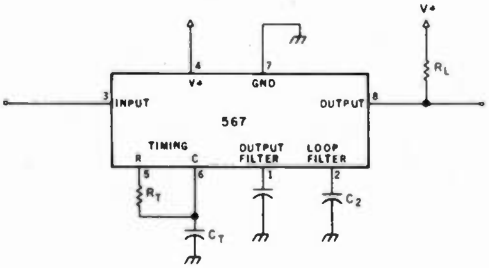



*Fig. 3. Basic 567 tone-detection circuit.*

## Overview

Fig. 1 shows a block diagram of the complete RTTY modem, both the modulator and demodulator.

The modulator generates either mark tones of 2125 Hz or space tones of 2295 Hz, depending upon the value of the keying voltage on its input. The keying input represents serialized Baudot data from an output port on the microcomputer. Each Baudot character is made up of mark and space bits, where a mark is high and a space is low. The output is nearly a pure sine wave, amplitudes of the mark and space tones are equal, and there are no switching transients.

The demodulator portion of the modem consists of a limiter, dual PLL detectors, and a slicer. The limiter controls input level and ensures consistent detector operation. Two independent tone detectors are set to react to the presence of input frequencies on, or very close to, 2125 Hz and 2295 Hz. The passbands are narrow enough to prevent erroneous locking onto nearby QRM and also narrow enough that the two passbands do not overlap. LED indicators attached to each section serve as tuning aids. Alternating flashes indicate a legitimate 170-Hz-shift RTTY signal.

Output from the individual detectors is fed into a slicer. Here the two inputs are combined back into a single output going to the input port on the microcomputer. Again, mark is high, space is low.

Fig. 2 shows how the modem fits into an amateur station.

## 567 Tone Decoder IC

In order to understand how the RTTY modem works, it is necessary to know a little something more about the 567. Basically, it is a phase-locked-loop tone detector which provides an open-collector output on pin 8 (see Fig. 3). When an input signal is present on pin 3 which falls within its capture passband, the output shorts to ground. Thus, if the output is "pulled up" to 5 volts through an appropriate resistor, $R_L$ (current must be limited to 100 mA or less), TTL-level transitions between 0 and 5 volts can be achieved. External components attached to other pins set center frequency, bandwidth, and output delay.

For the purpose of detecting RTTY signals, we want a center frequency of either 2125 Hz or 2295 Hz. In Fig. 3, $R_T$ and $C_T$ determine center frequency by the approximation: $f_o = 1/(R_T C_T)$.

Now, for RTTY, we want a minimum passband, for two reasons—to eliminate QRM and to prevent detection of both mark and space tones at the same time. Remember, they are only 170 Hz apart. $C_2$ and input voltage level $V_i$ determine bandwidth. The formula used to approximate bandwidth in terms of percent of $f_o$ is: BW (% of $f_o$) = $1070\sqrt{V_i/f_oC_2}$, where $C_2$ is in $\mu$F and $V_i$ is in volts rms.

A word of caution: The formula becomes less usable at lower values of $V_i$ (near 20 mV) combined with values of $C_2$ below about .5 $\mu$F and $f_o$ values in the 2000-3000 Hz range. Actual bandwidth realized is less than predicted by the formula.

The last characteristic of the 567 with which we must be concerned is output delay. All PLLs exhibit some delay to lock onto an input signal and confirm its presence on its output. This is expressed in terms of number of cycles (of input frequency). For 60-wpm RTTY, each bit (a Baudot character is a start bit, five data bits, and a stop bit) is 22 ms wide, except the stop bit which is 31 ms. We therefore want output delay to be something considerably less than 22 ms—which is 46 cycles for a mark bit (.022 sec. × 2125 Hz) and 50 cycles for a space bit (.022 sec. × 2295 Hz).

Unfortunately, output delay is controlled by $C_2$, and in a way that is opposite to the way it affects bandwidth. In other words, for large values of $C_2$, bandwidth is small and output delay is large. We would rather have both small. I said earlier, however, that at low input levels and low values of $C_2$, bandwidth is significantly smaller than predicted by formula—and small output delays are obtained at the same time! This is clearly a case of having your cake and eating it, too.

The circuit described in this article has a measured output delay of about 15 cycles, or about 7 ms. This means that the mark detector, for instance, takes 7 ms to lock onto a 2125-Hz input, resulting in an output which is only 15 ms wide, not 22 ms. If my circuit were of the type that uses only one PLL, the output would be severely distorted. Marks would be too short and spaces would be too long. Using dual detectors with an appropriate slicer eliminates this problem.

## Demodulator Circuit Description

Refer to Fig. 4. A jack is provided to attach a speaker for monitoring input audio from your receiver. A switch allows monitoring at attenuated volume, bypassing the attenuator for tuning purposes, or not monitoring at all.

The limiter is a high-gain amplifier using a 741 op amp (U1) which has parallel reversed diodes in its feedback path. The effect of the diodes is to limit output to about .6 volts—the forward-bias drop across a silicon diode. Gain of the amplifier is very high for low-level input, before the diodes begin fully conduct-

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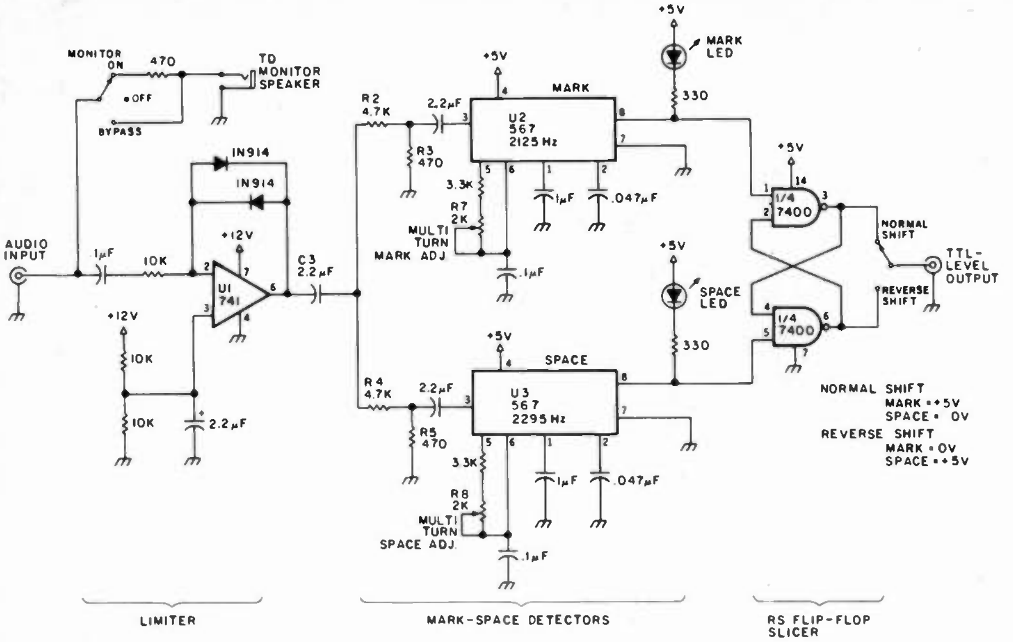


*Fig. 4. Demodulator circuit. Audio input is from phone output of receiver. Output goes to computer input port. LEDs indicate RTTY signal.*

ing. As input increases, gain decreases logarithmically due to the small-signal conduction characteristics of the diodes. If you look at the limiter output on a scope, you will not see a flat-top square wave, but instead a waveform with more rounded tops. Coupling capacitor $C_3$ is required to block the dc bias (+ 6 V) on the output of U1.

Limiter output is further reduced by voltage dividers R2-R3 and R4-R5 to approximately 30 mV rms which is used as input to PLLs U2 and U3. This sufficiently low-level input ensures a bandwidth of only about 100 Hz, or ± 50 Hz either side of center frequency. Trimpots R7 and R8 set center frequency.

Output on pin 8 of U2 and U3 falls low when the expected frequency is detected, which turns on the associated LED. I mentioned before that this output contains a 7-ms delay and also has approximately 1 ms of chatter.

These outputs are fed into a slicer which is simply an R-S flip-flop constructed of two NAND gates. Actually, the slicer in this circuit is intended to do more than simply recombine its two inputs into a single output. First, it serves as a debouncing circuit to eliminate the chatter I just mentioned. Secondly, it nullifies the output delays of the PLLs. To illustrate how this works, refer to Fig. 5. Individual output delays of each of the two detectors are shown as being exactly equal when, in reality, they may differ a little. Anyway, the slicer output is almost entirely free of distortion and is delayed in time by 7 ms.

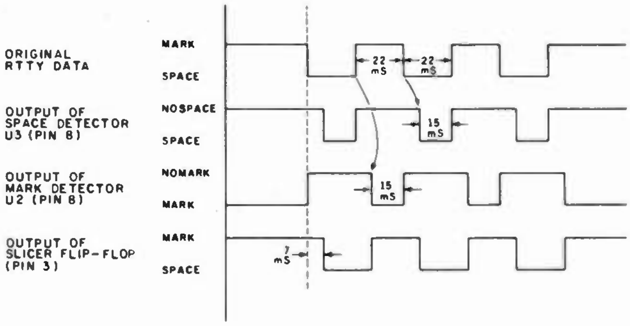


*Fig. 5. Slicer reconstructs original data from separate detector outputs. Notice that distortion is corrected and that the ouput signal has been delayed by 7 ms from original.*

The final advantage of the flip-flop slicer is that it only changes states if both mark and space tones are present. If noise or momentary loss of signal occurs during a single bit, its output state is maintained until the opposite tone is detected. This certainly doesn't solve all types of signal problems, but it helps.

A switch is provided on the output to select normal or reversed shift operation. Most amateurs use normal shift (mark = low tone, space = high tone) and lower sideband on HF RTTY.

### Modulator Circuit

Fig. 6 shows the AFSK modulator portion of the RTTY modem. It is based on the XR2206 function generator IC. Although this device has many uses, it is especially designed for two-tone AFSK generation. Read the excellent article by W2FPP for additional information.[2]

Mark and space frequencies are independently set by timing resistor trimpots R9 and R10 respectively. The timing capacitor between pins 5 and 6 is common. Output on pin 2 is a sine wave and is phase-continuous when switching, which makes it well suited for SSB FSK modulation. Component values should be high quality for best results.

The keying signal is applied to pin 9 and is a TTL-level signal directly from the microcomputer output port. + 5 volts selects the mark generator and 0 volts selects space.

Resistor R11 (10k) controls output level. This results in approximately 1 volt pp to the microphone input of the transmitter. Other levels may be obtained by changing this resistor.

The earphone jack was installed so that the output can be monitored for testing purposes.

### Power Supply

The power supply is rather straightforward (Fig. 7). The center-tapped transformer serves both the + 5- and + 12-volt supplies. Low current requirements allow the LM340 regulators to be mounted directly to the PC board without heat sinks.

### Construction

I built the RTTY modem on a Radio Shack 4½"× 4" universal PC board with a dual 22-pin edge connector and mounted everything into a 3½"× 8"× 6" metal box (see photos) also available from Radio Shack. Fig. 8 shows the component layout and pin allocation that I used. Layout is not critical, which allows a lot of flexibility in how you might build your own version. I intentionally left an area open on the board to give me room to later build a bandpass filter to help reduce QRM problems.

When I decide to build it, I'll just insert it in the circuit ahead of the limiter on the demodulator. The frequency-adjust trimpots for both the modulator and the demodulator are mounted on the board such that they are easily accessible when the board is plugged into the cabinet.

When working with TTL devices, it is normally good practice to add decoupling capacitors between the + 5-V supply pins and ground. Although not shown in the circuit diagram, disc capacitors 0.1 to .01 μF with short leads should be attached to the 7400 (pin 14) and to each of the 567s (pin 4).

Most parts, including the trimmer pots and the XR2206 IC, are available from Jameco Electronics, San Carlos CA 94070.

**Alignment**

Use a frequency counter to align the AFSK modulator. Attach the counter to the output jack, ground the input jack (or pin 9 of the XR2206) to select the space timing circuit, and then adjust trimmer R10 to get 2295-Hz output. Now remove ground on the input jack (or pin 9) which selects the mark timing circuit, and then set trimmer R9 to get 2125-Hz output. This completes modulator alignment.

Now align the demodulator. First, the mark detector. Apply a 1-V pp 2125-Hz sine wave to the demodulator input jack. I use the frequency marker signal from my transceiver, adjusted to frequency using the frequency counter, and adjusted to level using a scope. Adjust mark trimmer R7 until the mark tone LED indicator comes on. Now find the position which is midway between the two positions where the LED goes off. The center frequency should now be at or very near 2125 Hz. Alignment of the space detector is done in the same manner for a frequency of 2295 Hz.

At this time, you should verify that the bandwidth of each detector is no more than 150 Hz, or ± 75 Hz on either side of center frequency. With your receiver feeding into the input, slowly tune across a heterodyne or marker tone. One of the LEDs should light briefly and then the other. There should be a "dead spot" in between where neither LED is lit. There should not be any time when both LEDs are on for the same tone. If you have problems with these verification tests, check alignment of each detector and check to make sure that the input on pin 3 of each 567 is no more than 30-40 mV pp.

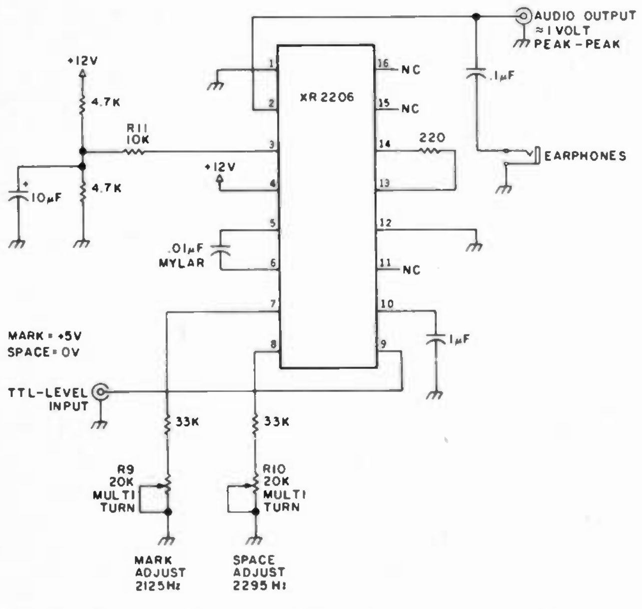


*Fig. 6. AFSK modulator circuit. Input comes from computer. AFSK output signal goes to microphone input of SSB transmitter. Earphone jack is for monitoring output.*

**Operation**

Using the modem on the air is pretty simple. When transmitting, the AFSK modulator is driving your transmitter at 100% duty cycle. So make sure that you set your microphone gain for reduced rf power output to protect your finals.

In receive mode, tune your receiver around the RTTY portions of your favorite band and then look for the distinctive blinking of the mark and space LED indicators when a valid RTTY signal is found. Make sure that your receiver's audio output level is sufficiently high to produce good, solid LED flashes. Also, you will usually want the Shift switch in the Normal position.

**Summary**

The RTTY modem was designed to provide inexpensive yet reliable operation for the amateur who wants to quickly get on AFSK RTTY. Because I wanted to use it with a microcomputer terminal, I attempted to eliminate some of the problems of other designs which were associated with conventional TTY terminal operation. The design is simplified by the use of a single IC modulator and a demodulator based on dual PLL tone decoders. Dual decoders have advantages over designs which use only a single decoder: They are easy to tune, immune to certain types of signal fading, noise, and distortion, and will not react to CW signals.

Although built to interface directly to my computer input/output ports, other types of interfaces, such as RS232C, current loop, or UART, could certainly be used if the appropriate circuitry is added. This makes no difference to

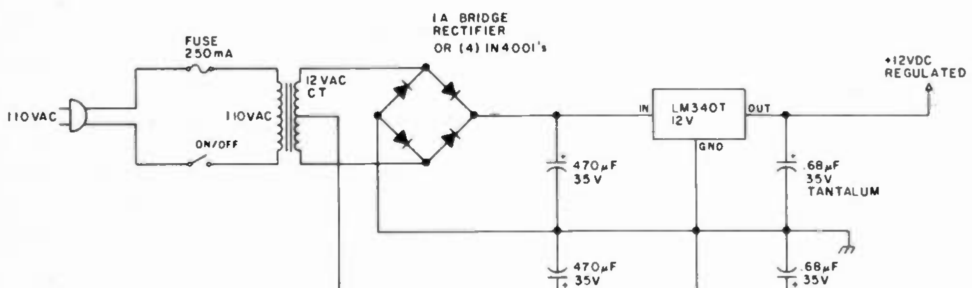


*Fig. 7. Power supply. Provides regulated + 5 V and + 12 V.*



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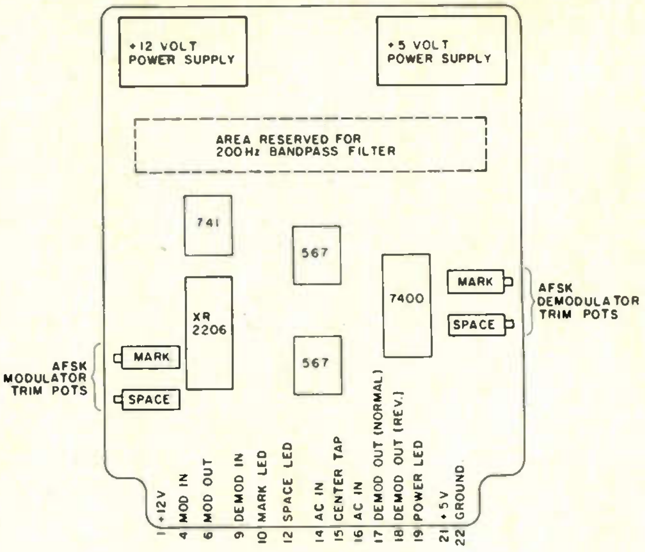


*Fig. 8. Parts layout and pin configuration (top view).*

the basic operation of the modem.

I wish to thank Bill Harrington WB4PEO for his assistance during the testing phases of this project. ■

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1. *The New RTTY Handbook*, a *73* publication, 1978.
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3. John Loughmiller WB9ATW, "Digiratt—RTTY AFSK Generator and Demodulator," *Ham Radio*, September, 1977, page 26.
4. *Linear Data Book*, National Semiconductor Corp., 1976.
5. *73 Magazine*, special RTTY issue, September, 1977.

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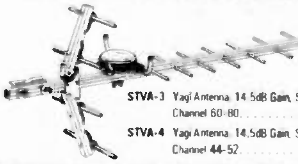

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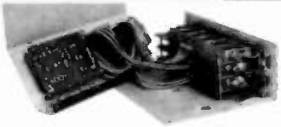

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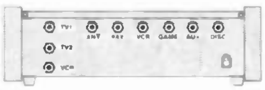

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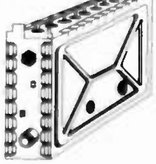

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Faced with this dilemma, I decided to grab the bull by the horns and see what could be done. There are two methods of obtaining FSK from a sideband transmitter: 1) the AFSK method and 2) the FSK method.

The AFSK method consists of feeding audio tones into the microphone jack while running the transmitter in the USB or LSB mode. If carrier and unwanted sideband suppression is sufficient, the resulting signal is identical to a true FSK signal when detected on the air. The drawbacks to this method, however, are many. Many transmitters do not have sufficient carrier suppression and it is easy to over-drive the transmitter and cause splattering just as is heard so often on the SSB bands. Another problem is that when using 850-cycle shift, the standard tone of 2975 Hz falls very close to the edge of the audio passband of the transmitter and is therefore attenuated, resulting in uneven power between mark and space tones on the air. Some rigs will not pass this tone at all.

Irv Hoff W6FFC has written several articles explain-

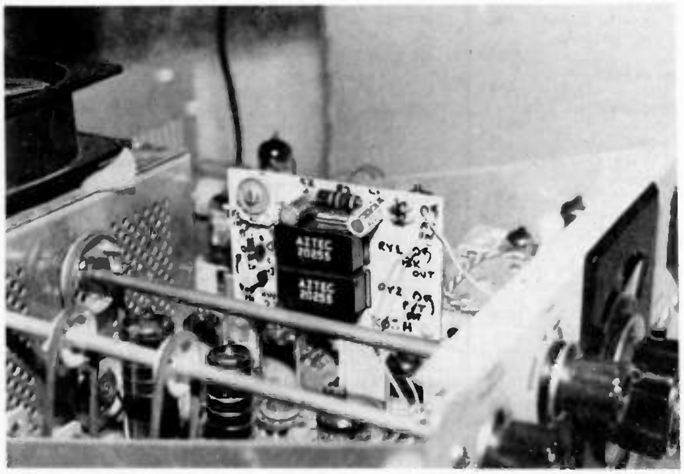

*Photo A. The circuit board is mounted on the left side of the LMO. The shift-adjust cap can be seen on the upper left corner of the board.*

*Photo B. Rear view of FSK board showing wires from computer.*

ing the pros and cons of using AFSK input to SSB transmitters and transceivers to obtain FSK on HF.[1,2] The instruction manual which comes with the HAL AK-1 AFSK generator has an excellent discussion and summary of the important points. At least one of these sources should be reviewed before attempting to obtain FSK in this manner. Remember, if the FCC detects any unwanted sideband or carrier on your signal, a pink ticket will follow.

The true FSK method is simpler and safer if it can be obtained. Unfortunately, many transmitters have vfo's that are very difficult to modify. Then, too, there is always the possibility of destroying the built-in stability if one tampers with a vfo without sufficient knowledge of the principles involved.

A close examination of the HW-101 schematic shows that in the CW mode, the balanced mixer is unbalanced and a crystal-generated carrier is allowed to pass through. It was a simple matter to connect a trimmer capacitor across this crystal and observe that the desired shift in the carrier frequency occurred.

The circuit of Figs. 1(a) and (b) was developed and has been used at KØJH to work 62 countries and 44 states in two months, running the HW-101 barefoot with only 75 Watts output into a mini-quad antenna on a thirty-foot mast.

The circuit assumes that you are running a computer with TTL output levels. If you have RS-232 output signals, simply add the circuit of Fig. 2 to convert the RS-232 to TTL signal levels. If you are running a normal 120-V-dc 60-mA teletype loop, you can use the circuit of Fig. 3 to obtain a TTL output which will drive the FSK input to the transmitter, but you will have to devise another method of turning the transmitter off and on. Doing it manually would be the easiest method. If any of the TTL signals are inverted, just add a hex inverter such as the 7404.

After trying several solid-state methods with less than complete success, relays were used to do the keying of the transmitter and the switching on and off the air. Perhaps someone else can modify the circuit to accomplish the same thing with a diode or transistor switch and eliminate the relays.

Power to run the relays was borrowed from the filament line which is easily accessible at the pilot lamp socket attached to the LMO. A simple rectifier and filter are used to get approximately 12 V dc. See Fig. 1(c). Relays are miniature magnetic-reed types and are available from two sources that I know of: ETCO 066RL[4] ($.99) and EDLIE DG1407[5] ($.79). Other relays of a similar fast-acting type will work just as well.

The entire circuit is laid out on a printed circuit board in about fifteen minutes using a resist pen. It is not reproduced here because the exact pattern will depend upon the actual components used. Nothing is critical so no special talent is required. There is no reason why wire-wrap or any other method of construction could not be used. The circuit board is mounted to the left side of the LMO, using existing metal screws (see Photos A and B).

The external lines are brought into the HW-101 through a molex® connector (Radio Shack 274-229/239) which fits nicely into the hole provided on the rear panel of the transceiver with a minimum of filing (see Photo C).

The connection to the CW crystal, Y3, is best made at pin 17 of the mode-switch rear wafer. The proper pin can be identified by the black wire which runs from it to a hole labeled "22" on the modulator circuit board right beside crystal Y3.

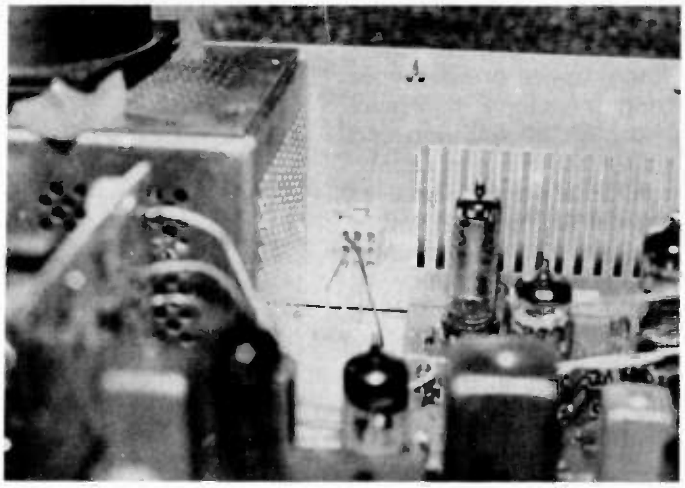

*Photo C. The molex® connector (Radio Shack 274-239) is installed on the rear panel.*

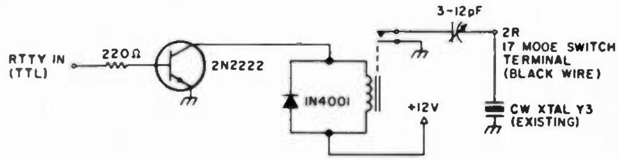


*Fig. 1(a).*

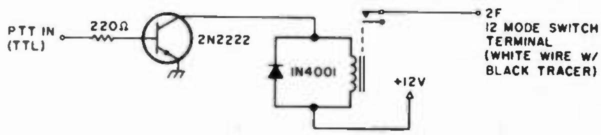


*Fig. 1(b).*

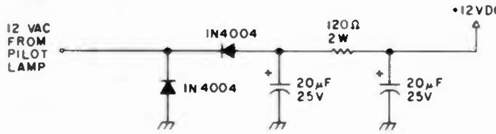


*Fig. 1(c).*

The connection to the PTT circuit is a little more complicated. The logical place to connect would be on the mode switch at pin 20 or to tube V12, pin 8. The mode-switch pin 20 is not easily accessible, however, and pin 8 of V12 is on the opposite side of the modulator circuit board from the place chosen to mount the FSK board. The point decided upon was the white wire with black tracer which connects to mode-switch pin 20 and then is routed from underneath the mode switch to the rear of that switch. A small piece of the insulation of this wire was carefully scraped away and the PTT connection was made to the wire.

To adjust the FSK circuit for 170-cycle shift, simply put the transmitter in the CW mode and, while connected to a dummy load, key the transmitter through the PTT circuit. Either tune your receiver until the proper mark frequency is obtained as determined by your RTTY terminal unit or, using a frequency counter, adjust the receiver until an audio output frequency of

2125 Hz is obtained. Now set the equipment to send a steady space or open your loop if using a high-level (120-V-dc, 60-mA) loop, and adjust the trimmer capacitor for a proper space as seen at the terminal unit or until the frequency counter indicates a frequency of 2295 Hz. (2295 − 2125 = 170-Hz shift.)

Provisions in this circuit are for 170-Hz shift only since nearly 100 percent of ham and MARS activity is now using that shift. If you need 850-Hz shift for some reason, simply add another trimmer capacitor in parallel with the existing one, arrange to switch it in for 850-Hz shift, and adjust it until 850-Hz shift is obtained (2975 Hz).

Now tune the HW-101 up in the CW mode as you usually would, but decrease the output power to around 60 Watts by backing off on the mic/CW level control. If you have the 400-Hz filter installed, be sure the filter control is in the SSB position. If you have not done so, you will soon see the need for VE3IOI's sidetone volume control modification.[3] Without some method of controlling the sidetone, you will be subjected to a piercing tone during the entire time the HW-101 is transmitting RTTY.

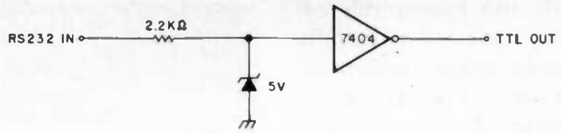


*Fig. 2.*

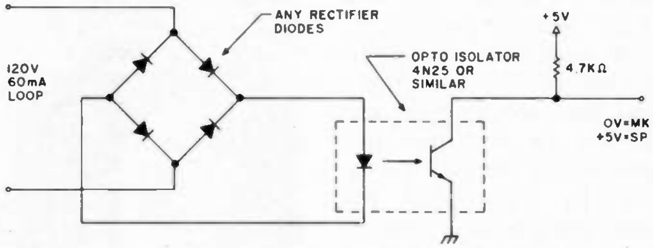


*Fig. 3. High-level RTTY loop to TTL.*

If you have never been on RTTY before, you are in for a treat. There isn't another mode which affords the quality QSOs that RTTY does. Everybody wants to chew the rag, even the DX stations in most cases. The average QSO lasts for an hour. You will also be amazed at the really good signals you will hear from stations who are running anywhere from 10 to 100 Watts. Probably 60 to 70 percent of all RTTY signals are being originated from transmitters putting out less than 100 Watts. One chap in Italy called me for a signal report and when I gave him an honest 589, he explained it was his first RTTY QSO using his new TS-130V which puts out 15 Watts. The HW-101 is a high-power rig by comparison. Try it—it's a ball. ■

### Notes

1. "AFSK for RTTY," Irv Hoff W8KDC, *QST*, June, 1965, page 32.
2. "AFSK for RTTY," Irv Hoff W6KKC, *QST*, February, 1969, page 11.
3. "Sidetone Volume Control for the HW-101," Hints and Kinks, *QST*, June, 1981, page 36.
4. ETCO Electronics Corp., North Country Shopping Center, Rte. 9N, Plattsburgh NY 12901 ($10 minimum order).
5. EDLIE Electronics, 2700 Hempstead Turnpike, Levittown NY 11756 ($22.50 minimum order).

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# No-Frills RTTY

## —$200 and you're on the air

*Luck Hurder WA4STO*
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Yup. Here's another article on radioteletype, folks. But before you turn the page with one hand (while stifling a yawn with the other), consider the following. I've got somewhat less than $200 invested in my RTTY gear and I'm not only going to show *you* how to do likewise, but I'll even give you a few pointers on how to hook all these weird gizmos together. The result? Loads of fun with no muss, no fuss.

What you *won't* find in this article is a lot of complicated math or any incredibly-expensive equipment. Don't look for any computer programs and don't expect a long list of formulas or incomprehensible graphs. Just pay attention to the pictures, chum, and enjoy the thrill of RTTY as much as a growing number of us are doing now. Got yourself positioned in your favorite chair? Super. Here goes.

First off, I'll make a couple of basic assumptions that should apply to you and your station. Assumption number one is that you presently have a transmitter/receiver (or a transceiver) lurking about somewhere and some sort of wire, aluminum tubing, or whatever that you can press into service as an antenna. Nothing fancy, mind you. If it had to be fancy, I wouldn't be writing about it! Anyone with the misfortune of having visited my shack will jump at the opportunity to verify that my antennas are among the worst possible. So whether your goal is HF or VHF RTTY, do what you can. One of my favorite sayings is that *any* antenna will work—but some do so better than others . . .

The second assumption is that you have a desire to become active in RTTY. Perhaps you have friends who consistently time out the local repeater with details about their latest zillion-dollar efforts at computerized transmission of the Miss April centerfold. Or maybe your programmable scanner locked itself up solid on 147.1 MHz the other night with those weird deedle-deedle-deedles that you'd just love to snoop in on. OK, OK—just hang in there for a few more para-

**Photos by Forest McCarty**

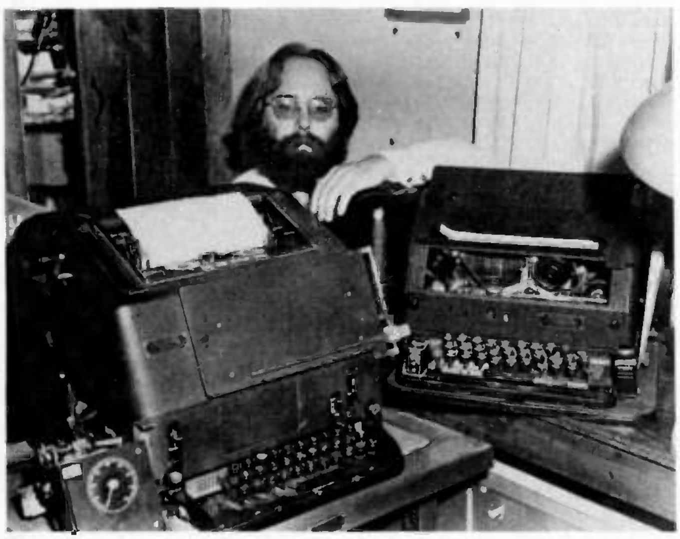

*Photo A. On the left is the Model 19 printer, with the Model 14 tape reperforator to the right. The sour look on my face is representative of how you will feel after lifting your first printer! But remember, the price is right.*

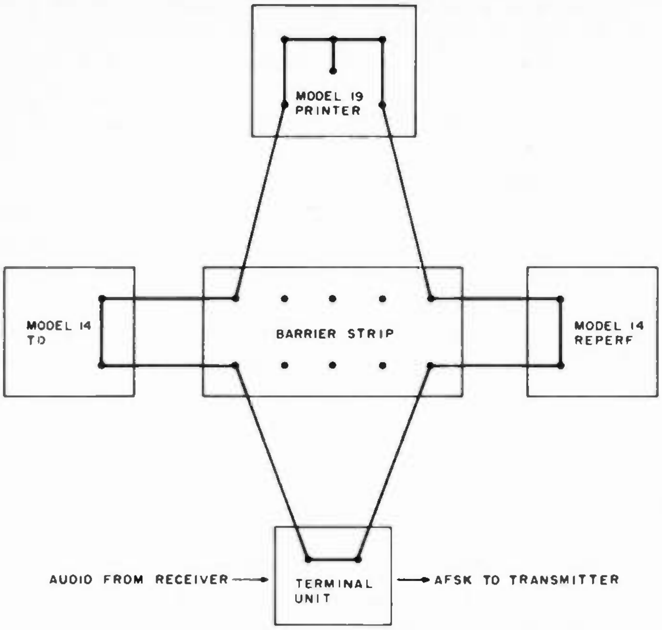


*Fig. 1. The "local loop" is nothing more than a dc loop of 60 mA connecting all of the RTTY station equipment. The use of a large barrier strip allows for additional pieces of equipment to be inserted into the loop with ease.*

*Photo B. The Model 19 printer with cover removed. Note the terminal strips with all the wires going every which way. Don't be intimidated! Only two sets of connections are really necessary, one for the ac and one for the dc loop. See Fig. 1 for loop details. Also note use of ¼-inch phone plugs for easy changes in equipment location.*

graphs and you'll be able to further your studies into human anatomy and/or the fine points of RTTY espionage!

The above assumptions are probably valid for the huge majority of you who have gotten this far into the article. And, let's face it, the theory hasn't become too deep yet, and you've not spent a dime.

Photo A shows yours truly and my mechanical marvels. They're marvelous for two reasons. First, they're older than I am, while probably working as well as the day they were built. And second, they were free! This particular Model 19 and all the associated tape gear was obtained gratis through the Army MARS program. Not that I'm suggesting that you join one of your state MARS teams just to get free equipment, but it certainly is one of the benefits that one hates to pass up, and you'll learn a lot if you participate in MARS.

I'd also like to point out that in the past year, five complete teleprinters have passed through my hands at no charge. Two were from the MARS program and three were from fellows who were glad to get them out of their shacks! Their loss was my gain, and there's absolutely no reason why you can't do the same. Spread the word on the repeaters, request help from your friends, write letters. Do anything reasonable, but keep at it. There's more free equipment out there than you'd dream possible. I've had to drive from where I live in the mountains of the Shenandoah Valley all the way into the suburbs of Washington DC more than once—a distance of about 100 miles each way. There are only a couple of reasons I'd drive there these days, and one is free RTTY gear!

Assuming that you've rounded up one or two of these fine old machines, now's the time to hook up your terminal unit.

"What's a terminal unit?" you ask in dismay! Well, without going into detail, the terminal unit (or TU) is that neat little gizmo that converts those deedle-deedles into something that your RTTY machine can use. There's a great profusion of TU equipment advertised these days, but if you'll take a glance at the accompanying photos you'll see the one I've been using. It's the TU-170, made by Flesher Corp., and their advertising is abundant in *73* as well as other magazines. In kit form the TU-170 was $150, and let me tell you, pal, if *I* can build it, *you* sure as heck can. Honest.

This particular TU has many features, including a gadget that will allow you to transmit RTTY as well as just print it. Also, it has an autostart feature which will allow you to receive RTTY

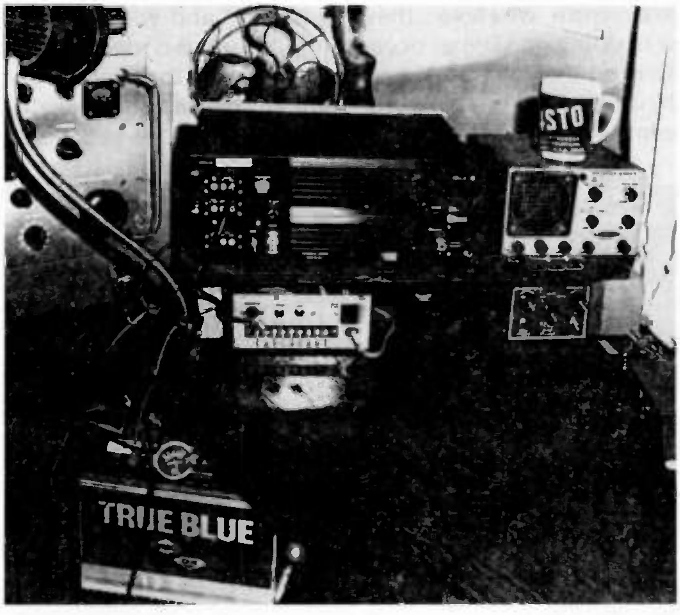


*Photo C. The only interconnection between the transceiver and the terminal unit required for receiving RTTY is from the "patch out" jack to the "receiver audio" lugs on the TU. The printer is normally plugged into the ac receptacle on the TU for autostart operation.*

messages while you're at work. But the nicest thing I'd like to pass along to you is that the people at Flesher are just as interested in getting your TU to work as you are. I've had to pull them away from whatever they were doing on several occasions on the telephone and they were *always* extremely helpful. I wrote and told 'em so, too. You wouldn't believe the foolish questions I've had to ask them, but they never flinched. Thanks, folks!

OK, now you've got your RTTY machine and you've got a TU and you're standing around wondering how in Sam Hill to begin hooking all this gadgetry together. Relax! Better yet, don't relax. Jump right up and run over to your collection of back issues of *73*. The September, 1977, issue is crammed full of much-needed information on the care and feeding of these old clunkers. What's that you say? Those nerds who've been running their mouths on the repeater refuse to give back your copy of the September issue? Never fear. Wayne Green sells back issues, and if he's all out, see if you can get an SASE into my mailbox and I'll try to answer your questions.

*Photo D. Transmitting RTTY is simplicity itself. Just plug the AFSK output from the TU into the mike jack of the transceiver, and enjoy!*

At any rate, take a peek at the accompanying closeup of the Model 19 printer (Photo B). This particular machine really had me buffaloed for an embarrassing number of weeks. I'd found several articles and books that told me how to hook up a normal printer (which has three terminal strips), but not a word about this particular beast. One of my MARS friends finally said, "Hey dummy! All they've done is combine the three normal strips into two," which explained why all my gyrations in the shack failed to produce the third strip from within the innards of this antique. You might be lucky enough to have the red and black plugs already there, just-a-waitin' to be hooked *in series* with your TU loop supply (see Fig. 1). If not, you may have to dig around a bit. If nobody has seriously butchered the internal wiring, you'll find the correct connnections with no problems. If you really get stuck, let me know.

One brief word of warning here. Keep your mitts away from the actual loop supply. I'm talking about something like 130 volts at 60 mA. That just might be enough to kill you! I've managed to ignore this advice thrice so far, and *it hurts!*

Now apply audio from your rig to your TU, and you should be able to tune in RTTY signals. Photo C shows how I managed my connections. It took about thirty seconds to figure this part out. The thrill of tuning past a RTTY signal and hearing the printer start chugging away was just super. I couldn't believe that this ancient equipment could possibly work so well! Given a bit of lubrication and a dab of TLC, I expect that these machines will live longer than I will, particularly if I ignore the previous paragraph another time or so!

Photo D shows how I managed to start transmitting. It was very difficult—I merely plugged in the AFSK output from my TU to the mike jack on my transceiver, adjusted the drive, and started typing!

I do, however, feel a touch of moral obligation to the RTTY neophyte. If you're using tubes in the finals of your rig, for Pete's sake, turn down the mike gain or otherwise reduce the power! I've ruined more 6146 finals than I'd care to comment on, and I've gone now to idiot-proof transistors. The rig that I presently use is capable of running all day at full power. Yours might not be so blessed. Find out, if you don't already know. End of sermon.

I've shown you my method for getting on RTTY. This is one of the simplest and cheapest ways I could come up with to obtain the features that I deemed important. I've got loads of ideas brewing in my head that I'm hoping to write about soon, so feel free to write and tell me what you liked or didn't like about this article. All SASEs will be answered.

I would like to express my sincere appreciation to Forest McCarty for his photographical expertise, as well as to Durwood WA4ZBP and all my many Virginia Army MARS friends for answering my never-ending questions. ■

*Phil Anderson W0XI*
*3005 West 19th*
*Lawrence KS 66044*

# Incredibly Simple RTTY

## —receive it on your TRS-80

If you have a transceiver and a TRS-80™, then you have nearly all the equipment necessary to receive radioteletype (RTTY). The only additions required are a 26-statement BASIC program, two TTL integrated-circuit chips, and a demodulator. The program and interface design are presented here, and a demodulator is recommended.

### RTTY System

As shown in Fig. 1, a RTTY system might consist of a radio receiver, a demodulator, a computer (in that case, the TRS-80), and a monitor or other form of readout. Most RTTY is sent as audio frequency shift keying (AFSK) via SSB radiotelephony. Hence, when a signal is tuned in on your receiver, it will be heard as two alternating audio tones. Those tones are called the mark and the space—the lower tone being the mark.

The job of the demodulator is to convert those audio tones into a computer-compatible on-off signal. Historically, demodulators have developed a 20-milliamp current signal for direct use with a teletype terminal such as an ASR-33. However, for interconnection to a computer, the demodulator, or demod, must present a logic signal that is compatible with standard logic chips. So, when the AFSK signal is received, the demod converts the lower tone to a logic one and the upper tone to a logic zero or zero volts.

The computer's job, then, is to convert the logic signal from the demod to a corresponding letter code for presentation on a monitor. The majority of the work is done with a BASIC program while the interface provides connection to the demodulator output.

### Demodulation

Let's take a look at the demod operation first. Suppose the letter Y is being received. A low audio tone will be received first followed by the start bit, a higher frequency tone. The demod will convert the low tone into a logic high signal, or mark, and the start bit into a logic low signal, or space, at zero volts. The actual code for the letter Y, as shown in Fig. 2, is then received as a sequence of marks and spaces: mark-space-mark-space-mark or high-low-high-low-high. The sequence is ended by a stop bit—a mark. All marks and spaces are 22 ms in duration except the stop which is 31 ms.

For testing of the TRS-80

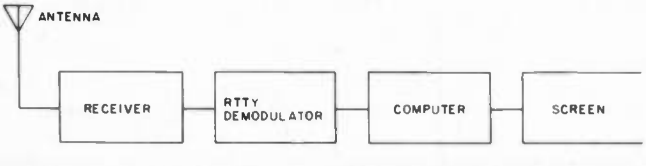


*Fig. 1. RTTY reception system.*

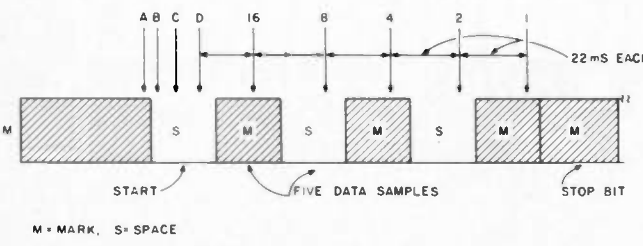


*Fig. 2. RTTY signal from demodulator.*

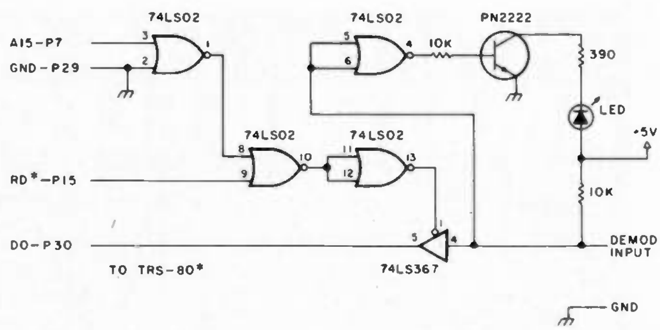


*Fig. 3. TRS-80/RTTY interface.*

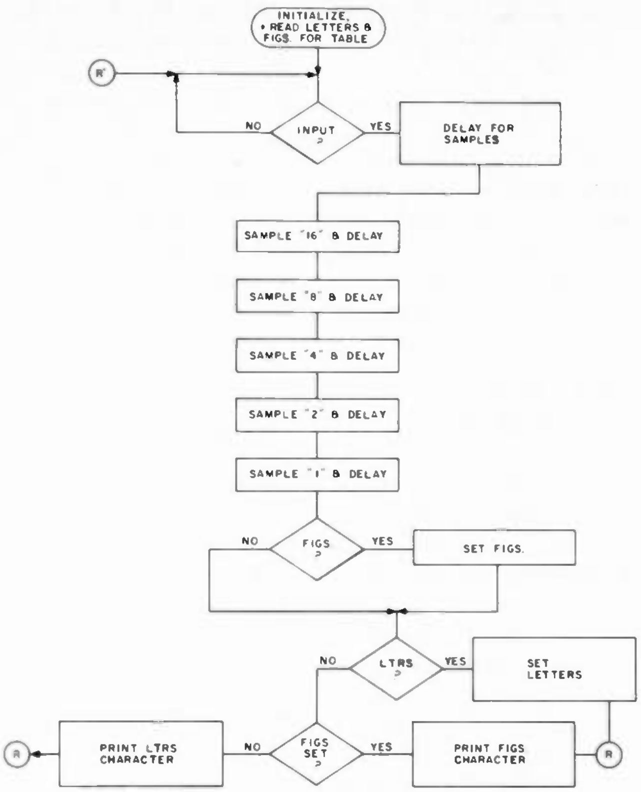


*Fig. 4. Flowchart for the RTTY program for the TRS-80.*

```
1Ø CLS:DIMA $(32):A$(Ø)=" ":REM TELETYPE RECEIVER PROGRAM
15 DIMB$(32):B$(Ø)=" ":M=Ø
2Ø REM FOR KANTRONICS' SIGNAL ENFORCER,11-2-8Ø, WØXI.
45 DATA K,Q,U,#,J,W,A,X,F,Y,S,B,D,Z,E,V,C,P,I,G,R,L
46 DATA *,M,N,H," ",O,*,T,*:B=Ø
47 FOR I=1TO31:READ A$(I):NEXT I
5Ø DATA (,1,7, ,',2,-,/,!,6, ,?,$,',3,-,*,Ø,8,&,4,)
51 DATA *,.,-,#," ",9,*,5,*
55 FOR I=1TO31:READ B$(I):NEXT I
1ØØ IF PEEK (-1)=254 THEN 11Ø ELSE 1ØØ
11Ø I=Ø:J=Ø:K=Ø
115 FOR L=1TO4:NEXT L
12Ø IF PEEK (-1)=254 I=I+16 ELSE I=I+Ø
125 J=J+Ø:K=K+Ø
13Ø IF PEEK (-1)=254 I=I+8 ELSE I=I+Ø
135 J=J+Ø:K=K+Ø
14Ø IF PEEK (-1)=254 I=I+4 ELSE I=I+Ø
145 J=J+Ø:K=K+Ø
15Ø IF PEEK (-1)=254 I=I+2 ELSE I=I+Ø
155 J=J+Ø:K=K+Ø
16Ø IF PEEK (-1)=254 I=I+1 ELSE I=I+Ø
17Ø IF I=4 M=1
172 IF I=Ø THEN 2ØØ
18Ø IF M=Ø PRINT A$(I); ELSE PRINT B$(I);
19Ø GOTO1ØØ
2ØØ M=Ø:GOTO1ØØ
```

*Fig. 5. 26-step RTTY program listing.*

RTTY system, the Kantronics Signal Enforcer™ audio filter was used. That dual filter has a TTL-compatible demod output. When a signal is tuned in, the Signal Enforcer demod output presents a logic high signal for a mark and a logic low signal for a space.

Now let's examine how the demod output can be interfaced to the TRS-80 hardware.

**Computer Interface**

Since the RTTY signal is only one voltage, either high or low as time goes by, only one signal line into the computer is necessary. However, in order for the TRS-80 to receive it, the signal must be gated onto the memory bus under the control of a "read" signal. In addition, the memory bus must be isolated from outside circuits, so a noninverting TTL logic chip is required.

As shown in Fig. 3, these requirements can be satisfied using two chips, a 74LS02 NOR gate and a 74LS367 gated buffer. The demod output status is transmitted to the memory bus via the buffer when pin 1 is set to a logic low. That is accomplished by executing the BASIC statement A=PEEK(−1). The minus factor sets the highest-order address bit of the address bus on, and the PEEK statement causes the "read" pulse to be issued simultaneously. The address bit is inverted by a NOR gate and then combined with the "read" pulse to provide the activating signal at pin 1 of the buffer.

The resulting data, then read off the memory bus, is inverted and assigned to the variable A. For example, if the demod output is high, the value for A will be 255, but if it is low, it will be set to 254.

A few more comments on the logic interface are in order. The line names at the left of Fig. 3 represent the pin connections to the TRS-80 I/O port. A15-P7 means address line 15 at pin 7; D0-P30 means data line 0 at pin 30; RD*-P15 means read pulse negative at pin 15; the ground connection is at pin 29. The user must supply his own 5-V-dc power source for the interface logic because the TRS-80 connector usually has that pin disconnected. In addition, if desired, the remaining NOR of the 74LS02 can be used to buffer the demod input and drive on the LED.

That completes the interfacing. Let's now take a look at the 26-statement BASIC program to decode and display RTTY signals.

**BASIC RTTY Program**

Again, take a look at Fig. 2. The standard RTTY 60 format includes a start bit of 22-ms duration, five 22-ms data slots, and a 31-ms stop bit. When no characters are being received, the demod output will be high continuously. When a letter or figure is received, it will commence with a start space. This is our key; we will have the program watch the demod output until a space is received. Then, proper delays can be built into the program so that samples are taken at approximately the center of each data slot.

For example, if a space is detected at B in Fig. 2, then the program will delay 22 ms and sample at 16, delay again for 22 ms and sample at 8, and so on, taking five samples in all.

Now let's take a look at the flowchart for the program as shown in Fig. 4. First, constants are initialized and letters and figures are read in via the data statements to form the RTTY character codes. Then, the program enters a continuous loop. If a space is received, proper delays are generated and samples are taken. If not, the program waits, continually sampling for an input. Once a sample is taken, the program must check to see if the figures or the letters code has been transmitted. Those codes are used to set lower- or uppercase letters or figures, for those characters to follow.

Now let's take a look at the program listing.

### 26-Statement BASIC Program

As shown in Fig. 5, the program is short—26 steps. It is probably possible to shorten it somewhat by combining some statements.

Statements 10 through 55 initialize constants and set the string variables with index numbers in two tables. Those indexed variables represent the letters and figures that can be printed by a Teletype™ machine. Statement 100 is used to continually sample for a start bit. Once one is detected, statements 110 through 160 sample a five-bit code. Statements 170 through 200 determine letters or figures states. For a TRS-80 Level II with 16K, statement pairs 120, 125 or 130, 135 will cause a delay of about 22 ms. Some adjustment may be necessary from machine to machine.

To summarize, let's suppose the letter Y is to be received. The program is started and waits at statement 100 for a space or start bit. Suppose one is received as at B in Fig. 2. The program then delays about 8 ms at statement 115 and then samples at 16, 8, 4, 2, and 1. With the code Y, a space is received at 8 and 2. That totals 10 and is used as the index to A$(10) so that Y may be printed on the screen.

73 and we hope you enjoy listening to RTTY. ■

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# The RTTY/Tribander Marriage

## —enjoy the 100% duty cycle

It seems that almost all electronic gear today is rated in terms of a duty cycle, which simply means how long or how hard it can work without resting and cooling off. In the days of AM when all transmitters and rf amplifiers were expected to operate under full power for long periods of time, we didn't give much thought to a duty cycle. True, perhaps some of the cheaper gear should have had such ratings because, as we all know, heat is the archenemy of electronic components, and much of the more lightly built stuff had frequent component failures.

Today, however, duty cycle is a big thing. Our gear is tiny indeed when compared to yesteryear's. Miniaturization is the thing. Solid-state technology has pygmytized those old boat anchors into neat little packages hardly larger than yesterday's external vfos. It has given us features few dreamed of twenty or thirty years ago when the names Johnson, B & W, Hallicrafters, and Collins, among others, were the respected leaders in manufacturing amateur radio equipment.

In many cases, these little runts even give us far more power output than their ancient counterparts. But there is one marked difference: They can't do it continuously.

And this duty cycle thing isn't limited to exciters and amplifiers. Many antennas also have duty-cycle ratings, although I can't recall any manufacturer saying so in black and white. Instead, they use terms like "...rated for full legal amateur power limit" or "...rated at 2-kW (or 4-kW) PEP."

Well, this sounds impressive, but when a body strips it down to its basics, it really doesn't say anything worthwhile. In the first place, PEP refers to SSB *input* power, not *output*. Some loosely apply the term PEP when talking about CW, which is neither here nor there. The power we should be concerned with—as long as we don't exceed the legal input limits—is that which runs up the feedline and makes a noise on the air. And believe me, this is always a whole lot less than what we're stuffing *into* the final!

Of course, manufacturers' power ratings usually apply to trapped antennas. But let's take the old familiar yagi tribander. I think almost anyone reading this will agree that these are by far the most popular HF antennas in the world and, with a very few exceptions, all have traps of varying design. They usually aren't as efficient on any one band as a monobander, but they serve well and allow flexibility with minimum expense and hassle, and we've been getting along with them for a long, long time.

And their physical designs have changed over the years. These new ones have sleek, compact trap assemblies with the coils enclosed in aluminum tubing, away from the elements and offering much less wind resistance than those old external coils we used to see. One of the main reasons they can do this is because AM on the ham bands is a thing to be discussed with nostalgia. Hardly anyone ever throws a kilowatt of plate-modulated power on the air any more, so the traps don't have to be so massive.

SSB and CW are intermittent, right? Therefore, the traps aren't called upon to perform under sustained high rf voltages, so now they can be made of aluminum wire-wrapped on injection-molded plastic coil forms and sealed inside aluminum housings. Neat. Very neat and efficient.

It has been said by wise men that about the only thing in this old world which remains constant is change. It's called progress, and thank goodness for it. But progress is not achieved totally without difficulties, as we shall see.

Amateur radioteletype and amateur television have been around for quite some time, but not until the last couple of years have they enjoyed much widespread popularity. Now, with the rapid advancements in solid-state technology bringing microprocessors and home computers within reach of the modestly-heeled amateur, one has only to tune across the bands and listen to the *deedle-deedle* of RTTY or the musical whirring of an SSTV rig to realize just how many hams have turned to these "new" and fascinating modes of communication. And interest is growing daily, judging by the number of manufacturers who advertise sophisticated RTTY and SSTV equipment in the pages of radio amateur magazines.

However, there begins to emerge a new problem. RTTY and SSTV have little in common with SSB or CW. Rather, they are first cousins to FM. To transmit in either mode demands that a steady carrier be placed on the air, and therein lies a problem which is causing growing concern among the manufacturers of multiband trapped antennas. Therein also lies the reason for this article. I hope that in sharing my own experience with fellow amateurs, I might help in some way to minimize, or even in some instances eliminate, upcoming problems. On the other hand, it is not my intention to single out any one manufacturer and add insult to injury by naming a product because, from what I have been told by manufacturers and amateurs alike, more than one manufacturer is hunting a solution.

In my own case, in March of 1979 I bought and installed a three-element triband beam made by one of the oldest and most respected manufacturers in the business, and it performed better than expected. Much of my operating time is spent on 20-meter RTTY, however, and a great deal of that is spent in running pictures. This is a blast, as any pix enthusiast will tell you. It is astounding to see the skill and ingenuity that has gone into the making of some of these and a thrill to watch one taking shape on the printer.

There are a few pictures around that take ten minutes or less to send, but there also are hundreds which take up to half an hour or even longer, all requiring a steady, unwavering carrier being fed into the antenna.

It is in this kind of service that the real weakness shows up in our new equipment. Few of today's transceivers are capable of much rf output under steady key-down operation because they are designed for intermittent use. The plate dissipation of the final tubes (or transistors), as well as the limitations of power supplies, must be taken into consideration and not exceeded. I run a Kenwood TS-820S, and the owner's manual plainly states that it is unwise to exceed 100-Watts input to the final in RTTY or SSTV modes; so I don't. But on 20 meters this produces an output of less than 25 Watts. And while this power level will get you by under good band conditions, it becomes pretty puny while trying to run a picture on 20 during crowded weekends. So the next thing, naturally, is to run an amplifier.

But even here there are limitations. First, many amplifiers, such as Heath's SB-220, should be allowed to cool after 10 minutes operation at 1 kW. They tell you so. But then, how many exciters are there around that will drive it to a full gallon? Not many, for they take lots of drive—on the order of 50 to 100 Watts, which means *output* from the exciter. So, in the case of the SB-220, you get about ten times the power out that goes in, or, typically, 250 Watts out with 20 or so Watts drive, which doesn't strain anything very much and is adequate for most RTTY or SSTV work.

Then another problem rears its ugly head. The summer of 1980 was a particularly warm one, and one day my swr rose far above the usual 1.2:1 at around 14.090. This was after I had again become the owner of a 1957-vintage Johnson Viking Kilowatt, the one that is contained in a beautiful gray steel desk. I had owned this very same rig between 1959 and 1965 before selling it to KØJTZ. He trucked it all over the country for 15 years, then moved back here and resold it to me. Since this jewel requires so very little drive, it is the ideal amplifier for RTTY and SSTV. Ten Watts will drive it to 2-kW PEP, so one can see how little strain there is on the TS-820S.

Well, I had been using this Johnson for about a week when my swr began to climb. True, there had been times when, in order to get a RTTY picture through heavy QRM on 20, I had run the power up near a kW, which put about 600 Watts into the beam. This was the beam's undoing, for one glance at it showed the 3-foot section outboard of the trap on the driven element was sagging about two inches. This was on just one end. Obviously, something had melted inside the trap.

Fortunately, it is no big hassle to climb the tower and remove the driven element, letting it down with a rope. And when I got it down and the trap disassembled, I found the plastic coil form melted like butter.

This beam has two coils inside the trap assembly. The inboard coil is the ten-meter trap while the outboard is for fifteen meters. Together, they form the 20-meter trap. It was the fifteen-meter trap that had melted, and inspection of the other trap showed it had split slightly and shrunk 3/16" in length, indicating imminent failure.

A letter and an order to the factory for new fifteen-meter traps brought a telephone call from the manufacturer. He was very nice and understandably very concerned. He said this certainly was not the first trap failure in his product, that it had been going on for well over a year and was due to RTTY and SSTV operation. He added that other manufacturers also were plagued with the same problem and all were trying to find a solution.

"These antennas have a duty cycle," he said. "They were never meant to take a steady carrier for long periods of time. The heat generated in the trap coils has no place to go, so the plastic melts. Power level is not the problem. It's a matter of duty cycle. No matter if you run high or low power, if you keep running RTTY with that beam, the traps eventually will fail. High power, of course, will do it quicker."

"I didn't see any mention of 'duty cycle' in your ads," I said.

"When the antenna was designed," he answered, "we had SSB and CW in mind, and the traps will handle the legal limit in those modes for years. But we didn't anticipate the sudden popularity of RTTY and SSTV."

He went on to say that they had hand-made some coil forms from Teflon™ which gave no signs of failing, but said their molds used for plastic would not accept Teflon, and retooling would be too expensive and run the production costs too high.

"How about drilling ventilation holes in the trap housings?" I asked.

"It would help," he admitted. "But we already have two small drain holes in the bottoms, and insects even find their way inside these. Then, when the rf starts, they can't get out. They become fried, and the resulting carbon buildup eventually shorts out the turns on the coils."

Stumped, that's what I was. Here I had a fairly expensive tribander sitting atop a 50-foot tower, and I wasn't about to give up my RTTY. There had to be a way, I told myself. There just *had* to be!

Having been in aviation more than 40 years, I was aware of the value of air-cooling, so I decided to ventilate the traps. Leaving a 3-inch strip on top of the aluminum housings untouched, I drew lines ¾" apart lengthwise on the rest of the surfaces. Then I marked them every ¾". Alternate lines were stagger-marked so the holes would likewise be staggered diagonally and would not structurally weaken the housings. After that, I center-punched each mark and, in three succeeding steps, drilled holes, the last drill being ½" in diameter. When I finished, the aluminum housings closely resembled the barrel housings on those World War I German Spandau machine guns. Each contained 94 holes, which would allow a considerable airflow around the coils.

Following this, using ordinary aluminum screen-door wire, I wrapped each completely, securing it in place with four stainless-steel hose clamps. The idea here was to defeat all but the tiniest of insects, as well as snow and ice, while still allowing warm air from the traps to escape. The screen impairs the flow-through of air, but everything nowadays is a compromise, isn't it? And with no holes on top to allow snow or rain to enter, I felt the coils were reasonably safe from the elements.

At any rate, for the past nine months or so I have been running from 200 to 600 Watts into that beam on RTTY, and during some pretty warm weather, I might add. So yesterday, out of curiosity, I took the element down and inspected the traps. I could find no evidence of cracking or melting, which seems to indicate that the ventilation system is working. This may not be the ultimate answer, but it certainly has to be an improvement for those RTTY and SSTV operators who are using a trapped triband beam. They already have their investment in both beam and equipment and, according to a popular manufacturer, are headed for eventual trap failure. So why not take this simple preventive measure? ■

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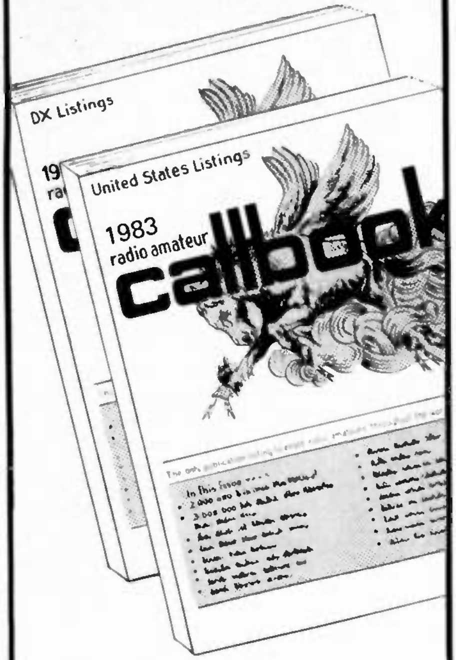


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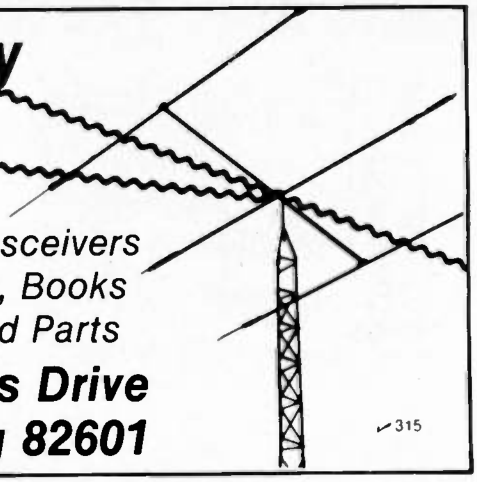

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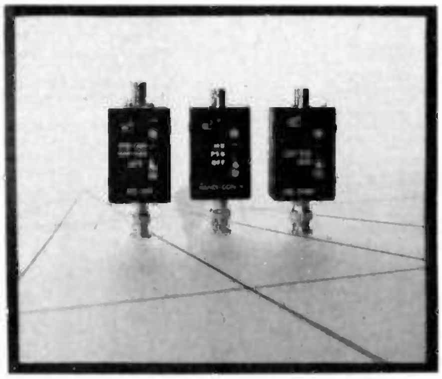

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# Confessions of a Counter Evolutionary

## —part II

**Editor's Note: *73* presents the second half of WA2FPT's "Confessions of a Counter Evolutionary." The August, 1982, issue featured the first half of this comprehensive design. The LSI Computer Systems LS7030 counter chip used in this project is available from Belco Electronics, 43 South 49th Ave., Bellwood IL 60104, for $12.75 plus shipping.**

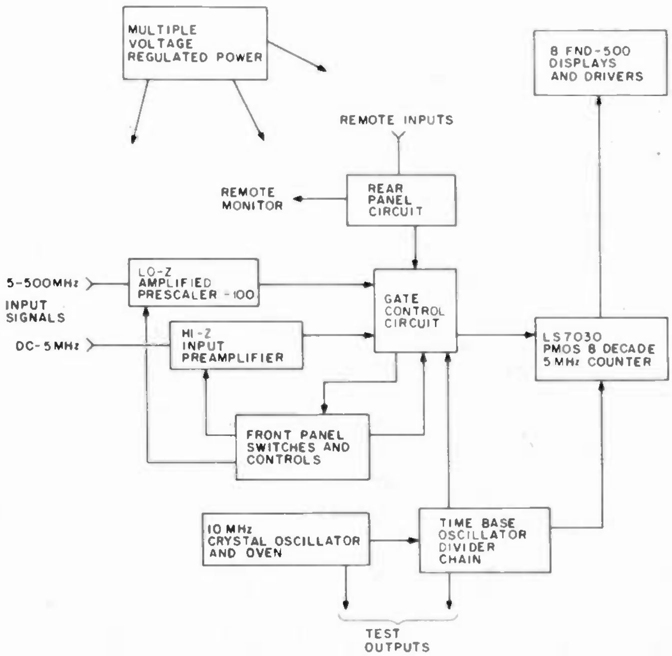



*Fig. 1. Block diagram.*

Last month we tackled the basic theory of counters and scrutinized the timebase, display, and counting circuitry. We'll finish the job this month. Let's start by looking at the front panel.

There is a conspicuous absence of rotary switches on the front panel. Instead, simple binary counters stepped with momentary-push-button SPDT switches are used with LED indicators to control all counter operations.

There are three such binary "rotary switch eliminators" employed: a four-position circuit for the four timebases (.01, .1, 1, and 10 seconds), a three-position input-display-select button for kHz, MHz, and prescaled MHz, and a mode-select switch for frequency, period, and events. Two additional push-button-switch circuits are enabled when in events mode and the lamp test, which was explained earlier.

The basis for these three counters is the four-position timebase-section counter of Fig. 12. The two 2-input NAND gates form a set-reset flip-flop that debounces the SPDT switch contacts, giving clean, glitch-free pulses to step the binary counter. Notice that the counters, 4013 dual-D flip-flops, are wired as toggles. That is, the outputs alternate low and high with each positive transition of the input clock

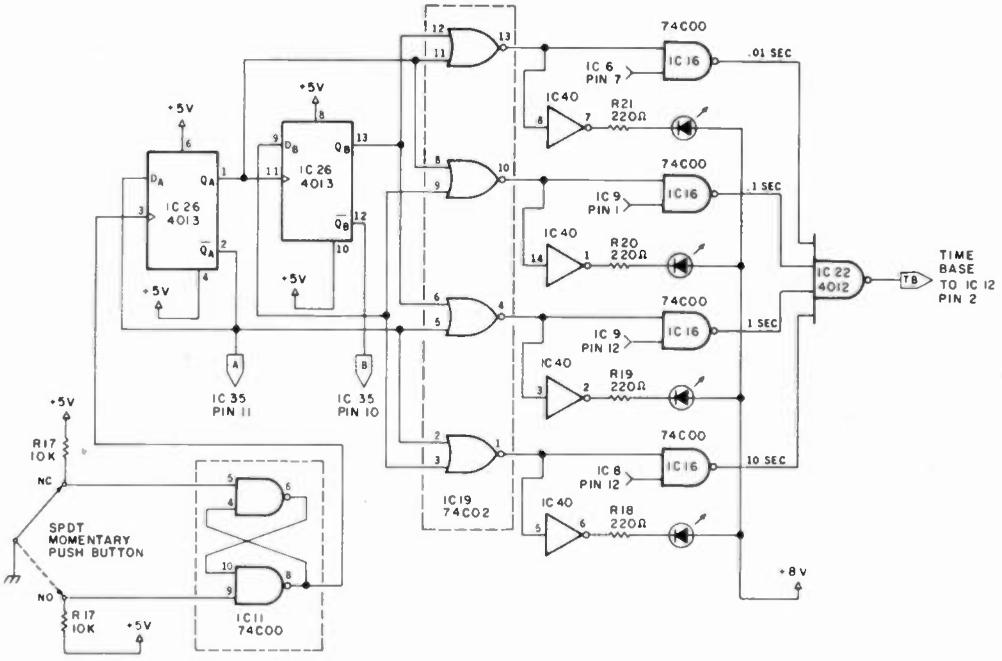



*Fig. 12. Timebase select.*

pulse. Two such arrangements are cascaded, resulting in a counter with four distinct output combinations. The output sequence of the four consecutive pushes of the timebase select button, taking the $Q_1$ and $Q_2$ outputs in pairs, is: 0,0, 1,0, 0,1, and 1,1, where 0 is almost GND and 1 is near +5 volts.

74C02 quad 2-input NOR gates are used as "zero-detecting" decoders to give unique 1 output levels for each of the four pairs of outputs. NOR gates can be used this way because they produce a high output only if all inputs are low. These decoded signals then control the selection and routing of the timebase signals. Fig. 12 shows the four timebases as inputs to the four NAND gates of IC16.

The output of each of these NAND gates is regulated by the condition of its control line, the four counter states, only one of which will be active (high) at a time. Therefore, only one of the four NAND gates will be passing pulses, with the remaining three outputs disabled at a high level. As the timebase button is pushed, the counter will step, activating the next control line, gating (enabling) the next corresponding timebase. All four timebases feed a 4012 (IC22) to give a single source of timebase outputs.

This kind of arrangement amounts to a 4-to-1 multiplexer, but I didn't have the one chip package available to do the job, a 4052.

Four jumbo LED front-panel indicator lights show which timebase is active. The control lines from IC19 accomplish this by turning on gates of IC40, a 75492 LED driver. Series resistors limit the current for the LED's safety. Since I ran the LEDs on 8 volts, I used quarter-Watt, 220-Ohm resistors that let about 30 mA flow through the LEDs.

All the resistors are mounted in DIP component carriers occupying sockets on the main wire-wrapped board. I'll admit this was an unnecessary extravagance, but they were a gift to my parts cabinet, so I used them.

The chosen timebase signal emerges from pin 1 of IC22 and goes to IC12, pin 2, the 74C157, where it is selected, or not, for frequency, or else disconnected for the other functions.

The input-display-select switch selects kHz or MHz readout of the displays. The third position, prescaled MHz, routes only signals from the 500-MHz amplified prescaler to the 7030 counter, again with the proper display.

Because only three positions are required, the basic four-position counter is modified to reset to the first position after stepping past the third state. This is done by using the output of the NOR gate decoding the fourth position of the counter to reset the counter to 0 by taking advantage of the 4013's direct (asynchronous) reset input. Whenever those inputs (pins 4 and 10 for both halves of a 4013) are brought high, the flip-flops set their Q outputs to 0, regardless of any other interval activity. The basic scheme in Fig. 13 is thus the same as in Fig. 12.

As explained before, IC11 is a set-reset flip-flop; IC33, a 4013, is the counter; the state decoders are a 74C02; and the display LEDs are driven from 75492 gates. Notice the labels on the 74C02 output lines—they are all important in controlling the various counter functions and we'll see more of them later.

The mode-select switch shown in Fig. 14 is a mirror image of the input-display select. The modes, as you probably have surmised by now, are frequency, period, and events. The period control line, labeled P, serves as the select line for IC12, the 74C157 that interchanges the period and the timebase.

The E line (for Events) has a little more work to do, however. Recall that our events totalizing needs the reset and load signals withheld from the 7030. What is required is a circuit that, upon user demand, will allow manual loading and resetting, but will default to the automatic supply of reset and load pulses to the 7030 chip as needed in period and frequency operation. The E line is the key to such control in this counter.

There are two front-panel push-buttons named display start-stop and count-reset that drive the circuit in Fig. 15. IC28 debounces both, and IC37 provides push-on, push-off toggling action. That is, each Q output from IC37 is latched at alternating 0s and 1s by the configuration shown. In effect, each is a single-pole, double-throw switch. The first push can set the flip-flop (output high), and the next push would reset it. Notice how the E line, inverted through a gate of IC24, only enables these flip-flops when in the events mode. Otherwise, the flip-flops are always set.

The direct reset or clear inputs are wired through two SPDT-switched rear-panel RCA phono jacks. This gives some external device a chance to reset and load the counter, if desired.

Remember the RC networks used to provide reset and load pulses? Well, each of these enters a separate AND gate, whose outputs finally go to the 7030 reset

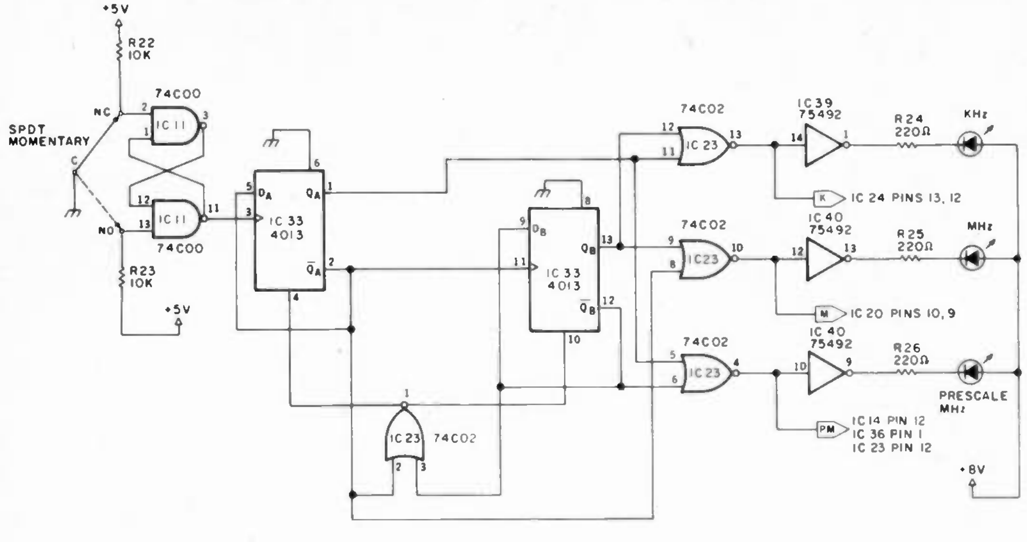



*Fig. 13. Input display select.*

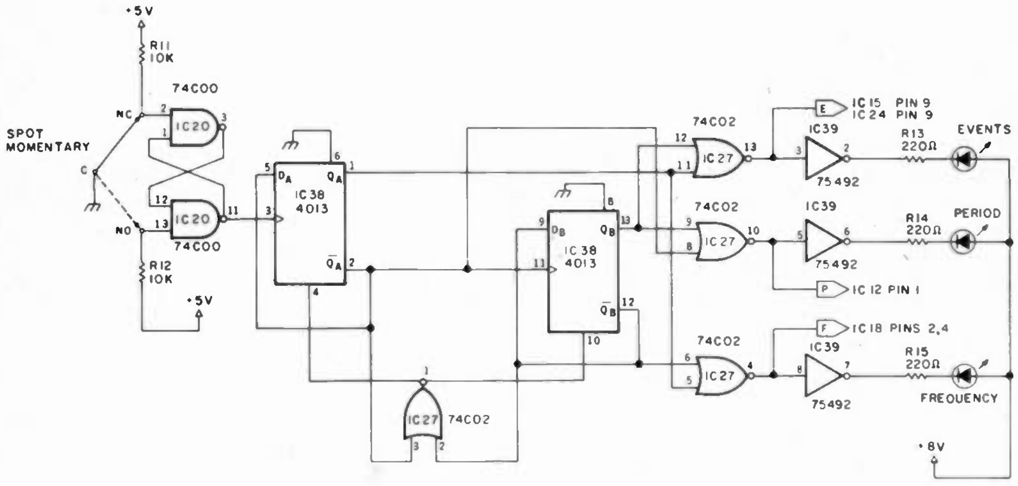



*Fig. 14. Mode selection.*

(pin 22) and load (pin 21) inputs. The AND gate also squares up the exponentially-rising input pulses nicely.

The utility and simplicity of the reset and load functions should relieve any misgiving you might harbor concerning the slight circuit complexity. As long as frequency or period mode is selected, IC37 remains set and the two AND gates of IC18 shown are always allowing the load and reset pulses to pass through to the counter.

When events mode is selected, the E line goes high, and the gate synchronizing flip-flop of IC13 is set via pin 4. IC15, pin 9 also is tied to the E line, preventing normal reset pulses. Simultaneously, the two halves of IC37 are enabled, and the display start-stop and count-reset push-buttons are active. IC18, pins 10 and 13 will not now pulse, because no pulse will reach either of the load or reset RC networks. See Fig. 11(a). Accordingly, the push-buttons so described will have complete and total control over the machine's resets and loads.

In the events mode, the display will be rippling with input counts, be static, or display zero. If it is rippling, the display start-stop is always delivering a load to the counter, and the count-reset button is telling the counter to count! (That is, *not* reset.) A push of the display start-stop button will freeze the display (no more load), but the 7030 still will be counting internally. Another touch of the DSS button will again provide a continuous display of the incoming events. As soon as the C-R button is pushed, the counter will reset internal circuits to zero. In order to view this zero, the DDS must be active; otherwise, the previous reading will be seen.

Making the internal 7030 counter controls separate from the display allows complete flexibility for elapsed-time operation and data-acquisition applications. The remote-control option multiplies the value of this feature.

**Decimal Pointers**

The decimal point changes positions, as you would expect, with kHz or MHz selection, and with the selection of each of the four timebases. It also offsets two places to the right to indicate proper MHz when the divide-by-100 decimal point also becomes visible only in frequency mode, because the period displays in microseconds and the events mode doesn't need it.

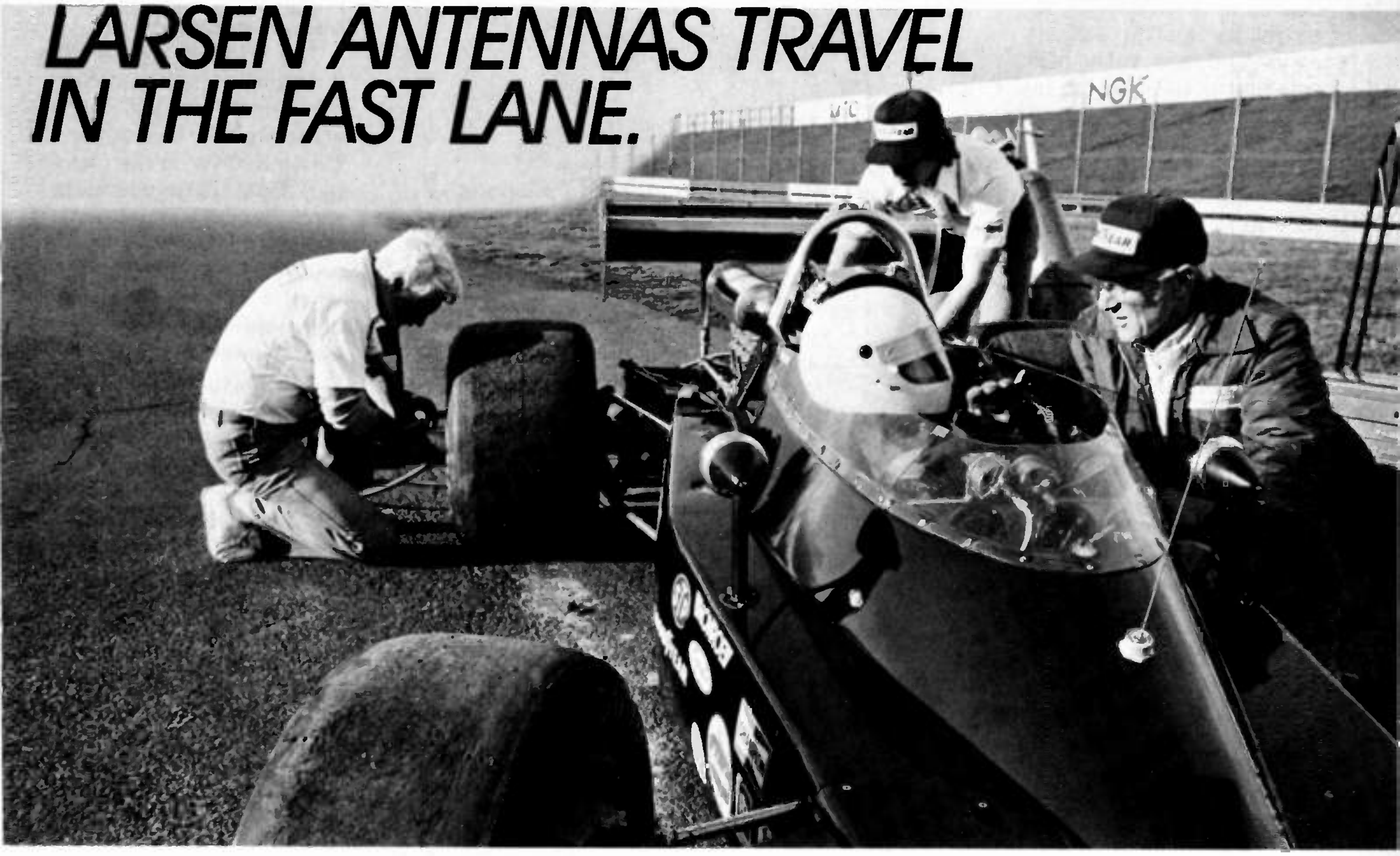
There was a good reason to save the description of the decimal-point circuitry until now, because its design is wholly dependent on two characteristics of this counter: the multiplexed display and the binary counters used in the function switching.

From the 7030 data sheet, I learned that in order to illuminate, for example, the decimal point in the fifth digit, the digit 5 strobe would have to be routed to both the decimal point input at pin 10 of the 7030 (to unblank the display) and to a suitable decimal point driver (a 75491). Four different timebases with the three different frequency representations give twelve switching combinations.

This challenge (for me, anyway) was simplified considerably by using two CMOS multiplexer chips, the now-familiar 74C157 quad 2-to-1, and the 74C151 8-to-1 multiplexer. If you have never played with multiplexer chips, you'll be in for a pleasant surprise when you see how this and similar switching problems are solved.

The four timebases are 10, 1, 0.1, and 0.01 seconds. For a proper readout in MHz, the decimal points to be activated must be the 8, 7, 6, and 5 digit strobes, respectively. A kHz readout requires digit strobes 5, 4, 3, and 2. The prescaled MHz display needs the strobe pulses for digits 6, 5, 4, and 3 for the different timebase.

Most of the work is handled by the 74C151. Eight



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digit strobes: 8, 7, 6, 5, 5 (again), 4, 3, and 2, are selected by a 3-bit address called C, B, and A. The high order bit is C. Using the input-display-select line, this is 0 for kHz and 1 for MHz (really *not* kHz). The B and A digits are the timebase-select outputs ($Q_1$ and $Q_2$) of the 4013 flip-flops.

The prescaled MHz decimal point placement requires a modified input of the digit strobes for the MHz section of the 74C151. Here the 74C157 is used to select either strobes 8, 7, 6, and 5, for normal MHz, or 6, 5, 4, and 3, for the prescaled MHz display. As you might guess, the PM (Prescaled MHz) control line, when active, selects the B-side strobes.

The complete decimal point circuit is shown in Fig. 16. The four high-order strobes to the 74C151 are selected by the 74C157, with the lowest group of four appearing as direct inputs for the kilohertz presentation.

As the 74C151 is addressed by the two output bits from the timebase select counter, the chosen digit strobe is sent out via the Y output (pin 5) to the data input of IC31, a 4013 flip-flop. IC35 can also be enabled by a separate strobe line itself, but here the outputs are always enabled by grounding pin 7. At IC31, the selected digit strobe is clocked by a 100-kHz signal through the AND gate of IC18, enabled by control line F (Frequency mode). The Q output sends the strobe, as mentioned earlier, to the 7030 decimal-point input at pin 10, and to the 75491 driver to the decimal point segments of the display. The leftover portion of IC22 is shown wired as an inverter to take the blank signal from the 7030 (pin 11) and properly reset IC3, preventing possible display damage. The 100-kHz clocking signal is more than adequate to accurately follow the 1-kHz scanning rate.

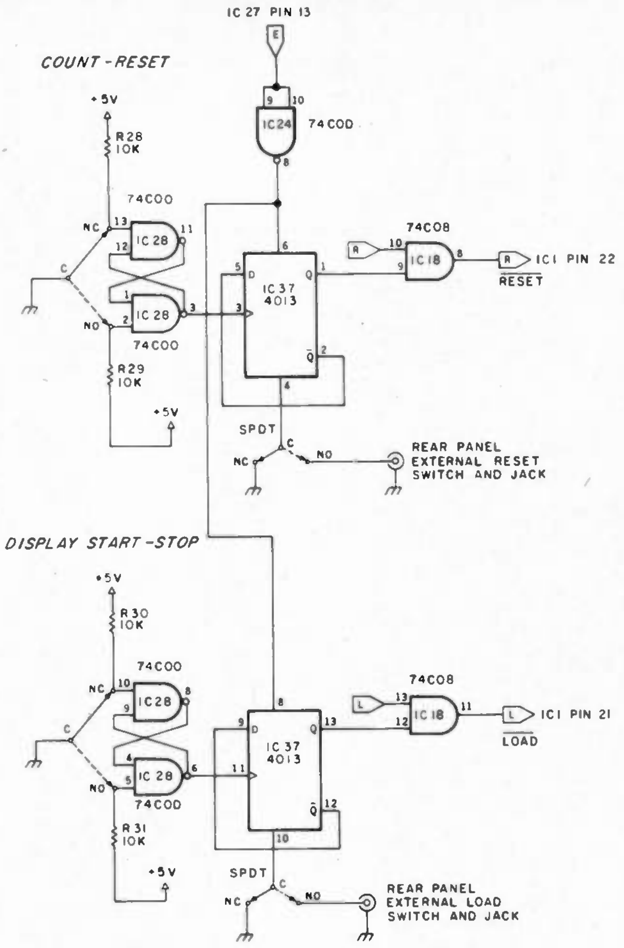


*Fig. 15. Count-reset and display start-stop.*

Another feature is that leading zero blanking is automatic when the decimal point is not used.

It might be helpful to remember that the digit strobe selection given here is for right-hand decimal-point displays. Left-hand decimal-point displays would use strobes 1-7 and 2-8.

## Front Ends and Odds

The input-signal conditioner, so well-loved and remembered from Elementary Counting, is manifested in a Hi-Z dc 5-MHz preamp, and a 5-500+-MHz Lo-Z divide-by-100 prescaler amplifier.

The Hi-Z unit (see Fig. 17) also was borrowed from WA1UFE's fine counter article in the December, 1976, *73 Magazine*. The only change I made was to omit the 68-pF silver mica capacitor shunting the 100k input resistor. Since the preamp is used only to 5 MHz, or so, this "speed-up cap" was not needed. Besides, I didn't have one in my junk box!

The same fine performance noted by WA1UFE still holds for my rendition of this excellent design. I do have something to contribute, however. An easy PC-board layout using tape is shown in Fig. 18(a), full-sized, with foil and component sides illustrated.

The Lo-Z 5-500-MHz preamp is also easily done with the "tape'n etch" method of PC-board fabrication. Fig. 20(a) gives the pattern for the board layout, while Fig. 19 shows the schematic. The basic design is from K4GOK, with some later embellishments by K4JIU in the February, 1978, issue of *Ham Radio*. My sole contribution, aside from the PC board, is the 39-Ohm emitter resistor in place of the earlier 47-Ohm one. This increases the current through the 2N5179 and lowers the input impedance a bit, but significantly improves the low end (5-10 MHz) sensitivity.

The 11C90 ECL prescaler is no longer a stranger to experimenters, so it will not be elaborated on. (See the article by K20AW in the October, 1976, *73* if you want some good 11C90 information.) Although the 11C90's price has dropped somewhat, I was still nervous, after soldering it in place, to apply power.

The 74196 divides the 11C90's pin 7 divide-by-ten output by 10 again, giving a divide-by-100 output. The output taken is the $Q_C$ output from pin 2 instead of the usual pin 12 $Q_D$ output commonly employed. The frequency is the same from each, but the $Q_C$ output has a 60% duty cycle compared with the 90% $Q_D$ duty cycle. This is done for the benefit of the 7030, which, from its data sheet, prefers as close to a 50% duty cycle as possible. It is only towards the operational limits of any device, including the 7030, that details such as this become important. Experience is a thorough, if humbling, teacher...

Both preamp boards are mounted by small right-angle brackets inside a small aluminum minibox (the 3 × 2 × 1¾-inch Bud Z100). UG-290 BNC connectors are used for the inputs, and their bolts hold the preamp box securely. I can't say for certain whether or not these shielding precautions are absolutely required, but there is no false triggering from strong nearby rf energy, either. Small-diameter coax (RG-174/U or similar) is used to bring both boards' outputs to the PC-board edge connector.

These TTL signals are converted into CMOS signals by a neat trick peculiar to CMOS. CMOS inputs are not directly connected to the outputs. Also, inputs can be paralleled for increased fan-in (the maximum number of allowable inputs), and the

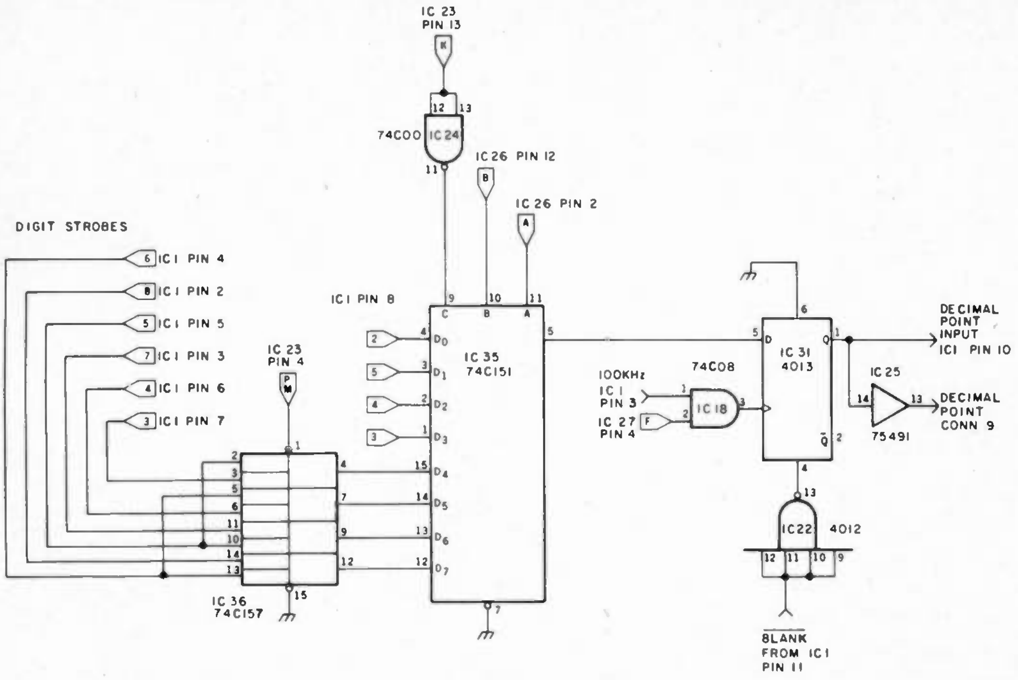


Fig. 16. Decimal point.

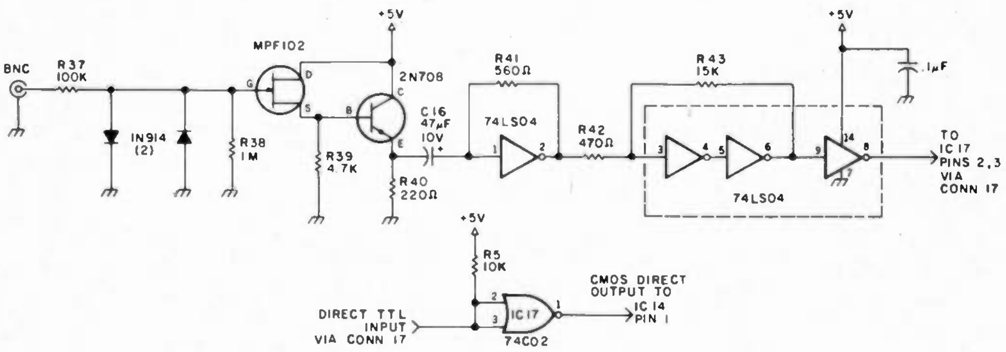


Fig. 17. Hi-Z dc to 5-MHz input preamplifier.

outputs for increased fan-out (the output load-driving capability).

The 74C02, IC17, is an example of how this CMOS quad 2-input NOR is put to work as a TTL-to-CMOS converter. Even though its physical location is on the main wire-wrapped board, it is shown in the front-end schematics of Fig. 17 and Fig. 19.

The output of the Hi-Z unit, a 74LS04 of modest power requirements, is converted to CMOS compatibility by a single NOR gate with two inputs tied together with a 10k-Ohm pull-up resistor to help the TTL 1 output up to a comfortable CMOS level.

Fig. 19 shows the remaining three 2-input NOR gates used to interface the Lo-Z preamp with the CMOS main counter circuitry, with all inputs and outputs in parallel. Try this with something other than CMOS logic! Such an arrangement provides needed buffering for the power-hungry 74196 output transistors.

Sensitivities for the Lo-Z unit are adequate between 5 and 10 MHz, becoming terrific out to the limits of my stone-age rf generator. With graphs and numbers aside, though, it's a real kick to stand 25 feet away from the counter and read those half-inch digits as I key my 1-Watt, 2-meter FM transceiver.

The Hi-Z unit exhibits a usable sensitivity of about 45 mV at the low audio range, down to about 10 mV to its externally imposed 5-MHz limit, as closely as I can determine from basement measurements.

## Power Play

Power supplies are usually the most boring part of any project, thanks to the voltage regulator integrated circuit manufacturers. I suppose this machine is no exception, but I did have some surprises during construction.

There are three 3-terminal regulators used, two 7805s and one LM340T-8, as can be seen from Fig. 21. One 7805 (+5 volts) is housed inside the box containing the

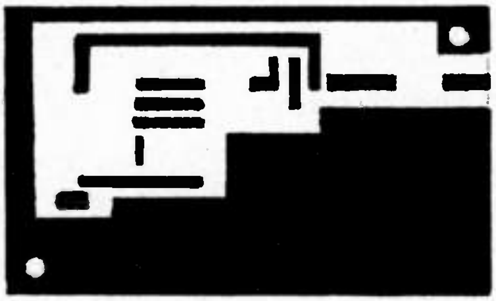

Fig. 18(a). Hi-Z preamp PC layout.

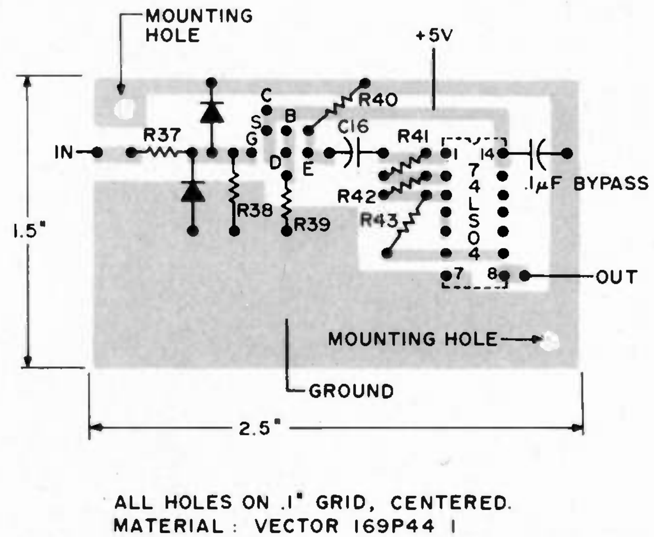


Fig. 18(b). Parts placement for Hi-Z preamp PC layout.

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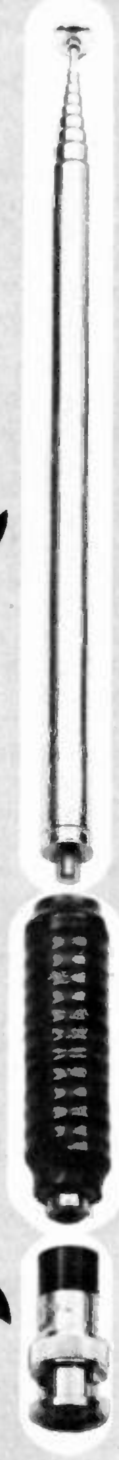

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front-end boards, and the TO-220 package is bolted to the aluminum case. Total power drawn for the front end is about 200 mA, most of which is eaten up by the Lo-Z board, as you might imagine, with its 11C90 and 74196.

The entire counter board, with the exception of the 75492s, is powered from the other 7805 and draws a scant 150 mA at 5 MHz. Yet CMOS has the rather nice property of using power only when it switches on or off, and practically zilch when static. Of course, the higher the frequency of switching, the greater the power consumption.

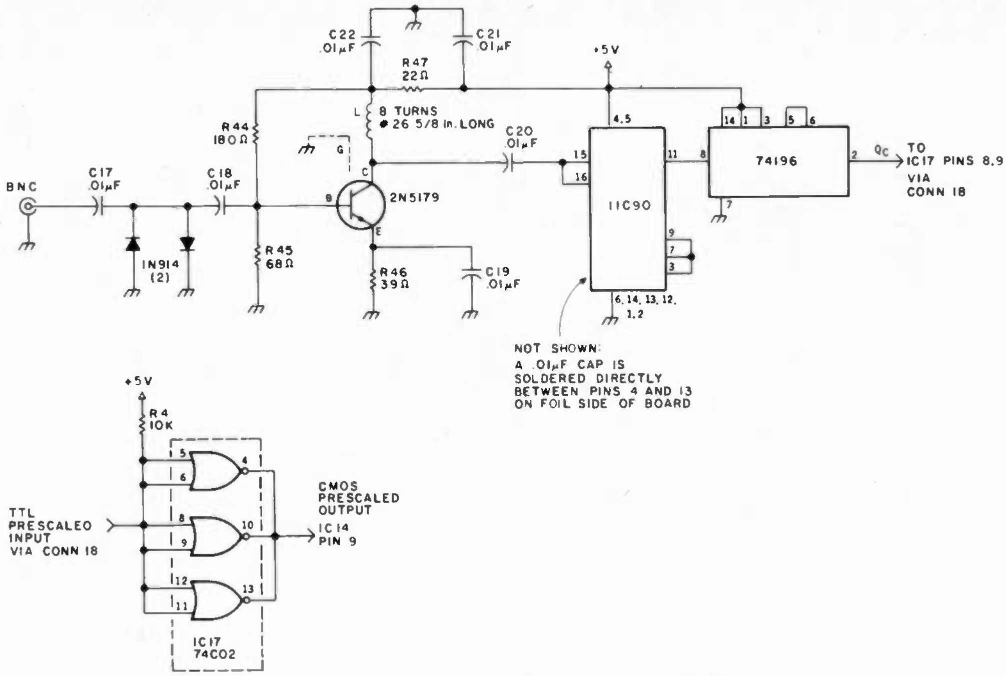


*Fig. 19. Lo-Z 5-500-MHz input amplified prescaler (÷100).*

The LED indicators and the FND 500 seven-segment display drivers are driven from the LM340T-8, an 8-volt regulator used to brighten the front panel a bit. Both the 8-volt and 5-volt regulators are heat-sinked (sunk?) by being bolted to the L bracket holding the 44-pin edge connector.

Back in the discussion on the master oscillator, the 723 regulator was explained, so I won't subject you to it again! The experience with the crystal oven does merit a few observations, however. The oven draws 750-800 mA at 9 volts. I had originally used a 5-volt LM309K raised by a 1.1k resistor "pedestal" (between the case common and the circuit ground) to 8 + volts. This was all mounted on the master-oscillator board inside the minibox.

Out on the bench in free air, it worked great. Buttoned up, however, the oven would cease to function after a few minutes. After a little careful thought along with my consternation, I figured out that the 309 was entering its thermal-shutdown mode because I had neglected to properly heatsink it. The air circulation in the haywired stage of the design had lulled me into a false confidence that "everything would be cool" once it was inside the minibox.

After ripping this failure out, I solved the whole problem with a single resistor, a capacitor, and Ohm's law. The raw dc from the full-wave rectifier was about 12 volts. Since the oven operates at 9 volts, I needed the value of resistor that would drop about three volts when the oven kicked in.

Ohm's law, assuming a 12-volt supply and a current of 750 mA, gave a 4-Ohm resistor value (3-volt drop = 750 mA × 4 Ohms) to produce the desired 9 volts for the oven. When the oven was off, the unloaded circuit voltage would climb back up to 12 volts, but that didn't matter.

I had a 5-Ohm resistor handy so it was tried, with success, even though the oven voltage was just a little over 8 volts. A 10-Watt resistor hardly gets warm, and a 5-Watt would probably be fine. The capacitor smooths the ripple resulting from the extra load on the transformer when the oven is operating. A front-panel LED turns on with the oven to show when the oven is active.

The 7030, being a good PMOS device, requires a negative bias when interfacing with TTL and CMOS. I used the brute force method of a separate transformer and a half-wave rectified 12-V zener diode to supply it with −12 V. Because only a few mA are drawn, however, virtually any arrangement that will provide a −12-V bias would work here.

At one point during the breadboarding stage, I was using a zener-biased pass-

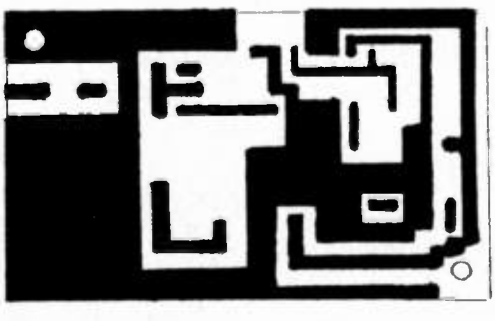

*Fig. 20(a). Lo-Z prescaler (÷100) PC layout.*

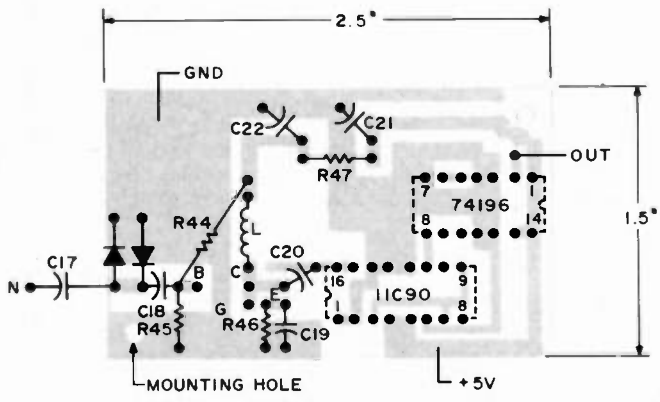


*Fig. 20(b). Parts placement for Lo-Z prescaler (÷100) PC layout.*

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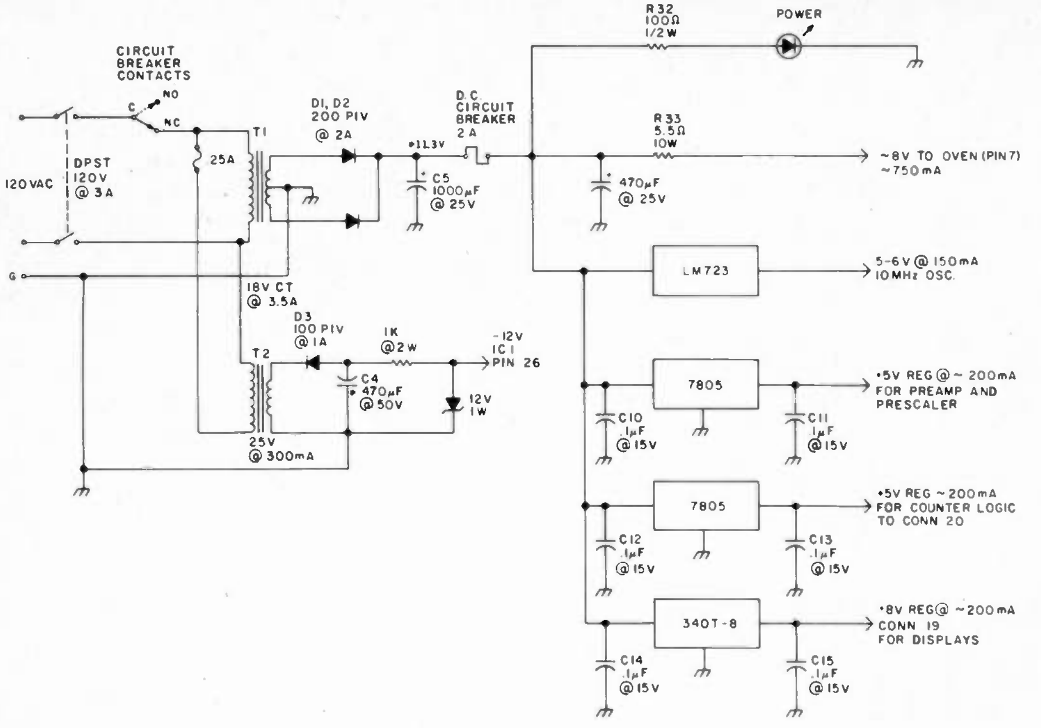


*Fig. 21. Power.*

transistor arrangement for the negative bias. Suddenly, I noticed the counter behaving erratically, giving some strange readings. After a few minutes of probing around, I was horrified to discover that the pass transistor had shorted and the −12-V nominal bias had soared to −32 volts! This, with the +5-volt positive supply, meant that the 7030 was enduring 37 volts! I was certain the 7030 had counted its last, but it survived, and so did I! In the interest of simplicity, I fell back to the present bias arrangement shown in Fig. 21, and there are no regrets yet.

Besides the ordinary fused primary-transformer-winding protection, I used a 2-Amp dc circuit breaker in series with the 12-volt positive supply. If this CB should trip, the ac line voltage will then drop out through the CB's external switch contacts. A dc circuit breaker is certainly not a necessity, but they can be had in most surplus houses for a dollar or so. I also used a DPDT power switch to completely disconnect the ac from any part of the counter when power is off. Because there are no CMOS inputs normally left floating, potential static damage is not a concern, either.

The power pilot LED is another of those weird yellow jobs that has its attendant 100-Ohm series resistor. It provides a good bright light when connected to the unregulated 12 V dc, as well it should!

All the 3-terminal regulators have 0.1 uF disc caps across the inputs and outputs for noise suppression and for better transient response (so I'm told). As the oven turns on, the raw dc drops to about 10.8 V, still plenty to properly power the various regulators. The main transformer for the positive supply used was one purchased from my friendly neighborhood Radio Shack, the RS273-1514, rated 18 V CT at 3.5 Amps. This is more than adequate, and a similar 2-Amp transformer would be sufficient.

### Construction Techniques

Most of this counter is wire-wrapped. Everything but the master oscillator, the power supply, and the two preamps are crammed on a Vector 3662 wire-wrapping board, with the matching 44-pin edge connector mounted on a homemade 1/8-inch aluminum L bracket. There is nothing sacred about using an edge-connected board. A cheaper perfboard would be adequate, but the plug-in board is handy for troubleshooting and easy modification.

The seven-segment displays also are pluggable.

22. 1-MHz 12-pin 74LS90 (master oscillator)
21. Ground
20. +5 V
29. +8 V
18. Prescaled inputs (Lo-Z)
17. Direct input (Hi-Z)
16. IC25, pin 9—segment a
15. IC25, pin 6—segment b
14. IC25, pin 2—segment c
13. IC21, pin 13—segment d
12. IC21, pin 9—segment e
11. IC21, pin 6—segment f
10. IC21, pin 2—segment g
9. IC25, pin 13—segment D.P.
8. IC34, pin 2—digit strobe 8
7. IC34, pin 1—digit strobe 7
6. IC29, pin 13—digit strobe 6
5. IC29, pin 9—digit strobe 5
4. IC29, pin 7—digit strobe 4
3. IC29, pin 6—digit strobe 3
2. IC29, pin 2—digit strobe 2
1. IC29, pin 1—digit strobe 1

Z. Lamp test NO H4, pin 3
Y. Gate LED H4, pin 4
X. Load NO contact
W. Load NC contact
V. Reset NO contact
U. Reset NC contact
T. Freq. LED H5, pin 1
S. Period LED H5, pin 2
R. Events LED H5, pin 3
P. Mode NO contact
N. Mode NC contact
M. kHz LED H5, pin 6
L. MHz LED H5, pin 7
K. Pre-MHz LED H5, pin 8
J. Input display NC
H. Input display NO
F. 0.1-sec LED H6, pin 4
E. 1-sec LED H6, pin 5
D. 10-sec LED H6, pin 6
C. .01-sec LED H6, pin 3
B. Timebase NO contact
A. Timebase NC contact

All LED connections are to cathodes. Anodes are tied to +8 V on front panel. All switch commons are grounded on front panel.

*Fig. 22(a). Logic-card edge-connector pin designation.*

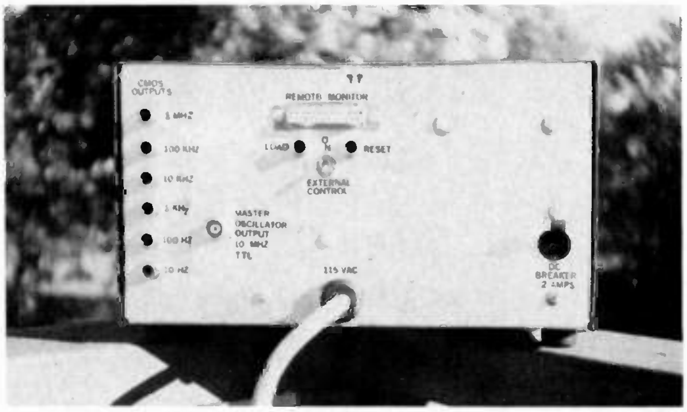


*Photo B. The Universal Counter's back panel provides outputs from different points on the timing chain and allows the use of a remote monitor.*

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Some DIP wire-wrapped sockets were cannibalized, the pieces were spaced on a narrow 6" piece of .1" perfboard, and the eight FND 500s were mounted. The segment pins then were wrapped daisy-chain style in parallel; these seven wires, plus the decimal-point wire and the eight common-cathode wires, form one wiring harness to the 44-pin edge connector. The other harness is composed of the cathodes of the eleven front-panel LEDs (crystal-oven and power-indicator wires are brought out separately) and eleven wires from the six push-button switches (5 SPDT and the SPST lamp-test switch). Other edge connector connections include +8 volts, +5 volts, the 1-MHz signal from the master oscillator board, and the two front-end signals. A ground completes the 44 pins—see Fig. 22(a). The −12-V bias is jumpered directly to pin 26 of the 7030 on the pin side of the board.

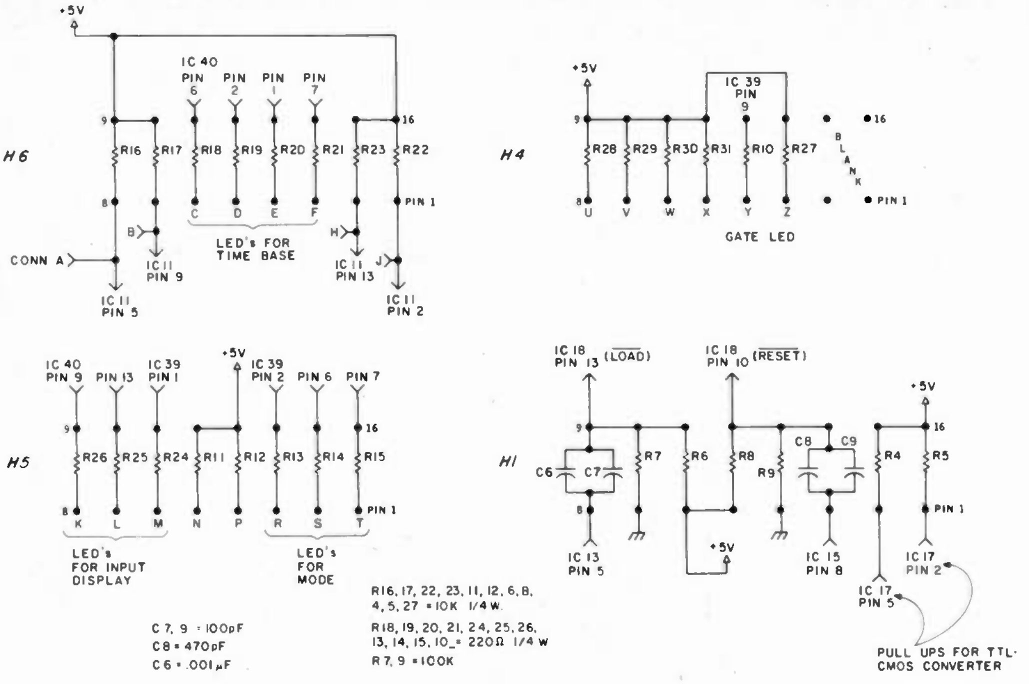


*Fig. 22(b). DIP component carriers.*

Five 16-pin DIP headers (Radio Shack 276-1980) are used to hold the 10k pull-up resistors, the LED current limiting resistors, and the two RC networks—see Fig. 22(b). Once again this is convenient, as these component carriers plug right into 16-pin wire-wrap sockets.

I decided to tap the available source of pulses always present in the oscillator divider chain for an external set of test signals, as shown in Fig. 22(c). Six frequencies, 1 MHz, 100 kHz, 10 kHz, 1 kHz, 100 Hz, and 10 Hz, were buffered with a 4049 hex inverter. A 16-conductor ribbon cable with a DIP socket takes the six signals to some RCA phono jacks mounted on the right rear chassis next to the master oscillator and crystal oven. These output connectors are quite suitable, as CMOS square-wave signals do not generate as many harmonics as do similar-frequency TTL signals, because of the slower rise times. The 10-MHz TTL master oscillator test signal does use a BNC output connector, however. All seven test outputs are dc-coupled by choice.

An EIA RS232C-type 25-pin connector is also on the back, labeled "Remote Monitor." Using the BCD (Binary Coded Decimal) outputs of the 7030 with each digit clocked out by its strobe, the information in the counter is made available to any desired external device that is plugged in. Movable jumpers soldered to the RS232 connector can sample this display information as well as enable the remote control of counter operations. An obvious candidate for such connection would be a microprocessor. If such mating is desired, it would be wise to recall that the sampling rate is equal to the multiplexed-display scan rate (1 kHz for this machine).

A DPDT switch, also on the back panel, selects whether or not the display-start-stop and count-reset 4013, IC37, flip-flop is controlled from the front pushbuttons or from another external source via two more RCA phono jacks.

The push-button switches are surplus computer types, bought for $1 each. They are large and bulky, but they "click" nicely. You could use whatever momentary SPDT switches are suitable and/or available.

Radio Shack was the source of the cabinet. Two reinforcing rods made from scrap phenolic are used to stabilize the chassis which becomes a little unsteady after all the components are mounted. It is quite sturdy, though, when the vinyl-clad steel cover is in place.

The jumbo LEDs are mounted in "Clip-lite" holders in ¼-inch holes. These sharp-looking mounting devices are worth every penny. You'll not be sorry if you spend for them. Quest Electronics (PO Box 4430C,

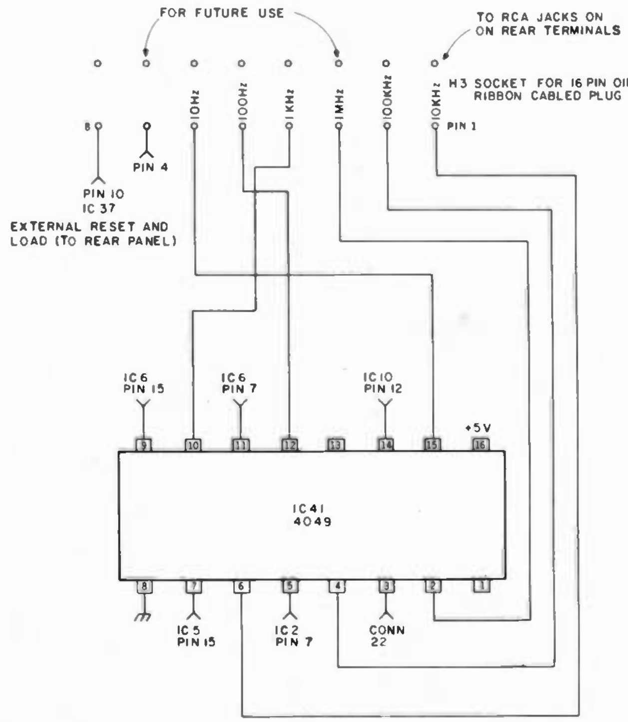


*Fig. 22(c). CMOS test-signal output buffer.*

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| 12098 | $1.28 | $1.12 | $.95 |

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|---|---|---|---|---|
| 50075 | .062 | 9 | 1.5 | $3.28 |
| 50076 | .062 | 25 | 4 | 4.36 |
| 50077 | .062 | 50 | 8 | 6.02 |
| 50078 | .032 | 33 | 1.5 | 4.08 |
| 50079 | .032 | 88.5 | 4 | 5.16 |
| 50080 | .032 | 175 | 8 | 6.82 |

## TI WIRE WRAP SOCKETS

Tin plated phosphor bronze contact – 3 wrap

| Stock No. | No Pins | 1-24 | 25 | 100 |
|---|---|---|---|---|
| 11301 | 8 | $ .45 | $ .40 | $ .36 |
| 11302 | 14 | .66 | .59 | .54 |
| 11303 | 16 | .72 | .64 | .58 |
| 11304 | 18 | .82 | .73 | .66 |
| 11305 | 20 | 1.11 | .99 | .90 |
| 11306 | 22 | 1.26 | 1.12 | 1.02 |
| 11307 | 24 | 1.41 | 1.25 | 1.14 |
| 11308 | 28 | 1.71 | 1.52 | 1.38 |
| 11309 | 40 | 2.31 | 2.05 | 1.86 |

## TI LOW PROFILE SOCKETS

Tin plated phosphor bronze contact pins with gas tight seal

| Stock No. | No Pins | 1-24 | 25 | 100 |
|---|---|---|---|---|
| 11201 | 8 | $.15 | $.13 | $.12 |
| 11202 | 14 | .18 | .15 | .14 |
| 11203 | 16 | .21 | .18 | .16 |
| 11204 | 18 | .24 | .21 | .19 |
| 11205 | 20 | .27 | .24 | .21 |
| 11206 | 22 | .30 | .26 | .23 |
| 11207 | 24 | .33 | .30 | .25 |
| 11208 | 28 | .38 | .34 | .29 |
| 11209 | 40 | .53 | .45 | .40 |

## ELPAC POWER SUPPLIES – DC/DC CONVERTERS

Stock No. 13801 – "Floppy Disc" Power Supply For Winchester Drives **$109.00**

13801-1 Data Sheet for 13801 .... $.25

| SINTEC Stock No | ELPAC No. | Input Voltage (VDC) | Output Voltage (VDC) | Output Current (MA) | Dimensions (HxWxD) in Inches | Price |
|---|---|---|---|---|---|---|
| 300 MW Type | | | | | | |
| 13825 | CB3801 | 3.0-7.0 | 12±0.6 | 0-25 | .48x.51x3.05 | $ 7.95 |
| 13826 | CB3811 | 3.0-7.0 | -12±0.6 | 0-25 | .48x.51x3.05 | 7.95 |
| 13827 | CB3802 | 3.0-7.0 | 15±0.7 | 0-20 | .48x.51x3.05 | 7.95 |
| 13828 | CB3812 | 3.0-7.0 | -15±0.7 | 0-20 | .48x.51x3.05 | 7.95 |
| 13829 | CB3804 | 3.0-7.0 | 28±0.7 | 0-10 | .48x.51x3.05 | 7.95 |
| 13830 | CB3814 | 3.0-7.0 | -28±0.7 | 0-10 | .48x.51x3.05 | 7.95 |
| 1.5 W TYPE: | | | | | | |
| 13831 | CL3801 | 4.0-7.0 | 12±0.6 | 125 | .651x1.2x1.77 | 59.95 |
| 13832 | CL3811 | 4.0-7.0 | -12±0.6 | 125 | .651x1.2x1.77 | 59.95 |
| 13833 | CL3802 | 4.0-7.0 | 15±0.7 | 100 | .651x1.2x1.77 | 59.95 |
| 13834 | CL3812 | 4.0-7.0 | -15±0.7 | 100 | .651x1.2x1.77 | 59.95 |
| 13835 | CL3804 | 4.0-7.0 | 28±1.4 | 50 | .651x1.2x1.77 | 59.95 |
| 13836 | CL3814 | 4.0-7.0 | -28±1.4 | 50 | .651x1.2x1.77 | 59.95 |

13825-1 DATA SHEET FOR DC/DC CONVERTERS .25

## ELPAC POWER SUPPLIES – SOLV SERIES FULLY REGULATED

| SINTEC Stock No. | ELPAC Part No | Output Voltage | Output Current Rating | Dimensions (HxWxD) in Inches | OVP | Price |
|---|---|---|---|---|---|---|
| 13802 | SOLV15-5 | 5 | 3.0A | 4-7/16x4x2 | Fixed included | $39.95 |
| 13803 | SOLV15-12 | 12 | 1.5A | 4-7/16x4x2 | Fixed included | 39.95 |
| 13804 | SOLV15-15 | 15 | 1.2A | 4-7/16x4x2 | Fixed included | 39.95 |
| 13806 | SOLV15-24 | 24 | 0.75A | 4-7/16x4x2 | Fixed included | 39.95 |
| 13808 | SOLV30-5 | 5 | 6.0A | 5-5/8x4-7/8x3-3/16 | OVP-4 | 59.95 |
| 13809 | SOLV30-12 | 12 | 4.0A | 5-5/8x4-7/8x3-3/16 | OVP-6 | 59.95 |
| 13810 | SOLV30-15 | 15 | 3.3A | 5-5/8x4-7/8x3-3/16 | OVP-4 | 59.95 |
| 13812 | SOLV30-24 | 24 | 2.0A | 5-5/8x4-7/8x3-3/16 | OVP-4 | 59.95 |

13802-1 Data Sheet for SOLV Series .... .25

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### DIGITAL MULTIMETER

Large easy to read .5" 3½ digit display-200 hours operating life with single 9v alkaline battery-low battery + polarity indicators – Five functions (DC Volts, Ohms, DC mA, AC Volts, Diode and transistor junction check in circuit)

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## PIN FORMING TOOL

puts IC's on their true row to row spacing. One side is for .300 centers. Flip tool over for devices on .600 centers. Put device in tool and squeeze.

ONE TOOL DOES 8 Thru 40 PINS!

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*Education Technology & Services, see page 81 October 1981 Issue of Ham Radio Magazine.

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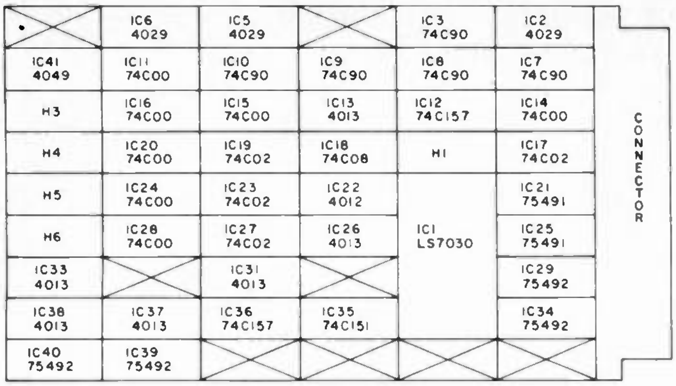


ICs on main counter board:

| | | | |
|---|---|---|---|
| IC1 | LS7030 | IC21, 25 | 75491 |
| IC2, 5, 6 | 4029 | IC22 | 4012 |
| IC3, 7, 8, 9, 10 | 74C90 | IC29, 34, 39, 40 | 75492 |
| IC11, 14, 15, 16, 20, 24, 28 | 74C00 | IC35 | 74C151 |
| IC12, 36 | 74C157 | IC41 | 4049 |
| IC13, 26, 31, 37,38 | 4013 | Preamps: 11C90, 74196, 74LS04 | |
| IC17, 19, 23, 27 | 74C02 | Master oscillator: 5400, 74LS90, LM723 | |
| IC18 | 74CO8 | Power supply: LM340T-8 and two 7805s | |

*Fig. 23. IC socket-location chart.*

Santa Clara CA 95054) has them, as do a few others. Dry transfer lettering identifies the lights and switches.

Here are a few helpful hints on the wire-wrap board. The 3662 Vectorbord® is 4.5 × 6 inches. The IC sockets, forty in all, densely populate the board. No effort was spared to carefully document and methodically wrap the circuits one section at a time. Four different colors of wirewrap were used: one for power, one for ground, one for all intra-board connections, and the last for board exits to the edge connector. Vector T-44 pins were soldered to the board's edge-connector pads to provide wrap points.

A necessary preliminary step is to make both a pin-side and a socket-view board map showing all socket and IC locations so you'll know which socket you are wiring (see Fig. 23). All power and grounds should be wrapped next. An ohmmeter will quickly spot shorts and opens. The TBOD chain was then wrapped, and the ICs were inserted and then powered up. After proper operation was observed (following a few corrections), the ICs were carefully removed and set aside in conductive foam. Each section was wired and debugged individually before the various control lines were sent to the far reaches of the board. The usual sequence was wire-wrap, IC insertion, smoke test, then debugging for the surviving ICs. The construction sequence I used was switching, display, decimal point, and, of course, the counter circuitry itself.

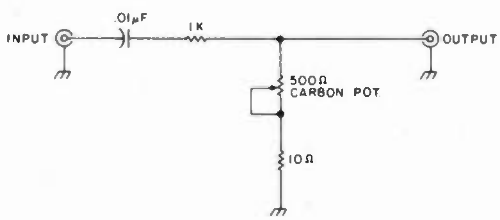


*Fig. 24. External Lo-Z attenuator.*

This sort of experience points out the extreme flexibility of wire wrapping. In this case, a fairly serious revision costs only some thought and a few wires. A printed-circuit approach would have resulted in at least the abortion of the first board layout, and probably abandonment of the project due to frustration. The other point is that I had breadboarded only a basic frequency-only counter to coarsely check out the basic counter circuits. The abandoned decimal-point circuit was initially conceived solely from a personal interpretation of the 7030 data sheet. Only reality and the actual circuit operations, or lack thereof, provided the necessary guides and corrections to my thinking. The value of breadboarding your first-order attempts can't be overestimated. The old adage, "If it works on a breadboard, it will work anywhere," has been proven many times.

Successful wire-wrapping of larger projects takes some persistence and defenses against paranoia. Persistence to follow through, and resistance to the slightly paranoid feeling that every little 30-AWG wire you miswrap could be the one that causes nights of insomnia and a new vocabulary for those around you.

This is the place where the documentation and organization of your project pay off in steady progression until successful completion, and in the building of confidence in yourself and in your design work. Remembering this can mean that your projects will perform reliably, as you intended, and that they can be fixed when necessary without resorting to a human sacrifice (you!) to appease that ever-lurking god of home-brew, *Nevor Wark!*

The rest of the pieces are best obtained from some of the great variety of small parts sources widely advertised. It is possible to save 30% or more on ICs and sockets, displays, etc., by comparison shopping.

If you are purchasing most of your components new, consider using all 74C90s for the divider chain, as mentioned earlier, since they are cheaper than 4029s and also less expensive to socket.

The counter has no internal attenuator because a useful one would not fit inside the cabinet. The Hi-Z input needs only loose coupling with proper shielding anyway to pick up virtually any signal, because of its sensitivity. The Lo-Z is about 30 Ohms or so at higher operating frequencies and doesn't mind being driven from a 50-Ohm source.

## Conclusion

The WA2FPT 7030 Universal Counter is an evolution of this ham's ideas and dreams. Taken by themselves, the various portions of its anatomy are not particularly new or daring. The useful combination of these common design techniques, though, has resulted in a counter that is a joy to use and has flexibility not found in counters at $500 or more.

Don't build this counter if all you want is that bare-bones $100 frequency counter or one of its brothers. Do create one, however, if you want the adventure of incorporating wire-wrapping, top-notch front ends, a voltage-tuned master oscillator, and all the other goodies. Then scrape together the $100-$150 you'll need and jump in. The little touches like the push-button function selection and LED indicators only serve to set this counter apart from all others. It's a small price to pay for a little distinction and some personal fulfillment. You, too, can build yourself as you build your counter. I'd be interested to learn how yours turns out.

It's been great "wrapping" with you! ■

# MFJ ANTENNA TUNERS 16 MODELS

## MFJ-941C 300 Watt Versa Tuner II

**Has SWR/Wattmeter, Antenna Switch, Balun. Matches everything 1.8-30 MHz: dipoles, vees, random wires, verticals, mobile whips, beams, balanced lines, coax lines.**


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**Flexible antenna switch** selects 2 coax lines, direct or through tuner, random wire/balanced line, or tuner bypass for dummy load.

**12 position efficient airwound inductor** for lower losses, more watts out.

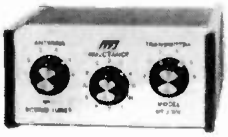
**Built-in 4:1 balun** for balanced lines. 1000V capacitor spacing.

**Works with all** solid state or tube rigs.

**Easy to use, anywhere.** Measures 8x2x6", has SO-239 connectors, 5-way binding posts, finished in eggshell white with walnut-grained sides.

**4 Other 300W Models: MFJ-940B, $79.95** (+ $4), like 941C less balun. **MFJ-945, $79.95** (+ $4), like 941C less antenna switch. **MFJ-944, $79.95** (+ $4), like 945, less SWR/Wattmeter. **MFJ-943, $69.95** (+ $4), like 944, less antenna switch. Optional mobile bracket for 941C, 940B, 945, 944, $3.00.

### MFJ-900 VERSA TUNER



MFJ-900

**$49.95 (+ $4)**

**Matches coax, random wires** 1.8-30 MHz.

**Handles up to 200 watts output;** efficient airwound inductor gives more watts out. 5x2x6".

**Use any transceiver,** solid-state or tube.

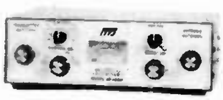
**Operate all bands** with one antenna.

**2 OTHER 200W MODELS:**

**MFJ-901, $59.95 (+ $4)**, like 900 but includes 4:1 balun for use with balanced lines.

**MFJ-16010, $39.95 (+ $4)**, for random wires only. Great for apartment, motel, camping, operation. Tunes 1.8-30 MHz.

### MFJ-949B VERSA TUNER II



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**$139.95 (+ $4)**

MFJ's best 300 watt Versa Tuner II.

**Matches everything** from 1.8-30 MHz, coax, randoms, balanced lines, up to 300W output, solid-state or tubes.

**Tunes out SWR** on dipoles, vees, long wires, verticals, whips, beams, quads.

**Built-in 4:1 balun.** 300W. 50-ohm dummy load. SWR meter and 2-range wattmeter (300W & 30W).

**6 position antenna switch** on front panel, 12 position air-wound inductor; coax connectors, binding posts, black and beige case 10x3x7".

### MFJ-962 VERSA TUNER III

MFJ-962

**$229.95 (+ $10)**

**Run up to 1.5 KW PEP,** match any feed line from 1.8-30 MHz.

**Built-in SWR/Wattmeter** has 2000 and 200 watt ranges, forward and reflected.

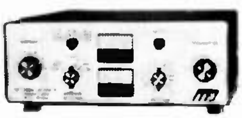
**6 position antenna switch** handles 2 coax lines (direct or through tuner), wire and balanced lines.

**4:1 balun.** 250 pf 6KV cap. 12 pos. inductor. Ceramic switches. Black cabinet, panel.

**ANOTHER 1.5 KW MODEL: MFJ-961, $189.95** (+ $10), similar but less SWR/Wattmeter.

**MFJ-10, 3 foot coax with connectors, $4.95.**

### MFJ-984 VERSA TUNER IV



MFJ-984

**$329.95 (+ $10)**

**Up to 3 KW PEP** and it matches any feedline, 1.8-30 MHz, coax, balanced or random.

**10 amp RF ammeter** assures max. power at min. SWR. SWR/Wattmeter, for./ref., 2000/200W.

**18 position dual inductor,** ceramic switch.

**7 pos.** ant. switch. 250 pf 6KV cap. 5x14x14".

**300 watt dummy load. 4:1 ferrite balun.**

**3 MORE 3 KW MODELS: MFJ-981, $239.95** (+ $10), like 984 less ant. switch, ammeter. **MFJ-982, $239.95 (+ $10)**, like 984 less ammeter, SWR/Wattmeter. **MFJ-980, $209.95** (+ $10), like 982 less ant. switch.

### MFJ-989 VERSA TUNER V

MFJ-989

**$329.95 (+ $10)**

**New smaller size** matches new smaller rigs — only 10-3/4Wx4-1/2Hx14-7/8D".

**3 KW PEP.** 250 pf-6KV caps. Matches coax, balanced lines, random wires 1.8-30 MHz.

**Roller inductor,** 3-digit turns counter plus spinner knob for precise inductance control to get that SWR down.

**Built-in 300 watt, 50 ohm dummy load.**

**Built-in 4:1 ferrite balun.**

**Built-in lighted 2% meter** reads SWR plus forward/reflected power. 2 ranges (200 & 2000W).

**6 position ant. switch.** Al. cabinet. Tilt bail.

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## LARSEN ANTENNAS

| | REGULAR | SALE |
|---|---|---|
| LM-MM-150 2 MTR 5/8 MAGNETIC MOUNT | 46.50 | 39.50 |
| TLM-150 TRUNK LIP 5/8 2 METER ANT | 46.50 | 39.50 |
| LM-150K 3/4 INCH HOLE MOUNT 2 MTR 5/8 ANT | | 33.50 |
| LM-MM-Q MAGNETIC MOUNT 1/4 WAVE FOR 144/450/220 | | 19.50 |
| LM-MM-220 220 MAGNETIC MOUNT 5/8 ANT | 46.50 | 39.50 |
| LM-TLM-220 TRUNK LIP MOUNT 5/8 220 ANT | 46.50 | 39.50 |
| LM-220K 3/4 INCH HOLE MOUNT 5/8 ANT FOR 220 | | 33.50 |
| LM-QK 3/4 IN HOLE MNT 1/4 WAVE FOR 144/220/450 | | 16.50 |
| LM-MM-450 450 MHZ MAGNETIC MT GAIN ANT | 46.50 | 39.50 |
| LM-TLM-450 TRUNK LIP MOUNT GAIN ANT FOR 450 | 46.50 | 39.50 |
| LM-450K 3/4 IN HOLE MOUNT GAIN ANT FOR 450 | | 33.50 |
| LM-MM MAGENTIC BASE FOR LM MOUNT ANTENNA | | 16.50 |
| LM-Q QUARTER WAVE WHIP FOR VHF/UHF FITS LM MT | | 3.50 |
| LM-K 3/4 IN HOLE MOUNT KIT FOR LM ANTENNA | | 7.50 |
| WHIP REPLACEMENT WHIP FOR LM-150 OR LM-220 | | 8.50 |
| LM-GC GUTTER CLAMP MOUNT FOR LM ANTENNA | | 16.50 |
| LM-150/220 ETC COIL ONLY (WHIP NOT INCLUDED) | | 23.50 |
| LM-450 COIL AND WHIP ASSEMBLY | | 29.50 |

## LARSEN QUICK MOUNT

| | REGULAR | SALE |
|---|---|---|
| QM-100 HI-QUALITY TWO-WAY RADIO SLIDE MOUNT | 36.00 | 34.50 |
| QM-100R RADIO PORTION OF MOUNT ONLY | | 19.50 |
| QM-100V VEHICLE PORTION OF MOUNT ONLY | | 17.50 |
| QM-LOCK KEY LOCK SYSTEM FOR QM-100 | | 15.50 |
| QM-102 PROVIDES TWO ADDITIONAL CONTACTS | | 4.50 |

## NYE VIKING

| | REGULAR | SALE |
|---|---|---|
| MASTER KEY CW KEY W/ HEAVY BASE NAVY KNOB AND CABLE | | 27.50 |
| 310-003 STANDARD CW KEY W/ SWITCH | | 12.50 |
| 312-003 BRASS PLATED CW KEY W/ SWITCH | | 16.50 |
| 320-003 NICKEL PLATED HEAVY DUTY CW KEY W/SW | | 15.50 |
| 321-003 CHROME PLATED HEAVY DUTY KEY W/SW | | 24.50 |
| 322-003 BRASS VERSION OF 320-003 | | 16.50 |
| 404-002 CODE PRATRICE SET W/KEY | | 26.50 |
| SSK-1 DUAL PADDLE SQUEEZE KEY WITH BASE | | 27.50 |
| SSK-1CP CHROME-PLATED SSK-1 | | 38.50 |
| 046-003 HY-BRID PHONE PATCH WITH SPEAKER | | 77.50 |
| SSK-1K IAMBIC KEYER W/SQUEZZE PADDLE 110VAC/9VDC | | 114.50 |
| SWR-001 AUTOMATIC SWR WATTMETER | | 124.50 |
| 330-1CP CHROME PLATED MASTER KEY | | 48.50 |

## NYE VIKING TUNERS

| | REGULAR | SALE |
|---|---|---|
| MB II -01 3KW BALUN SWR/WATT METER ROTOR INDUCTER | 365.00 | 317.50 |
| MB II -02 AS ABOVE WITHOUT BALUN | 335.00 | 294.50 |
| MB II -03 BALUN KIT | | 33.50 |
| 50216-A 7000 VOLT 290 PF VARIABLE CAPACITOR | | 75.50 |
| 50216-B AS ABOVE TWO SECTION 135PF PER SECTION | | 77.50 |
| 50217 24 MICRO-HENRY VARIABLE INDUCTOR | | 76.50 |
| 020-001 50 OHM 3KW LOW PASS FILTER | | 27.50 |

DRAKE

## RL DRAKE

| | REGULAR | SALE |
|---|---|---|
| TR7A DIGITAL HF XCVR 160-10 W/GEN COVG RCVR | 1699.00 | 1533.50 |
| R7A 0-30 MHZ DIGITAL SYNN RCVR | 1698.95 | 1488.50 |
| SP-75 SPEECH PROCESSOR | 159.95 | 157.50 |
| CW-75 ELECTRONIC KEYER | | 79.50 |
| P-75 PHONE PATCH | | 79.50 |
| NB-7 NOISE BLANKER FOR TR-7 | | 90.50 |
| SL-300 300 HZ CW FILTER | | 59.50 |
| SL-500 500 HZ CW FILTER | | 59.50 |
| SL-1800 1800 HZ RTTY FILTER | | 59.50 |
| SL-4000 4KHZ AM FILTER | | 59.50 |
| SL-6000 6000 HZ AM FILTER | | 59.50 |
| AUX-7 AUX RANGE PROGRAM BOARD FOR TR-7 | | 45.50 |
| WARC-7 WARC BAND KIT FOR TR-7 | | 24.50 |
| FA-7 FAN FOR TR-7/PS-7/DL-1000 | | 29.50 |
| RV-7 REMOTE VFO FOR TR-7 | 195.95 | 186.50 |
| MS-7 SPEAKER FOR 7-LINE | | 49.50 |
| MMK-7 MOBILE MOUNT FOR TR-7 | | 49.50 |
| 7073 DYNAMIC MOBILE MIC FOR TR-7 | | 29.50 |
| 7077 DYNAMIC DESK MIC FOR TR-7 | | 49.50 |
| 7037 TR-7/R-7 SERVICE KIT | | 50.50 |
| 7804 SERVICE MANUAL FOR TR-7 | | 35.50 |
| 7805 SERVICE MANUAL FOR R-7 | | 35.50 |
| R-7/TR-7 CABLE INTERFACE KIT | | 29.50 |
| NB-7A NOISE BLANKER FOR R-7 | | 90.50 |
| RP-700 RCVR FRONT END PROTECTOR | | 90.50 |
| MN-75 200W 160-10 METER TUNER | 259.95 | 240.50 |
| MN-2700 2KW 160-10 METER TUNER | 349.00 | 325.50 |
| B-1000 4/1 BALUN FOR TUNERS | | 29.50 |
| CS-7 REMOTE CONTROL ANT SWITCH | 169.95 | 166.50 |
| WH-7 2000 KW HF WATTMETER | 129.95 | 127.50 |
| DL-300 300 WATT DUMMY LOAD | | 26.50 |
| DL-1000 1000 WATT DUMMY LOAD | | 53.50 |
| PS-7 POWER SUPPLY FOR TR-7 110/220V | 299.00 | 277.50 |
| PS-75 POWER SUPPLY FOR TR-7 110/220V | 199.00 | 190.50 |
| L-7 160-15 2KW AMP & PS | 1019.00 | 984.50 |
| L-75 160-15 1.2KW AMP & PS | 699.95 | 650.50 |
| 3-500Z TUBE (2 NEEDED FOR L-7) (1 FOR L-75) | | 120.50 |
| 7000E KEYBOARD COMMUNICATIONS TERMINAL | 1095.00 | 822.50 |
| TR-5 TRANSCEIVER 160-10 MTRS SOLID STATE | 799.95 | 743.50 |
| NB-5 NOISE BLANKER FOR TR-5 | | 90.50 |
| TR-930 9" BLACK AND WHITE VIDEO MONITOR | | 195.50 |
| DMM AUTO RANGING LCD 3 1/2 DIGIT MULTIMETER | | 95.50 |
| RV-75 SYNN VFO FOR TR7A AND TR5 | 299.95 | 278.50 |
| 1544 ADAPTER FOR USING RV75 WITH R7A | | 29.50 |
| LF-2 TWO RECPT AC LINE FILTER/SUPPRESSOR | | 39.50 |
| LF-6 AS ABOVE SIX RECEPTICAL | | 69.50 |
| SURGE SHUNT FOR ANTENNA ON RECEIVERS/XCEIVERS | | 24.50 |
| 3001 REPLACEMENT FILL ELEMENT FOR SURGE SHUNT | | 4.50 |

# TUFTS ELECTRONICS

## ROHN TOWER

| | REGULAR | SALE |
|---|---|---|
| 25G 10 FT TOWER SECTION | | 45.50 |
| 25AG-3 TOP SECTION W/SUPPORT TUBE 2 1/4" OD | 83.50 | 62.50 |
| 25AG-4 TOP SECTION W/BEARING PLATE TOP | 83.50 | 62.50 |
| SB-25G SHORT BASE TO MOUNT IN CONCRETE | 23.95 | 20.50 |
| SBH-25G HINGED SHORT BASE FOR CONCRETE | 49.50 | 40.50 |
| BPC-25G CONCRETE BASE PLATE | 44.50 | 36.50 |
| BPH-25G HINGED CONCRETE BASE PLATE | 83.50 | 68.50 |
| 3/4X12"PP PIER PIN NEEDED WITH CONCRETE BASES | | 4.50 |
| 1/2X12"BB BASE BOLT FOR HINGED BASE PLATE | | 4.50 |
| FR-25G FLAT ROOF MOUNT | 47.00 | 39.50 |
| PR-25G PEAK ROOF MOUNT | 39.00 | 33.50 |
| RP-25G ROTOR POST | | 7.50 |
| AS-25G ACCESSORY SHELF (ROTOR PLATE) | | 13.50 |
| GA-25G GUY BRACKET WITH TORQUE ARMS | 27.50 | 24.50 |
| GB-25G GUY ASSEMBLY | 17.00 | 15.50 |
| HBU UNIVERSAL HOUSE BRACKET 6" TO 30" | 23.95 | 20.50 |
| TB-50 BUSHING FOR 25AG-3 | | 5.50 |
| TB-3 THRUST BEARING | 67.00 | 55.50 |
| WP-25G WORK PLATFORM | 34.00 | 29.50 |
| EF-2545 ERECTION FIXTURE | 193.00 | 145.50 |
| 506 GUY LINE INSULATOR | | 5.50 |
| M200 10 FT STEEL MAST 2 INCH OD | 27.95 | 24.50 |
| M200H 10 FT STEEL MAST HEAVY WALL 2 IN OD | 49.50 | 41.50 |
| 1/4 TH THIMBLES FOR GUY WIRE | | 0.50 |
| 3/16 CCM 3/16 CABLE CLAMPS FOR GUY CABLE | | 0.50 |
| 3/8 TB E&E TURNBUCKLE EYE AND EYE | | 10.50 |
| 3/8 TB E&J TURNBUCKLE EYE AND JAW | | 14.50 |
| 3/16 EHS GUY WIRE 3/16" STEEL PER 100 FT | | 19.50 |
| 25G-50FT 50 FT TOWER PACKAGE WITH HOUSE BRACKET | 410.25 | 299.50 |
| 25G-50FT/G 50 FT TOWER PACKAGE GUYED | 660.05 | 499.50 |
| TRT-36 3 FT STEEL TRIPOD | | 12.50 |
| TRT-60 5 FOOT TRIPOD STEEL | | 17.50 |
| TRT-112 10 FOOT TRIPOD STEEL | | 29.50 |
| SAB-25G-2 SIDE ARM BRACKET | 39.95 | 33.50 |
| UHF-25G SIDE ARM BCKT FOR SMALL ANT (2 NEEDED) | | 9.50 |
| GAC-253 5 FT CONCRETE GUY ANCHORS AND EQUALIZERS | 22.95 | 19.50 |
| 6 TOWERS ANY COMB OF 6 TWR PKGS SAVE 20% | 0 | 0.50 |
| H30 30 FT TELESCOPING STEEL MAST | 37.95 | 29.50 |
| GR384 3/8" 4 FOOT GROUND ROD | | 4.50 |
| GR386 3/8" 6 FOOT GROUND ROD | | 6.50 |

## ROHN FOLDOVERS

| | REGULAR | SALE |
|---|---|---|
| FK2548 48 FOOT 25G FOLDOVER TOWER | 945.00 | 749.50 |
| FK2558 58 FOOT 25G FOLDOVER TOWER | 1050.00 | 849.50 |
| FK2568 68 FOOT 25G FOLDOVER TOWER | 1155.00 | 899.50 |

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|---|---|---|
| 1746 WEATHER-GUARD 8 OZ CAN | | 5.50 |
| A-1123 ANTI-CORROSION COMPOUND | | 2.50 |
| CL-33 3 EL 10/15/20 MTR BEAM SS HDW | 345.00 | 243.50 |
| CL-36 10/15/20 MTR 6 EL BEAM SS HDW | 456.00 | 321.50 |
| TA-33 10/15/20 MTR 3 EL BEAM | 303.00 | 220.50 |
| TA-33JR LOW POWER VERSION OF TA33 1000 WATT PEP | 223.00 | 167.50 |
| TA-36 10/15/20 MTR 6 EL BEAM | 458.00 | 323.50 |
| DIV-80 GENERAL PURPOSE DIPOLE ANT | | 19.50 |
| RV-4C 10-40 METER VERTICAL ANT | | 92.50 |
| RV-8C 80 MTR CONVERSION FOR RV-4C | | 57.50 |
| RKV-345 ROOF MTG KIT FOR RV-4C | | 21.50 |
| TA-40KR 40 MTR CONVERSION FOR TA33/36 | | 140.50 |
| CL-203 20 MTR BEAM 13 ELEMENT | 385.00 | 271.50 |
| S-402 40 METER 2 ELEMENT BEAM | 418.00 | 295.50 |
| MPK-3 HIGH PWR CONVERSION FOR TA33JR | | 87.50 |

YAESU

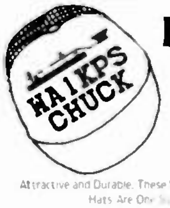
## YAESU ELECTRONICS

| | REGULAR | SALE |
|---|---|---|
| FT-902DM 160-10 METER XCVR W/MEMEORY AND KEYER | 1535.00 | 1299.50 |
| FV-901DM SYNN VFO | 415.00 | 369.50 |
| FC-902 ANTENNA TUNER | 199.00 | 189.50 |
| SP-901P SPEAKER PHONE PATCH | | 76.50 |
| SP-901 REMOTE SPEAKER | | 35.50 |
| FTV-901R TRANSVERTER W/2MTR MODULE | 389.00 | 359.50 |
| 6MTR MODULE MODULE FOR FTV-901R | 110.00 | 107.50 |
| 70CM MODULE MODULE FOR FTV-901R | 255.00 | 239.50 |
| YO-901P MONITOR SCOPE W/PANADAPTER | 515.00 | 454.50 |
| YR-901 CW RTTY READER (VIDEO MONITOR EXTRA) | 730.00 | 643.50 |
| YK-901 ASCII KEYBOARD | 175.00 | 163.50 |
| FT-107M 160/10 MTR/SLD ST/DIGITAL/MEMORY/AC-DC | 1149.00 | 999.50 |
| FP-107E EXTERNAL AC SUPPLY FOR 107 | 145.00 | 135.50 |
| FP-107 INTERNAL AC SUPPLY FOR FT-107 | 139.00 | 131.50 |
| FC-107 ANTENNA TUNER | 150.00 | 140.50 |
| FV-107 EXTERNAL VFO | 150.00 | 140.50 |
| SP-107P SPEAKER PHONE PATCH | | 65.50 |
| SP-107 EXERNAL SPEAKER | | 29.50 |
| FTV-107R TRANSVERTER W/2 MTR MODULE | 304.00 | 269.50 |
| FT-101ZD 160-10 MTR XCVR DIGITAL APF WARC | 925.00 | 829.50 |
| FV-101Z EXTERNAL VFO | 175.00 | 162.50 |
| DC-101ZD DC CONVERTER | | 59.50 |
| AM-101Z AM UNIT FOR FT101ZD | | 27.50 |
| FM-101Z FM UNIT FOR FT101ZD | | 56.50 |
| FT-707 80-10 MTR COMPACT XCVR FOR MOBILE/BASE | 810.00 | 729.50 |
| FV-707DM MEMORY/SCAN VFO | 279.00 | 256.50 |
| FP-707 AC POWER SUPPLY | 162.00 | 152.50 |
| FC-707 ANTENNA TUNER | 129.00 | 119.50 |
| MMB-2 MOBILE BRACKET | | 21.50 |
| XF8.9HC 600 HZ FILTER FOR HF RIGS | | 45.50 |
| XF8.9HCN 350 HZ CW FILTER FOR HF RIGS | | 49.50 |
| XF8.9B AM FILTER FOR HF RIGS | | 45.50 |
| YH-77 LIGHTWEIGHT HEADSET FOR COMM EQUIP | | 19.50 |
| QTR-24D QUARTZ WORLD CLOCK | 49.00 | 47.50 |
| YS-200 200W SWR/WATTMETER GOOD TO 150MHZ | | 79.50 |
| YS-2000 2000W SWR/WATTMETER GOOD TO 60MHZ | | 95.50 |
| YP-150Z DUMMY LOAD WATTMETER | 135.95 | 126.50 |
| YC-1000L LOGGING DATA PROCESSOR | 1800.00 | 1371.50 |
| FA-9 COOLING FAN | | 22.50 |
| FRG-7700 DIGITAL SYNN VLF TO 30MHZ RCVR | 549.00 | 499.50 |
| MU-7700 MEMORY UNIT | 149.95 | 140.50 |
| FRT-7700 ANTENNA TUNER | | 59.50 |
| FF-5 VLF LOW PASS FILTER | | 20.50 |
| DC-7700 DC ADAPTER KIT | | 8.50 |
| FRV-7700 118-150 MHZ CONVERTER | 149.00 | 140.50 |
| YE-7A HAND MIC FT101ZD | | 17.50 |
| YD-148 DESK MIC HI/LO FOR FT101ZD | | 32.50 |
| YM-34 DESK MIC HI/LO FOR 107/707 | | 31.50 |
| YM-35 SCAN MIC 107/707 | | 20.50 |
| YM-36 HAND MIC 107/707 | | 20.50 |
| YM-37 HAND MIC 107/707 | | 10.50 |
| YM-38 DESK SCAN MIC 107/707 | | 39.50 |
| FT-ONE ALL BAND XCVR CPU GEN CVG RCVR KEYER ETC | 2995.00 | 2495.50 |
| XF8.9KC 600HZ 8 POLE FILTER FOR FT-ONE | | 49.50 |
| XF8.9KCN 300 HZ 8 POLE FILTER FOR FT-ONE | | 49.50 |
| XF8.9KA 6 KHZ 8 POLE AM FILTER FOR FT-ONE | | 49.50 |
| XF10.7KC 800 HZ 6 POLE 3RD IF FILTER FOR FT-ONE | | 44.50 |
| RAM UNIT MEMORY BACK-UP BOARD FOR FT-ONE | | 19.50 |
| KY-ONE CURTIS 8044 KEYER UNIT FOR FT-ONE | | 49.50 |
| DC-CABLE DC CABLE FOR FT-ONE | | 14.50 |
| FV-101DM SYNN SCANNING MEMORY VFO FOR FT-101ZD | 359.00 | 329.50 |
| FT-180 HF SOLID STATE XTAL CONTROLLED XCVR | 895.00 | 789.50 |

## YAESU VHF/UHF

| | REGULAR | SALE |
|---|---|---|
| FT-208R 2 MTR SYNN WALKIE LCD MEMORIES TTP SCAN | 359.95 | 329.50 |
| FNB-2 BATT PACK OF FT-208R | | 29.50 |
| YM-24A SPEAKER MIC | | 39.50 |
| NC-7 BASE CHARGER | | 59.50 |
| NC-8 RAPID BASE CHARGER | | 99.50 |
| PA-3 MOBILE ADAPTER CHARGER | | 39.50 |
| LCC-8 LEATHER CASE | | 35.50 |
| FT-290R ALL MODE 2 WATT 2MTR PORT/MOBILE XCVR | 399.00 | 359.50 |
| NC-11B WALL CHARGER | | 9.50 |
| LCC-90 CARRY CASE | | 38.50 |
| NICD NICAD C CELLS | | 5.50 |
| FT-480R 2 MTR SYNN MULTI-MODE XCVR | 529.00 | 469.50 |
| FT-127RA 220 FM SYNN MEMORY SCANNING | 479.00 | 422.50 |
| FT-127 12 CHANNEL 220 FM XCVR | 299.00 | 249.50 |
| FT-680R SYNN ALL MODE 6 MTR XCVR | 520.00 | 459.50 |
| FT-780R 430-440 MHZ SYNN MULTI-MODE | 785.00 | 699.50 |
| FP-80 MATCHING SUPPLY 480/680/780 | | 95.50 |
| SC-1 STATION CONSOLE | | 199.50 |
| FSP-1 REMOTE SPEAKER FOR MOBILE | | 21.50 |
| FP-12 12 12VDC SUPPLY W/SPEAKER | 135.00 | 126.50 |
| YM-39 SCAN KEYBOARD MIC FOR 720 | | 76.50 |
| YM-48 TONE ENCODING MIC FOR 480 | | 69.50 |
| MMB-11 MOBILE BRACKET AND ADPATER FOR 290R | | 34.50 |
| FL-2010 10 WATT AMP FOR 290R (FITS MMB-11) | | 99.50 |
| FT-708R 70CM SYNN HANDHELD 440-450MHZ BATT&CHGR | 359.00 | 326.50 |
| FT-690R SIX METER SYNN PORTABLE MULTI-MODE | 379.00 | 339.50 |
| FT-230R 2 MTR 25WATTS SYNN LCD SCAN & MEMORY | 359.00 | 329.50 |

# CALL LETTER HATS

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## COAX CABLES

| | REGULAR | SALE |
|---|---|---|
| 503 3 FT RG-58U W/PL-259 BOTH ENDS | | 3.50 |
| 515 15 FT RG-58U W/PL-259 BOTH ENDS | | 5.50 |
| 520 20 FT RG-58U W/PL-259 BOTH ENDS | | 6.50 |
| 550 50 FT RG-58U WITH PL/259 BOTH ENDS | | 12.50 |
| 575 75 FT RG-58U W/PL-259 BOTH ENDS | | 16.50 |
| 5100 100 FT RG-58U W/PL-259 BOTH ENDS | | 21.50 |
| 803 3 FT RG-8U W/PL-259 BOTH ENDS | | 5.50 |
| 825 25 FT RG-8U W/PL-259 BOTH ENDS | | 15.50 |
| 850 50 FT RG-8U W/PL-259 BOTH ENDS | | 26.50 |
| 875 75 FT RG-8U W/PL-259 BOTH ENDS | | 29.50 |
| 8100 100 FT RG-8U W/PL-259 BOTH ENDS | | 39.50 |
| 8C-100 100 FT 8 CON ROTOR CABLE (SPECIFY LENGTH) | | 36.50 |
| 8C-100H 100 FT 8 COND ROTOR CABLE HEAVY | | 59.50 |
| 8X-100 100 FT RG-8X (AVAIL 100 FT AND UP) | | 22.50 |
| 8214-100 BELDEN 8214 HI/QUALITY RG-8U | | 54.50 |
| 59U-100 100 FT RG-59U COPPER BRAID | | 18.50 |
| RG-8U-100 100 FT 8U FOAM COPPER BRAID GOOD QUALITY | | 44.50 |
| RG-213-100 50 OHM COAX 100 FT LENGTH HI QUALITY | | 46.50 |
| 450-100 450 OHM XMISSION LINE 1 KV 100 FT OR UP | | 14.50 |

## TEN-TEC INC

| | REGULAR | SALE |
|---|---|---|
| ARGONAUT QRP XCVR SSB/ CW 80-10 METERS | 469.00 | 399.50 |
| ARGOSY SSB/CW 80-10 METERS | 579.00 | 531.50 |
| OMNI DIGITAL 160-10 METERS XCVR | 1289.00 | 1079.50 |
| DELTA SSB/CW 160-10 XCVR | 869.00 | 749.50 |
| 227 ANTENNA TUNER | 89.00 | 87.50 |
| 228 ANT TUNER/ SWR BRIDGE | 110.00 | 104.50 |
| 225 SUPPLY 110/230VAC FOR ARGOSY | 129.95 | 125.50 |
| 255 DELUXE SUPPLY 110/230VAC FOR XCVRS | 199.00 | 186.50 |
| HERCULES 1 KW LINEAR SLD STATE&SUPPLY | 1895.00 | 1689.50 |
| 234 SPEECH PROCESSOR | 139.95 | 130.50 |
| 214 ELECTRET MIC FOR 234 | 45.00 | 42.50 |
| 243 REMOTE VFO FOR OMNI | 189.95 | 177.50 |
| 283 REMOTE VFO FOR DELT | 189.95 | 184.50 |
| 209 300 WATT DUMMY LOAD | 26.00 | 24.50 |
| 645 ULTRAMATIC DUAL PADDLE KEYER | 85.00 | 81.50 |
| 670 SINGLE PADDLE KEYER | 39.00 | 37.50 |
| 208A NOTCH CW FILTER FOR ARGONAUT | 59.00 | 57.50 |
| OMNIC/HERCULES SPECIAL PACKAGE | 3625.00 | 2599.50 |
| 229 2 KW ANTENNA TUNER W/SWR BRIDGE (NEW) | 279.00 | 256.50 |

## VIC-20 MICROCOMPUTER

| | REGULAR | SALE |
|---|---|---|
| VIC-20 HOME COMPUTER 4K GRAPHICS/COLOR BASIC | 299.95 | 259.50 |
| VIC-1530 DATABETTE TPE RECORDER FOR VIC-20 | 75.00 | 69.50 |
| VIC-1515 VIC GRAPHIC PRINTER 80 COL 30 CPS | 395.00 | 348.50 |
| VIC1210 3K MEMORY EXPANDER CARTRIDGE | | 39.50 |
| VIC1110 8K MEMORY EXPANDER CARTRIDGE | | 59.50 |
| VIC1011A RS232C TERMINAL INTERFACE | | 49.50 |
| VIC1112 IEEE-488 INTERFACE CARTRIDGE | | 99.50 |
| VIC1211A VIC 20 SUPER EXPANDER/HI RES GRAPHICS | | 69.50 |
| VIC1212 PROGRAMMERS AID CARTRIDGE | | 59.50 |
| VIC1213 VICMON MACHINE LANGUAGE MONITOR | | 59.50 |
| VIC1901 VIC AVENGERS CARTRIDGE | | 29.50 |
| VIC1904 SUPERSLOT CARTRIDGE | | 29.50 |
| VIC1906 SUPER ALIEN CARTRIDGE | | 29.50 |
| VIC1907 SUPER LANDER CARTRIDGE | | 29.50 |
| VIC1908 DRAW POKER CARTRIDGE | | 29.50 |
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# Double Trouble on 50 MHz

## —Home-Brew Contest runner-up

**Ed. Note: KL7GLK's article was the runner-up in our Home-Brew Contest. Larry will be receiving a $100 bonus in addition to his normal article payment.**

*Larry Jack KL7GLK*
*1 East Lake Drive, Bay Ridge*
*Annapolis MD 21403*

"That's *milli*watts," I explained to the Florida station. It's okay, I thought; three of his neighbors had missed the milli part the first time, too, or maybe they just didn't believe it. The truth was that I was just as surprised as I talked to one six-meter station after another on less than one quarter of a Watt. True, the band was hopping with summer E skip, but that didn't diminish my thrill of working QRP DX.

I was using a little double sideband transmitter I'd originally designed for the license-free 49-MHz band. For you fellow Forty-Niners, it works quite well there (reduce the input to 100 mW). It has been heard over 25 miles. When six opens up and the ham in you returns, changing the crystal to 50 MHz is when the fun really begins.

### Circuit

The transmitter centers around an active balanced modulator fed by a crystal oscillator. Two stages of linear amplification result in a signal of 250-400 mW with a carrier suppression on the order of 40 dB. I have had mixed results with passive diode ring modulators at 50 MHz. Carrier suppression is tricky. This active design, however, tunes cleanly right from the start and should present no tune-up difficulties.

The oscillator is a particular gem. The credit goes to K1CLL (May, 1970, *73*) for such a trouble-free design. L1 is 15 turns of #30 enamel wire close wound on a 3/8-inch-diameter slug-tuned form. The crystal tap is 5 turns from the collector end of Q1. The oscillator feeds the emitters of the balanced modulator through a resistor network. R1, a 2.5k trimpot, is used to null the carrier. L2 is also a 3/8-inch-diameter slug-tuned coil, but it is center-tapped, 24 turns of #26 enamel wire. L3 is six turns of insulated hookup wire wound over the center portion of L2.

The audio stage that drives the modulator is a salvaged amplifier out of a defunct tape recorder. Any 1-Watt amplifier will work fine. There are so many inexpensive sources of these amplifiers that it does not pay to spend the time building one yourself. T1 is the normal output transformer that once fed a 16-Ohm speaker. If all that is available is an 8-Ohm output transformer, it will work, but it will not give as much drive. A speech clipper using a pair of 1N695 diodes

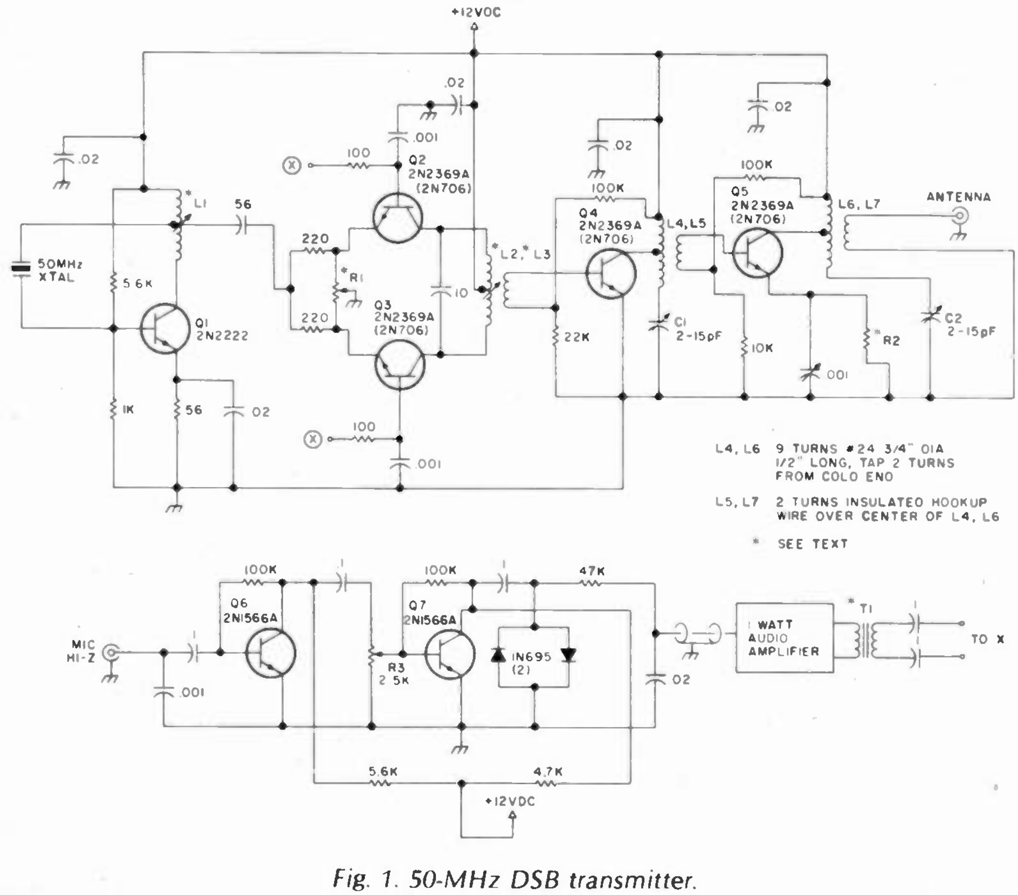



*Fig. 1. 50-MHz DSB transmitter.*

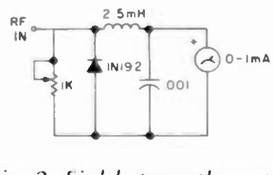



*Fig. 2. Field-strength meter.*

limits the audio frequency response. This feeds into the input of the audio amplifier. Q4 and 5 are biased as linear amplifiers; depending on the value of R2, the input can vary from a few milliwatts up to 400.

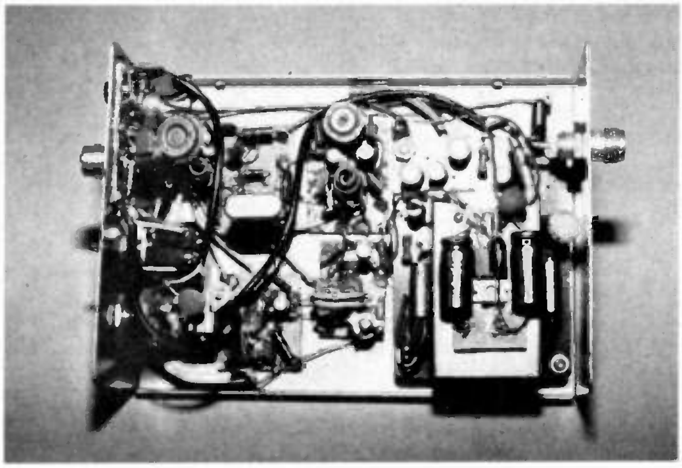
### Tune-Up

I have found using a field-strength meter (FSM), Fig. 2, the easiest way to tune up this transmitter. Power is applied to both the oscillator and the balanced modulator, but disconnect the audio stages. Clip the FSM to one side of the emitters of Q2 or 3 and adjust L1 to maximum. Remove the meter and attach it to the base of Q4. Adjust L2 for maximum, then R1 for a minimum reading. It should be possible to achieve a deep null by alternating the tuning of R1 and L2. This will adjust the level of carrier suppression. Remove the FSM and apply power also to the audio stages. With a 50-Ohm ½-Watt resistor as a dummy load and the FSM attached to the output at L7, apply a tone (i.e., whistle into the microphone) and adjust C1 and C2 for maximum.

You're ready to go on the air.

### Life On DSB

If you've never operated DSB before, be prepared for some strange signal reports. Most stations will not be able to tell a difference between DSB and the other SSB signals on the band. A few will be confused by that extra sideband . . . Ah, but that only makes things all the more exciting. Wait until the other guy also finds out it's only a quarter Watt of power. You'll have no end of interesting QSOs after that. ■



*Six-meter DSB transmitter in a minibox.*

**Parts List**

**Transistors**

Q1 2N2222 HEP equivalent HEP55
Q2-5 2N2369A (2N706) HEP equivalent HEP50
Transistors came from a "grab-bag" from Poly Paks, Inc., Lynnfield MA. Priced individually from a parts house as HEP equivalents, approx. $1 each.

**Crystal**

50-MHz 3rd overtone in HC6/U holder
Available from Jan Crystals, PO Box 06017, Fort Myers FL 33906.

**Capacitors**

C1,2 Johnson air variables 1.7-14.9, miniatures, type T-6-5
Available from Semiconductors Surplus, 2822 North 32 St., Phoenix AZ 85008.
10 pF silver mica
56 pF silver mica
From the same source above.
6 .02 uF ceramic capacitors
General capacitor assortments from Poly Paks or Radio Shack; values from .005 to .01 work fine.
4 .001-uF ceramic capacitors
Same sources as above; values .001-.005 uF work fine.
5 .1-uF ceramic capacitors
Same sources as above; values .01-.1 are suitable.

**Resistors**

1 56 Ohms
2 100
2 220
1 1k
1 4.7k
2 5.6k
1 10k
1 22k
1 47k
4 100k
All these are 1/8-Watt 10% carbon resistors. From grab-bag assortments from Poly Paks. Available also from Radio Shack.

R1, 3 2.5k miniature trimpots
A-B type F number FR252U is the type used, although any small 2.5k variable resistor will work fine.

**Diodes**

1N695 SK3087, 1N914, 1N456, HEP 158 will also be suitable; from a grab-bag of diodes, silicon types.

**Coils**

L1,2,3 Salvaged iron slug-tuned coil; for number of turns, see text. Ramsey Electronics or Digital Research: Parts, PO 401247B, Garland TX 75040. Variable inductors for forms.
L4-7 Free-handed wound coils of #24 copper wire. See text.

**Audio Amplifier**

1-Watt audio amplifier with a 16-Ohm output transformer. Salvaged from a Radio Shack tape recorder. Any Hi-Z input audio amplifier with an 8-16-Ohm (see text) output transformer of approx. 1-Watt output is suitable (i.e., from a clock radio, portable AM/FM radios—hamfest materials).

**Miscellaneous**

Cabinet Small 5 × 7 × 3 inch metal box from Radio Shack.
BNC coax connectors
Microphone jack from Radio Shack
DPDT switch (for T/R)
Pilot lamp
PC board
Q6,7 2N 1566A RCA SK equivalent SK 3009

**RF tuning meter**

M1 Any milli- or microamp meter movement; can also be a multimeter attached to the diode-choke network.
RFC 2.5 mH Any surplus choke in this range; also jumble winding about 200 turns of #30 wire on a high value 2-Watt resistor will work. 2.5 mH choke from Radio Shack.
1N192 Can be any silicon diode. See above sources.

Stephen Gibson
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Hollywood CA 90038

# The $100 TVRO Receiver

## —Satellite Central, part IX

**Ed. Note: Part I of 73's "Cheap Trick" $100 satellite TV receiver series appeared in the August, 1982, issue.**

Building your first TVRO receiver can be fun if you start with a well-thought-out design such as this dual-conversion model by Dwight (Rex) Rexroad. Despite Cheap Trick's cost, you'll be surprised at the results. The proof is in the picture!

Last month, we covered the simple downconverter box which used cheap components to get the 3.7-to-4.2-GHZ TV satellite signals down to 500 to 1000 MHz i-f. See the diagram in Fig. 1(a). According to Rex, "The conversion gain of the tuner is about 10 dB. The levels into the i-f amp are not unlike those found in other receivers made today."

### Clever Construction Technique

Building a home-brew VHF device such as this has its own set of problems. Because this will probably be a one-of-a-kind unit, it doesn't make a lot of sense to sit still long enough to engineer a PC board layout. Likewise, the Vectorbord® point-to-point wiring technique can eat time like a parking meter. So Rex applies a secret used by many VHF experimenters. The entire baseband unit is built on copper-clad perfboard, which is ideal because you put the clad portion on the top and do the wiring on the bottom (see Photo B). Says Rex, "I've got this humongous ground plane there. Anywhere I want to ground, I just stick a wire in a hole and solder." A hole that must allow a wire to pass through is cleared of excess copper with a ¼-inch drill bit operated by hand. This trick not only saves time, but keeps even the most cantankerous VHF circuit from running off on its own. As Rex says, "This is not a critical receiver. You've just got to apply good layout, grounding, and short leads."

### Bandpass Filter

Rather than use adjustable coils in his filter (see Fig. 2), Rex chose to use fixed coils and adjustable

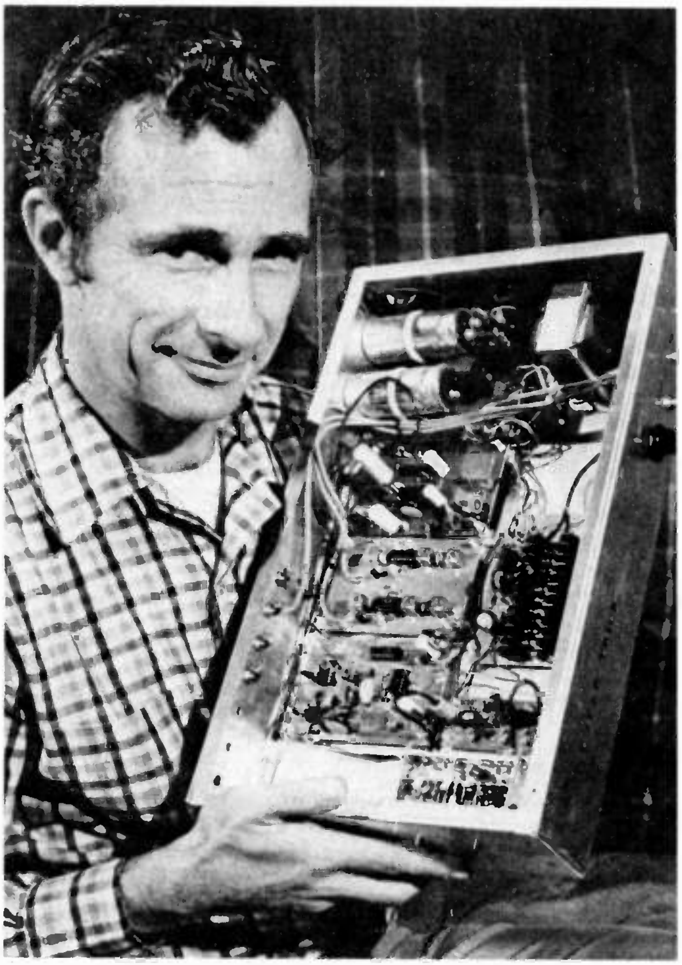

*Photo A. Dwight Rexroad with his $100 receiver.*

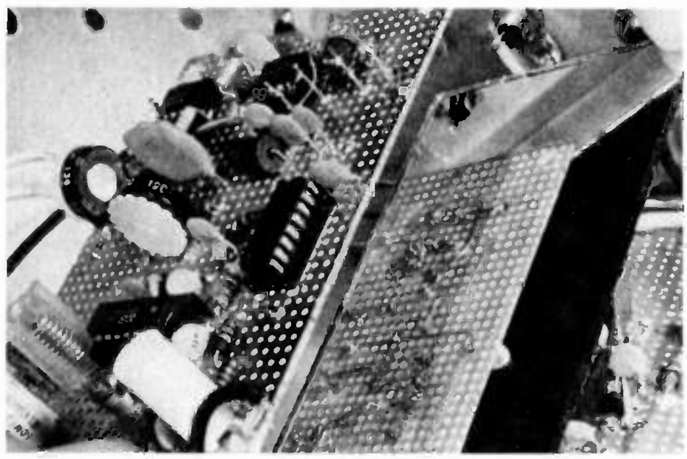

*Photo B. Believe it or not, everything is socketed. No problem at 70 MHz as long as you have a large groundplane nearby. The mirror in the photo shows the wiring below the groundplane.*

capacitors to save money. For a further saving, Rex suggests you buy the coil assortment sold by Radio Shack and rewind your own. Or you can use the Amidon T-50-6 cores.

Rex comments, "Design-wise, the filter is similar to that by Taylor Howard. Alignment is best done with a sweep generator, because you'll go crazy using anything else. The ideal curve would be flat as a pancake from 55 MHz to 85 MHz. Try to keep it especially flat from 60 to 80 MHz for best results. I'd like to make a nonadjustable filter work. Maybe I'll figure one out with Cheap Trick II."

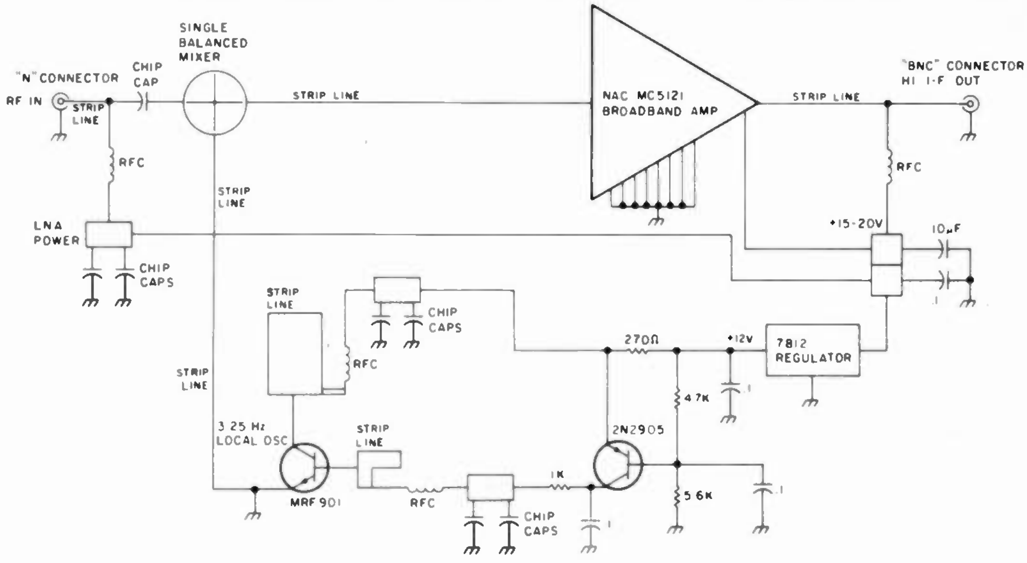


*Fig. 1(a). A fixed-frequency local oscillator drives a balanced mixer in the first conversion stage of the Cheap Trick receiver. The MC5121 amplifier drives a modified UHF TV tuner where the signal is downconverted again. This circuitry was described in last month's edition of Satellite Central.*

## Get Out of the Mud

Moving on to the 70-MHz i-f amplifier in Fig. 3, we find that Rex did what every TVRO designer should have done in the begining—He used off-the-shelf parts. Here's a perfect example: He used the readily available MC1350. This is the workhorse i-f amplifier used in many TV sets and bootleg subscription-TV decoders built today. With a cost of only $1.38 and easy availability, it's a natural. The input impedance of an MC1350 is more than 1k, so Rex put a 75-Ohm resistor on the input to properly terminate the i-f filter.

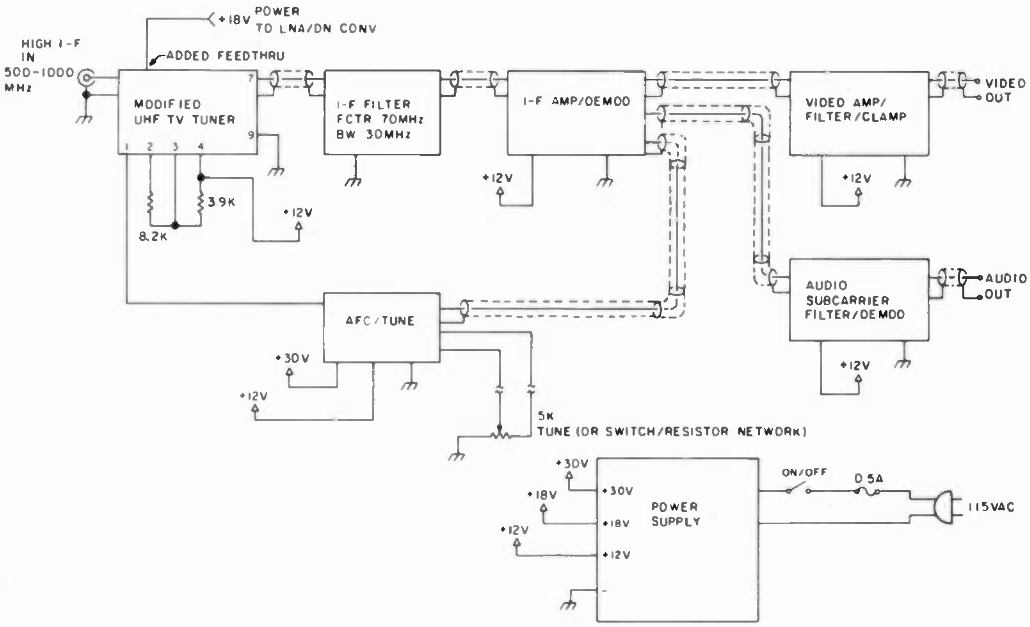


*Fig. 1(b). The baseband circuits consist of off-the-shelf ICs.*

"At 70 MHz, the MC1350 has about 20-dB gain in the broadband mode. Of course, they run much better at 45 MHz where you find them in your TV. The MC1350 has both differential inputs and and outputs. One differential input is bypassed to ground. Pin 5 is the i-f gain-control input. Like everything else in this circuit, it is bypassed." Later on, you can feed your agc into this pin. If you were to try your hand at using a 564 PLL detector, you might have to put the control on the front panel since the 564 is level sensitive. On the other hand, using the nifty MC1357 quadrature detector can make the i-f gain a simple "set and forget" operation.

Rex suggests using peaking coils on the differential output because he found an expected gain slope. "It starts around 20 MHz and goes downhill pretty fast. I have a sweep of it running from 10 to 100 MHz. It's a nice diagonal line!" Putting .18-uH coils on the 220-Ohm load resistors will peak the MC1350 on 70 MHz. The 500-pF coupling capacitors are not critical.

The other parts values in the circuit are right out of the Motorola handbook. "I use Amidon slip-on ferrite beads. A bagful of beads is a lot cheaper than a batch of chokes. You don't need large inductance values here, not at 70 MHz. A bag of beads is only a buck, and one sack will do."

The second stage, like the first, uses typical book values. The gain resistor on pin 5 is the current-limiting resistor value for a maximum gain. It's just that simple. Interestingly enough, Rex found that grounding pin 5 on the MC1350 did not produce maximum gain. Instead, it produced less. But start to add some resistance at pin 5 and the gain will rise to maximum at about 5.2k Ohms. The output feeds a broadband transformer wound on still another ferrite bead.

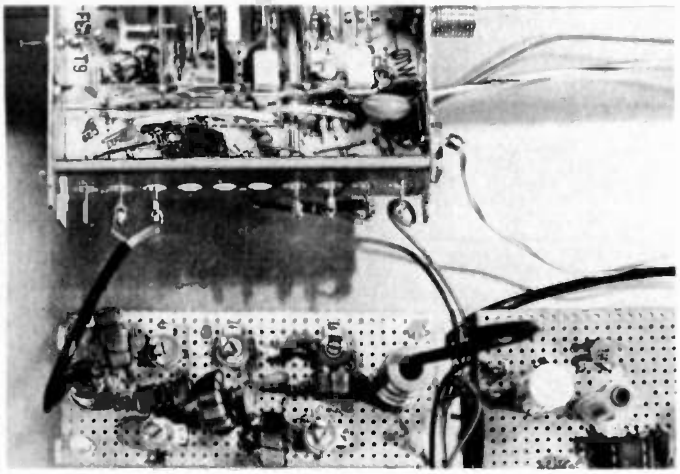

Photo C. You can get away with RCA jacks on the 70-MHz filter, seen below the UHF tuner.

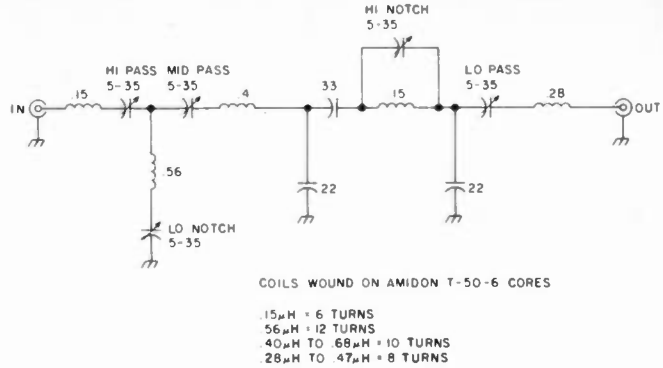


Fig. 2. Diagram of the 70-MHz filter. The circuit uses adjustable capacitors for tuning.

The diodes on the secondary afford an excellent spot to attach a 1-mA carrier meter for antenna aiming, tune-up, an S-meter, or even agc. Here's a typical place where Rex applied excellent engineering technique. Previous designs had used a small capacitor and a series resistor to feed the diodes. A few moments of thought brought Rex to the conclusion that what is really needed is just a single capacitor with about the same series reactance as the resistor. This will allow you to eliminate the resistor (one less part) and get exactly the same results! "I can't help it," says Rex, smiling. "This project must be truly cheap."

## Divide the Headache in Half

Back now to the rf transformer. The secondary feeds one half of a 74S112, a divide-by-two circuit which shifts the 70-MHz signal down to 35 MHz where the detector can deal with it better. The 500-Ohm pot was chosen as a good value to make adjustment easy. "Despite the doubters, it works like a charm. The adjustment is not critical. All the pot does is set the bias for the trigger input. Just find a weak signal, and tweak for minimum sparklies. The symmetrical gain limiting in the previous stages (not found in all satellite i-f amplifiers) makes this adjustment very easy."

Perhaps you've noticed that the 74S112 is running from a 12-volt supply. Impossible? Probably. Instead, the voltage-divider combination of the 500-Ohm pot and the 180-Ohm dropping resistor set the Vcc for the chip to about 5 volts. Those of you who handle workhorse ICs such as this know that you can fiddle with the voltage nearly a volt either way and not see any big problems. This technique saves the cost of a zener diode. And the brand of IC doesn't matter. It costs less than a buck. Just be sure to use a 74S112 rather than a 74LS112 which may only make it to 50 MHz.

## Some Receivers Look Bad, But Not This One

Gain margin in this system is about 20 dB. If the input level to the divide-by-two circuit changes radically, you will need to readjust the pot. "That's what happens with so many of the typical divide-by-two designs used in receivers today," comments Rex. "If you transport them from one dish/LNA setup to another, you may need to reset the threshold. Still, it's not as critical as a design that uses the 564 PLL.

"The signal level on the output of the 74S112 should be peak-to-peak just under 5 volts. A flip-flop

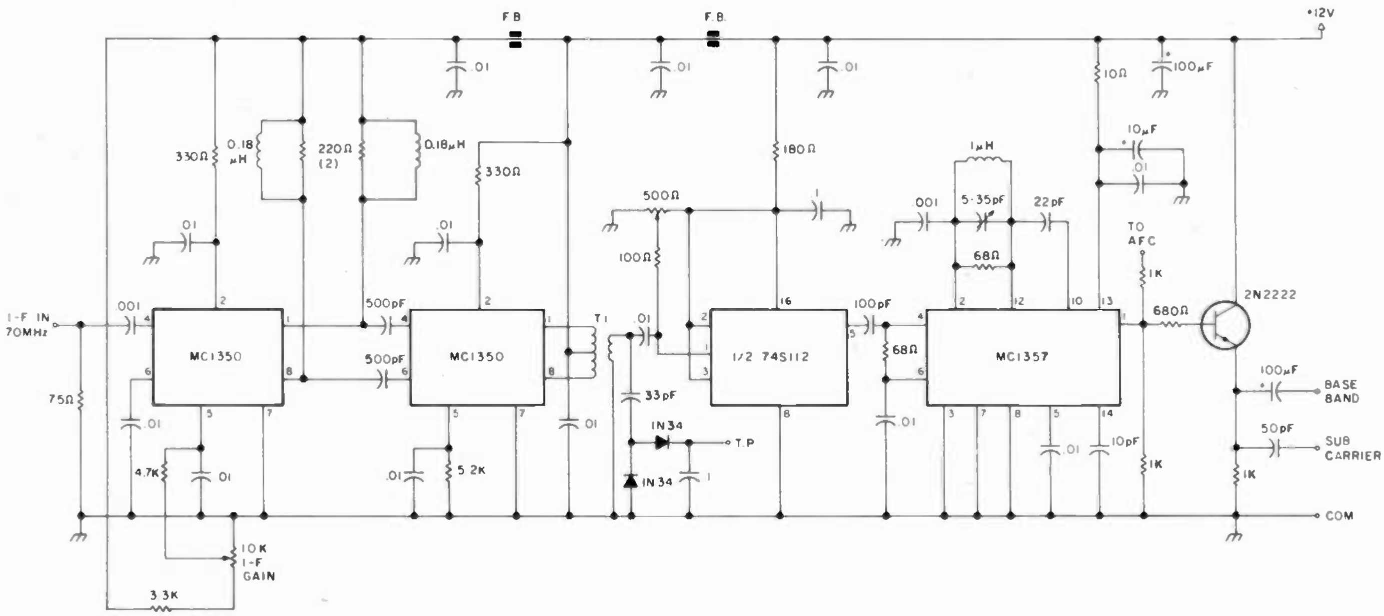


Fig. 3. Bargain-basement ICs highlight this baseband design. The MC1357 quadrature detector produces a better picture than most PLL detectors. T1: pri.—4 trifilar turns; sec.—2 trifilar turns; #28 wire, Amidon 101-43 bead.

running at high speeds usually does that," comments Rex. "Funny thing is, the MC1357 detector that follows has about 40 dB more gain, so we've got to swamp it down on the input with a 68-Ohm resistor. It really doesn't seem to matter much value-wise.

"The input to the MC1357 is differential so we bypass one and use the other. The only critical thing about the detector is that you must use short leads, especially to ground. Pin 5 has a bias de-emphasis capacitor with pin 14 acting as high-frequency de-emphasis. We don't get around to true video de-emphasis until later. The output stage has a tendency to oscillate at deviation extremes. You wouldn't hear it at audio, but you'd see it in video. So I've got that 10-pF cap which rolls us off at the high end just a bit, but not enough to suck out the subcarriers. Use a twisted-wire gimmick if you want." Rex believes you could even forget the cap if you don't mind knowing that your sync tips will look dirty.

### Avoid Oscillation

It must be remembered at this point in the description that this is indeed a VHF device. Using little 10-pF caps won't mean a thing if your lead dress is long and sloppy. Chances are it won't work at all. If you do build the unit on perfboard, be sure to keep everything short. A sure sign that lead dress needs attention will be poor high-frequency response. Use plenty of bypasses such as on pin 13 of the MC1357 where parasitics can occur. Interestingly enough, oscillation at this point will likely come from the amp in the chip itself rather than the i-f amps. Like everything else in Cheap Trick, the cost of the MC1357 is less than that of the popular 564 PLL—about $1.50.

The quadrature coil on pins 2 and 12 is very noncritical. Rex comments, "The S curve is wider than the bandwidth we want, so all you'll get if you mistune it is an offset dc output. It could be a problem when you add the afc loop. Another symptom is that the picture will be a little bit washed out. But you'd have to mistune it radically for that to happen!"

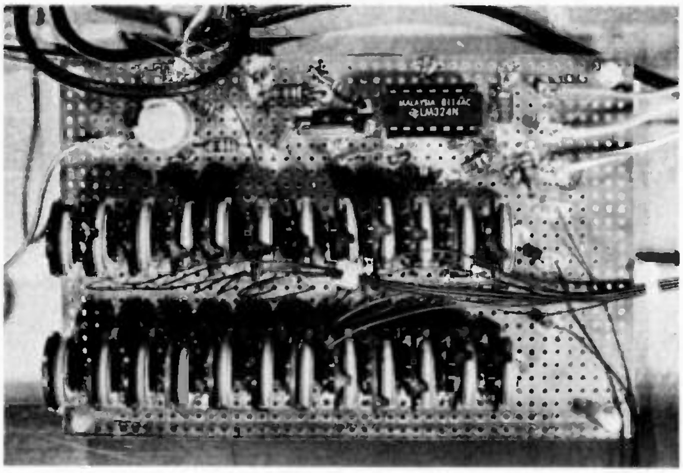

*Photo D. Tune like the pros with a rotary switch thanks to a stable design and afc loop. Buy the pots at a swap meet to keep the total receiver cost from inching past $100.*

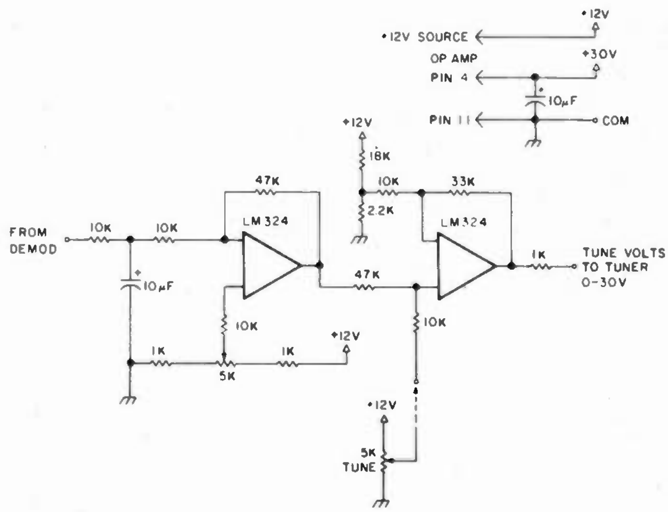


*Fig. 4. This simple afc loop circuit samples the detected video offset to control the UHF tuner local oscillator.*

The tune/afc circuit in Fig. 4 is simply a feedback loop. Rex filters the video with an RC network. He used an LM324 wired to the single-ended 30-volt supply. A 5k pot on the non-inverting input not only sets the output to zero volts, but compensates for the discovery that the MC1357 detector doesn't always yield an output at exactly half the supply.

The second amp mixes the 5k tuning control with the afc feed to control the UHF tuner. The resistive divider on the inverting input allows the amplifier to develop a zero voltage output which is necessary for the UHF tuner range. The LM324 is one of the few amps that can work at these voltages. And you still have 2 unused amps in the chip which can be for optional metering or agc circuits.

If you find a deal on small 5k pots somewhere, Rex suggests you mount a batch of them on a board as seen in Photo D and feed a rotary switch to get decent tuning. This method works very well thanks to the good stability of the design and positive action of the afc circuit.

### Video Magic

The detector output is fed into an emitter follower (a 2N2222 costs 10 cents) where the baseband video feeds a 100-uF capacitor. The sound subcarrier signals are fed from the same point through an RC high-pass filter to the detectors. Moving on to the video circuit in Fig. 5, the 75-Ohm video de-emphasis circuit that follows is unique because it uses fewer parts and does essentially the same thing as commercial designs. More importantly, Rex says, "it uses parts that are closer to standard values than other designs. You can buy all the parts over the counter."

The pi network that follows acts as a low pass to yank out the sound subcarriers and noise. The 75-Ohm resistor that follows acts as a proper termination to ensure that the standard values you use will get the same response. The signal is dc-coupled into a 733 video amplifier which also has a differential input. Because Rex used a single-ended supply, he used a voltage-divider network to feed the inputs. The 10-uF capacitor in the divider is necessary because the signal has a lot of low-frequency components. The 10k pot acts as a gain control and should give you enough control for even half transponder video levels. "The 733's minimum gain is higher than the 592. That's the only difference I can tell," says Rex. "They both cost about a buck. Performance-wise, it's a toss-up. I use the flat-pack versions. You could skip the video polarity switch since a jumper will do."

### Getting a Perfect Picture

The clamp circuit re-

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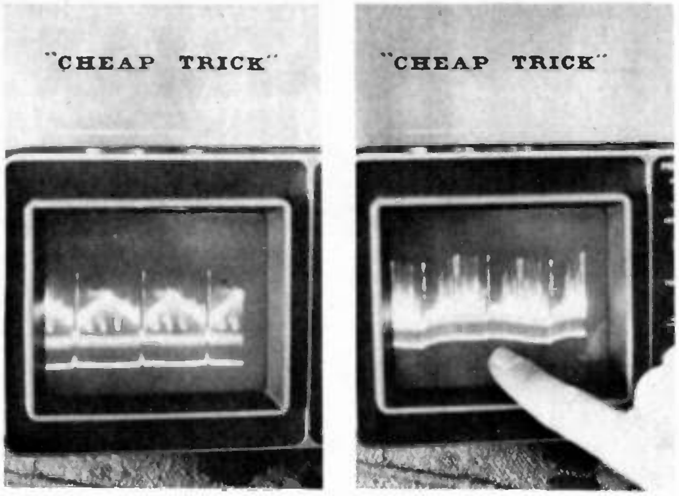


*Photo E. Tweaking the clamp-circuit coupling capacitor will reduce picture flicker, but it may also affect the video baseline (seen at right).*

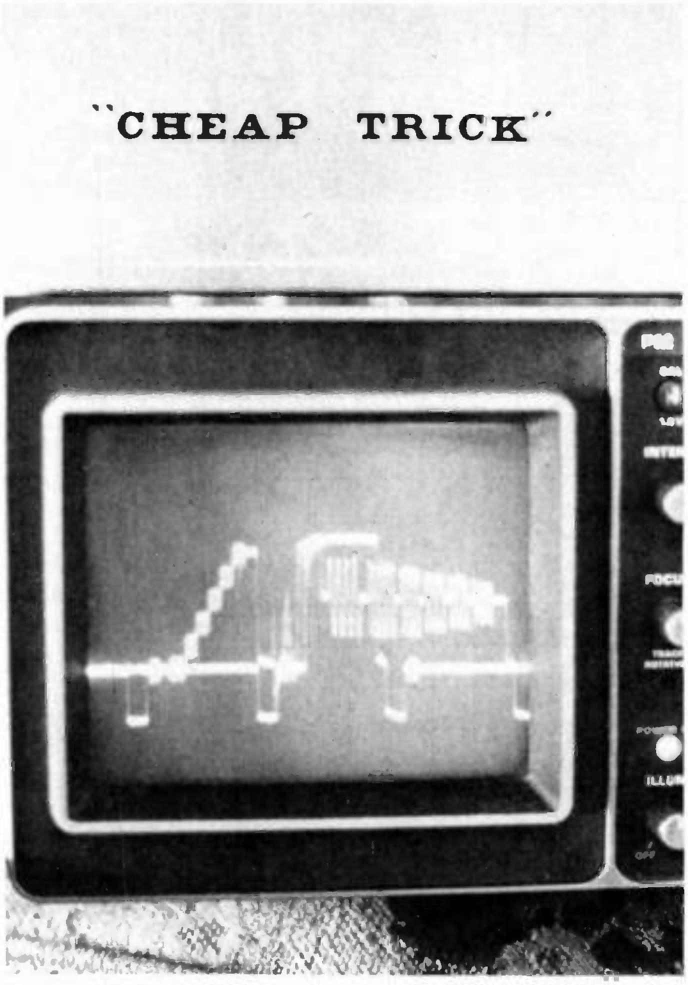


*Photo F. The proof is in the pudding. This multiburst display from Satcom 3 shows that the receiver high-frequency response is none too shabby.*

moves the frequency-dispersion waveform from the signal. This is a common design used in many receivers today and is described by Lancaster in the *Cheap Video Cookbook*. "It doesn't work perfectly. You can make some trade-offs. If you are getting too much flicker in the picture, you can lower the value of the 1-uF cap feeding the diodes." Rex goes on to say that, "too much reduction in that value will produce a large amount of tilt in the vertical interval." This means the idea is fine unless you want to chase data hidden in the vertical interval later on (see Photo E). Most TV sets don't see the tilt, but a high-speed data comparator will. The last emitter follower has a low output impedance, so a terminating resistor is placed in series. It works well with cable lengths up to 50 feet without ringing. The final output high-frequency response can be verified by looking at the multiburst waveforms in the vertical interval of some transponders. You'll be amazed at the quality of this receiver as seen in Photo F.

The sound demodulator in Fig. 6 is straight out of your typical 4.5-MHz TV set sound section with a clever trick to make it work slightly better and still use cheaper parts! Rex uses input transformers that are the surplus 10.7-MHz i-f types found in cheap portable FM sets. They are retuned to 6.8 MHz, the most often used sound frequency. "A common source is Poly Paks where they cost about 28 cents apiece!" You may find that you'll need to adjust the values of the parallel 56-pF caps from 50 to nearly 120 pF to get the entire range of possible subcarrier frequencies. See Satellite Central VI and VII for more background on subcarriers.

The transformers are wired back to back on the input. The signal feeds the low-impedance winding from the 50-pF cap back into the video demodulator. The circuit then becomes a conventional bandpass with the output low-impedance winding of the second transformer feeding the input to the CA3065 FM quadrature sound demodulator. "This configuration works very nicely since they were designed that way. There are a lot of 4.5- and 10.7-MHz circuits out there using these parts," comments Rex. "The circuit is right out of the handbook. I use the same value of quadrature tuning cap (82 pF) which seems to hold over the band. I was just too cheap to use a coil in the

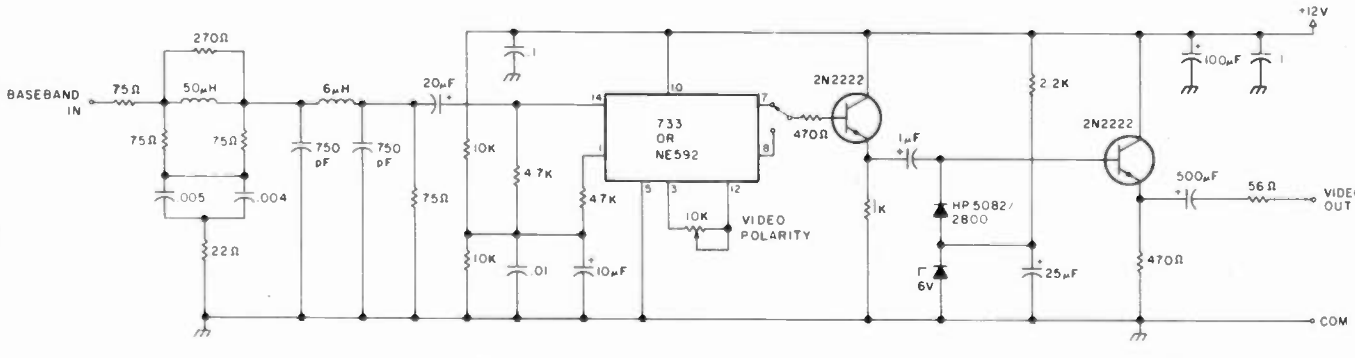


*Fig. 5. Easy video processing with a standard component low-pass filter, clamp circuit, and video DA.*

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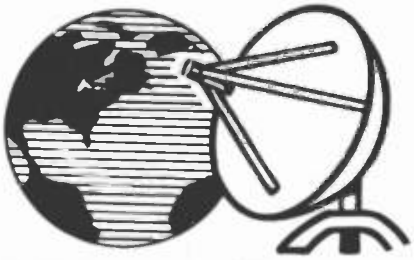

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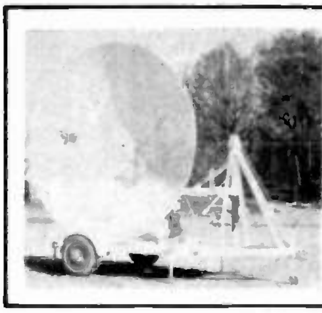

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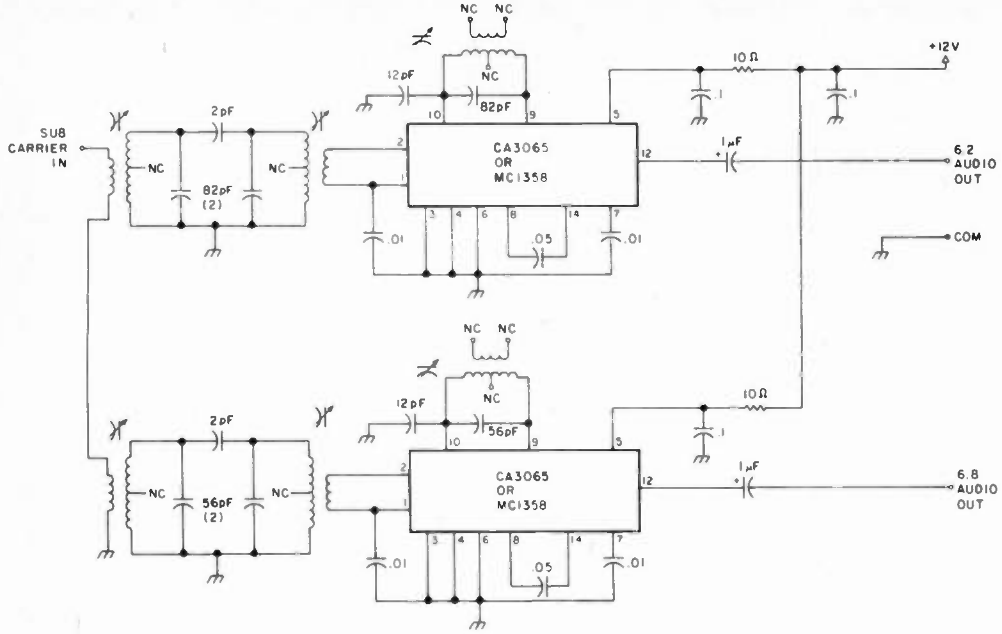


*Fig. 6. The subcarrier sound detector uses a single TV sound section IC. Good sound quality results from using cheap FM i-f transformers in a bandpass network on the input.*

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# Digital Basics

## —part I

*Joseph J. Carr K4IPV*
*5440 South 8th Road*
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Digital electronics has hit amateur radio—and hobby electronics in general—in a big way! This field of electronic endeavor was once the province of a few freaky computerniks, military electronics technicians, and industrial electronics types, but today, *none* of us can safely ignore digital electronics.

Digital electronics is, in a way, actually simpler than conventional analog electronics because the digital logic devices recognize only two states, i.e., ON and OFF. This fact makes digital circuits similar to relays and mechanical switches. Simple, huh? In fact, some digital circuits are little more than high-frequency electronic versions of simple switches. It is my opinion that anyone who can understand simple relay and switch circuits also can understand the basics of digital electronics! Certainly anyone who can understand the vagaries of single-sideband and FM communications equipment will be able to understand digital electronics.

In this three-part series, we will explore the various forms of IC logic elements: gates, flip-flops, and multivibrators. In this first installment, I am going to give some basic definitions, introduce you to the popular IC-device families, and explore the principal forms of logic gates.

### Logic States

I have mentioned that digital circuits respond only to two different input states—ON and OFF—which can be called 1 and 0 (after the two permissible digits of the *binary*, i.e., base 2, number system), HIGH and LOW, or (in older textbooks) "true" and "false." These designations are used to refer to two different voltage levels. In this article, I will stick to the HIGH/LOW designation because it will graphically describe what is actually going on in the circuit.

Transistor-transistor logic (TTL) responds to 0 and +5 volts for the two logic levels. If any other voltage levels are used, then the TTL device will either (1) fail to work, (2) work unpredictably, or (3) burn out (ZZZAPPP!).

Fig. 1 shows the TTL logic levels.

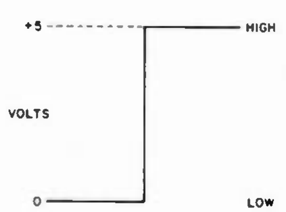


*Fig. 1. TTL logic levels: 0 volts is LOW, 5 volts is HIGH.*

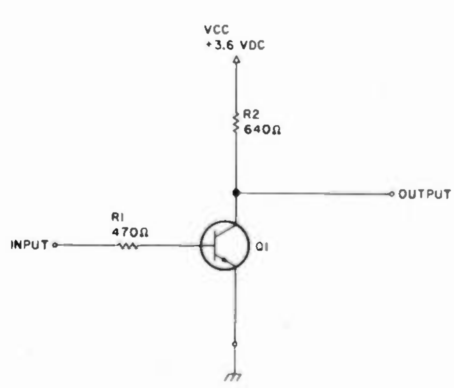


*Fig. 2. This typical RTL (resistor-transistor logic) inverter circuit produces a LOW output when the input is HIGH. A LOW input is accompanied by a HIGH output. For RTL, 0 volts is LOW and 3.6 volts is HIGH.*

### Positive and Negative Logic

You may sometimes hear the terms positive logic and negative logic. These terms sometimes tend to confuse the newcomer; they mean nothing more than how the HIGH and LOW *logic states* are related to *voltage levels*. In *positive logic*, the HIGH is logical 1 and will be a positive voltage (e.g., +5 volts in the case of TTL). The LOW, logical 0, is the 0-volts condition (e.g., in TTL). Logical 0 may be a negative voltage in some CMOS circuits. In *negative logic* these designations are reversed (i.e., HIGH = logical 0 and LOW = logical 1). In the vast majority of uses, positive logic is specified. In fact, the descriptive names given to digital IC devices reflect a bias toward positive logic. This potential confusion is why I prefer HIGH/LOW designations. The 1/0 designation will be reserved for the illustrations and truth tables . . but keep in mind that *positive logic* is used unless otherwise noted.

### Logic Families

A *logic family* is a series of IC devices that may easily be interconnected and which use similar technology in their construction. All of the devices within a given family will have the same input and output circuits, so that direct interconnection is possible.

The only major consideration is whether an output can supply sufficient current to drive all of the inputs that are connected to it. But in any given logic family, output voltage and current levels and input voltage and current requirements are fixed by agreement. They are defined in terms of units of *fan-in* and *fan-out*. This unit is the current requirement of a single standard input at the fixed voltage level. Such an input has a fan-in of *one unit*. If an IC is said to have a fan-out of, say, five, it will *drive five standard inputs*. The device, therefore, can supply sufficient current to drive all five inputs satisfactorily. The total fan-in of all devices connected to any output must be equal to, or less than, the rated fan-out of the output.

The logic families which we will consider are: RTL, DTL, TTL, HTL, ECL, and CMOS. Of these families, CMOS and TTL are the most popular today; RTL and DTL are obsolete and no longer used in new designs. Plenty of older equipment still in use, however, contains RTL and DTL devices.

### Speed vs. Power

The principal factors governing the speed (i.e., maximum operating frequency) of a digital IC are the internal resistances and capacitances. If resistances are increased so that power consumption drops, then the RC time constant of the device is longer. Long RC time constants mean slower operating speeds. As a general rule, higher-speed logic families require greater power consumption. CMOS devices, which require very little current (hence are low power), operate well only to 4 or 5 megahertz (MHz), with some devices tooting along to 10 MHz. TTL devices, on the other hand, usually work to 18 or 20 MHz, with some devices operating to well over 80 MHz.

### RTL Devices

Resistor-transistor logic (RTL) is an obsolete logic family that was popular in the early to mid-60s. Fig. 2 shows a typical RTL inverter circuit, i.e., a circuit that produces a LOW output when the input is HIGH and a HIGH output when the input is LOW.

RTL logic IC devices used 0 volts for logical 0 and +3.6 volts for logical 1. If the input of the RTL inverter is grounded (i.e., placed LOW), then the output voltage will be HIGH, which in this case means +3.6 volts. But, if the input voltage is +3.6 volts, then the output will be 0 volts.

RTL devices usually carry type numbers in the uL900 range (mostly 8- and 10-pin metal cans) and MC700 series (mostly 14-pin DIPs).

### DTL Devices

The next popular IC logic family was the diode-transistor logic (DTL) family. These devices operated at speeds greater than most RTL devices. Fig. 3 shows a typical DTL inverter.

When the DTL input is HIGH, diode D1 is reverse-biased. In that condition, R1 will forward-bias transistor Q1, which in turn forward-biases D2 and Q2. Voltage levels in most digital circuits are selected to *saturate* the transistors, so when Q2 is turned on, it is turned on to full saturation.

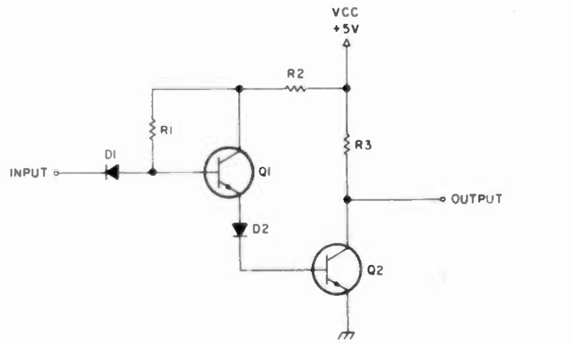


*Fig. 3. DTL (diode-transistor logic) offers better speed than RTL. A typical DTL inverter is shown here.*

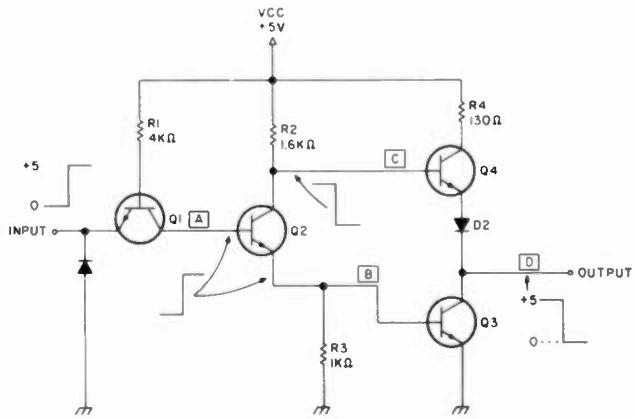


*Fig. 4(a). The TTL (transistor-transistor logic) family has LOW values ranging from 0 to 0.8 volts. HIGH is 2.4 to 5.0 volts. An inverter is shown here.*

This condition means that the output of the inverter, which is the collector terminal of Q2, goes nearly to ground. The actual voltage $V_{ce(sat)}$ of the transistor is on the order of a few tenths of a volt at most.

When the input is LOW, the cathode of D1 is grounded. Since D1 is now forward-biased, the base of Q1 is essentially grounded. Under this condition, Q1, D1, and Q2 are reverse-biased. With Q2 cut off, then, the output voltage rises to that of Vcc (+). Most DTL devices carry part numbers in the MC800 and MC900 ranges (Motorola designation).

### TTL Devices

Probably the most widely used digital IC logic family is the transistor-transistor logic (TTL) family. When most people speak of digital ICs, it is the TTL family of devices to which they re-

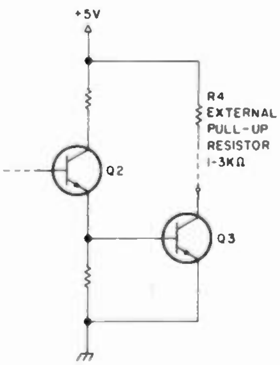


*Fig. 4(b). An open-collector TTL circuit results when the output circuit is simplified. An external resistor is needed between the output and +5 volts.*

fer. Most TTL devices carry type numbers in the 7400 range. (Those devices in the 5400 range are military equivalents to the 7400-series, i.e., a 5447 is a 7447 in uniform. The principal difference between the 5400 and 7400 devices is in the operating temperature range—0 to 80° C for commercial devices and −55 to +125° C for military devices.)

Fig. 4(a) shows the circuit for a typical TTL inverter IC. Like the DTL device, the TTL input acts as a *current source* while the output acts as a *current sink*. The typical TTL input will source 1.8 mA and will be LOW if the voltage is 0 to 0.8 volts and HIGH if 2.4 to 5.0 volts are applied. Performance at values of input potentials between 0.8 and 2.4 volts is not defined, so operation of the devices is unpredictable.

When the TTL input is HIGH, Q1 is cut off, so point A goes HIGH. This condition turns on Q2, forcing point B HIGH and C LOW. We find, then, Q3 is turned on and Q4 is off. This forces the output LOW. Again, the transistors are operated either totally cut-off or totally saturated-on.

If the input is LOW, then exactly the opposite situation occurs: Q1 is turned on (forcing point A LOW), Q3 is off, and Q4 is turned on, i.e., it is connected to Vcc(+).

TTL devices must have a regulated dc power supply of +4.75 to +5.25 volts. In fact, there are some circuits of combinations of devices that require a more limited range of voltages nearer to +5 volts dc. Voltages greater than +5.25 volts often result in a high failure rate of TTL devices.

Some TTL devices are described as being *open-collector* devices. These are essentially the same as regular TTL devices except that the output circuit is modified, i.e., Q4 and D2 are missing. An example of an open-collector circuit is shown in Fig. 4(b). These devices require an external 1k- to 2k-Ohm resistor between the output terminal and the 5-volt dc power-supply line.

Open-collector devices can be useful if you need to tie the outputs of two or more gates together or if you are driving something other than TTL.

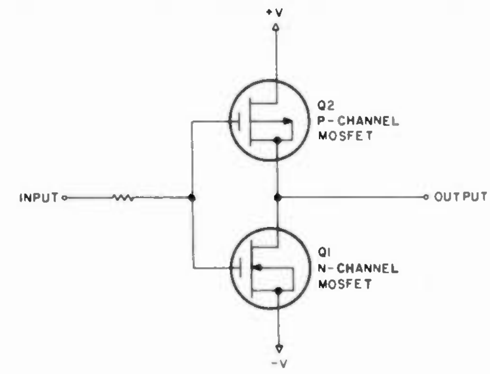


*Fig. 5(a). A typical CMOS inverter circuit.*

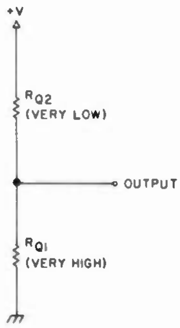


*Fig. 5(b). An equivalent circuit for LOW input, HIGH output.*

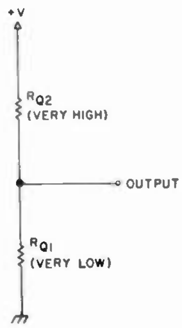


*Fig. 5(c). An equivalent circuit for HIGH input, LOW output.*

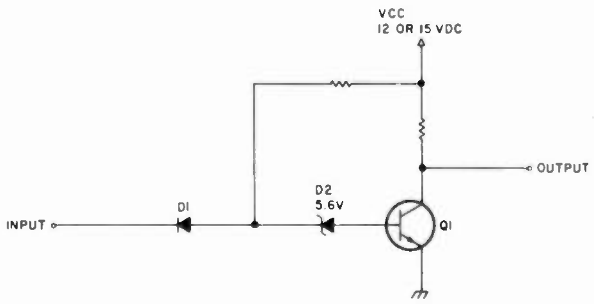


*Fig. 6. HTL (high-threshold logic) is useful in applications where noise pulses may be a problem.*

## CMOS Devices

CMOS IC devices use MOSFET transistors instead of the PNP or NPN bipolar transistors that are used in other logic families. CMOS inputs, therefore, offer a very high impedance. Fig. 5(a) shows a typical CMOS inverter circuit. Note that this family is called *complementary* because the output circuit consists of a complementary pair of MOSFET transistors, i.e., an n-channel and a p-channel in series.

CMOS circuits work over a wide range of voltages, with most devices using a LOW of 0 to 1 volt and a HIGH between 3 and 15 volts. The optimum power supply and HIGH value is usually between 9 and 12 volts. In some instances, a bipolar supply may be used.

CMOS outputs are not directly TTL-compatible, although some specific ICs in the CMOS line are designed to have a TTL-output stage (e.g., the 4049 and 4050 devices). These TTL-compatible devices are often used to directly interface CMOS and TTL devices.

Figs. 5(b) and 5(c) show the equivalent circuits for a CMOS inverter in both possible input conditions, i.e., input HIGH and input LOW. Recall that a p-channel MOSFET turns on when the gate is LOW, while the n-channel device turns on when the gate is HIGH.

Fig. 5(b) shows the situation in which the input is LOW. Transistor Q1 will have a very low (e.g., 200 Ohms) channel resistance. In this case, the output is equivalent to a 200-Ohm resistor to the V+ power-supply line.

In Fig. 5(c), we see the situation in which the input is HIGH. Transistor Q2 now has a very high channel resistance, and Q1 has a very low channel resistance (again, about 200 Ohms). In this case, the output looks like a 200-Ohm resistance to ground, so the output is LOW.

The CMOS ouput stage always looks like a high and low resistor in series across the power supply—see Figs. 5(b) and 5(c). The overall current drain, therefore, is very small.

But CMOS devices do have a problem: They contain MOSFETs, so they are sensitive to static electricity. All A-series CMOS devices (e.g., the 4001A) have this problem, but it is less severe in B-series (e.g., the 4001B) devices. The B-series have built-in diode gate-protection to bypass high static potentials around the sensitive gate structure. Even so, they should be handled with care.

## HTL Devices

Noise pulses often are seen by logic circuits as valid input pulses. This problem is especially bothersome in high-speed TTL devices that are normally able to pass high-frequency, short-duration pulses. The solution in noisy environ-

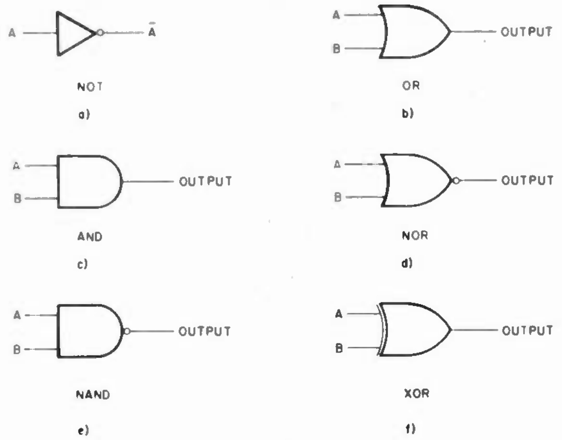


*Fig. 7. You can determine the function of a TTL gate by looking at its schematic symbol.*

ments is to use a digital IC logic family that requires a high input voltage to trigger. CMOS devices operated at high V− and V+ values meet this requirement, but the older bipolar *high-threshold logic* (HTL) may also be used (Fig. 6).

HTL (also sometimes called *high-noise-immunity logic*, or HNIL) uses V+ values of 12 or 15 volts depending upon the series. As a result, the logic levels also are high, so it requires a bigger noise pulse to cause trouble.

**Emitter-Coupled Logic**

Up until now we have been talking about *saturated* logic families, i.e., the transistors in the ICs are either all the way on or all the way off (cut off or saturated). *Emitter-coupled logic* (ECL) is called an ac logic family because the transistors are operated in a nonsaturated mode. As a consequence, ECL devices are capable of very fast operation. Most commonplace ECL devices operate to 80 or 120 MHz, while some costly special devices operate to over 1 GHz (that's 1000 MHz!). The usual *prescaler* for a digital frequency counter is nothing more than an ECL frequency divider that divides the 500-MHz input signal down to 50 MHz.

Note that it is necessary to use VHF/UHF circuit design and layout techniques when working with ECL devices. The very high frequencies used are, after all, in the UHF range.

**Gates**

A digital electronic *gate* is a circuit whose output is HIGH or LOW depending on the input. Gates operate under a set of well-defined rules. The basic forms of digital electronic gates are: NOT, OR, AND, NOR, NAND, and XOR (Exclusive-OR). In the paragraphs to follow, we will discuss all of these basic gates.

**NOT Gates**

NOT gates, also called *inverters*, produce an output that is the opposite of the input signal. Recall that digital circuits respond only to HIGH and LOW voltage levels. In an inverter circuit, therefore, the output will be HIGH when the input is LOW and LOW when the input is HIGH.

The circuit symbol for the inverter is shown in Fig. 7(a), while the truth table is given in Fig. 8(a). Note that any digital symbol with a *circle* on the output produces an *inverted* output. Similarly, if one or more inputs has a circle on it, then that input is inverted. The rules for the operation of the inverter are:

1) A HIGH on the input produces a LOW output.

2) A LOW on the input produces a HIGH output.

**OR Gates**

An OR gate will be HIGH if any of its input is HIGH. The symbol for an OR gate is shown in Fig. 7(b), while the truth table is given in Fig. 8(b). The truth table shows the rules of operation for the two-input OR gate, and these are summarized below:

1) If both inputs A and B are LOW, then the output is LOW.

2) If either input A or B is HIGH, then the output is HIGH.

3) If both inputs A and B are HIGH, then the output is HIGH.

**AND Gates**

The AND gate is the opposite of the OR gate. The AND gate produces a HIGH output only when *all* inputs also are HIGH. The circuit symbol for the AND gate is given in Fig. 7(c), and the truth table is shown in Fig. 8(c). The rules for the operation of the two-input AND gate are:

1) If both inputs A and B are LOW, then the output is LOW.

2) If either input A or B is LOW, then the output is LOW.

3) If both inputs A and B are HIGH, then the output is HIGH.

**NOR Gates**

The NOR gate is a combination of a NOT gate (inverter) and an OR gate, hence the designation NOR, which means NOT/OR. It is, therefore, an OR gate with an inverted output. The NOR gate is, in fact, sometimes represented in textbooks as an OR gate with an inverter following. The NOR gate symbol, shown in Fig. 7(d), is an OR gate symbol with the circle denoting inversion at the output. The truth table for the two-input NOR gate is shown in Fig. 8(d), and the rules for its operation are summarized below:

**(a) NOT**

| Input | Output |
|---|---|
| 1 | 0 |
| 0 | 1 |

**(b) OR**

| Input A | Input B | Output |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

**(c) AND**

| Input A | Input B | Output |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

**(d) NOR**

| Input A | Input B | Output |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 0 |

**(e) NAND**

| Input A | Input B | Output |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

**(f) XOR**

| Input A | Input B | Output |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

*Fig. 8. Understanding a truth table is the key to using logic devices. The 1 designates a HIGH state and the 0 designates a LOW one.*

1) If both A and B inputs are LOW, then the output is HIGH.

2) If either input A or B is HIGH, then the output is LOW.

3) If both inputs A and B are HIGH, then the output is LOW.

**NAND Gates**

The NAND gate is a NOT/AND gate, i.e., an AND gate followed by an inverter. The symbol for the NAND

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gate is shown in Fig. 7(e). This symbol is the AND gate symbol with the circle at the output to denote inversion. The truth table for the two-input NAND gate is shown in Fig. 8(e), and the rules are presented in summary below:

1) If both A and B inputs are LOW, then the output is HIGH.
2) If either input A or B is LOW, then the output is HIGH.
3) If both A and B are HIGH, then the output is LOW.

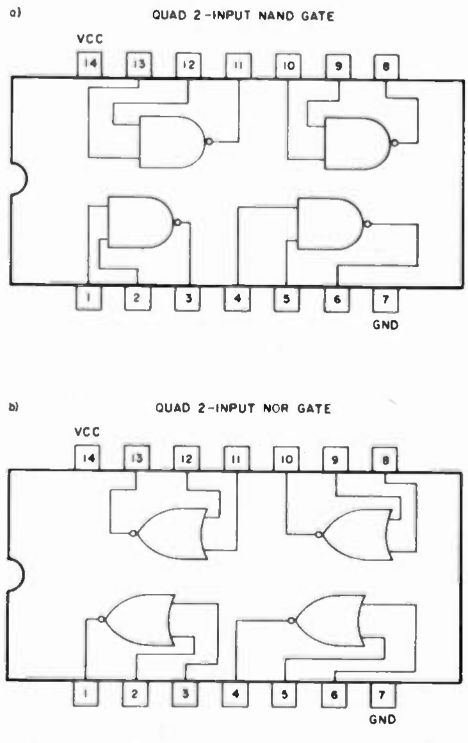



*Fig. 9. A chip may contain as many as six individual gates.*

### XOR Gates

An Exclusive-OR (XOR) gate is like the OR gate discussed earlier except that it will have a LOW output if more than one of its inputs is HIGH. For a HIGH output, there must be one exclusive HIGH input. The XOR gate symbol, shown in Fig. 7(f), is a modified OR gate symbol. The XOR operation is summarized by the truth table in Fig. 8(f) and the rules below:

1) If A and B are both LOW, then the output is LOW.
2) If A is HIGH and B is LOW, then the output is HIGH.
3) If B is HIGH and A is LOW, then the output is HIGH.
4) If A and B are both HIGH, then the output is LOW.

### TTL and CMOS Examples

Earlier in this article, I introduced you to several different families of IC digital-logic devices. Of these, several are considered obsolete, so they will not be discussed further. The TTL and CMOS families, however, are very much alive and form the basis of most digital projects today.

### TTL/CMOS NAND Gates

In the TTL IC logic family, the most popular NAND gate (and probably the most popular IC) is the 7400 (see Fig. 9). This device contains four two-input NAND gates and usually sells for less than 25¢—or around six cents per gate. Each of the four NAND gates in the 7400 package is an independent entity, but shares the common power supply and ground connections (pins 14 and 7, respectively).

The 7401 and 7403 are similar to the 7400 except that they are open-collector devices. This means that pull-up resistors are needed, i.e., one 2k- to 4k-Ohm resistor from each output to the +5 volt line.

The 7430 is an eight-input NAND gate (one per 14-pin DIP package). The 7430 device, therefore, has eight distinct inputs . . . and all eight must be HIGH before the output drops LOW. If any one of the eight inputs remains LOW, then the output stays HIGH. Since most microcomputers today are eight-bit machines, the 7430 is often used as an address, or I/O port, decoder.

The 7410 and 7420 are three- and four-input TTL NAND gates, respectively.

In the CMOS line, we also have several different types of NAND gates. The 4011 is a quad two-input NAND gate that is reminiscent of the 7400. The 4012 device is a dual four-input NAND gate. All four inputs of either gate must be HIGH for the respective output to be LOW. The 4023 device is a triple three-input NAND gate, while the 4068 is an eight-input NAND gate.

### TTL/CMOS NOR Gates

The 7402 TTL NOR gate is by far the most common example from the TTL line and is almost as popular as the 7400 device. The pinouts for the 7402 are shown in Fig. 9(b)—see 9(a) for pinouts for the 7400, for comparison. Note that the pinouts of the 7400 and 7402 are different, as are their logical responses.

### And Now . . .

We have just gotten our toes wet in the study of digital electronics. In part II, we will progress a little further: We will be up to our ankles in flip-flops. For now, however, you have sufficient information to begin experimenting with flip-flops. ■

✓See List of Advertisers on page 114

# The Vertical Deuce

## —40 and 75 meters

*Russ Rennaker W9CRC*
*1011 Linda Drive*
*Kokomo IN 46901*

There has been much written about antennas, a good portion of which has been about verticals. This is no great scoop and probably has been told in one form or another many times over. It is, however, an easy way to achieve efficiency out of a single antenna for both forty and seventy-five meters.

Of course, the most commonly used method to work multiband on a single antenna is with traps. I have used trapped antennas for many years—allband trapped; twenty, forty, and eighty trapped; ten, fifteen, and twenty trapped; and even forty/seventy-five trapped. I have always experienced many problems with traps, the greatest of all being the limitations in bandwidth, i.e., swr. The method described here solves all of the problems, including bandwidth and high swr.

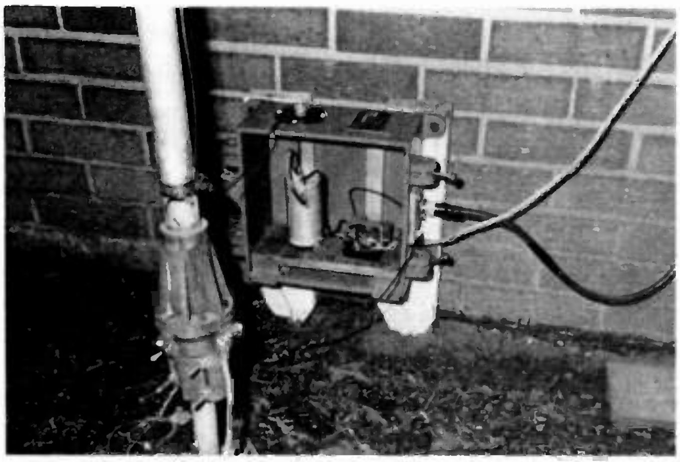
I have been running a monoband, forty-meter vertical for some time and an additional antenna for seventy-five. After disapproving looks from my neighbors at the half-wave doublet strung from one end of the house to the top of my beam tower, with the coax dangling halfway in between, I decided to do something.

The sketch and the picture tell the rest of the story. The mast I used was 1¼" aluminum tubing, and the height was 29'6" from base insulator to top-hat. The top-hat was made from old TV antenna elements and consisted of eight "spokes," each 24" long. There are several methods of fastening the spokes to the vertical tubing. I used a 5"-diameter piece of aluminum, flattened the end of the tubing, and bolted it to the circular plate. Be sure to use two bolts to ensure that the spokes stay in place and don't swivel out of line.

The coil I used was an old B&W, 2" in diameter, with 20 turns of #12 wire. The tap strap was RG-59/U coax shielding removed from the cable and flattened. It should be as short as possible, and when the final position is determined, it should be soldered to the coil turn solidly. The relay was an old one from the junk box, but anything will do *if* it makes good, solid contact when closed. It could be 110 V ac or some optional dc voltage you might happen to have handy in the shack. Be sure to use correct voltage as indicated by the spec on the coil, since the relay will be closed during all forty-meter usage and we wouldn't want it to get too warm from too much current flowing through it.

Of course, the relay and coil should be enclosed. A metal enclosure did not seem to affect the tuning of the coil in the slightest. I just happened to have an old cast-aluminum box once used in the military for an antenna tuner. It already had a PL-259 connector on one side and a feedthrough insulator on the top. Anything you can come up with will do the trick.

Tuning the antenna is very simple. Since I already had the antenna working on forty meters, no adjustment to length was required. However, if you start from scratch, I suggest you make the mast adjustable by using the top half inserted into the bottom half and a hose clamp to fasten permanently when the correct length is determined. If you are proceeding from scratch, you will want to start with the antenna a little longer than the ultimate will be. Use a grid-dip meter or an in-line swr meter and shorten the mast two or three inches at a time until it resonates in the portion of the forty-meter band you desire. The change-over relay must be closed when tuning the antenna for forty meters—at this point the shorting strap on the coil need not be fastened at all.



*A close-up of the relay/tuner box showing the #6 wire connected to the base of the aluminum tubing, likewise the ground wire attached to the bottom half of the base.*

Now that we have the antenna working on forty, we will resonate it on seventy-five. I used a CRC 100-uF, 5000-volt capacitor across the coil. This is a tubular capacitor and I suspended it inside the coil, soldering it to each end of the coil. Of course, if you use some other value or the coil size is not the same, you will have to make necessary changes in the tuning procedure.

The procedure I used was to open the relay, leaving the entire coil in series with the forty-meter antenna. See what the resonant point is with all of the coil in. If you can't resonate it at your desired frequency, you will have to either add to the coil turns or to the capacitance. In my case, it resonated below the 3.8 MHz—meaning the coil was too long. I tried the shorting strap two turns down from the top and checked again, but it still was too long. I moved it two turns at a time until I found the correct turn for 3.8 MHz. It turned out to be the fifth turn from the top. I soldered it firmly to that turn, closed the enclosure, and that was it.

I found that at forty meters my antenna had an swr of 1.3 to 1 from 7.1 to 7.3 (making it flat across the phone band) and 1.4 to 1 at 7.0 MHz—just about as good as anyone could expect. On seventy-five the swr was 1.7 to 1 at 3.7 MHz, 1.2 to 1 at 3.8, 1.7 at 3.9, and 1.75 at 4.0 MHz. It sure beats all those unsightly overhead wires.

The control box for the change-over switch is a small 2" × 3½" aluminum item, common in any parts store or out of your junk box at home. The switch is a simple single-throw/single-contact which I found in my junk box. I wired a pilot light across the "on" side so that I could easily tell when the switch was in the forty-meter position. Another color pilot light could be wired across the other side of the switch to indicate it was in the seventy-five-meter position—but I didn't think that was necessary. In addition, I wired the switch to my master switch which turns on the rig, so it would be impossible to leave the relay on when the shack is not occupied. It probably wouldn't hurt it to leave it on all night since it draws little current, but everything in my shack is turned on by a master switch and I made no exception for the relay circuit. ■

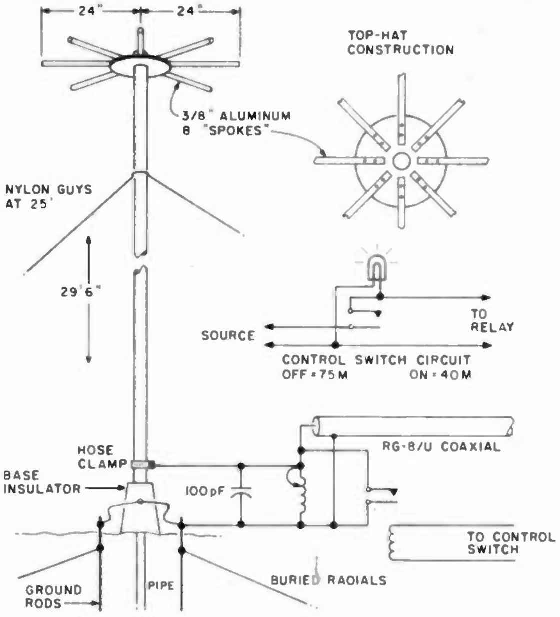
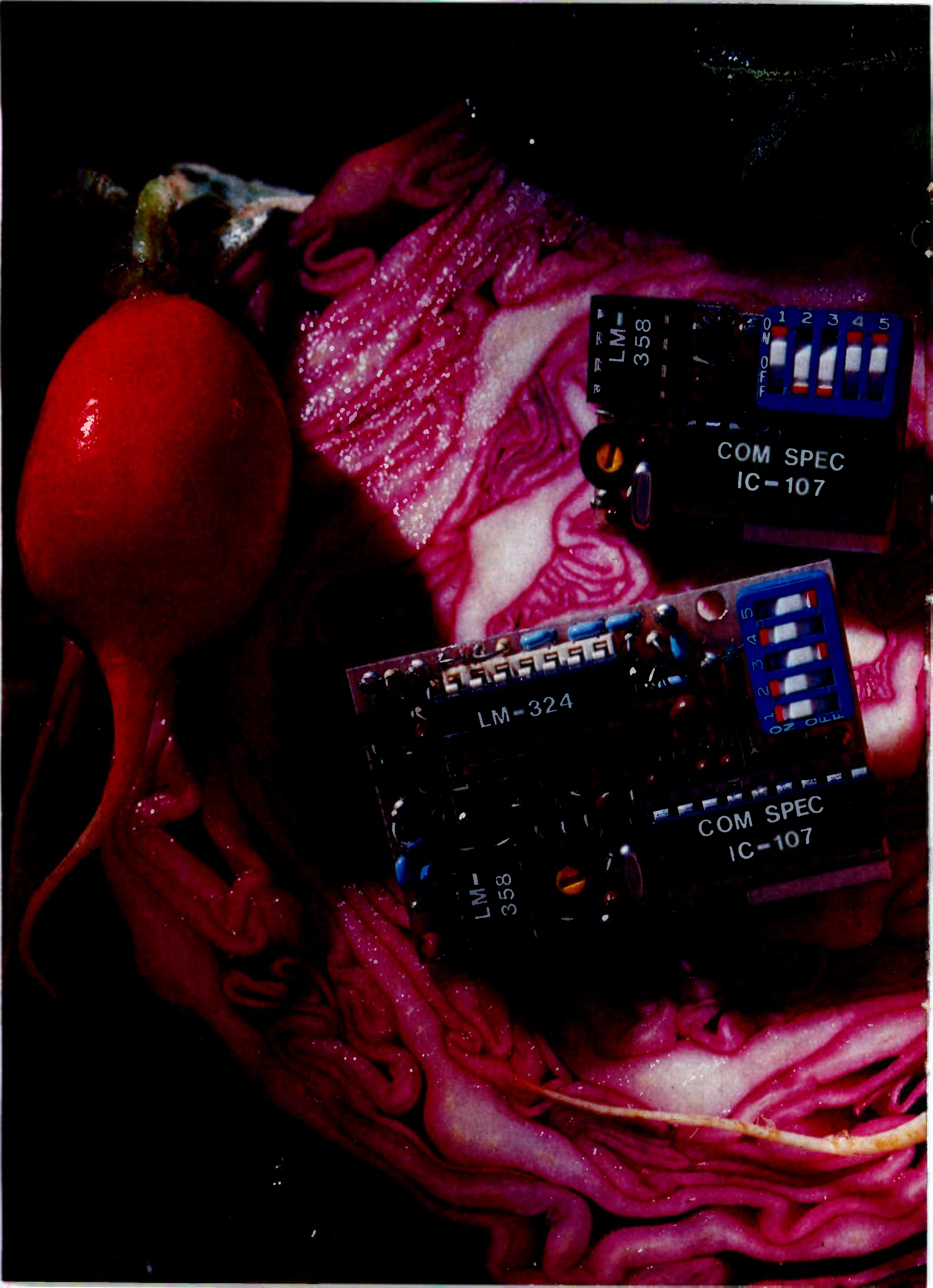



*Fig. 1.*



✓See List of Advertisers on page 114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Several years ago while attending business college at New Mexico State University in Las Cruces, I was bitten by the 2-meter FM bug. There was lots of 2-meter activity in town, and I, being limited in funds, began playing with various types of home-brew antennas. I stumbled on the J-pole section of the ARRL antenna book and began experimenting with various J designs.

I had seen a couple of old-timers using the J antenna made from CB whips and they complained of the J's susceptibility to breakage when whacking trees or other overhead obstructions; they also complained of the difficulty in building a proper balun with which to couple the feedline to the antenna.

In my case, even CB whips were out of my price range, so I cast about for alternatives. I had often noticed the colorful fiberglass "bicycle flags" on the kids' bikes and how much they resembled antennas. I decided to try them. These rods are really very nice for all types of hamming needs. They are sometimes fiberglass and sometimes plastic, and of course the fiberglass ones are the best buy. They seem to cost around $.99 to $5.00 depending on whether they're on sale or not.

I was in love with the J design from the first. The first few I built were tricky to tune and quite fragile, but they worked well. I went through several designs before settling on the present one. I discovered that doing away with the balun arrangements simplified the matching procedure, improved the antenna's performance, and greatly increased the longevity of the antenna (less to break or vibrate loose). As you may discern by looking closely at this antenna, there are several ways to construct it. Use your own imagination and ingenuity to make use of what you have to build it. You might wish to coat the whole antenna assembly with boat varnish or other sealant *after* the coax is attached and tuned satisfactorily.

See Figs. 1 and 2 for assembly details. You may note in Fig. 3 that I use the bike mounting bracket that comes with the pole. If it is mounted as shown, the mount will have a hinge action that will allow the antenna to harmlessly fold back when a low overhead obstruction is encountered, but keep the device erect while driving normally. Also, one of the great advantages of this antenna is

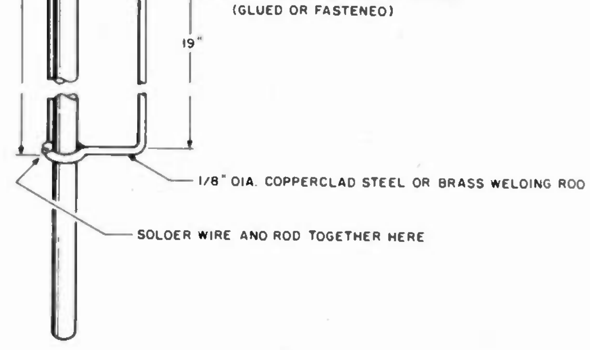


*Fig. 1.*

that, requiring no ground plane, it may be placed essentially anywhere on the vehicle you wish without adversely affecting its performance. Offered in Fig. 3 are 3 variations in mounting that should adapt to most vehicles. The bolt-action mount saves the antenna (and your car) when you hit tree limbs, etc.

This antenna has several natural applications: motorcycles and bicycles, 18-wheelers and recreational vehicles, backpack frames, as a hand-held for great gobs of gain with portables, bumper or headache-rack mounting on any vehicle, easy mounting on light bars for public safety vehicles, and installation against the window in a motel or apartment!

To adjust the antenna for lowest swr, merely slide the shield and center conductor up and down on the lower portion of the J until the lowest swr point is found. The wire and welding rod need to be scraped and clean for this procedure. Solder the connections when you find the right point. If you have any difficulty, try reversing the shield and center conductor connections. The antenna will work either way as long as you can get it to match properly.

I have compared this antenna to many of my own friends' 5/8-wave 3-dB gain antennas. I haven't seen one yet that this J-pole will not compare to or outperform. Usually the J-pole, mounted or held near the competing antenna's former location, exhibits about an S-unit gain on receiving a weak repeater. Try it sometime. (By the way, one S-unit compares roughly with 1 dB on all the imported radios I've checked.) I keep a spare antenna around the house for motel mobile and it's easy to walk out to a friend's car, get a meter reading on a distant repeater, then remove his antenna and hold the J-pole temporarily near the same spot. Usually the J-pole will have noticeable gain. I theorize the greater height of the J-pole plus the lack of ground sensitivity account for the difference.

I have shown this antenna to several engineer-type friends who shake their heads in disgust over its simplicity and lack of balun, etc. However, they all agree that for some reason it works well . . . and that's what it's all about, isn't it?

It would not be fair to ignore some disadvantages with this antenna. It is *not* as sturdy as most commercially-made antennas. Weather, vibration, wind, and corrosion will necessitate repairing the antenna occasionally—depending on your climate. (Usually the soldered connections give the most frequent trouble. I usually have to repair mine every 9 months or so.) This antenna may exhibit some minor directivity. However, *all* antennas on vehicles are directive to some degree, depending on the mounting location. Depending on the rigidity of your rod, you may find under road speeds the swr changing as the antenna bends backward. I have good luck in mounting the antenna with the stub facing forward or sideways so the spacing of the stub doesn't change as the antenna flexes.

In conclusion, I have presented here a simple, inexpensive, and very effective 2-meter antenna. It can be adapted easily to 220 or 450 use by experimentation and scaling of the dimensions. None of my antennas has ever been stolen and no one has ever asked me if I monitored channel 19. It may be, as some engineers insist, much like a bumblebee (too heavy to fly). However, if you try it, you will agree it works anyway! ■

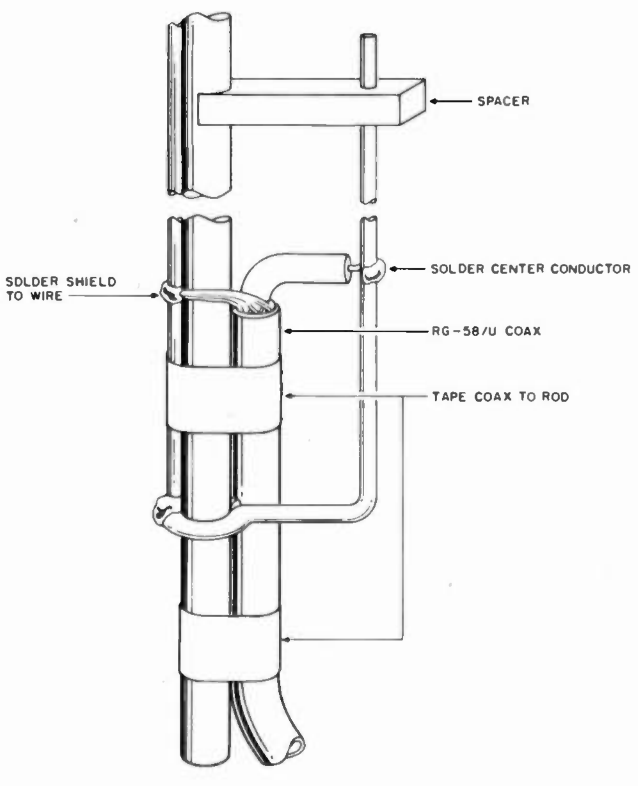


*Fig. 2.*

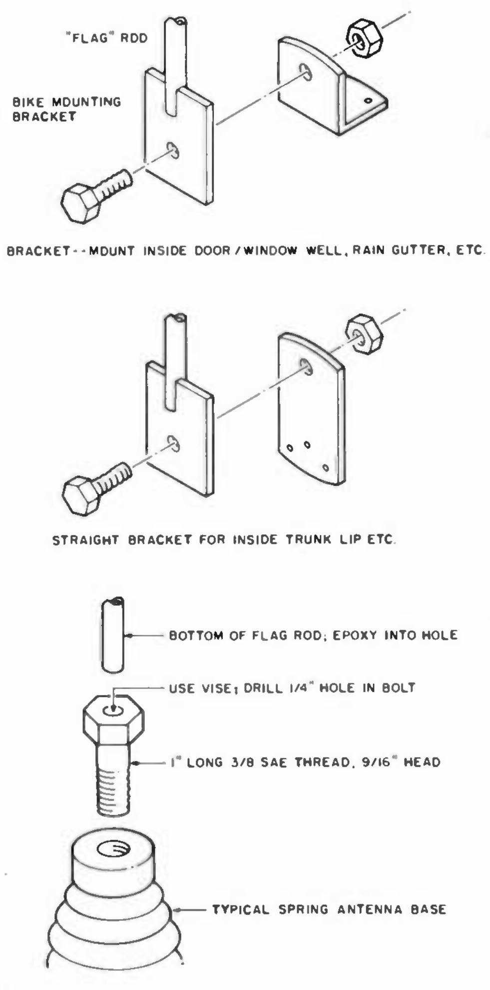


*Fig. 3.*

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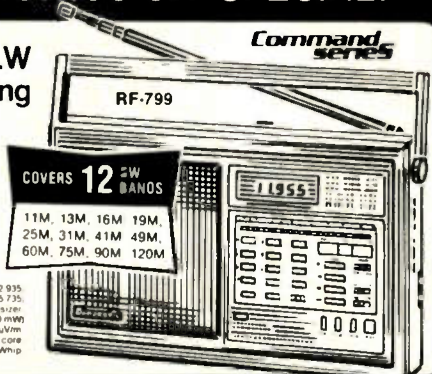


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# SOCIAL EVENTS

*Listings in this column are provided free of charge on a space-available basis. The following information should be included in every announcement: sponsor, event, date, time, place, city, state, admission charge (if any), features, talk-in frequencies, and the name of whom to contact for further information. Announcements must be received at 73 Magazine by the first of the month, two months prior to the month in which the event takes place. Mail to Editorial Offices, 73 Magazine, Pine Street, Peterborough NH 03458.*

**HARRISBURG PA**
**SEP 5**

The Central Pennsylvania Repeater Association will hold the 9th annual Hamfest/Computerfest on September 5, 1982, beginning at 8:00 am, at the Harrisburg Farm Show parking lot, off the Route 81 Cameron Street exit. (Follow the signs to the Farm Show building.) Registration is $3.00; sellers' 10-foot space, $5.00; tailgating, $1.00. Talk-in on 144.87/5.47, 146.16/.76, and .52. For more information or a map, contact Irvin Sanders K3IUY, RD #3, Box FA53, Harrisburg PA 17112, or phone (717)-469-2185.

**HAMBURG NY**
**SEP 10-11**

Ham-O-Rama '82 will be held on Friday and Saturday, September 10-11, 1982, at the Erie County Fairgrounds near Buffalo NY. Hours are 6:00 pm to 9:00 pm on Friday and 7:00 am to 5:00 pm on Saturday. Advance tickets are $3.50 (deadline: September 1st) and tickets at the gate will be $4.50. Children under 12 will be admitted free. The outside flea market is $3.00 per space and the inside flea market is $10.00 per space. Features will include new equipment displays, computers, technical programs, ladies' programs, and valuable awards. Talk-in on 146.31/.91. For advance tickets, send an SASE to Dave Baco WA2TVT, 130 Vegola Avenue, Cheektowago NY 14225.

**AUGUSTA ME**
**SEP 10-12**

The Augusta Emergency Amateur Radio Unit will hold the ARRL-approved Northeast Area Hamfest on September 10-12, 1982, at Windsor Fairgrounds, located just off Route 17, 10 miles east of Augusta ME. Facilities for campers will be available. Activities will include a flea market and regularly scheduled speakers and demonstrations, as well as the usual events. Talk-in on 146.22/.82 and .3940.

**AUGUSTA NJ**
**SEP 11**

The Sussex County Amateur Radio Club will hold its fourth annual SCARC '82 hamfest on Saturday, September 11, 1982, at the Sussex County Farm and Horse Show grounds, Plains Road off Rte. 206, Augusta NJ, just north of Newton. Pre-registration for outdoor flea-market sellers is $4.00; at the gate, $5.00. Pre-registration for indoor flea-market sellers is $5.00; at the gate, $6.00. Other registration is $2.00. There will be door prizes and acres of free parking. Talk-in on 147.90/.30 and 146.52. For additional information or pre-registration, write Sussex County Amateur Radio Club, PO Box 11, Newton NJ 07860, or Lloyd Buchholtz WA2LHX, 10 Black Oak Drive, Vernon NJ 07462.

**UNIONTOWN PA**
**SEP 11**

The Uniontown Amateur Radio Club will hold its 33rd annual gabfest on Saturday, September 11, 1982, on the club grounds located on the Old Pittsburgh Road, just off Route 51 and the 119 bypass, Uniontown PA. The pre-registration fee is $2.00 each or 3 for $5.00. There will be free parking, free coffee, and free swap and shop setups with registration. Prizes will be awarded, including a first prize of a Ten-Tec Argosy 525 HF. Featured will be a DX contest, demonstrations, and refreshments. Talk-in on 147.045/.645, 144.57/145.17 and 146.52/.52. For further information, contact UARC Gabfest Committee, c/o John T. Cermak WB3DOD, PO Box 433, Republic PA 15475, or phone (412)-246-2870.

**MARION IN**
**SEP 11**

The Grant County Amateur Radio Club Hamfest will be held on Saturday, September 11, 1982, at McCarthy Hall, Marion IN, from 8:00 am until 4:30 pm. Admission is $2.00 in advance and $3.00 at the gate. There will be good home cooking, hourly drawings, and major prizes. Talk-in on 146.19/.79 and 146.52. For more information or tickets, send an SASE to Beecher Waters WB9YHF, RR #1, Box 357, Converse IN 46919.

**MELBOURNE FL**
**SEP 11-12**

The Platinum Coast Amateur Radio Society will hold its 17th annual hamfest and indoor swap-and-shop flea market on September 11-12, 1982, at the Melbourne Auditorium, Melbourne FL. Admission is $3.00 in advance and $4.00 at the door. Swap tables are $10.00 for one day and $15.00 for both days. There will be unlimited free parking, a tail-gate area, air-conditioned swap and exhibit area, awards, forums, and meetings. Talk-in on .25/.85 and .52/.52. For reservations, tables, and information, write PCARS, PO Box 1004, Melbourne FL 32901, or call (305)-245-5116.

**WARNER ROBINS GA**
**SEP 11-12**

The Central Georgia Amateur Radio Club (CGARC) will hold the fourth annual Central Georgia Hamfest and ARRL Georgia State Convention on Saturday and Sunday, September 11-12, 1982, at the Warner Robins Recreation Center, 800 Watson Boulevard, Warner Robins GA. Donation tickets will be available at the door for $1.00 each, 6 for $5.00, or 13 for $10.00. There is no registration fee. Indoor or outdoor flea market space is $3.00 per day (bring your own table). Features will include meetings, forums, a Sunday morning breakfast for the Georgia State CW Association, activities for YLs and harmonics, a Friday night hospitality room, and Saturday night pickin' and grinnin'. Talk-in on 146.25/.85. For more information, contact Jim Piper W4HON, 618 American Boulevard, Warner Robins GA 31093.

**BUTLER PA**
**SEP 12**

The Butler County Amateur Radio Association will hold its annual hamfest on Sunday, September 12, 1982, from 9:00 am to 4:00 pm, at the Butler Farmshow Grounds at Roe Airport, Butler PA. Fly-in at Butler Farmshow Airport. Admission is a $1.00 donation and children under 12 will be admitted free. Overnight campers are welcome and food and refreshments will be available. There will be an indoor flea market (vendor space will be $3.00 per 8-foot table), a free outside flea market, free parking (including for the handicapped), and prizes, including a Kenwood TS-830S HF transceiver. Talk-in on 147.96/.36, .52, and 147.84/.24. For additional information, contact Leighton Fennell, Crestmont Drive, RD 6, Butler PA 16001, or phone (412)-586-9822.

**WILLIMANTIC CT**
**SEP 12**

The Natchaug Amateur Radio Association will hold a giant flea market on Sunday, September 12, 1982, from 9:00 am until 4:00 pm, at the Elks home, off Rtes. 32 and 6, Willimantic CT. Tables may be reserved in advance for $5.00 until September 1st; after that date, they will be $7.00 at the door. Admission is $1.00. There will be free parking, as well as raffles and door prizes. Talk-in on 147.30 and 147.90/.50. For further information, contact Clifton Pease KA1HYW, 268 Main Street, Willimantic CT 06226, or phone (203)-456-1432 after 4:00 pm.

**CARTERVILLE IL**
**SEP 12**

The Shawnee Amateur Radio Association will hold its 26th hamfest, SARAFEST '82, on Sunday, September 12, 1982, at John A. Logan College, Highway 13, Carterville IL. Admission is $2.00 in advance and $3.00 at the door. There will be an air-conditioned flea market, forums, computers, refreshments, contests, and prizes, including a first prize choice of a Kenwood 130S HF transceiver, a microwave oven, an RCA color TV, or an automatic dishwasher. Talk-in on 146.25/.85, 146.52, and 3.925. For further information, contact William May KB9QY, 800 Hilldale Avenue, Herrin IL 62948, or phone (618)-942-2511 days.

**PORT JEFFERSON LI NY**
**SEP 12**

The Suffolk County Radio Club will hold the 5th annual flea market on Sunday, September 12, 1982, at the Odd Fellows Hall, Jayne Boulevard, Port Jefferson Station NY. The rain date will be September 19th. Admission for buyers is $1.50 each and YLs, XYLs, and harmonics will be admitted free. Sellers, including car and driver, will be charged $3.50 each. There will be raffles and food and drink, plus drawings for door prizes. Talk-in on 145.21/144.61. For additional information, contact Floyd WA2SDI at (516)-234-9376 after 6:00 pm.

**GRAND RAPIDS MI**
**SEP 18**

The Grand Rapids Amateur Radio Association, Inc., will hold its annual swap and shop on Saturday, September 18, 1982, at the Hudsonville Fairgrounds. There will be prizes and dealers, with an indoor sales area and an outdoor trunk swap area. Gates will open at 8:00 am for both swappers and the public. Talk-in on 146.16/.76. For more information, write Grand Rapids Amateur Radio Association, Inc., PO Box 1248, Grand Rapids MI 49501.

**PEORIA IL**
**SEP 18-19**

The Peoria Area Amateur Radio Club will hold the Peoria Superfest '82 on September 18-19, 1982, at the Exposition Gardens, W. Northmoor Road, Peoria IL. The gate opens at 6:00 am; the commercial building at 9:00 am. Admission is $3.00 in advance or $4.00 at the door. Activities include forums, amateur radio and computer displays, a free flea market, and, on Saturday evening, an informal get-together at the Heritage House Smorgasbord. At the hamfest site, there will be free movies Saturday night. Full camping facilities are available, as well as a Sunday bus to Northwoods Mall for the ladies. Talk-in on 146.16/.76. For more information, contact Charles W. Kuhn WD9EGW, PAARC Director, 7005 N. Tobi Lane, Peoria IL 61614.

**MT CLEMENS MI**
**SEP 19**

The L'Anse Creuse Amateur Radio Club will hold its 10th annual swap and shop on Sunday, September 19, 1982, from 9:00 am to 3:00 pm, at the L'Anse Creuse High School, Mt. Clemens MI. Take I-94 eastbound to the Metropolitan Parkway exit; then take the Metropolitan Parkway to Crocker; go left on Crocker to Reimold and then right on Reimold to the last school, L'Anse Creuse High School. Admission is $2.00 at the door or $1.00 in advance. FCC representatives will be there, as well as plenty of new and used gear. There will be lots of food and parking, plus hourly prize drawings. Prizes include a first prize of $250, a second prize of $100, and a third prize of $50. Talk-in on 147.69/.09 and 146.52. For more information, send an SASE to Maurice Schietecatte N8CEO, 15835 Touraine Ct., Mt. Clemens MI 48044.

**AUGUSTA GA**
**SEP 19**

The Augusta Amateur Radio Club will hold its annual hamfest on September 19, 1982, at the Julian Smith Casino in Augusta GA. Admission is $3.00 per person; tailgating will be $2.00. There will be prizes, a barbecue, bingo, and a hospitality room on September 18th from 4:00 pm to 11:00 pm at the Ramada Inn West, Rooms 108-110. Talk-in on 147.72/.12. For more information, contact John Schumacher N4DOU, PO Box 3072, Augusta GA 30904, or phone (404)-860-4460 from 6:00 pm to 9:00 pm EDT.

**PENNSAUKEN NJ**
**SEP 19**

The South Jersey Radio Association will hold its 1982 annual hamfest on Sunday, September 19, 1982, from 8:00 am to 4:00 pm, at Pennsauken High School parking lot, Route 73 and Remington Avenue, Pennsauken NJ. There will be door prizes, food, and fun. Admission is $3.00; tailgate sales are $5.00. Talk-in on 146.220/146.820 and 146.52. For ticket sales and more information, contact Fred Holler W2EKB, 348 Bortons Mill Road, Cherry Hill NJ 08034.

**VENICE OH**
**SEP 19**

The Forty-Fifth Annual Cincinnati Hamfest will be held on Sunday, September 19, 1982, at Stricker's Grove, State Route 128, Venice (Ross) OH. Admission and prize ticket, $5.00. There will be exhibits and booths, prizes, a flea market (radio-related products only), a hidden transmitter hunt, and an air show. Food and refreshments will be available. For further information, write Lillian Abbott K8CKI, 317 Greenwell Road, Cincinnati OH 45238.

**MONTGOMERY AL**
**SEP 19**

The Central Alabama Amateur Radio Association will hold its 5th annual hamfest on Sunday, September 19, 1982, at the Civic Center, downtown Montgomery AL. There will be free admission, free parking, and 22,000 square feet of air-conditioned activities, including a flea market. Setup will be at 0600, doors will be open from 0800 to 1500, and a prize drawing will be held at 1400 CDST. Restaurants and motel accommodations are located within a short walk of the Civic Center and refreshments will be available in the Civic Center. Talk-in on 146.04/.64, 146.31/.91, 147.78/.18, or 147.045/ ± 600T. For further information or market reservations, write Hamfest Committee, 2141 Edinburgh Drive, Montgomery AL 36116, or call Phil at (205)-272-7980 evenings.

**NEW KENSINGTON PA**
**SEP 19**

The Skyview Radio Society will hold its annual hamfest on Sunday, September 19, 1982, from noon until 4:00 pm, at the club grounds on Turkey Ridge Road, New Kensington PA. Registration fee is $2.00; vendors, $4.00. There will be awards. Talk-in on .04/.64 and .52.

**NEWTOWN CT**
**SEP 19**

The Candlewood Amateur Radio Association will hold a flea market and auction on Sunday, September 19, 1982, rain or shine, at the Essex House, Rte. 6, exit 8 off I-84, Newtown CT, from 10:00 am to 4:00 pm. Admission fee of $1.00 includes one door prize chance. Tables are $6.50. Featured will be an equipment raffle of a TR-2500 handie-talkie, dealers, and a magic show for the kids. Refreshments will be available. Talk-in on 147.72/.12. For advance table reservations, write CARA, PO Box 188, Brookfield Center CT 06805. For more information, call George WB2THN at (914)-533-2758, Ken KA1GDS at (203)-744-6953, or George AF1U at (203)-438-0549.

**ELMIRA NY**
**SEP 25**

The Elmira Amateur Radio Association will hold the seventh annual Elmira International Hamfest on September 25, 1982, at the Chemung County Fairgrounds. Breakfast will be available for several hours after the gates open at 6:00 am. Advance tickets are $2.00 and tickets at the gate are $3.00. Featured will be tech talks, a free flea market, dealer displays, and prizes, including a grand prize of an Icom IC-730. Friday night camping will be available on a limited basis at the fairgrounds and lunch will be available starting at 11:00 am on Saturday. Talk-in on 147.96/.36, 146.10/.70, and 146.52. For advance tickets, write John Breese, 340 West Avenue, Horseheads NY 14845.

**WICHITA FALLS TX**
**SEP 25-26**

The Wichita Amateur Radio Society will hold its first annual hamfest on September 25-26, 1982, at the National Guard Armory, Wichita Falls TX. Pre-registration closes Wednesday, September 22, 1982, and is $4.00 per person and $3.00 per swap table. Registration at the door is $5.00 and starts at 8:00 am on Saturday and Sunday. There is free shuttle service from the Kickapoo Airport (¼ mile south), free RV parking without hookups at the armory, and a concession stand open both days. There will be dealer displays, an inside flea market with 24-hour security, scheduled ladies' activities and prizes, contests, meetings, a grand prize, and other prize drawings. Talk-in on 146.34/.94 and 147.75/.15. For more information and pre-registration, write to WARS Hamfest, PO Box 4363, Wichita Falls TX 76308.

**GRAYSLAKE IL**
**SEP 25-26**

The Chicago FM Club will hold the 12th annual Radio Expo on September 25-26, 1982, from 9:30 am to 4:00 pm, at the Lake County Fairgrounds at the intersection of Rtes. 45 and 120, Grayslake IL. Admission is $3.00 in advance and $4.00 at the door. There will be displays, seminars, technical talks, a flea market (open from 6:00 am to 6:00 pm), full food services, a free camping area, acres of free parking, ladies' programs, children's events, and prizes. Talk-in on 146.16/146.76 and 222.52/224.10. For more information and/or reservations, contact Harold G. Rowlett, c/o Radio Expo, PO Box 1532, Evanston IL 60204, or phone (312)-588-3976.

**BEREA OH**
**SEP 26**

The Cleveland Hamfest Association will present the 8th annual Cleveland Hamfest on Sunday, September 26, 1982, at the Cuyahoga County Fairgrounds in Berea OH, from 0800 to 1700 hours. Activities will include indoor exhibits, forums, a ladies' program, and an outdoor flea market with separate parking. Food services will include both breakfast and lunch. There will be three main prizes and a mobile check-in prize. Talk-in on 146.52. Advance tickets are $2.50 prior to August 31st and $3.00 at the door. For more information, contact the Cleveland Hamfest Association, PO Box 27211, Cleveland OH 44127.

**NEW LONDON NH**
**SEP 26**

The 6th annual Connecticut Valley FM Association Hamfest/Flea Market will be held on Sunday, September 26, 1982, from 9:00 am to 5:00 pm, at King Ridge Ski Area, New London NH. Adult admissions are $2.00, a flea-market setup is $5.00, and children under 16 will be admitted free. King Ridge will have the food concession. For more information, contact Francis Callahan KA1BWE, Box 173, East Wallingford VT 05742.

**ADRIAN MI**
**SEP 26**

The Adrian Amateur Radio Club will hold its 10th annual hamfest on Sunday, September 26, 1982, at the Lenawee County Fairgrounds, Adrian MI. Talk-in on 146.31/.91 (W8TQE). For tickets, tables, and more information, contact the Adrian Amateur Radio Club, Inc., PO Box 26, Adrian MI 49221.

**GAINESVILLE GA**
**SEP 26**

The 9th annual Lanierland ARC Hamfest will be held on September 26, 1982, beginning at 9:00 am, in the Holiday Hall at Holiday Inn, Gainesville GA. There will be free tables and an inside display area for dealers and distributors (doors will open at 8:00 am for dealer setups). Prize tickets are $1.00 each or 6 for $5.00. Food and drink will be available, as well as a large parking lot for a free flea market. A boat anchor auction will be held and all activities and facilities will be free. Talk-in on 146.07/.67. For information and free space to dealers, contact Phil Loveless KC4UC, 3574 Thompson Bend, Gainesville GA 30506, or phone (404)-532-9160.

**BOXBORO MA**
**OCT 2-3**

The Federation of Eastern Massachusetts Amateur Radio Associations will hold the New England ARRL Convention on October 2-3, 1982, at the Sheraton Boxboro Hotel, Route 495 at Route 111, Boxboro MA. On Saturday the hours will be 9:00 am to 5:00 pm and on Sunday, 10:00 am to 5:00 pm. Early-bird registration is $4.00. The Saturday evening banquet, dance, and show is $13.50. Features will include a Wouff Hong midnight ceremony Saturday and YL programs on both days. For reservations and advance registration, send an SASE to Arthur Tomkinson W1THT, 9 Oliver Terrace, Revere MA 02151 and make checks payable to FEMARA.

**WARRINGTON PA**
**OCT 2-3**

The Pack Rats sixth annual Mid-Atlantic VHF Conference will be held on Saturday, October 2, at the Warrington Motor Lodge, Rte. 611, Warrington, PA. Advance registration $3.00; at the door, $4.00. Price includes admission to the 11th annual Pack Rats Hamarama on Sunday, October 3, at the Bucks County Drive-In Theater, Rte. 611, Warrington, PA. Admission to the flea market $2.00 and tailgating $4.00 per space. Bring your own table. Gates open at 7:30 am. Talk-in via W3CCX on 146.52. Information for both events is available from Hamarama '82, POB 311, Southampton PA 18966 or Lee A. Cohen K3MXM at (215)-635-4942.

**ROCK HILL SC**
**OCT 3**

The York County Amateur Radio Society will hold its 31st annual hamfest on Sunday, October 3, 1982, at Joslin Park, Rock Hill SC, starting at 0700. Pre-registration is $3.00; at the gate, $4.00. There will be prizes. Talk-in on 146.43/147.03 and 146.52. For additional information, contact YCARS, Box 4141 CRS, Rock Hill SC 29730.

**YONKERS NY**
**OCT 3**

The Yonkers Amateur Radio Club will hold its electronics fair and flea market on Sunday, October 3, 1982, from 9:00 am to 5:00 pm, rain or shine, at Yonkers Municipal Parking Garage, corner of Nepperhan Avenue and New Main Street. Admission is $2.00 each; children under 12 will be admitted free. Sellers' spaces are $6.00 (bring your own table) and include one admittance. Gates will be open to sellers at 8:00 am. There will be live demonstrations, hourly prizes, an auction, free parking, refreshments, and unlimited free coffee all day. Talk-in on 146.265/146.853, .52, or CB channel 4. For further information, write YARC, 53 Hayward Street, Yonkers NY 10704, or phone (914)-969-1053.

**VIRGINIA BEACH VA**
**OCT 9-10**

The ARRL Virginia State Convention and Tidewater Computer Show-Hamfest-Electronic Flea Market will be held on Saturday and Sunday, October 9-10, 1982, from 9:00 am to 5:00 pm both days, at the pavilion in Virginia Beach VA. Admission is $3.50 for both days. Flea-market tables are $5.00 for one day or $8.00 for both days; commercial flea-market tables are $15.00 for both days, and commercial booths are $30.00 for both days. Featured will be dealers, special displays, forums, computers, satellite equipment, special XYL programs, and a cocktail party Saturday night. There will be an advance ticket drawing for a hand-held transceiver, as well as many valuable door prizes. For more information and/or tickets, contact Jim Harrison N4NV, 1234 Little Bay Avenue, Norfolk VA 23503, or phone (804)-587-1695.

**ASHEVILLE NC**
**OCT 9**

The Western North Carolina Amateur Radio Society will hold its seventh annual Autumnfest on October 9, 1982, at the Asheville Civic Center, Asheville NC. Admission is $3.00 in advance and $4.00 at the door. Flea market tables will be $5.00 at the door. Activities (all indoors) will include the McElray Memorial CW Competition, bingo for the ladies, and dealer and flea market tables. Travel, motor home, and camping facilities will be available. Talk-in on .31/.91, .16/.76, and .52. For more information, contact WCARS, PO Box 1488, Asheville NC 28802.

**PARAMUS NJ**
**OCT 10**

The Bergen ARA will hold a ham swap 'n sell on October 10, 1982, from 8:00 am to 4:00 pm, at Bergen Community College, 400 Paramus Road, Paramus NJ. Buyers will be admitted free and sellers will be charged $3.00. There will be tailgating only; bring your own table. Thousands of spaces will be available. Talk-in on .79/.19 and .52. For more information, contact Jim Greer KK2U, 444 Berkshire Road, Ridgewood NJ 07450, or phone (201)-445-2855.

**LIMA OH**
**OCT 10**

The Northwest Ohio Amateur Radio Club will hold its sixth annual hamfest on Sunday, October 10, 1982, at the Allen County Fairgrounds, Lima OH. Indoor flea market tables will be available for $5.00 for an 8-foot table or $3.00 for half a table. Tickets are $2.50 in advance, $3.00 at the door. Doors will open at 6:00 am and grand prizes will be drawn at 3:00 pm. Overnight camping will be available at the fairgrounds. Talk-in on .07/.67, .63/.03, .34/.94, and .52/.52. For more information, write NOARC, Box 211, Lima OH 45802.

**BALTIMORE MD**
**OCT 10**

The Columbia Amateur Radio Association will hold its 6th annual hamfest on Sunday, October 10, 1982, from 8:00 am to 3:30 pm, at the Howard County Fairgrounds (15 miles west of Baltimore, just off I-70 on Rt. 144, 1 mile west of Rt. 32). Admission is $3.00, tables are $6.00, tailgating is $3.00, and indoor tailgating is $5.00. Food will be available and prizes will be awarded. Talk-in on 147.735/.135 and 146.52/.52. For table reservations or information, write Sue Crawford, 6880 Mink Hollow Road, Highland MD 20777, or phone (301)-286-3805.

**WAUKESHA WI**
**OCT 10**

The Kettle Moraine Radio Amateur Club will hold its annual Ham, Computer, Video Fest on Sunday, October 10, 1982, at the Waukesha County Expo Center, Highways F and FT, Waukesha WI. Tickets are $2.00 in advance and $3.00 at the door. Tables are $3.00 for each 4-foot length; reservations will be accepted until October 1, 1982. Since all facilities will be indoors, the hamfest will be open rain or shine, beginning at 8:00 am. There will be prizes, food, commercial exhibitors, a "happy hour," and free parking. For table reservations, send a check payable to KMRA Club, PO Box 411, Waukesha WI 53187.

**CHELSEA MA**
**OCT 17**

The 19-79 Repeater Association of Chelsea MA will hold its annual flea market on Sunday, October 17, 1982, from 11:00 am to 4:00 pm (sellers admitted at 10:00 am), at the Beachmont VFW Post, 150 Bennington Street, Revere MA. Admission is $1.00. Sellers' tables are $6.00 in advance and $8.00 at the door, if available. Talk-in on .19/.79 and .52. For table reservations, send a check to 19-79 Repeater Association, PO Box 171, Chelsea MA 02150.

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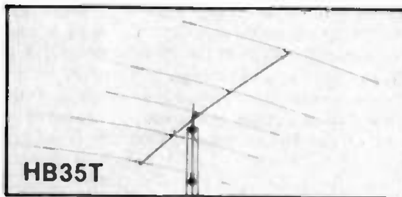

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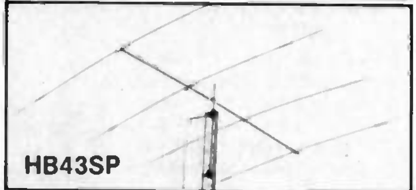

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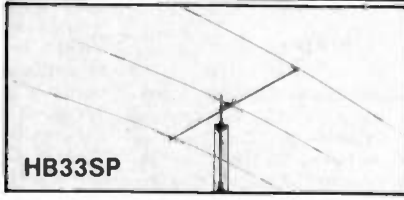

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| 2200 mfd @ 35V | 1 - 11 | 1.29 ea. |
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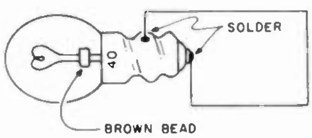
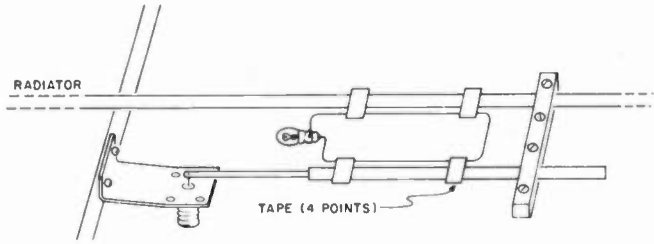
# CIRCUITS

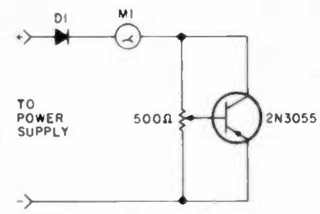
*Do you have a technique, modification, or easy-to-duplicate circuit that your fellow readers might be interested in? If so, send us a concise description of it (under two pages, double-spaced) and include a clear diagram or schematic if needed.*

*In exchange for these technical gems, 73 offers you the choice of a book from the* Radio Bookshop, *to be sent upon publication. Submit your idea (and book choice) to: Circuits, Editorial Offices, 73* Magazine, *Peterborough NH 03458. Submissions not selected for publication will be returned if an SASE is enclosed.*

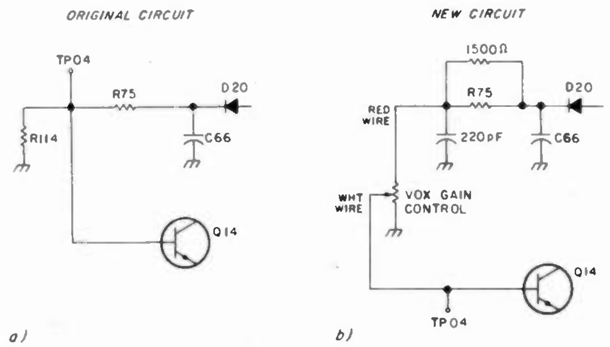


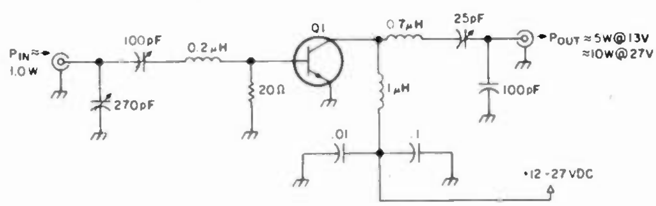

*VISUAL ADJUST FOR GAMMA MATCH: In an emergency or when you don't have your swr meter handy, you can still adjust a gamma match with good results by doing the following: Make a rectangular "Hertz loop" (see diagram) by soldering a piece of solid hookup wire to a 6.3-V, 150-mA, no. 40 pilot lamp. You may use a socket if desired. The loop is the same height as the gamma and about half the width. If the exciter is QRP, it may be necessary to increase the width of the loop a bit. Fix it to the gamma with masking tape and excite the antenna with about 10 Watts (or enough power for the lamp to start to glow). Adjust the gamma for maximum brightness of the lamp. If the lamp becomes too bright, you may decrease the coupling between the Hertz loop and the gamma by bending one end of the loop slightly away from the match. Caution: Do not touch the antenna with the power on. After adjusting for maximum brightness, remove the loop and the antenna is matched. Even if you use an swr meter at the transmitter end of the scale, it may falsely indicate a perfect match with certain lengths of coax. However, if you also use the Hertz loop, it quickly verifies that the gamma is adjusted for maximum power transfer.*—Jose Vicente PY2AUC, Campinas, SP, Brazil.



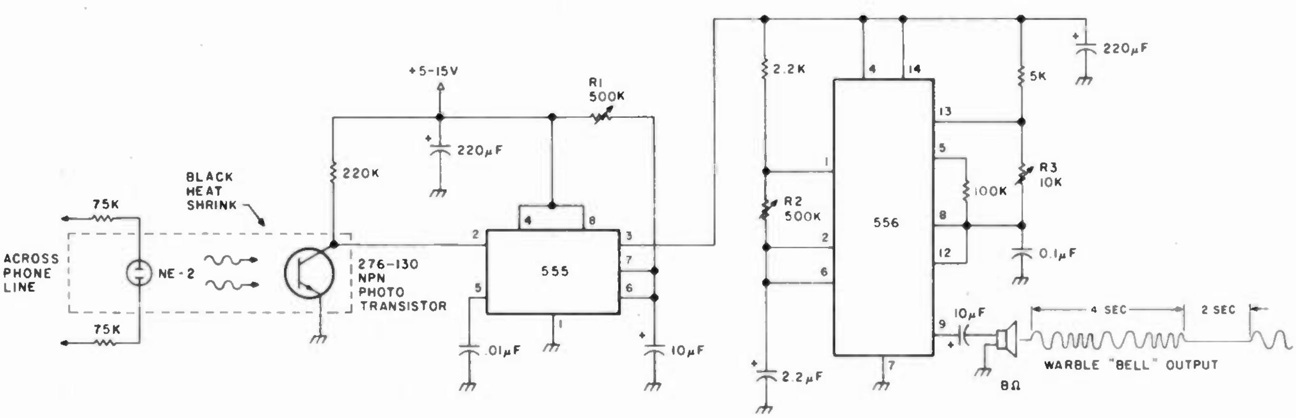

*DUMMY LOAD FOR POWER SUPPLIES: The series pass transistor is used as a variable resistor and will handle up to 15 Amperes or 115 Watts. The base bias is set by the resistor so that the conduction can be varied. The transistor will get rather hot. It must be mounted on a heat sink and should have forced cooling if heavy loading is anticipated.*—Glen Deibart, APO NY.




*NOISE-BLANKER MODIFICATION FOR THE YAESU FT-707: Fig. (a) is the original circuit in which full gating is used. Fig. (b) shows the new circuit which employs variable gating on Q14, improving the suppression of ignition noise. I had no need for the VOX control, so I disabled it and used the potentiometer for the noise-blanker gate control. Results were very good; adjust the control until the ignition noise and strong adjacent signals disappear.*—Carl Weiche W5NLB, Tulsa OK.




*SIX-METER AMPLIFIER: This class C six-meter amplifier produces a respectable signal when driven with about one Watt from a military GRC or PRC FM transceiver or a conventional amateur transmitter. The CB transistor operates only slightly warm with two square inches of heat sink. The Q of the output network is 7 when operated at 13 volts. The input network Q is 3.5.*—Al McKenna WB6BSP, Healdsburg CA.




*ELECTRONIC PHONE BELL: The speaker emits a distinctive warble tone when ring pulses are applied to the phone line. Use this circuit as a remote bell or disconnect the phone's ringer for direct use. R1 adjusts the duration of the output; R2 and R3 control the tone's duty cycle and frequency. The transistor is a general-purpose NPN photodevice. The neon bulb and transistor are coupled with the heat-sink tubing to form an optoisolator.*—John Mairs AA4DX, Springfield VA.

# HAM HELP

*We are happy to provide Ham Help listings free, on a space-available basis. We are not happy when we have to take time from other duties to decipher cryptic notes scrawled illegibly on dog-eared post cards and odd-sized scraps of paper. Please type or print your request (neatly!), double spaced, on an 8½" × 11" sheet of paper and use upper- and lowercase letters where appropriate. Also, please make a "1" look like a "1," not an "l," which could be an "el" or an "eye," and so on. Hard as it may be to believe, we are not familiar with every piece of equipment manufactured on Earth for the last 50 years! Thanks for your cooperation.*

I am looking for a schematic for a keyboard manufactured by Incoterm Corp., assembly 055-13-02-70REV. I am also looking for any information on how to interface this keyboard to a RTTY or microprocessor system.

**W. G. Mott**
**2 London Bridge**
**London SE1 9RB**
**England**

I would like to hear from somebody who can repair a Digital Frequency Display, Model DD-1K.

**J. M. Garcia KP4EE**
**PO Box 66**
**Aguadilla PR 00605**

I am looking for a schematic for a 1934 Philco table-model Type 89, Code 123, Ser. No. D-15143.

**Charles Owens**
**Denbow Rd.**
**Durham NH 03824**

I am looking for a Central Electronics 200-V transmitter in any condition or parts for the same.

**Ted Wilson KA7LVT**
**12439 So. Giles St.**
**Las Vegas NV 89124**

Wanted: OS8N oscilloscope, a Sencore TC28 tube tester hybridster, Ameco R5 receiver, and a Knight Kit vfo. Please state price and condition.

**Kevin Neal**
**Rte. A, Box 221A**
**Flippin AR 72634**

Looking for equipment donations to help initialize a ham club station at a recently-opened veterans home. All donations accompanied by a note giving approximate values will be accordingly acknowledged since they are tax deductible.

**David Basham AE8Y**
**Chief, Social Services**
**Barboursville Veterans Home**
**512 Water St.**
**Barboursville WV 25504**

Schematics or manuals on the following would be appreciated:

- Hallicrafters SX 104-30-50MC receiver.
- Precision Applications E400 series sweep generator.
- Knight capacitance checker.
- Tektronix 541-535 O-Vert plug-in.
- Military OS-8U oscilloscope, PS1J power supply, and P1B2X8J oscilloscope.
- Electalarm Model ID60 alarm by Nuclear Electronics Corp.
- American Telephone alarm, Model AE 202UL, c/o ATA Controls Systems.
- Sears Micromatic IC cassette tape recorder.

Costs for postage and/or copying will be paid, but let me know them first.

**Kevin Neal**
**Rte. A, Box 221A**
**Flippin AR 72634**

I need a schematic and manual for the IC-2F VHF 2-meter transceiver and a schematic for the IC-3P power supply 3375, made in 1970.

**Harold Nelson WB9QMX**
**401 East Wisconsin Ave.**
**Silver Lake WI 53170**

I need the dimensions for the CW radials for the Hy-Gain 18AVTWB antenna.

**Sam Creason K6EW**
**2940 Arlington Ave.**
**Fullerton CA 93635**

I need information and schematics for a Phonics TV phone, part #690-56331, manufactured by AMF Electronics Products Div., in Herndon, Virginia. I am also looking for information on converting a J.I.L. 202SSB CB to 10 meters. I will pay for any copying costs involved.

**Jeff Parker WA1WXL**
**2001 Jack Frost Rd.**
**Virginia Beach VA 23455**

I need information/schematic/instruction manual for the Bu Ships LM-21 xtal calibrator, freq. indicating 125-20,000 kHz, type 74028-A. I would also like some information on building a suitable power supply for this unit.

**William Stahl**
**PO Box 262**
**Marlton NJ 08053**

I need the operating manual for the Supreme oscilloscope, Model #546A. I will pay any mailing and copying costs.

**Glenn Churchill KA2IOI**
**Box 504**
**Hudson Falls NY 12839**

I am looking for schematics and any other info for the Lafayette He-45 6-meter rig.

**Sean Poole KA4LWX**
**8926 Byron Ave.**
**Surfside FL 33154**

I am looking for the manual and/or schematic for the Hammarlund FM-5 VHF equipment. I will pay for copying and postage.

**Bill Ryan WA2DND**
**CC 140, Rensselaer Polytechnic Institute**
**Troy NY 12180**

Would anyone who has modified a calculator to measure Ohms (April, 1982, *73 Magazine*) please contact me?

**Kevin Neal**
**Rte. A, Box 221A**
**Flippin AR 72634**

Wanted by my friend DJ0QN, near Munich: a repeater offset kit or schematic of same for the Comptronix FM-80 10-meter FM rig. Send price/info to me, please.

**Doug Smith WA6GON**
**1369 Tree Garden Pl.**
**Concord CA 94518**

I need a copy of the Frequency Selection Code Book and Service Manual for the Tennelec Model MS2 memory scanner. I will pay shipping and duplicating costs.

**Kenyon B. Courts KA7JJJ**
**5267-B Mather St.**
**Eielson AFB AK 99702**

Here are some items I am looking for:

- Assembly instructions/operating information for a Tel-Rex Model TC-99C triband beam antenna
- Copies of the operating manuals, shop manuals, and modifications for the Collins 75A4 receiver and a Central Electronics 100-V transmitter
- The current address of Wesley R. Schum, the developer of the 100-V broadbanded exciter-transmitter

I will copy and return immediately with postage refund, or pay for copies.

**Bob Robinson KU8C**
**Route 3 Box 302**
**Fairmont WV 26554**

I need a copy of the service manual for the Bearcat 220. I will be glad to pay copying costs and postage.

**Jose Nunez YV2BSV**
**PO Box 390**
**Merida 5101A**
**Venezuela**

I'm looking for the antenna coupler CU-286/FRR-33 part of the radio receiving set AN/FRR-33, and the control monitor C-1012/FRR, keyer KY-82/FRR and loudspeaker LS-179/U parts of the radio receiving set AN/FRR-34.

**Roberto Pieraccini**
**Via V. Veneto 66**
**51013 Chiesina Uzzanese**
**Italy**

Wanted: Members of school clubs, teachers, and students to participate in education networks to aid technical and non-technical classes. Those interested please send schedule information, or information about existing high school and college networks.

**N. S. C. C. Radio Club (K7WWP)**
**14861 6th Ave. NE**
**Seattle WA 98155**

I am looking for a 40-foot breakover tower manufactured by Tele-Tower in Enid, Oklahoma.

**Howard Russell N6EBF**
**1291 Sandra Court**
**Upland CA 91786**

I am looking for software and the required interface to operate RTTY/CW using the TI-99/4A computer.

**Steve Shaw W6SLY**
**7740 Larchwood Way**
**San Diego CA 92120**

I need a mobile mounting bracket for the Midland 13-510A 2-meter transceiver.

**George Stephens KA3DSA**
**5813 Bryn Mawr Road**
**College Park MD 20740**

I am looking for information on how to modify the Bearcat 220 scanner so that it will receive on 29.6 MHz and 52.525 MHz.

**Marty Linke WD9ABG**
**621 North Grace St.**
**Lombard IL 60148**





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# DX

*Chod Harris VP2ML*
*Box 4881*
*Santa Rosa CA 95402*

**WILL HEARD BE HEARD?**

A DXpedition to Heard Island, in the southern Indian Ocean, nears reality. At the International DX Convention in Visalia, California, last April, Ian Hunt VK5QT announced tentative plans to activate this rare radio location. In the months following, the details (and especially funding) started to fall into place.

Heard Island is a small rock sticking out of the frigid seas not far from Antarctica. To locate Heard on the globe at your neighborhood library, put your finger on Saskatoon, Saskatchewan. Now find the diametrically opposite point on the globe, the spot antipodal to Saskatoon. Unless the manufacturer's logo is covering it up, you should have found Heard. Getting radio equipment and operators to Heard won't be so easy.

Heard sits in the middle of some of the worst weather in the world. Temperatures as low as −60° and winds in excess of 300 km/h have been recorded on the coast of Antarctica, the nearest significant land mass to Heard. Far from shipping lanes and lying in the dreaded wind belt that sweeps around Antarctica, Heard is about as isolated and inhospitable a spot as one can find.

So why are amateurs going there at all? Several mountaineers plan to scale Big Ben, Heard's 2700-meter high, ice-covered volcano. Splitting the costs with the mountaineers in return for providing top-notch radio communications in case of emergency puts the Heard Island DXpedition into the realm of the possible although costs for the radio part of the trip alone will top $30,000.

The International DX Foundation and the Northern California DX Foundation have offered $10,000 each toward the trip, and the Wireless Institute of Australia will provide four stations and has pledged $7,000, which it hopes to raise through donations.

The DXpedition is under the guidance of the DX Chasers Club, a Western Australia group, with Gordon Nichols VK6XI as chairman. Two or three hams will spend the month of February, 1983, on the island, while the mountain climbers do their thing. Since there is absolutely nothing to do on Heard except try to keep warm, the hams should have plenty of time to operate.

The two DX foundations will finance their contributions directly from their treasuries, but they hope to gain new members and receive extra contributions for the effort. The International DX Foundation asks for $25.00 for a one-year sustaining membership (write PO Box 117, Manahawkin NJ 08050). The Northern California DX Foundation (PO Box 2368, Stanford University CA 94305) also will accept Heard funds. But the official Heard Island account is care of the Wireless Institute of Australia, PO Box 10, West Perth 6005, Western Australia.

Incidentally, the International DX Foundation gained quite a bit of notoriety recently with an up-front article in *Time* magazine (May 3, 1982, page 7). Written by Navassa DXpeditioner Ed Magnuson W2IJB, a *Time* staffer, the article brought the world of DXpeditions to 1.6 million readers. The highly successful KP2A/KP1 Navassa trip bodes well for the success of the Heard Island trip. We'll have more on both the Navassa trip and the IDXF in future columns.

Assuming everything stays on track, VK0HI should be on the air early next year. We'll be providing more details on Heard and the DXpedition plans in coming months, but meanwhile, why not send a donation to one of the groups above?

One callsign which will be conspicuously absent from the VK0HI pileup will be that of longtime DXer Jesse Bieberman W3KT.

**JESSE BIEBERMAN W3KT**

The DX fraternity was greatly saddened to hear of the death of one of its most valued members, Jesse Bieberman W3KT. Jesse passed away on May 28, at the age of 77.

A native and longtime resident of Philadelphia, Jesse displayed an undying dedication to two of his loves: teaching and ham radio. He worked with students both in his job as teacher and in ham radio, founding the school radio club as well as staying active in the prestigious Frankford Radio Club.

In his later years, Jesse served amateur radio as Vice Director of the Atlantic Division of the ARRL for ten years, and then, after 1980, as Director. He attended the IARU conference in Lima, Peru, in 1980 as a member of the Foreign Affairs Committee of the ARRL board, and he served as the board liaison to the DX Advisory Committee.

Jesse's radio career spanned more than six decades, beginning with his first license in 1920. His longtime dedication to DX kept his call on the top of the DXCC Honor Roll on both SSB and Mixed. And when the CW DXCC award was announced, Jesse was ready. He earned CW DXCC Number 1 in 1975, at the age of 70. He also was an active contester, consistently operating for the Frankford Radio Club's winning efforts.

Jesse was best known for his efforts in QSLing. He served as the volunteer manager of the W3 QSL bureau for 33 years, sorting other amateurs' cards and making sure they got to their proper destinations. And in that 33 years, not one amateur officially complained about the bureau, an absolutely remarkable record given the notorious impatience of DXers!

But Jesse did more than handle the incoming cards for hams in the third call area. He shared his years of QSLing experience with any amateur. Jesse ran the W3KT Outgoing QSL Service, the most respected DX QSL forwarding service anywhere. For just a few cents a card, Jesse would locate the best possible QSL route for a given station: direct, through a manager, or whatever. He forwarded your card with others for the same station, with return envelopes. When the cards came back, he distributed them via the incoming QSL service, keeping the costs of the service within the reach of every DXer. Jesse knew all the tricks, all the ways to increase QSL returns.

The W3KT QSL service is now closed. Those cards in the pipeline will be forwarded, but no new cards are being accepted. Jesse's shoes are just too big to fill.

But the DX world has lost more than the best QSL service; it has lost a dedicated DXer who unhesitantly helped others, a fine example to new and experienced operators alike, a man who gave freely of himself so that others could enjoy the hobby that he loved so much. We have lost a good friend. We will miss you, Jesse.

**CHINA UPDATE**

China continues to make DX news. Both Chinas, in fact. More details of the future of amateur radio in the People's Republic of China leak out around the now-tattered bamboo curtain, and Tim Chen's QSL manager, K2CM, provides some additional details on BV2A/B.

BY1PK has been on and off the air since the first legal operation from mainland China in 30 years began earlier this year. Operator training continues with materials provided by various amateur radio organizations, including the ARRL. The operators will soon return to their homes, carrying with them the experience gained in Beijing. Sometime in the not-too-distant future, these new ops will activate more stations in China, and BYs will be heard more than sporadically.

Meanwhile, bootleggers have been enjoying open season with the BY1PK callsign. The Chinese operators have been deluged with QSLs from well-meaning amateurs who worked someone signing BY1PK. Most of the stateside hams received very nice postcards from China in return for their QSLs and IRCs, but, alas, not a single QSL card. The few hams lucky enough to catch BY1PK on the first run (mostly JAs) can justifiably treasure their colorful cards.

The BY1PK operators stayed on CW, often haunting frequencies 30 kHz up from the bottom of the band, especially on 15 and 20 meters. A straight key and a request for a full QSO with exchange of names and QTHs was typical. QSLs with IRCs to Box 6106, Beijing, People's Republic of China, have gotten a response. How soon will BYs be as prevalent as JAs? Not right away, but BY won't be on the top of the most-wanted list for much longer. Meanwhile, there is always the "other" China.

Charlie Moraller K2CM was kind enough to share additional details about Tim Chen and BV2A/B. First, those calls are assigned to the China Radio Association. The club station is quite distant from Tim's home QTH, which limits activity, but Tim continues to be the only member of the Association with permission to operate. The frequent typhoons which rip through the region force dismantling of the yagi every year. The normal yagi emits a far better signal than the dipole used in typhoon season.

Charlie says that Tim wants the QSOs from BV2B QSLed direct to Box 101, Taipei, Taiwan, Republic of China. K2CM is the QSL manager for BV2A. Tim's choice. QSL BV2A via K2CM, 70 Silverbrook Road, Shrewsbury NJ 07701.

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# RTTY LOOP

*Marc I. Leavey, M.D. WA3AJR*
*4006 Winlee Road*
*Randallstown MD 21133*

Sometimes you just can't win. I mean, I try to plan out this column for months ahead, and then you all go and respond to me, and now here I am with a ton of mail on my desk! Oh well, one of the things I most enjoy is answering questions here in the pages of *73*, so I guess this month I'll plunge right in.

Interest in applying microcomputers has never been higher. Dennis Adamkiewicz KA8ETB, from Cleveland Heights, Ohio, drops a line that he is trying to put his home-brew 6803/6847 system up onto RTTY. This sounds like a reasonable combination, and with suitable software should be just the ticket for a silent terminal. The programs published in this column a few years back can provide a starting point for such software, and I am sure that the sequence we are going through now will also be helpful. Let us all know how the project progresses, Dennis.

Chuck Evola is another 6800 buff, but this time with the old Altair 680b. A few months ago, I noted in this column that Chuck was trying to get his system up on RTTY, and the next thing he knew he was exchanging software and printing RTTY using a modified version of the receive program from this column. Chuck sends along his version. I have cleaned it up a tad, and it is printed here for all you 680b fans out there.

Another question posed by Chuck is about a technique to prevent printing unless "true" RTTY is present. I will suggest at this time that such a technique is indeed feasible, using multiple-sampling methods. The receive routine I will develop for the terminal described in July (to continue next time) will use just such a technique, so don't go away.

While we are on the subject of 6800s, Keith Diehl AL7CC up in Anchorage, Alaska, writes of the availability of the A.M.I. 65051/68051 ACIA chip. He notes that this 6800-compatible chip can be interfaced much as the more-common 6850 ACIA, but that it is able to handle five-bit words with a 1½-bit stop pulse. Sounds interesting, Murray or less! Wonder if anyone else is using this chip.

Letters with lists of questions sometimes arrive, and such is the case with a note from Todd A. Lefkowitz, M.D., an opthamologist who enjoys shortwave listening with a special ear towards utilities DXing. Todd's first question is the killer: "Which decoder do you recommend?" I really cannot endorse anyone's RTTY demodulator, Todd, partly because I want to be fair and partly because I have not seen everyone's in use to compare. I can tell you that, in general, you get what you pay for, and that the available low-end demodulators, such as the iRL FSK-500 and Flesher TU-170, provide good performance at an attractive price. Moving up to units such as the iRL FSK-1000 or one of the Hal units may be needed if you need some bells and whistles, but I suggest you write for data sheets from several of these companies and compare specs for yourself.

Two related questions Todd poses are about a source for RTTY frequencies other than Tom Harrington's book reviewed here last year and other sources for Oliver Ferrell's RTTY frequency guide. I am afraid that if Gilfer Associates, the publisher, has indicated to you a lack of copies of the Ferrell book, then you have shot the wad. I know of no other source. The Harrington book, which is available from the *73* Radio Bookshop, remains an excellent (and to my knowledge, the only such) guide to utility and other RTTY signals.

Todd's last question is a common one which I have fielded any number of times. He asks for books or magazine articles on RTTY principles and basics. Unfortunately, there is no book currently available which covers RTTY basics with modern techniques. What is around are ten-

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                       NAM    680b RECEIVE
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              * RTTY Loop by Marc I. Leavey, M.D.
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0038 4D                FCB    $4D,$4E,$48,$20,$4F,$00,$54,$00
              *
0040 00       FIGTBL   FCB    $00,$28,$31,$37,$00,$27,$32,$2D
0048 2F                FCB    $2F,$21,$36,$07,$3F,$24,$22,$33
0050 3B                FCB    $3B,$3A,$30,$38,$26,$34,$29,$00
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0060 00       CRLFST   FCB    $00,$0D,$0A,$15,$00,$04
              *
0066          XSTORE   RMB    2
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0100                   ORG    $100
              *
0100 BE 4000  START    LDS    #$4000
0103 86 04             LDA A  #$04
0105 B7 F00B           STA A  $F00B          : PIA CNTL REG
0108 B6 F00A  SLOOP    LDA A  $F00A          : PIA DATA REG
010B 4D                TST A
010C 27 FA             BEQ    SLOOP
010E 8D 4A             BSR    MSEC10
0110 C6 05             LDA B  #$5
0112 4F                CLR A
0113 48       CLOOP    ASL A
0114 8D 41             BSR    MSEC20
0116 BA F00A           ORA A  $F00A
0119 5A                DEC B
011A 5D                TST B
011B 26 F6             BNE    CLOOP
011D B1 1D             CMP A  #$1D
011F 27 2E             BEQ    CRLF
0121 B1 04             CMP A  #$04
0123 27 0F             BEQ    FIGS
0125 81 00             CMP A  #$00
0127 27 04             BEQ    LTRS
0129 81 1B             CMP A  #$1B
012B 26 10             BNE    GETCHR
012D CE 0020  LTRS     LDX    #LTRTBL
0130 DF 66             STX    XSTORE
0132 20 09             BRA    GETCHR
0134 CE 0040  FIGS     LDX    #FIGTBL
0137 DF 66             STX    XSTORE
0139 8D 1F             BSR    MSEC10
013B 20 CB             BRA    SLOOP
013D B7 0143  GETCHR   STA A  LOCATE+1
0140 DE 66             LDX    XSTORE
0142 A6 00    LOCATE   LDA A  X
0144 BD FEB3           JSR    $FEB3          : CHAR OUT TO TERM
0147 CE 0200           LDX    #$0200
014A 09       LOOPA    DEX
014B 26 FD             BNE    LOOPA
014D 20 B9             BRA    SLOOP
              *
014F CE 0060  CRLF     LDX    #CRLFST
0152 BD FEC1           JSR    $FEC1          : PDATA
0155 20 B1             BRA    SLOOP
              *
0157 8D 01    MSEC20   BSR    MSEC10
0159 01                NOP
015A CE 0232  MSEC10   LDX    #$232          : 75 WPM
015D 09       DLOOP    DEX
015E 26 FD             BNE    DLOOP
0160 39                RTS
              *
                       END
```

*Program listing.*

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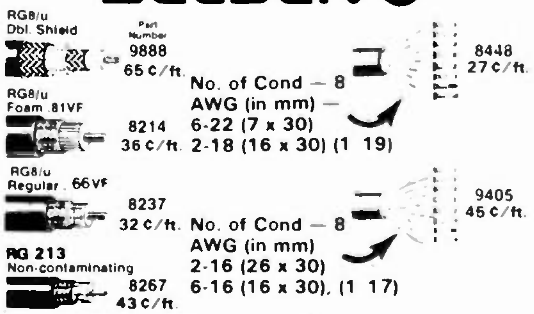
The Ratings continue - 2 meter mobile month: Kenwood TR9130, excellent sensitivity, easy operation, light output; ICOM IC290A, good performance, cheaper pricing; Yaesu FT480R, great reliability, medium pricing.

ICOM IC25A - Kenwood TR7730 - Yaesu FT 230 - All popular, All the same basic flavor. Yaesu FT208R - biggest seller; Kenwood TR2500 - durable; Santec St144 $\mu$P- most features; ICOM IC2AT - basic reliable workhorse.

Consider the various Mod Kits out FOXTANGO, W6TOG, ICOM-Kenwood users, etc.: Our repair dept. has tried several & they are excellent, plus an affordable way to "upgrade" an old radio (TS820?). Remember our service dept. What we can't fix with a hammer, we don't work on.

**See you next month!**

### BELDEN

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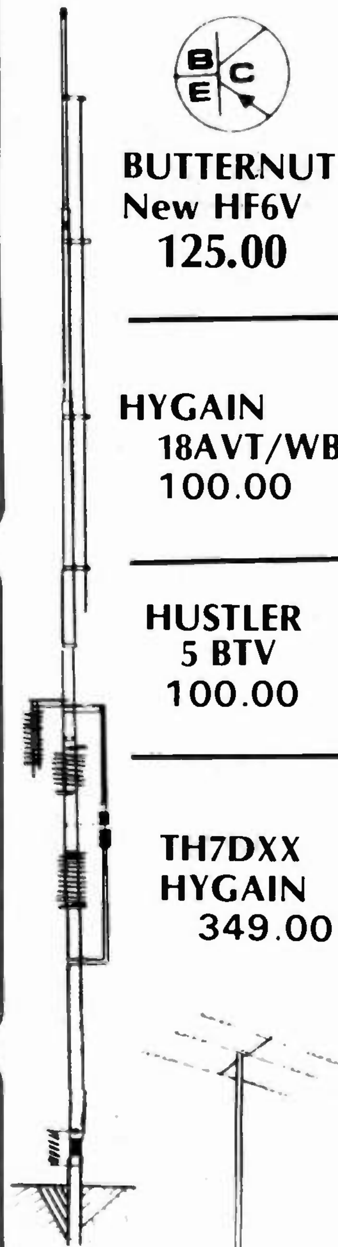

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and twenty-year-old circuits and books which predate ASCII and much other recent development. Hopefully, this is a situation which will be soon corrected by the gang at *73*. As far as magazine articles, you are reading the most consistent source for RTTY information for the last five years. Within the covers of this magazine, I am sure you will be able to find the answer to many, if not all, of your RTTY problems. If you have specific questions, drop me a line and I will see what I can do to reply in a future column.

Carl E. Nelson KI0H, in Blaine, Minnesota, touches base with his recently-developed interest in RTTY. He wants to put an ASR-33 Teletype® machine on the air and is looking for plans for an AFSK generator and demodulator. He also is interested in ASCII-to-Murray (Baudot) conversion, for use on five-level circuits.

A similar question comes from Dr. William W. Fulcher, Jr., N4WF, over in Hendersonville, Tennessee. Bill is looking for help in wiring a Teletype Model ASR-28 he has obtained for amateur use.

Well, gentlemen, and ladies in attendance also, many of these questions have been answered in previous editions of "RTTY Loop." In the five years of this column, I have covered the hookup of many types of Teletype machines and have presented various circuits for transmitting and receiving. At present, there is no compilation of this material available. Hopefully, something of this kind will be available in the not-too-distant future. If you are interested, drop me a line and let me know what you would like to see in such a publication.

A gentleman who makes his wants clearly known is Larry Marcus W5MDT, from Plano, Texas. Larry is looking for a book or source that will give a "comprehensive understanding of the various computer software available as well as the dedicated machines" that he sees advertised. The biggest problem with this, Larry, is the huge variety of stuff. It would be difficult to assemble a collection of all that is out there in one place to "A/B" compare it, and short of such a direct comparison, any presentation is bound to be biased. Nevertheless, I would refer you to the many articles presented here in *73* and in our sister publication, *Microcomputing*, for some help. I have tried to review whatever I have been able to get ahold of, and in the past have looked at several systems. Many manufacturers, however, are less than willing to submit their systems for criticism. Again, I am sorry, but to the best of my knowledge, no book is available that would answer your need specifically.

Speaking of manufacturers, I have a note here from Bob Pearson KH6AKW, who runs an outfit called Hawaiian Computer Software. Bob has a program for the Ohio Scientific Superboard II that enables that computer to run Murray and ASCII with a variety of features and enhancements. It looks interesting, although I am unable to try it out, for lack of a Superboard II! A random thought which occurs to me is that the Superboard II is a 6502-based computer, much as the Apple and Pet. Wonder if some conversion would be possible to these systems? Might be worth looking into, Bob. Anyway, if you are interested, drop Bob a line at Hawaiian Computer Software, 99-060 Lohea Place, Aiea HI 96701. Make sure you mention *73 Magazine's* "RTTY Loop" in your note, OK?

More next month, with a return to the super 6800 RTTY terminal we have been describing. Remember, if you want a question answered here in the column, send it to me at the above address. If you would like a personal reply, you must enclose a self-addressed stamped envelope. I try to answer all questions received, but I do have quite a backlog. Just be patient, and keep watching "RTTY Loop."

# REVIEW

## THE INFO-TECH M500ASR

This is not really meant to be a "product review" but a down-to-earth look at some of the excitement and problems a new product can bring and the way it affects the health and well-being of the owner of a new piece of gear—especially if it is of new design.

The Info-Tech M500ASR is a state-of-the-art communications terminal for use in the transmission and reception of RTTY in the ASCII and Murray (Baudot) codes as well as for sending and receiving Morse code. It is a microprocessor-controlled unit based on the Fairchild F8 (3850) and has 20K of memory which is divided up into 8K ROM, 8K RAM, and 4K video RAM. There is an option that allows the addition of 10K of RAM for the mailbox systems.

The system consists of three major units: the mainframe, which houses 95% of the electronics, the keyboard, which is connected to the mainframe via an umbilical cord, and the monitor, which is a Sanyo VM4512, 12-inch black and white monitor.

### Features

The M500ASR will encode and decode ASCII up to 1200 baud and Baudot up to 100 baud. In the ASCII mode at 110 baud, it uses an eleven-unit code which consists of 1 start bit, 7 data bits, 1 parity bit, and 2 stop bits. When using 150 to 1200 baud ASCII, the M500ASR uses the ten-unit code which is the same as the eleven-unit code except there is only 1 stop bit. The use of parity is also keyboard-selectable from odd, even, or none. When none is selected, parity is marking. In the Baudot mode, the M500ASR uses the standard 7.5-unit code. In the Morse mode, it will send and receive CW from 5 to 100 wpm, with auto-tracking on receive.

There are five types of transmitting modes in RTTY: letter mode, word mode, line mode, buffer mode, and clocked mode. In the letter mode (or character





✓See List of Advertisers on page 114

mode, as it is more accurately described), each letter is transmitted as it is entered from the keyboard. In the word mode, the pre-typed word is sent only after the space bar is entered. In the line mode, an entire line of text is transmitted only after the return key is depressed. In the buffer mode, pre-loaded buffers are dumped on command.

Of all the different modes that are available, the clocked mode is the most unique. The output is slowed to a speed that depends upon the setting of the clock output value. It allows the transmitted character output to maintain a constant rhythm that gives the station on the receiving end the illusion that you are typing at a smooth and even rate. In selecting clock values, a selected value of 1 would be full speed and 9 would cause the output to be one ninth the normal rate.

The M500ASR has several different message systems available. There are ten programmable messages of up to 144 characters each. Each message can be sent separately or the entire contents of messages 0 through 9 may be linked to allow up to 1440 characters to be preloaded. This is especially handy for "brag tapes" or message handling. There are two types of ID messages available. One is CW ID only and the other allows a RTTY message to be incorporated into the ID. This message is preprogrammable and allows you to ID in RTTY then CW. After CW ID, it will go back to the original mode and speed automatically.

### The Modem

The modulator/demodulator system (modem) of the M500ASR uses an envelope detector tuned to a center frequency of 1000 Hz for the detection of Morse code. However, as with any other system that receives Morse code, it must receive decent CW. If you try to copy someone who uses his own brand of spacing (the type that makes Sam Morse roll over in his grave), you will get nothing but garbage on the screen. However, if the transmitting station is using an electronic keyer with proper weighting or, better yet, another computer, you will get 100 percent copy (depending on band conditions and QRM, of course).

In the RTTY mode, a three-shift active filter demodulator is used for all Baudot speeds and 110-baud ASCII. The shifts are 170, 425 and 850 Hz. The 425-Hz shift is really handy for those serious SWLs who love to see the news before anyone else does, or get the latest in the weather directly from the National Weather Service in Kansas City. A separate active filter is provided for ASCII speeds from 150 to 1200 baud. The RTTY tones are provided in several different ways. There is a three-function generator used to generate the audio tones that are fed directly into the mike of your rig. In addition to AFSK, there are FSK, inverted FSK, and RS-232 keying outputs.

For automatic operation of the keying circuit of your rig, there are several different push-to-talk (PTT) lines available. Now, while we are on the subject of AFSK and FSK, some of you old-timers will be saying, "He should tell new operators to use FSK only, because AFSK causes adjacent channel splatter and unnecessary QRM." Well, let me say this: I have been using nothing but AFSK for over a year and have not run into any problems yet. The catch is that you must be very careful not to overdrive your rig and must check your outgoing signal regularly for flat-topping and distortion. Should you find the AFSK generator is flat-topping, splattering, or distorting, the level can be lowered from the factory-set value of 1.5 volts.

### Hard Copy

If you decide to become a "green key," at some time you will find the need to have a hard copy of what you have received. (If for nothing else, just to show your friends the pictures of the nudes being sent on 14.0895 MHz.) This is one area where the M500ASR really shines. There are several different printer inputs and outputs available, including a fully-isolated loop for those of you who still insist on using a mechanical monster such as a model 15. For the newer printers, RS-232 and MIL-188 are available. But that's not all. The printer outputs are fully regenerated. You can copy 110-baud ASCII on your 45-baud model 19 or 1200-baud ASCII on your Epson set at 300 baud without the need for external converters.

There is a limit to this. If you try to copy 1200-baud ASCII and print it on a printer set at 300 baud, the printer buffer on the M500ASR will fill up, overwriting text that was already in the buffer. Also, let me remind those of you who are into SWLing that what you copy is for your eyes only. Don't make the mistake of printing out a long story from the AP or UPI and showing it to your neighbor. If you do you will be violating FCC regulations.

### Tape Interface

RTTYers tend to be very long-winded. This is where a cassette interface becomes very handy. Most RTTYers have compiled brag tapes that give a rundown of their station equipment. Some include personal information, general info about the XYL, the rug rats, dog, cat, job, etc. Most of the cassette interfaces in use today are really nothing more than a few simple connections which allow you to record and play back through your terminal.

The M500ASR cassette interface is more like the type of interface you would find on a personal computer. It actually outputs data in blocks using Kansas City standard tones. The data is loaded and stored in fixed blocks of 1008 characters. Each data block is preceded by two groups of synchronizing leaders and followed by a group of end-of-block transfer codes. The codes are automatically generated when a recording is made, and tested when it is played back. When the cassette load or dump command is entered, the cassette motor control will turn on, starting the cassette recorder. Then the first synchronization group will be sent. After the recorder comes up to full speed, the second group will be sent followed by the data block and end-of-block group. After the end-of-block group is sent, the cassette motor control will turn off.

Because of the way the tape is formatted, it is not necessary to start the tape at a specific point when playing back or loading data. Also, all other functions may continue in normal operation as long as you do not try to access the buffer where the tape operation is originated.

In actual operation, I have found that the tape interface is a handy device, but it is not too well suited for use in running brag tapes or picture tapes due to the limit of the buffer. What it will allow you to do is to make a tape of your general operating parameters. Then all you have to do is turn the power on and enter the cassette-load command. While the cassette interface is loading your CQ message, ID, CW ID, Sel-Cal codes, and WRU answer codes, you can drink a cup of coffee while the machine does all the work.

### Screen Options and Mailbox

The M500ASR has a "split screen" which divides the transmitted text and received text, both of which are displayed at the same time. The upper portion of the screen is the received text and is brighter in intensity than the lower, which shows the transmitted text or the text entered into the transmit buffer.

The system uses a 25-line by 72-character format of which any number of lines from 2 to 15 can be assigned to the transmit buffer. The bottom (25th) line is reserved for the status line which shows the current operating parameters of the unit and the time and date in local or Zulu time.

The receive video has word wraparound, a feature which prevents the unit from cutting off a word of 15 characters or less at the end of a line. When operating in the word or line mode, the transmit video area has the same feature. The system uses dual cursors. One, known as the keyboard cursor, indicates where on the screen the next character entered from the keyboard will be placed. The other cursor, called the transmit cursor, shows what character is next on line to be transmitted. This allows you to see how far ahead of the output you are when typing into the buffer and serves as an indicator of the number of characters which remain to be transmitted.

There are several keys available to the operator of the M500ASR. Along with the CQ and DE keys, there is a break key which, when depressed, causes the RTTY outputs to remain in the mark condition. When operating in the Morse mode, it causes the transmitter to be turned on. There is a run/load key which

✓See List of Advertisers on page 114

controls the transmit buffer output condition. There is a repeat key which, when held down in conjunction with any other key, will cause that character to be repeated until one of the keys is released. The blank key causes the keyboard cursor to move back one space for each time it is depressed, up to the beginning of the line. There is a reset key which clears all of the RAM and initializes the operating parameters and causes a self test of the various segments of RAM. For Morse operation, there are special keys for AR, AS, BK, BT, SK, "Attention," and "Understand."

What do I do if I make a mistake when I am loading a message into the transmit buffer? Well, with the M500ASR's powerful editor, all you do is enter a few simple commands and, at the stroke of a key, you can delete a character, insert a character, or insert a string of characters. To edit text that has scrolled off the transmit video screen, you must enter the receive area buffer editor mode. Then you can edit the text in the same manner as you would when in the transmit buffer editor. The operation may sound complicated but it is not. The dual editor is a very powerful and extremely useful device. I have typed out several letters, and I even wrote this article using the M500ASR as a word processor.

I mentioned a mailbox option that is available for the M500ASR. I operated the system with the mailbox option, and, to be completely honest, I would not call it a mailbox. Generally, you think of a mailbox as being an electronic depository for the operator to receive messages while he is away from the shack. In reality, the M500ASR mailbox allows only others to send and receive messages. It gives stations total and complete control of the system. They can list a directory of messages in the mailbox. A station can call up a selective directory that lists only those messages that are for him. He then can read those messages and erase them. It really works well for other stations but it serves no purpose for the owner of the system.

The owner of the system cannot read a message or write a message for someone else. In fact, he cannot use it at all, because when in the mailbox mode, the keyboard is completely locked out. The only way to remove the system from mailbox operation once you are in that mode is to press the reset key or turn the power off. It is, in effect, a "blind mailbox." This would be a nice option for a RTTY repeater.

**Problems**

Murphy's law states that what can go wrong will go wrong, and believe me, for a while I thought I was Murph's stepson. When I traded my M200F and M300C for this brand new top-of-the-line system, I was, to say the least, very excited. I never had one bit of trouble with the other system, but when I hooked up the new system things started changing rapidly. During the first day of operation, the system showed some very strange and erratic behavior, bordering on being schizo. I had a choice. Either I was becoming senile (at age 28) or the microprocessor had a mind of its own.

The mark tuning LED went first. Then the system started refusing commands from the keyboard. Steadfastly, it ignored everything, while the colon on the block winked merrily away. A phone call to Info-Tech confirmed my suspicions: They were having problems with the programming of the ROMs and knew how to fix it. So, back to the factory it went. (Let me point out that I got the fourth production unit off the line and was really not too concerned with the problem. We all know that when something is new it is subject to several attacks of Murphy's law.)

Ten days later, the dust was barely settling in the tracks of the UPS truck when I had the system back on line. What happened now? Nothing happened. Murphy struck again. Now I am starting to have some second thoughts. Oh well, a phone call produced some reassuring sounds on the other end, and it was back on the road again for my M500ASR.

Like clockwork, ten days after I returned the unit the second time, T.J., the UPS lady, returned with my M500ASR. This time she did not even get a chance to get out the door before I had the unit hooked up and the power on.

Did it work? Well, it worked for a while, anyway. The mark tuning LED was fixed and everything seemed to be okay for about 15 minutes. And then? Data started jumping around to weird places. The entire screen filled with characters and started an endless scroll to oblivion. Bits and pieces from the recallable messages were popping onto the screen out of nowhere. Every time I tried to operate in the load mode, the system would try to send the status line over and over again.

I would hate to be on the receiving end of the phone call that would result from a problem like this. Luckily, John, at Info-Tech, had some more very interesting sounds to make. I think he could have been a politician.

**A Short Time Later . . .**

Someone is knocking on my door. Oh! "Hello T.J., I see you have a package for me. Great! It's my brand new (rebuilt) M500ASR. Thanks, T.J., see you later." As she shut the door behind her, I made a mad dash for the bench and started hooking up the unit. Let's see now. Power on. Looks good so far. Monitor on. All systems go. Status line normal. I want to assign four extra buffers to the transmit buffer, so I depress the SHIFT and CTRL keys at the same time and enter XB-4*. Yep, it works. I start tuning around the band, signals everywhere. Let's see, there's a strong one. It's 6D5M, with a nice signal in here calling CQ. I answer him, and we have a nice chat. Well, everything seems to be working OK. Maybe it's fixed.

Did you ever feel like you were Charlie Brown trying to fly a kite? You know, when the kite-eating tree always devours his pride and joy. Well, you can't blame the tree, it's probably hungry. Gremlins are like that, hungry all the time. They need three squares a day of silicon.

The same problems were there and I was getting a little tired of sending this system back to the factory. I saw a trend developing. After a long discussion with John, he said that he would send me a new set of EPROMs with some of the revisions to the program on them.

**Even Later . . .**

Someone is knocking on my door. "Hello, T.J., how are you doing? I see you have a package for me. Thanks, T.J., see you later."

Ten minutes later everything is hooked up and ready to go. What's that noise? I still hear little grumbling sounds. Must be my imagination. Power on. Everything looks good. Status line normal. Add four buffers to the transmit buffer. All systems go. I start tuning around the band. Wow! A 25 over signal. Its HH2CL with a great signal in here. Solid copy. Well, how about that, everything seems to be working fine. That makes the final score Info-Tech 1, gremlins 3. Not bad for a new player on the team.

One week later the battle cry of gremlins is loud and clear. They lost the battle, but the war is not over. They attack from all directions. The treaty is broken. Charlie Brown has better luck than this. Okay now, count to 10, stay cool, be calm, don't get excited. I am sure there is a logical explanation for this.

After some lengthy discussion with John, he decides to send me a new set of 2716 EPROMs and a new set of RAMs, on the thought that one or more of the RAMs could be bad. Well, at least it is not so bad this time. I can still operate RTTY while I am waiting for the new parts. The system acts only a little screwy.

Five days later T.J. is back at the door. After I scribble my name on the necessary form, not even the Roadrunner could catch me as I smoke the trail between the door and the bench.

It took longer this time, but two weeks later the gremlins were at it again. This time I think they are in for the duration. They are doing things I have never seen before. They are even attacking the keyboard, making some of the keys operate funny. I think this unit is jinxed.

Back on the phone with John. (I think I will put in a WATS line.) We discuss the problems and come to the conclusion that it would be best to send me a brand new system.

Three days after I shipped the unit back to Info-Tech, I called John to follow up and see that the unit had arrived. Indeed it had, but it did not make the trip in too good a shape. It seems as if UPS bounced it around a little and reduced it to a metal and silicon junk heap. Don't worry, I had it insured. John informed me that they had already shipped me a new system and he would take care of the insurance claim from that end.

**Murphy Lives!**

Nothing is ever as simple as it sounds. Three days later, T.J. left a package for me on the door step. Imagine my dismay when I saw a yellow damage tag on the package. I thought they had damaged my new unit. Upon opening the package, I found it was the old one. Old Serial Number Four! Pieces of M500 were stuffed in the box. Great! What now? Out to the shack to call John and find out what is going on.

When I told John what had happened, the silence on the other end was deafening. His first words were "Oh, boy!" Then, after we discussed what had happened, he told me he would call me back and let me know what to do with the old one. In the meantime, my new system should be there the next day.

Here comes T.J. up the drive, and about thirty minutes later I had the new system (Serial Number 25) up and running. Everything was doing what it was supposed to do, and doing it well. And now that I had operated a fully-functional system, I realized that it was worth the time and trouble. Info-Tech has made a great advancement in the state of the art of RTTY.

John tells me that they want to put the old unit to the torture test and see if they can run the resident gremlins off. I wish them all the luck in the world. But right now I have to get dressed as T.J. and I are going to dinner and a show to celebrate.

The M500ASR (with 12" monitor) has a list price of $1475. A memory-expansion board with mailbox option costs $180. For more information, contact the manufacturer of Info-Tech equipment: *Digital Electronic Systems, Inc., 1633 Wisteria Court, Englewood FL 33533.* Reader Service number 482.

**Jim Brown N4DDS**
**Eads TN**

## THE MFJ CW COMPUTER INTERFACE

MFJ Enterprises has done it again. For about $70.00, you can obtain a compact (6" × 4" × 2") yet complete interface for receiving and sending Morse code with your computer. Of course, you must write the software. But at least the hardware problem is largely solved.

In this review I will discuss the various aspects of the MFJ-1200 with emphasis on its design, features, and limitations. I will also explain why an interface is needed. Finally, I shall supply you with a BASIC program to receive Morse code. In this way, you can try out your 1200 right away while you are developing more sophisticated software to suit your own application. And, if you are a Heath H-8 and H-89 computer owner and cannot wait to get on the air with your machine, write me. I have a good program at a reasonable price available separately or in a package with the 1200.

First of all, what do you need to use the computer to read Morse code? Essentially, you must solve two problems: the hardware interface and the software support. First, let's look at the hardware. Imagine if you can the audio output of a radio receiver tuned to a CW signal. If you view it on an oscilloscope, you will see a train of audio oscillations of various widths interwoven with periods of no output. Each packet of audio waves represents an audible tone and its width determines whether it is a dot or a dash. The times when there is no output are the intracharacter, intercharacter, or interword spaces.

You can draw a curve around each wave packet. This curve is constructed to be tangent at each local maximum (peak) of the audio oscillation and is called an envelope. Ideally, the envelope is a rectangular wave, but in practice it will have finite rise and decay times. Of course, what I am describing is nothing more than an audio signal modulated by a rectangularly-shaped wave of a much longer period. Typically, the audio tone has a frequency of 1000 Hz or a period of 1 millisecond. At 20 words per minute, the envelope is about 180 milliseconds in length for a dash and one third of that for a dot.

The computer wants only the envelope, or, rather, its upper or lower half. The audio is only a carrier, and the situation is completely analogous to AM modulation and detection. Thus, the CW detector must extract the envelope, shape and enhance it, and then present it to the computer at a compatible level. This is precisely what half of the MFJ interface accomplishes. The computer will see a series of logical highs and lows at its input, where the length of time between transitions represents a dot, dash, or space. It is now up to the computer to convert the digital information to readable text.

Take a look at the schematic design of the MFJ-1200, Fig. 1. Beginning at the audio input jack, we find a simple diode noise clipper followed by a two-stage, multiple feedback, bandpass filter. The calculated center frequency is 850 Hz and the 3-dB bandwidth is 175 Hz for each stage. The second stage also drives an LED indicator which blinks with the CW input and provides an indication of proper tuning. Following this is a simple diode detector with a sense switch, and this circuit precedes a second-order, VCVS low-pass filter with unity gain and a calculated cutoff frequency of 75 Hz. This additional filter takes out unneeded detection products. Next, a comparator circuit shapes the detected output to produce a rectangular wave with a fast rise time and to generate RS-232 levels. Finally, a transistor converts the RS-232 to TTL levels.

Using a function generator and an oscilloscope, I found the center frequency to be 860 Hz and the 3-dB bandwidth to fall in the 780-to-950-Hz range. My frequency meter does not allow resolution finer than 10 Hz, so these values are certainly in agreement. I also measured the

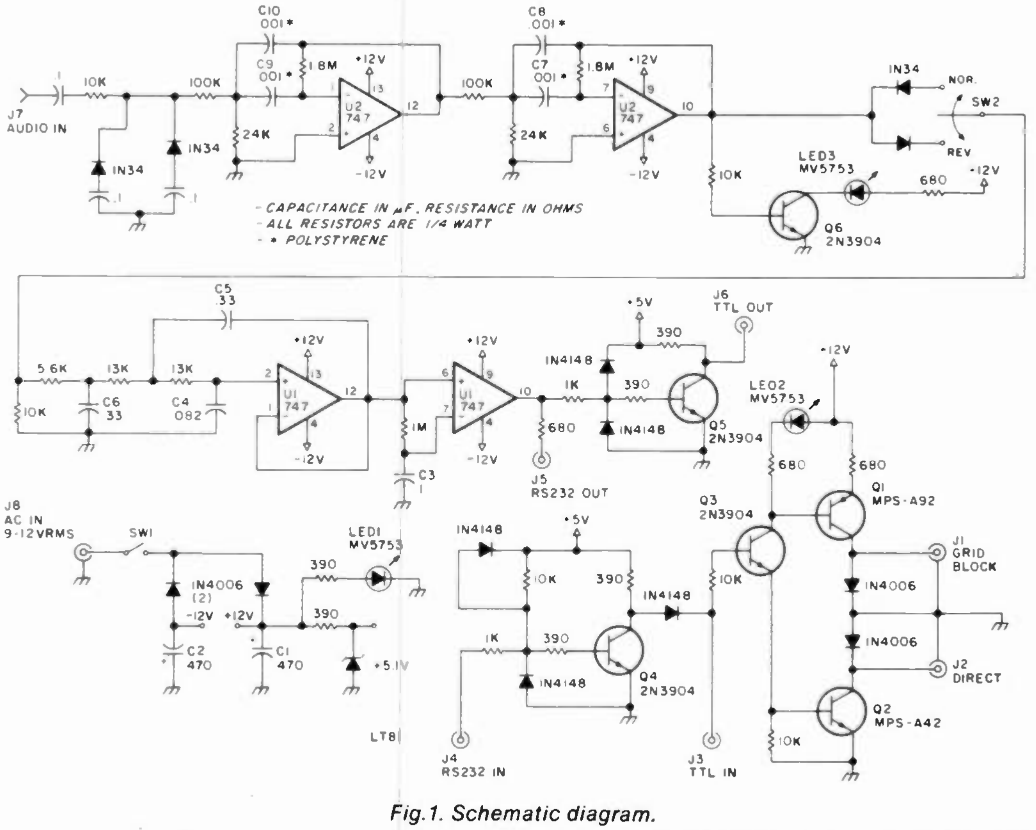
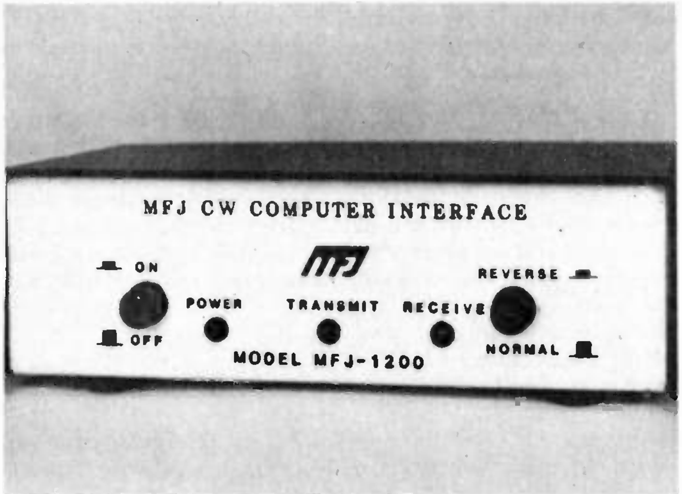



*Fig.1. Schematic diagram.*




*The MFJ CW computer interface.*

low-frequency filter cutoff and read a 3-dB point of about 60 Hz. And, finally, I checked the rise time of the TTL output with an input code signal of about 22 words per minute and found it too short to measure.

The detector circuit is quite simple—a diode and a low-pass filter. It differs from the more frequently used 567 tone decoder. MFJ told me that they had experimented with the decoder but finally decided on the circuit described. It does, however, have a slight disadvantage, and that is that the bandwidth is rather strongly dependent on amplitude. I found that the higher the input amplitude, the wider the range of response. In contrast, a 567 will respond only over a width of about 14% of its free-running frequency once the input magnitude exceeds a certain threshold. But I have experienced no difficulty in actually using the 1200, and the documentation cautions the user to reduce the input until only the desired CW signal is activating the received-signal LED.

The MFJ-1200 will also key a transmitter. A transistor converts RS-232 to TTL levels, and a second transistor drives two high-voltage keying circuits. Unfortunately, the documentation does not give the maximum allowed ranges, but the catalog lists −300 volts at 10 mA and +300 volts at 100 mA. An LED glows when the transmitter is keyed. I have also used the unit to activate a battery-operated code-practice oscillator when running my AUTOSEND program. This program produces random or fixed-length code groups for learning Morse, and the 1200 not only allows me to hear the output but also to make practice tape recordings.

Let us now look at the MFJ-1200 from the user's standpoint. There are two switches on the front panel. One applies power. (The rectifier and filter circuits are inside; the power transformer is external and is built into the wall plug. Thus the unit expects 9-12 volts ac, and the application of dc can damage it.) The other push-button is a sense or normal/reverse switch. The output logic is reversed if this is pushed in. The usual convention is for a logic 1 to be an electrical low. However, with this switch the opposite sense can be chosen.

In addition to being able to accommodate various hardware/software arrangements, the sense switch has a rather unusual application. Some CW utility stations occasionally use frequency-shift keying. The various Navy stations on 8.090 and 12.135 MHz transmit with an 850-Hz shift from time to time. To take maximum advantage of CW FSK, you should have a RTTY modem such as the iRL FSK-1000. However, with the MFJ-1200 you can read either the mark frequency or the space frequency by changing the sense.

On the back are seven phono sockets and the ac-power connector. It is best to attach the audio input in parallel with the speaker line because the receiver volume control can be used to regulate the input level. This is important for readable code.

Two sockets give the detected output to the user at either TTL or RS-232 levels. These are the inputs to the computer. However, you cannot really use a serial input port even though the output from the 1200 is itself serial data. This is because Morse output does not have the form expected by the computer interface (UART) of start bit, data bits, parity bit, and stop bit(s). Rather, the software itself must perform as the UART. What the computer really needs is a one-line parallel port.

Many computers have parallel ports which usually operate at TTL levels, and it is quite easy to read them using assembly or high-level-language programs. Some computers have no parallel ports which are provided by the manufacturer. A good example is the Heath H-89, but even in this case it is easy to find input and output lines which are not part of the serial signal-in and signal-out paths. Many UARTS, such as the INS8250 and the 8251, provide several lines to control modems or other peripheral devices. For example, the 8250 has eight—four each for input and output. The output lines are located at port address +4 and are called Modem Control Lines. Similarly, the modem status lines at port +6 can be used for input. The 8251, while not quite so versatile, has one input and two output lines which can be found at port address +1. In some cases, the modem lines can even be used to generate interrupts. For more information, see your computer documentation.

The next two connectors on the MFJ-1200 are TTL or RS-232 inputs from the computer. The same remarks about output lines apply, and attachments should be made from a parallel port or modem control line and not from a signal-serial-output port. Finally, two sockets, one for direct and one for grid block keying, are provided. A subminiature phone jack is used for 12 volts ac.

To use the 1200, a CW signal is tuned until the received signal LED blinks brightly. The amplitude of the signal is then reduced until only the signal itself turns on the light. Too much drive causes the unit to interpret noise and adjacent channel interference as valid signals. The resulting output to the terminal is rubbish, with the periods between transmissions filled with Es and Ts. I found that with relatively careful tuning and regulation of volume, the received code was printed very accurately.

One of the most difficult aspects of using the unit is getting the volume level set properly to avoid false triggers and setting the center frequency accurately. The two go together since the detector allows a wider bandwidth with high amplitude. It would be a great help to have a tuning meter. One must balance economy with performance, of course, but it would be really useful to at least have a socket on the back where a simple meter could be connected. I found that after an initial setting, I could improve the accuracy by reducing the volume until the LED became quite dim and then returning for maximum brightness. Things do not have to be absolutely perfect; there is enough tolerance for minor errors, and the technique just described is adequate.

How well does it work? To find out, I tried it with several Morse programs and made a few heuristic comparisons. I also made a qualitative comparison with another CW detector—the iRL FSK-1000. Before you say that iRL makes only RTTY demodulators, let me remark that the FSK-1000 is an outstanding unit for CW, although for some reason the company never mentions this explicitly. Excellent filters, AM and limiter-detection modes, narrow bandwidth, and many other features make it a versatile unit for digital communications. I also point out that it costs eight times as much as the MFJ-1200, and its purchase for CW use alone is not sensible.

In all cases, we obtained good accuracy on machine-sent CW from the various utility stations. It seemed that a few more errors were made with the 1200 than with the FSK-1000, but the difference was not great. Amateur reception was not as good, but this has little to do with the characteristics of the CW interface or the program but rather with the nature of amateur communications itself. At this point, we should perhaps mention that computer CW may initially be a disappointment to some. Even very good Morse programs do not tolerate bad sending, and unfortunately it can be found everywhere. It takes an astute combination of eye, ear, and experience to use the computer in such code since a high percent-

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## CW SOFTWARE

The purchase of the MFJ-1200 solves a vexing hardware problem, but you still must write or purchase a program to fit your needs. You can test your new 1200 with a simple but effective BASIC program which I have shamelessly lifted from an article in *Kilobaud Microcomputing* by Robert W. Kurtz W8PRO (see References). Originally written for the Kim computer, I have tightened and modularized the code but left the basic technique intact. The original look-up table also has been modified by adding all Morse characters, and I have replaced the author's use of a "-" for a missing character by a null string. Finally, I have not hesitated to use the various features of MICROSOFT® BASIC such as integer representation and double-letter-variable names. However, the original variable names used by the author have not been altered. (For a detailed description of the theory of operation, see the original article. We will supply a copy for an SASE. If you are running HDOS, send us a disk and we will return a copy of the program as well.)

When you adapt the listing for your system, you may leave out the REM statements as well as those lines and comments preceded by an apostrophe. You can replace double-letter names by other variables. You also can omit line 240 if you do not have integer specifications, and you can omit the error-handling subroutine at 250. It is used to keep integer overflow from stopping the program. This will occur if the integer variables DO and DA are constantly incremented by noise without a chance to reset. It is not serious and it will never happen when receiving normal code.

The error routine also reminds you to set the input port parameters when you first run the program. Let us tell you how we connected the MFJ-1200 to our computer and this will explain the settings we used at line 790: 790 DATA &076, &040.

On a Heath H-8, there are several serial and parallel ports. Four of these are controlled by an 8250 UART. We attached the RS-232 output of the 1200 to the Data Set Ready (DSR) modem status line at a port addressed at 070 octal. DSR can be read by detecting the fifth bit at port address +6. Hence the input to the port must be ANDED with 00100000B (040 octal) to be read. This explains the values in the BASIC line above. The ampersand is MBASIC'S way of designating an octal constant. Equivalent decimal integers can also be used.

The program expects a value of A = 0 when the key is down. You will have to modify the program if the port read subroutine returns a different value for the same condition. Alternatively, you might be able to use the sense switch on the 1200 if the logic is simply being inverted.

If you have an H-89, use the port at 330 octal (0E8H). Attach the 1200's RS-232 output to pin 6 on the D-connector and ground to pin 7. (This is standard RS-232 protocol.) It is not necessary to attach anything inside the computer. For other

```
100 REM          ****** MORSE CODE READER ******
110 '
120 REM WRITTEN FOR KIM BASIC BY:       ROBERT L. KURTZ, W6PRO
130 REM                                 4 SANTA BELLA ROAD
140 REM                                 ROLLING HILLS, CA 90274
150 REM
160 REM MODIFIED FOR MICROSOFT BY:      WILLIAM S. HALL
170 REM                                 MLM ASSOCIATES
180 REM                                 5621 MAPLE HEIGHTS COURT
190 REM                                 PITTSBURGH, PA 15232
200 REM                                 412-683-4742
210 REM 1 JANUARY, 1982
220 '
230     REM:  INITIALIZE EVERYTHING
240 DEFINT A-B: DEFINT D-N              'USE INTEGERS FOR SPEED
250 ON ERROR GOTO 980
260 GOSUB 630                           'LOAD MORSE CODE CHARACTERS INTO ARRAY
270 '
280     REM:  MAIN PROGRAM LOOP
290 GOSUB 830:IF A<>0 THEN 290          'READ PORT AND LOOP FOR KEY DOWN
300 B=0                                 'KEY IS DOWN.  SET COUNTER TO ZERO
310 GOSUB 830                           'LOOK AGAIN AND INCREMENT COUNTER
320 IF A = 0 THEN 360 ELSE GOSUB 880    'WAIT FOR DASH TO FINISH
330                                     'ELSE PROCESS DOT
340 C=((5*C)+(2*B))/6                   'UPDATE TIMING CONSTANT
350 GOTO 400                            'BYPASS DASH PROCESSOR
360 IF B < .5*C THEN 310 ELSE GOSUB 930 'IF B TOO SMALL STAY IN LOOP
370                                     'ELSE PROCESS DASH
380 GOSUB 830: IF A=0 THEN 380          'WAIT FOR KEY UP.  KEEP COUNTING
390 C=((4*C)+B)/5                       'UPDATE SPEED CALCULATIONS
400 B=0                                 'RESET COUNTER
410 GOSUB 830                           'NOW MEASURE SPACE LENGTH
420 IF A=0 THEN 380                     'KEY IS DOWN AGAIN.  GO BACK
430 IF B < .5*C THEN 410 ELSE GOSUB 540 'SEE WHAT KIND OF SPACE WE HAVE
440                                     'IF LONG ENOUGH CHARACTER IS FORMED
450 GOSUB 830                           'KEY DOWN YET?
460 IF A = 0 THEN 300                   'YES, SO START NEXT CHARACTER
470 IF B < 2*C THEN 450 ELSE PRINT " "; 'NO, PRINT SPACE IF UP LONG ENOUGH
480 K=K+1:IF K < 72 THEN 290 ELSE PRINT 'UPDATE LINECOUNT AND PRINT NEW LINE
490                                     'IF NEEDED
500 K=0:GOTO290                         'RESET LINE COUNT.  START AGAIN
510 '
520     REM:    CONVERT AND PRINT CHARACTER SUBROUTINE.  SEE ORIGINAL
530     REM     ARTICLE FOR EXPLANATION OF CODE CONVERSION METHOD
540 DA = DA*2
550 D=DA+DO
560 IF D > 361 THEN D=100               'INVALID CHARACTER.  PRINT NULL
570 PRINTA$(D);
580 DA=0:DO=0                           'RESET VALUES FOR NEXT CHARACTER
590 K=K+1                               'BUMP LINECOUNT
600 RETURN
610 '
620     REM:    SUBROUTINE TO LOAD MODIFIED BYRANT CODE AND PORT DATA
630 DIM A$(361)
640 FOR N=1 TO 119:READ A$(N):NEXT N    'LOAD MOST MORSE CHARACTERS
650 DATA E,T,I,A,N,M,S,U,R,W,D,K,G,O,H,V,F,U',L,A',P,J,B,X,C
660 DATA Y,Z,Q,O',CH,5,4,<SN>,3,E',,,2,<AS>,<AU>,<AR>,,,A^,,1,6
670 DATA <BT>,/,,,<NK>,,,7,,,N',8,,9,0,,,,,<SK>,,,,,,,?
680 DATA -,,,,,-,,,,,,,,,,,,,,,,,',,,-,,,,,,,,,,,;,,,(,,,,,,-,,,,,:
690 A$(76)=CHR$(95)                     'LOAD SOME SPECIAL CHARACTERS
700 A$(81)=CHR$(34)                     'DIFFICULT TO DISPLAY DIRECTLY
710 A$(114)=","                         'IN BASIC
720 A$(196) = "<BK>"                    'LOAD MORSE CHARACTERS WITH
730 A$(255) = "<EE>"                    'LARGE BRYANT CODES
740 A$(361) = "%"
750 '
760     REM:    LOAD PORT PARAMETERS.  DATA IS PORT ADDRESS AND BIT SELECT
770     REM:    USER MUST ENTER DATA BEFORE PROGRAM WILL RUN
780 READ I,J                            'READ PORT I, AND WITH J
790 DATA
800 RETURN
810 '
820     REM:    PORT READ SUBROUTINE
830 A = INP(I) AND J                    'RETURN A = 0 IF SIGNAL PRESENT
840 B=B+10                              'INCREMENT COUNTER
850 RETURN
860 '
870     REM:    SHIFT LEFT AND ADD ROUTINE FOR DOTS
880 DO=2*DO:DA=2*DA
890 DO=DO+1
900 RETURN
910 '
920     REM:    SHIFT LEFT AND ADD ROUTINE FOR DASHES
930 DO=2*DO:DA=2*DA
940 DA=DA+1
950 RETURN
960 '
970     REM:    ERROR TRAPPING ROUTINE
980 IF ERR=4 THEN 990 ELSE PRINT:PRINT "ERROR NUMBER";ERR;"AT LINE";ERL:RUN
990 PRINT "ENTER PORT AND BIT NUMBER IN DATA LINE";ERL+10:END
```

*Program listing.*

machines, please consult your documentation. If you have a TRS-80, MFJ has a special version of the MFJ-1200 for you.

If you want to experiment with a sending program, you can try to use BASIC, but it will not be very satisfactory unless you can use character instead of line input. In Morse code it is better to send out a character as soon as it is entered on the keyboard. Microsoft's INPUT$ offers such a method. See also Reference 2.

age of what is typed out is either incorrect, badly spaced, or both.

On the other hand, keyboard and computer CW are received very well. It is a great pleasure to run along at 50-60 words per minute, and this is where this kind of digital communication method comes into its own. We have had some excellent QSOs at these speeds.

In conclusion, I found the MFJ-1200 a very satisfactory unit. It performs well, and its price is well within a range most of us can afford. It can open new worlds to amateur radio operators and to those interested in shortwave listening. It gives the computer user a new area of exploration. Despite its "ancient" (1836) origins, Morse code remains a viable and widely used method of communication, especially in the maritime services. I routinely listen to UPI news, read weather broadcasts and telegrams, and decode Russian CW in addition to our usual amateur activities. If you are interested in a list of utility stations I have received, or if you would like a copy of Cyrillic CW, write me for more information.

The MFJ-1200 can be purchased directly from *MFJ Enterprises, PO Box 494, Mississippi State MS 39762* for $69.95 plus postage. If you need a power supply, add $9.95. Reader Service number 483.

**William S. Hall**
**5621 Maple Heights Court**
**Pittsburgh PA 15232**

**References**

1. Kurtz, R. L., "World Of the Brass Pounders: Receive Morse the Easy Way," *Kilobaud Microcomputing*, November, 1978.
2. Gillett, M., "CW and the TRS-80," *73 Magazine*, April, 1980.

## THE FLESHER TU-170 TERMINAL UNIT

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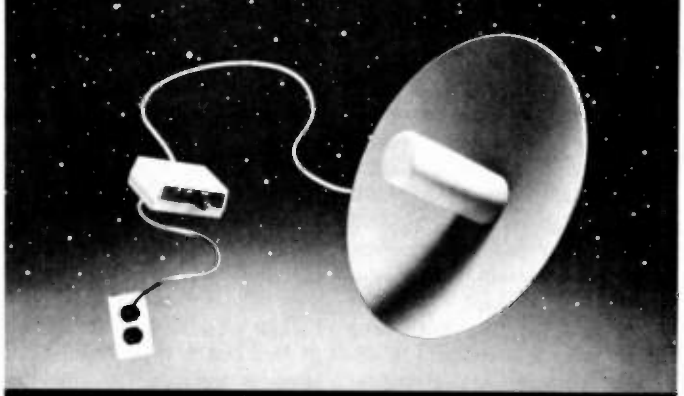

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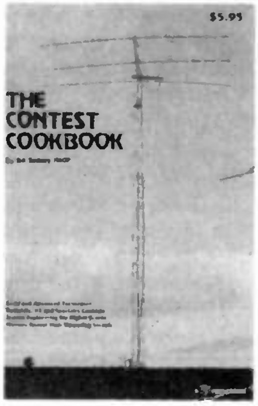


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tions were using 170-Hz shift, and that there are in general two basic types of demodulators in use, the phase-locked loop type and the filter type. It also seems that fancier stations have autostart capabilities: the capacity to turn on an unattended TTY when a remote station starts sending.

Further reading disclosed that phase-locked loop demodulators tend to work great if there is no interference or adjacent strong signal, but that they tend to lock easily onto strong, adjacent signals, which could be a problem in HF work. Filter-type demodulators, however, are somewhat more immune to adjacent strong signals. Even further reading disclosed that the Flesher Corporation of Topeka, Kansas, marketed a TU using the filter type of demodulator, and that the unit had a tuning meter, autostart, and a built-in loop supply. Also, Flesher markets the unit in either kit form or assembled and tested. A phone call the next day to Topeka resulted in a small bruise to my VISA card, and the arrival one week later of my TU-170 kit.

For those readers who are accustomed to Heathkit® instructions, the Flesher unit will not exactly bring smiles of joy. The instructions are adequate, but the kit is best assembled by an experienced kit builder. The instructions are straight to the point and lump similar steps together. (For example, "Install all diodes" on board.) The kit builder working from a pictorial of the board first installs the jumpers (there are eight), then the diodes and resistors, and then the integrated circuit sockets. Although the kit does not include IC sockets, a slip of paper in one of the parts bags informs the builder that IC sockets are now supplied and that they should be installed instead of the ICs called for in the instructions. I installed the sockets where it said to install the ICs, and did not insert the ICs until after completing all soldering.

The Flesher TU-170 consists of one single-sided printed circuit board measuring approximately 6" by 6", a heat-sink plate which mounts to the PC board and in back of the front panel, and a Ten-Tec-type chassis/cabinet which consists of a U-shaped front panel/bottom-rear panel, a top, and two sides. Construction takes between 12 and 20 hours, depending upon your ineptitude. A small pencil-type soldering iron should be used, and care should be taken to minimize the heat, particularly around the front-panel switches.

A special caution should be noted about the front-panel switches. They are very inexpensive and are especially susceptible to heat damage. Being of frail plastic design, if too much heat is applied to the contact posts, the plastic body may become soft, allowing the contact post being soldered to move and the switch to become inoperative. If this should happen, as in my case, a call or letter to Topeka will result in a new switch arriving about one week later. Do not bother, as I did, to try to find a replacement switch around town. A search of Los Angeles found no suitable switches which would exactly fit the square hole in the Flesher front panel. The factory is very polite and helpful in such situations, but it does take about a week from the time they are notified to get a new one.

Other rules of kit building that one should observe include:

1) Follow the instructions!

2) After finishing the PC board, check each component for correct value and orientation, as well as for a good solder connection. Also check for and remove any solder splashes.

3) Do not rush!

4) Use a good wire stripper, not a pair of cutter pliers.

5) Do not rush; follow the instructions.

Assuming that you observe the above cautions, it is highly probable that a completed TU-170 will appear several nights after you started, along with some burn marks on several fingers.

Before discussing alignment, it is useful (as they say in the text books) to look at the Flesher TU-170 from the functional point of view. Fig. 1 shows a block diagram of the unit. It is divided into three major functional blocks: the demodulator with autostart and loop-keying circuitry, the modulator, and the power supplies.

With the exception of the autostart line-switching solid-state relay, meter, switches, jacks, and input/output terminal board, all of the circuit components are mounted on the 6" by 6" PC board.

Details of the demodulator are shown in Fig. 2. The audio input from the transceiver, containing the mark tone at 2125 Hz and the space tone at 2295 Hz, passes through the mark and space filters and is then rectified. The negative half of the filtered space signal or the

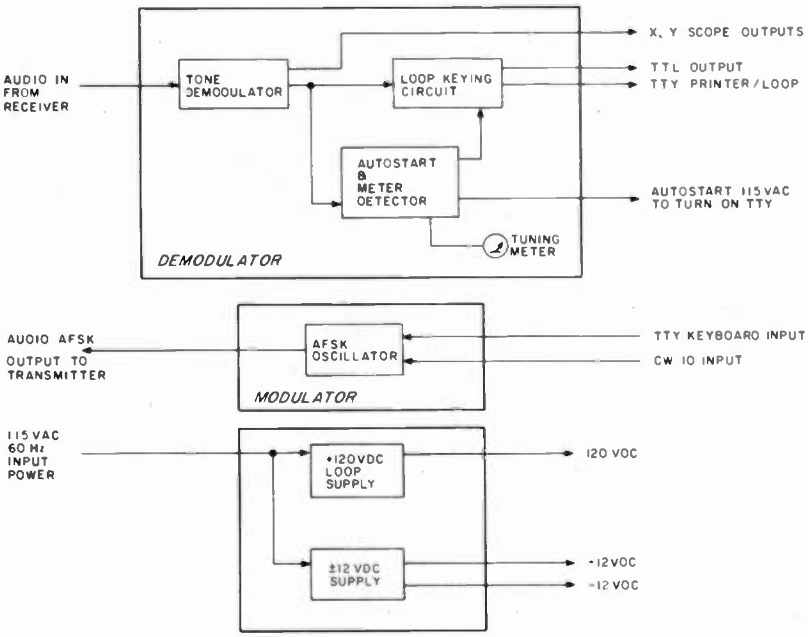


*Fig. 1. TU-170 terminal unit functional block diagram.*

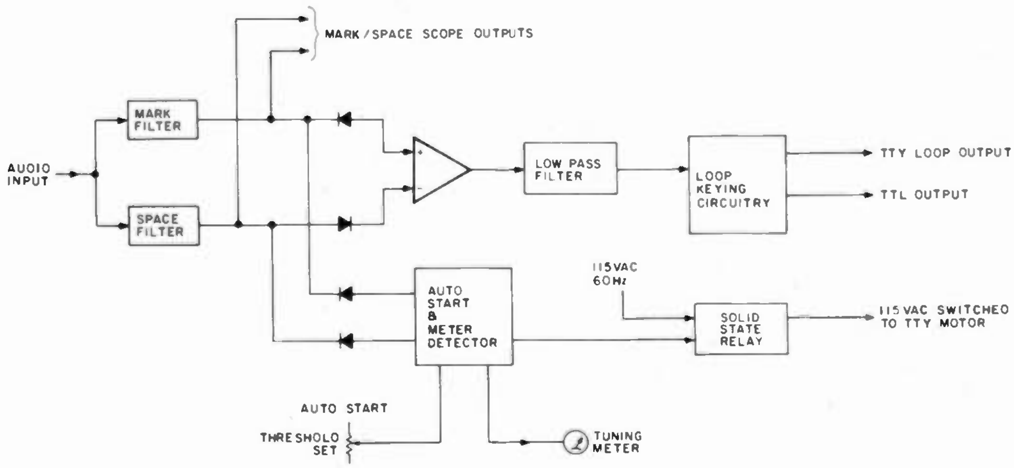


*Fig. 2. Demodulator detailed block diagram.*

positive half of the filtered mark signal then drives an amplifier either hard positive or hard negative. The output of the detector then is low-pass filtered to remove the high-frequency audio components, and then squared off and sent to the loop-keying circuitry. The loop-keying circuitry switches the +120 V dc which runs the TTY printer magnets.

For computer enthusiasts, a TTL-level output is available. Also available at the mark and space filter outputs are high level signals (15-volt peak-to-peak) to drive the horizontal and vertical channels of an oscilloscope. The mark signal is normally applied to the horizontal channel, and the space signal to the vertical channel of the scope. These signals will provide a cross or crossed-ellipse pattern when connected to the scope when the RTTY signal is properly tuned.

The filtered mark/space signals also have their negative halves rectified and are fed into the autostart/meter detector. The front-panel meter will indicate maximum deflection when a signal is properly tuned. The autostart circuit will turn on 115 V ac through a solid-state relay when a RTTY signal is present. The 115 V ac may be used to turn on the TTY motor. A front-panel potentiometer allows the autostart detector to be set at any desired minimum signal level, thus avoiding activation of the TTY on noise or low-level signals. The transmit and receive modes are controlled by the Send/Rec switch on the front panel. A set of contacts on this switch sends +12 V dc to the loop-keying circuit, thus preventing spurious output from the demodulator from keying the printer during transmit. A second set of contacts on the Send/Rec switch can be used to trip the push-to-talk circuit on the transceiver.

The TU-170 modulator generates the audio mark/space tones. Fig. 3 shows a block diagram of the audio modulator. The TTY keyboard contacts provide a switched loop voltage which, after going through the loop-keying circuit, provides a high- or low-level input to the modulator. The frequency of the modulator is generated by a 555 timer/oscillator integrated circuit. By changing the value of the resistance in the 555 frequency-determining components, either a 2125-Hz mark or a 2295-Hz space signal will be generated. A high input to the modulator will cause a mark to be generated, and a low input, a space.

For a space, the frequency is changed by a transistor and FET which switch a resistor in parallel with the mark-frequency-determining resistor, thus presenting a lower resistance to the 555 and causing a higher frequency to be generated—in this case, a 2295-Hz space frequency. For CW ID, a separate input is provided which changes a capacitor connected to the 555, thereby providing for a 100-Hz shift for a key to send your call in shifted CW.

The output of the 555 is filtered through an active filter. A pot allows the filter to be centered and, therefore, equal amplitude on both mark and space signals can be adjusted. The 555 circuit and filter provide a very clean and coherent signal.

Alignment of the TU-170 is very straightforward. First the modulator is set to the correct mark and space frequencies. A counter is needed for this step. The mark is set first by adjusting a potentiometer. Then a jumper from +12 V dc will switch the 555 to a space and the space tone pot is set for 2295 Hz. During the first hour or so of operation after power on, some drift will be seen on the counter for both the mark and space frequencies. About 10 Hz over an hour's period was observed. Since both the mark and space tones drift about the same amount, this will present no problem for amateur demodulators since these small drifts are well within the demodulator's bandpass.

After setting the frequency of the mark and space tones, their amplitudes are set by a third pot to be about equal. An oscilloscope or a VTVM is needed for this adjustment. The tone output then is jumpered to the demodulator input, and the mark and space filters are adjusted. Three pots in each filter are adjusted for maximum deflection on the front-panel meter. Add a cover and sides, and the TU-170 is completed. The unit now is about 7.25" wide by 3.25" high by 7.25" deep. It is grey and black, and rather attractive. It easily blends into most stations.

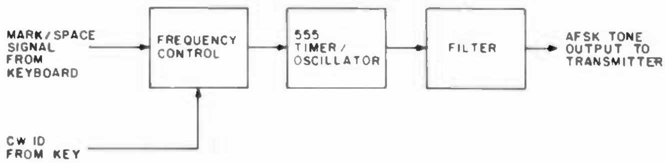


*Fig. 3. Modulator detailed block diagram.*

The next step is to hook up the TU-170 to the station transceiver and teletype. I use a Yaesu 227R here, on 2m FM. Yaesu has thoughtfully provided all of the necessary connections needed on an accessory connector on the rear panel of the 227R. These signals are: push-to-talk, microphone audio input, and speaker audio output. I leave my speaker connected while in the RTTY mode so that I can hear the tones and know that everything is OK.

You should use shielded cable for all connections between the TU-170 and your transceiver. Multi-conductor cable with a single outside shield is OK, but I used separate lengths of individually-shielded wire for each signal. Just use good techniques and you won't have any problems.

If your rig does not have an auxiliary connector with the proper signals available, then you can use the microphone input jack and earphone/speaker jack. If you do use the auxiliary connector, as I did, the TU-170 modulator will be in parallel with your transceiver microphone. When receiving, you then will hear a tone coming out of your microphone, since the TU-170 is always generating a tone whether it is in transmit or receive. The microphone in this case acts as a speaker. Also, you probably will not be able to transmit on FM voice when the tone is on, since it is strong enough to drown out the audio from the microphone. The simple solution is to turn the TU-170 ac power switch off whenever you are in the FM voice mode. An alternate solution is to add a switch to the TU-170 to disable the 555 oscillator. A number of other stations use computers on RTTY in our area. The TU-170 has TTL input and output lines to allow it to be connected easily to your favorite computer.

Once your hookup is complete, you are ready to start. I would suggest that you listen at first to get a feel for how conversations are held. Good operating practice is to wait after a station has signed to allow others to break in. When you feel ready, jump in with your call.

Well, there you have a description of my first experiences with RTTY. The Flesher TU-170 has now been in use here at WB6CRD for some time without any problems whatsoever. It is a first-class unit for either the beginner or the old-timer, and can be used with computers. The world of RTTY has now been opened to me, and it is a fascinating world. I highly recommend it to you.

The TU-170 is available in kit form for $169.95. For more information, contact *Flesher Corporation, 507 Jackson, PO Box 976, Topeka KS 66601*. Reader Service number 484.

**Tony Gitt WB6CRD**
**Culver City CA**

**DAIWA DK-210**

The gang at *73* knows I'm a CW freak and spend most of my time at the low end of the various bands, hanging out with others of like persuasion. For years, I've been using a time-honored but somewhat passé


*The Daiwa DK-210 electronic keyer.*

"TO" keyer...one of the tube-type keyers made by Hallicrafters as the HA-1...but still a real standard in many shacks, even today.

Like many of you, I suspect, I didn't even know that Daiwa made a keyer. Sure, we all know about their swr and power meters...the ones with the "crossed" pointer readout... and we know about their line of antenna tuners, but a *keyer*?

First impressions are important, and Daiwa doesn't let us down on this vital part of product marketing. The Daiwa DK-210 electronic keyer comes in the expected plastic-wrapped package with accessories separately wrapped and packed in the same carton. These include two RCA phono plugs, a power cord, and a power plug.

The DK-210 is dark grey in color and feels quite heavy... heavier than you'd expect for its size...a quality feeling. The crinkle finish is well done, and the front-panel markings stand out clearly against the dark finish color.

In this model, there are five small rectangular LEDs in the upper left-hand corner, surrounded by a white outline. Each LED is labeled with a number: 10, 20, 30, 40, and 50 (wpm); more about these later. The left-hand knob is labeled SPEED and obviously sets the speed of the dots and dashes generated by the keyer's electronics. A segmented circle around the knob is marked with the same numbers, corresponding to the LEDs...again an obvious (but welcome) feature.

A second knob is labeled WEIGHT and has a scale whose limits are marked MIN and MAX. This knob controls the dot-dash ratio and space; at MIN, the ratio is exactly three to one... that is, the length of time occupied by one dash is exactly equivalent to the time occupied by three dits. If you like to slur your keying and send code that has a different ratio, you have plenty of adjustment to play with. I would guess that beyond about the ten o'clock position of the pointer on the knob, you might succeed with a setting that nobody could decipher!

The DK-210 has a built-in speaker and tone generator so that you can monitor your own sending. The tone is pleasant and sounds something like the monitor of the transmitter itself. There is an external volume control, while the tone's pitch may be adjusted by a small screwdriver-slotted plastic shaft on the rear panel of the keyer. As it was received, I'd guess the tone was about 700 Hertz...just right for my ear, so I didn't bother changing the pitch. If you like stereo, you can use the transmitter's own keying monitor playing counterpoint to the built-in keyer monitor. I do that sometimes to relieve the monotony of a single tone.

A rotary switch allows you to select SEMI-AUTO, AUTO, and TUNE. In the SEMI-AUTO position, dots are generated automatically but dashes must be made manually, like the old-fashioned bug keyers. In the AUTO position, the key is a full electronic keyer with all automatic functions, including the desirable iambic-keying capability...something I've not yet taught myself to use. No matter—it works just fine with my old-fashioned type of thumb and forefinger input. (One of these days, though, I've got to learn to use iambic, or "squeeze," keying as it's called.)

The tune position is to allow you to turn your transmitter on in the way you used to do by holding the old pump handle in the down position...that is, to make a steady tune-up signal on the ~~band~~, er...ah, the dummy load. Finally, at the extreme right side of the front panel is the toggle switch that turns the power on and off, as indicated by an LED just above it. Below the toggle switch is a standard quarter-inch phone jack. Naturally, I had to change mine from the one I had on it back to the standard! Oh, yes, I almost forgot: It's labeled KEY and that's where you plug in your paddle.

On the back panel there's an accessory power-input jack for the usual 8-to-13.8-volt dc power-input plug...the style that you are used to seeing on tape recorders and other electronic devices that need that kind of power. More about *this* later, too!

Two RCA-type phono jacks are also on the rear panel. One is red and the other, black. The red one says DIRECT and the black one says GRID BLOCK. This means you can use the Daiwa 210 to key an old-fashioned cathode-keyed rig (limits are 300 V, 100 mA, max.) or one of the newer rigs in which the grid of a control tube, or a solid-state device, is keyed (limits are − 100 V, 10 mA, max.).

Having an Icom IC-720A to key, I used the grid block outlet and managed to use one of the accessory phono plugs thoughtfully provided by Daiwa. Next, I looked for a source of power. Failing to locate an appropriate source of 12 volts dc with the proper plug right away, I decided to remove the top cover of the keyer (per instructions) to locate the battery holder...and install a 9-volt battery.

Whoopee! The keyer lighted up and a few dots and dashes caused the LEDs to glow...first the 10, then the 20, and finally the 30...sort of a progressive display running from left to right. The instructions suggest that if you run on battery power it would be a good idea to disable the LEDs to reduce power consumption. Likewise, it would be a good idea to forgo use of the keying monitor/speaker.

I quickly tuned in a station, gave him a call, and asked for a critical keying-quality report. The reply was a definite "Sounds great here, OM." I was in business!

All that evening I used my keyer, even forgetting the 300-mA current drain, until the battery started running low. Low battery power is evidenced by the keyer failing to keep up the set speed and the LEDs failing to light up. The "weight" is not affected, however.

Knowing that my time on remaining battery power was limited, I decided to hook up the small utility supply I had to provide all the power I would need for a weekend of CW. Easy, I figured...just do the normal thing...hook up the positive lead to the center pin, the negative lead to the shell, and *oops*! Immediately I suspected my supply, but that turned out okay. A closer look at the input jack on the Daiwa showed the reason (I needed a magnifying glass to read it). The center pin, friends, is negative while the sleeve is positive! After changing the leads on my supply, I got an immediate indication of all being normal and happy with the keyer.

I checked the LED indication of speed (in which several characters are integrated by the circuitry to read out an average speed) and the dial setting of speed, and they seemed to coincide very well. My normal conversational keying speed is around 30 or 35 wpm, and that's where I set the speed control; it also was what the LEDs indicated I was doing. I found that at higher speeds a slight slurring of dots and dashes is smoother sounding, and this was easily achieved by adjusting the "weight" control pot to about the 9 o'clock position. Just enough to make it pleasing to my ear.

The 6-inch-wide, 2.5-inch-high, and 6-inch-deep box hardly occupies any space at all on my operating desk. In fact, it's so neat-looking and so unobtrusive that I have given it a place of honor right next to my transceiver...which it complements beautifully. Altogether, I guess I've operated the little Daiwa 210 electronic keyer about 25 or 30 hours now, and it hasn't missed a beat.

Complaints: none, except at my own stupidity for not reading the nice little instruction brochure with its illustration of polarity on the power plug plainly shown! I have known for years that one ought to read the instructions first, but—like many of us—I figure it's so simple that reading instructions isn't necessary. Well, I learned.

I don't have much stray rf floating around the shack as all my antennas are current-fed, and the high-voltage points are far removed from the equipment. Nevertheless, if you end-feed an antenna and bring it into the shack to your tuner, you might have to use shielded keying leads between the output of the 210 and your transceiver. Rf has a funny way of producing not-so-funny results with solid-state devices.

Anything else? Just one thing: Daiwa also makes a nice version of this keyer without the LEDs, and it's called the model 200. Just in case you don't care for the speed-readout system, or don't feel it's necessary, or maybe want to save a few pennies, you might prefer the 200.

The DK-200 is priced at $82.50 and the DK-210 sells for $99.50. Daiwa keyers and instruments are distributed in the United States by *MCM Communications, 858 Congress Park Drive, Centerville OH 45459*. Reader Service number 480.

**James Gray W1XU**
***73 Magazine* Staff**

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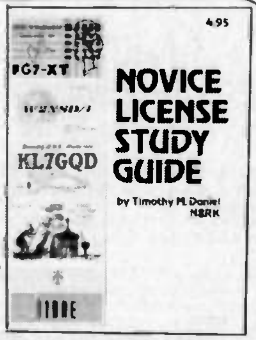


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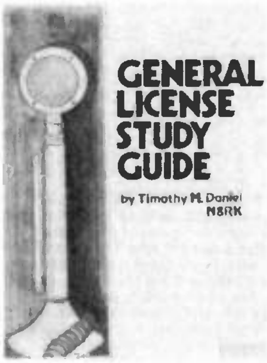


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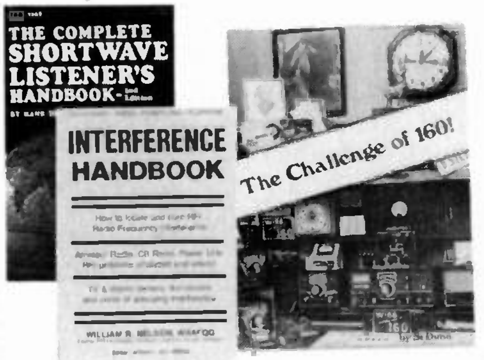


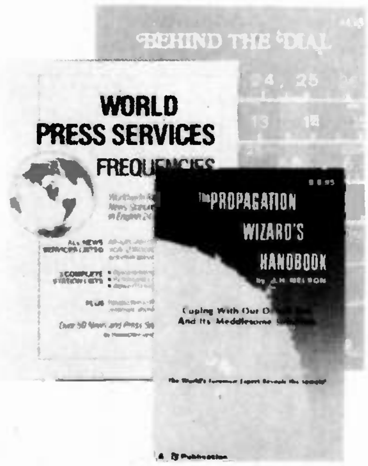


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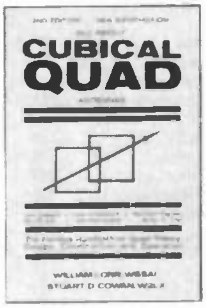




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☐2. Strictly business

B. Do you own a microcomputer?
☐1. Yes ☐2. No

C. If you answered yes to Question B, which of the following applies:
☐1. I use my microcomputer entirely for amateur radio.
☐2. I use my microcomputer for several things, including amateur radio.
☐3. I don't use my microcomputer for amateur radio.

D. Which band(s) do you usually operate on?
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☐2. 6 ☐5. 20 ☐8. 160
☐3. 10 ☐6. 40 ☐9. Other________

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☐1. I currently own a TVRO.
☐2. I will build or buy a TVRO in the near future.
☐3. I'm interested in learning more about satellite TV.
☐4. I am not interested in satellite TV.

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☐2. Look at about half of the ads ☐5. Look only at color ads
☐3. Look only at ads for certain products ☐6. Don't look at ads

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☐2. Good

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☐2. Simple construction articles ☐7. Theory
☐3. Complex construction articles ☐8. Beginner
☐4. Historical ☐9. Humor
☐5. Antennas

I. What do you think of the saddle stitch binding now being used on *73 Magazine*?
☐1. Love it ☐2. Ok, no bettter than the old binding ☐3. Bring back the old binding
☐4. Don't care

J. Which amateur radio magazines do you read regularly
☐1. *73 Magazine* ☐3. *Ham Radio* ☐4. *CQ*
☐2. *QST*

K. How many issues of *73 Magazine* have you read during the last year?
☐1. 1-3 ☐3. 7-10 ☐4. 11 or 12
☐2. 4-6

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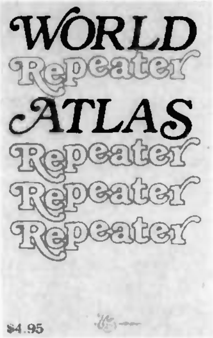


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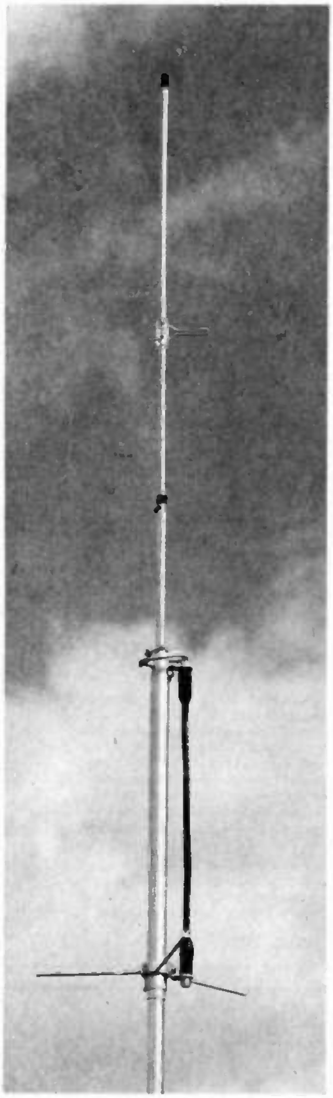

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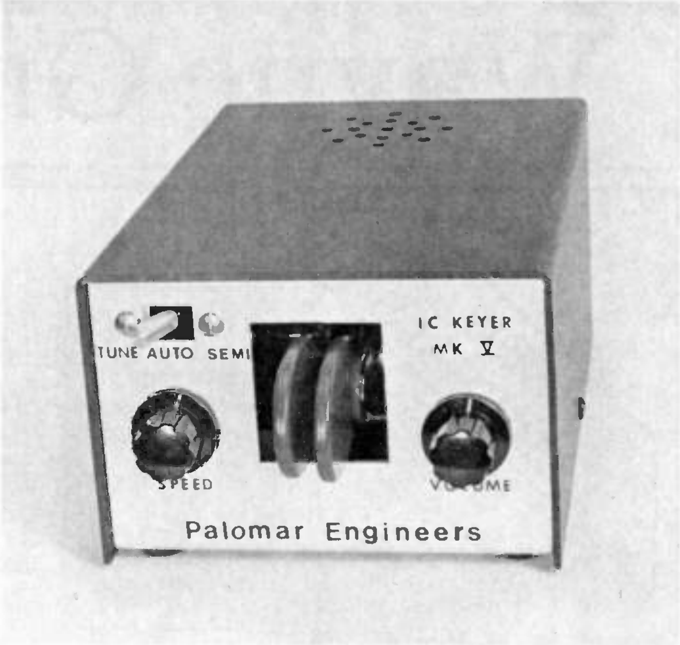
The frequency synthesis network includes dual vfo's with three tuning rates, split operation, and memory. Analog control of frequency with the incremental tuning on either TX, RX, or both. Full metering of receive-signal strength, transmit-relative rf output, compressor level, ALC and collector current, plus a built-in swr meter.

A large selection of options allows tailoring the IC-740 to your needs: a frequency marker, FM module, built-in electronic keyer, two 9-MHz i-f CW filters, three 455-kHz i-f CW filters, and optional internal power supply. The suggested base price for the IC-740 is $1099.

For more information, contact *Icom America, 2112 116th Ave. NE, Bellevue WA 98004.*

*The Icom IC-740 transceiver.*




*Palomar Engineers' MK V electronic keyer.*

## PALOMAR ENGINEERS' ELECTRONIC KEYER

Palomar Engineers has announced the new IC keyer, the MK V. It features a 1-Ampere silver contact relay output that will key all ham rigs and most shipboard transmitters. It keys either polarity without change of jumpers.

The keyer features the fully-adjustable Ham-Key paddle and Curtis IC. It is available with either standard operation or type-B action. The keyer has a sidetone oscillator, speaker, volume and speed controls, mode switch, and an internal pitch control. It operates from a clip-on 9-volt battery for complete portability, or you can use a 9- or 12-volt dc power supply.

The MK V sells for $132.50 plus shipping/handling. For more information, contact *Palomar Engineers, 1924-F West Mission Road, Escondido CA 92025.*

## AUTOCONNECT'S AUTOPATCH

AutoConnect introduces Private Patch. Since Private Patch does not employ the sampling technique, there are no repetitious squelch tails. In addition to simplex capability, AutoConnect's technique of audio and digital signal processing also permits operation through repeaters.

A five-digit user-programmable access code and long distance/operator-restrict switch protect your phone bill. A front-panel ringback switch permits incoming calls when desired.

Additional features are CW identification and a six-minute shut-down timer with reset code for additional talk time.

The Private Patch's introductory price is $489. For additional information, contact *AutoConnect, PO Box 4155, Torrance CA 90510.* Reader Service number 477.

## THE GLOBAL SPECIALTIES SOLDERLESS BREADBOARD

Designed specifically for microprocessor applications, the new PB-105 solderless breadboard from Global Specialties Corporation contains five binding posts, 18 distribution buses, and six solderless breadboarding sockets. The 9.2" x 11.4" x .05" (234 x 290 x 1.3mm) "Superboard" offers 50 percent more breadboarding area (up to 48 14-pin ICs) than the next smaller size.

Conductive spring clips within the breadboard body securely grasp component leads and connecting wires. Parts plug in and pull out without damage. Vinyl feet are mounted to the underside of the backplate to prevent slipping or damage to the bench top.

Proto-Board assemblies are engineered for use in design, test fixturing, quality control, prototyping, evaluation inspection, and custom circuit applications. Suggested US resale price is $115.50.

For further information, contact *Global Specialties Corporation, 70 Fulton Terrace, New Haven CT 06509; (203)-624-3103.* Reader Service number 484.

## MFJ ACTIVE RECEIVING ANTENNA

MFJ has introduced a new active outdoor receiving antenna with outdoor whip that gives reception of 50-kHz to 30-MHz signals. At lower frequencies, it is equivalent to an outside wire antenna hundreds of meters long. At high frequencies, it has high-gain amplifying action.

A high-dynamic range rf amplifier is mounted at the antenna for maximum signal-to-noise ratio. A 20-dB attenuator switch on the control unit prevents receiver overload.

The new antenna comes complete with a 50-foot coax cable with connector. It is available from MFJ Enterprises, Inc., for $129.95 plus shipping and handling.

For more information, contact *MFJ Enterprises, Inc., PO Box 494, Mississippi State MS 39762.* Reader Service number 478.

**CORRECTION**

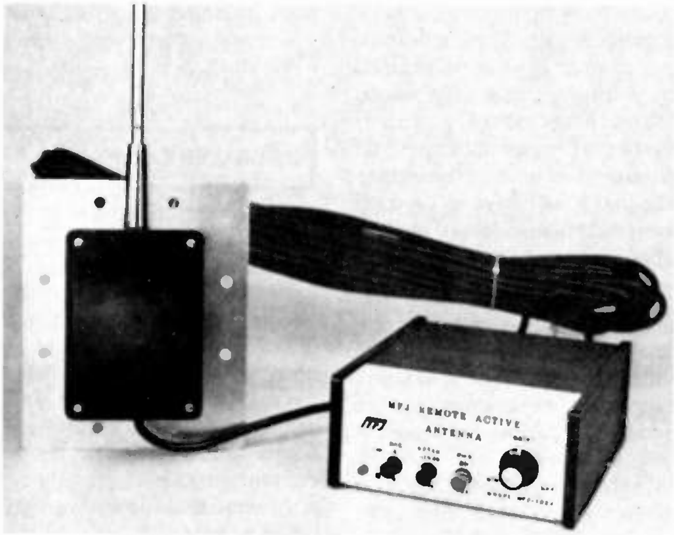
Please note that the TMAC Products weather station mentioned in our July issue (page 106) is powered by 115 volts (*not* 155 volts as stated).

## THE DYNATRACER DT-1 CIRCUIT ANALYZER

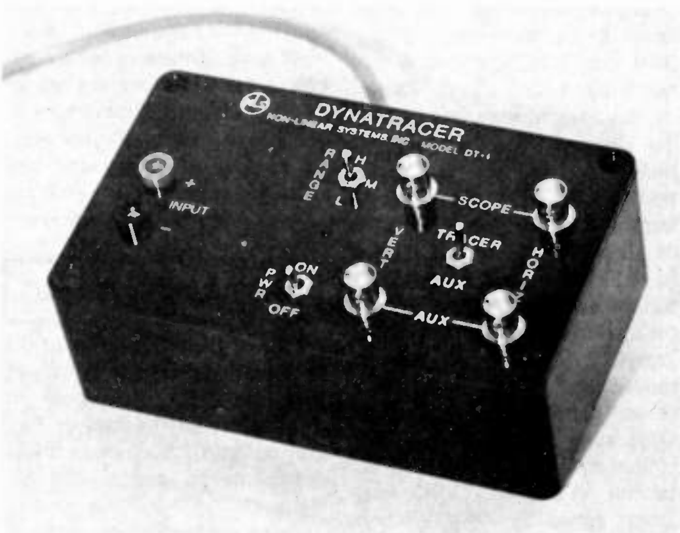
Non-Linear Systems, Inc., has added the DT-1 Component Signature Analyzer as a companion to its line of miniscopes. Designated the DT-1, the instrument has a capability as an in-circuit tester producing displays distinctive to the particular component or circuit being tested without the application of power to the circuit under test. DT-1 can be used with any oscilloscope equipped with an X-Y input.

The unit will display on the associated oscilloscope screen waveform pattern the condition of any component or group of components within a circuit. Accessories include a test-lead assembly, BNC-to-BNC cables for attachment to scope, and a unique component test adapter for testing radial-lead components without test leads.

The price for the DT-1 is $150. For more information, contact *Non-Linear Systems, Inc., PO Box N, Del Mar CA 92014.* Reader Service number 481.




*The MFJ outdoor active receiving antenna.*




*The Dynatracer DT-1 circuit analyzer.*

# LETTERS

### PRO CODE

I just wanted to get my two cents in on dropping the code as mentioned in Wayne's editorial. Like the column "Never Say Die," in my opinion, "the code never will." Code has always been a great part of ham radio and I hope it stays. Code is a language everyone can enjoy and communicate by. It took me quite some time to learn it, I grant you, but I stuck with it. If you want something bad enough, you can do it—and with great satisfaction.

Sounds like code came very easy for you—5 wpm in one hour. You must not have enjoyed something coming so easily, since now you feel code should be abolished. My spelling is terrible and I learn slowly. But I made my Extra and sure am proud of it. And if I can do it, most anyone can.

I'm sure glad Garth Evans is on our side of the fence. Like Garth said, "you have to dangle a carrot in front of the horse to get more privileges." Wayne, you say Bash is cheating, but are you sure you're not getting some kickback from Bash? Because with no code test, all you have to do is buy a Bash book, read a few hours, and you'll have your ham ticket. By the sounds of it, Wayne, you would like to see the ham bands turned into another 11 meters (chicken band). Well, that's my two cents. All in all, Wayne, you have a great magazine, but not all your opinions are great.

**Ron Ostman KA0AYN**
**Eden Prairie MN**

*Ron, I admit that my opinions may not seem all that great if you ignore most of what I write and take little bits out of context and try to argue about them without mentioning the rest. Never have I ever suggested doing away with the code test and then leaving everything else the same. I guess you just read little parts of what I write and then wonder why I am not clear in my thoughts. You must really think I* *am stupid if you think I want any of our ham bands to be like a CB channel. No, whenever I suggest canning the code, I also tie with it a much more serious technical exam, one which Bash will be unable to compromise. We have what is supposed to be a technical hobby, not a skill hobby, and the entry exam should reflect this.—Wayne.*

## NO CODE

I've read and reread your thoughts about code-free amateur licenses in the March issue of your mag, and hope someone out there listens to you. I've wanted to become a ham since I got into electronics in 1946 (remember the old jokes about the "drip pan for the grid leak?") but have simply *no* interest in learning Morse code. The technical side of ham radio and electronics in general is fascinating to me, and I spend much of my free time working up a new circuit I've seen somewhere or trying to keep up on technical reading (that could be a full-time job nowadays!). Of course, *73* occupies a few hours every month.

I designed high-fidelity amplifiers back in the '40s when nobody else knew what I was talking about and thought I was kind of nutty. I made the transition to solid-state with only mild trauma. I even went the CB route for a short while, but gave it up. They are, generally, foul-mouth rednecks with IQs in the low 80s or so. There are some exceptions, sure, but they are too rare. I have a lot of reading and research to do on TVRO now (great series by WA4CVP and WA4OSR you've been running lately), so I'll take out my frustrations on the microwaves. Keep up the good work.

**Jim White**
**Sacramento CA**

## WELFARE ATTITUDE

Here I am again, reading the June *73* Letters column. Seems as though you continue to bash away at Bash, and your no-code license controversy goes on unabated.

Assume for the moment that you get your way. The most obvious question is, how do you propose making your theory test Bashproof?

As for the club idea, it has been my observation that most clubs, no matter how enthusiastic they start out, soon deteriorate into the usual 5% doers and 95% hangers on. It would seem that the result would be to put into the hands of a few elitists the power to decide who gets a license. A disinterested FCC bureaucrat hireling is probably best qualified to apply the rules equally to all applicants.

I think the basic problem lies not specifically with ham radio, but with our society in general. Only when the pride of personal accomplishment replaces the welfare attitude will Bash die and amateur radio grow—no matter what the entrance requirements.

**Henry Testa KB6PM**
**San Diego CA**

*Henry, it isn't* our *society that is different. . . people have always been like that. People do things because they enjoy them and feel some sense of responsibility and accomplishment. The more we get people involved in amateur radio with responsibilities, the more enthusiasm I think we'll have. Amateurs who have been around for ten years can remember the real enthusiasm of the FM and repeater pioneers. Clubs formed all around the country. We had growth, enthusiasm, and excitement.—Wayne.*

## EMERGENCY SYSTEMS

I have been a reader of *73* since Wayne started it in Brooklyn NY, and have been an avid reader of the "Never Say Die" column. I must make a few comments on your June, 1982, issue.

You are advocating a national policy for emergency communications, which, by the way, I agree with with only one difference. I am afraid, Wayne, that our equipment is becoming so complex and sophisticated that very few hams have the capability and know-how to maintain/service same. In a real emergency, when the big national/military systems have gone up in atomic smoke, most of our present equipment will have gone the same way through the action of EMP (see AK0Q's article in the same issue). This guy knows something that few hams know.

I am retired now but have been involved in military communications planning for many years and have come across this subject many times. Much of the material is still in the Top Secret drawers. While the military can replace its black boxes because they have thousands in reserve and cost is no object, the poor ham is out of business when all our beautiful idiot lights are out. I suggest you give this some thought and, instead of advocating more sophisticated emergency equipment, let's think of survivability also. The only way to survive in my opinion is if hams can maintain their own equipment with minimum reliability on the manufacturer. Yes, I am thinking the unthinkable. Emergency equipment should be simple tube equipment, with at least one of each tube on the shelf in reserve. Above all, it should be maintainable.

Also, Wayne, let's face it: If the unthinkable ever happens, there will be no power and no gas for our gas-guzzling generators, so all of our emergency equipment should be battery-operated with, perhaps, a solar trickle charger. Some enterprising company might be induced by you to engineer a packaged transceiver/battery power system at reasonable cost and simple to maintain, remembering that it will have to be used and maintained when all has gone up in smoke.

I am sure that there are enough amateurs in every state to organize a truly compatible national emergency system. With your persuasive powers and *73 Magazine*, I am sure it can be done. I am truly interested in seeing such a system established, because I know that should the big cloud ever rise over New York, Washington DC, Chicago, etc., etc., all other systems will be down. There will be no power, no telephone, no commercial radio, and no transportation. Only a truly compatible, maintainable amateur system can survive.

Hope to hear more on this most important subject from you. Keep up the good work, Wayne. We need more like you.

**Arnold Samuels KH6COY/7**
**Ocean Shores WA**

*Oh, I'm familiar with EMP, those electromagnetic pulses which accompany nuclear bombs. Getting information on the subject is difficult, but there have been some good articles in the more technical journals. It appears that unless we are hit close enough so we won't be around to worry about it, most of our solid-state ham gear will survive. . . particularly if it is not connected to an outside antenna. One of the nice things about solid-state equipment is its ability to run from twelve volts. Now, we may have a shortage of 120 V ac to run tube equipment, but it is going to be a long time before we run out of 12-V dc sources. You can even run transistor equipment from solar cells if you have to, but forget it with tubes. If you are worried about servicing the more complicated electronics, I suggest you turn the job over to a teenager, if you can find one. You've been spending too much time in the company of old-timers who are afraid to even try to fix transistor and IC circuits. Kids plunge right in and have a ball. . . and fix them. I can remember back to my early days in amateur radio when I built anything I wanted, fixed anything, and had a ball. —Wayne.*

## EX-DEALER CONFESSIONS

I was an amateur radio dealer. After many years of screwing around with the hobby, I found myself on the other side of the counter. The excitement was profound and when our first big order arrived, you can imagine the feeling. I mean, gosh, golly, see, I can open any one of those boxes and play to my heart's content. Anyone else would call it a mental disease but we call it being a "ham."

Imagine what it was like getting ready for opening day. All the expectations were there in full force. The doors went open, the phone was activated, and the ads were placed. And they came, saying, "Hey, this is great—we have a real ham store in town!"

For a few weeks it was, without a doubt, the peak of my long involvement with ham radio. What ham could ask for anything more? Then it started to happen. "Can't you fudge the tax for me?" "How about a better discount?" "Can't you ship the box to a friend in Pennsylvania and let me take the rig?" I actually shipped a cinder block in a Yaesu box to PA. Guess what happened. The damned block broke up, UPS

✓See List of Advertisers on page 114

opened it and discovered the contents, and sent an inspector to investigate! Needless to say, I felt like a jerk and had a hard time explaining that one. I said it was just a joke. Dumb people do dumb things.

Then came the advent of CB. Not normal CB, but HF CB. All of a sudden, strange people were selling the same equipment I was—out of their garages and basements. I was one of those high-minded nincompoops who refused to sell to the HFers and required a ham license in order to buy a transmitter. Although I was able to purchase the equipment cheaper than these pseudo-dealers, I couldn't fudge the tax and I wouldn't "clip the brown wire" and cater to those illegal operators. You can see right there that I was never gonna make any money.

I would go to a hamfest in my own state and have to stand there like a jerk while an out-of-state dealer beat me out by not charging sales taxes! Complaining didn't do any good. Finally, after I went out of business, all hell broke loose at the Rochester hamfest. The state was wrong in their tactics but right in principle. Everyone in New York State lives with sales taxes and I don't see any of them pounding on the walls. It's ridiculous for hams to expect special consideration just because they're hams. If I was a hot-shot model-airplane enthusiast, I don't think I could expect to be exempt from sales taxes because my little airplane could fly typhoid serum across a flooded river in an emergency. We all do what we can.

When you operate a business, you're faced with all sorts of expenses. Aside from the normal bookwork, you have the state and federal government taking up a good percentage of your time. Then there's the overhead in keeping a walk-in showroom going. Insurance, upkeep, test equipment, tools—the list goes on and on.

Then there is "salesmanship." I'm a technical type and always tried to give the inexperienced the benefit of my knowledge. Unfortunately, most hams are already "experts" and no matter what you tell them, they know more than you do or their "buddy" does. The real culprit is the attitude of most amateurs. There was once a day when the amateur was accepted as a fairly knowledgeable radio type. He got discounts at the local radio store. Today, it's a different story. Amateur radio is a limited, special-interest hobby and is treated as a consumer item by the big importers.

The majority of rigs (at that time) were being sold to the HFers and not the hams. That was the era of the "Big Boom." This consumerism approach forced prices down and discounts were given because of the competition (via the 800 numbers). It was no longer feasible to keep an open showroom for people to come in, try the gear, make their decision on what to buy, and then call an 800 number and order to beat the tax. To make a long story short, the doors were closed.

I will be the first to agree that price is important. The only useful purpose of a local dealer is convenience—providing the opportunity to inspect and try the gear you're interested in and being there for service. But hams don't care about paying for service or convenience. After all, the manufacturer provides a warranty.

The only way any dealer can make it is to rely on mail-order sales or locate in a highly populated area. More significant is the realization that all this could end should the manufacturers and importers decide that they don't need dealers. Since they are providing the warranty anyway, they could install an 800 number and take over sales. Once the majority of the big outfits did this, they would have absolute control over pricing. As I stated, "ham radio is a limited, special-interest hobby" and there is no need for discounting. People don't build anymore, so where would you go to "beat the price?"

Once I discovered the requirements of a likeable and lovable dealer, I realized that I couldn't make money at it. I didn't have the personality for it. I couldn't stand cheapness, I couldn't stand listening to a guy who just went to Radio Shack and bought his coax and then came to me and bitched about the price of a couple of fittings. Yuk. I had guys who actually complained about paying a seven-cent sales tax on a dollar item. I've had people buy their radios elsewhere and come with a rig under their arm looking for warranty service. I've had people order parts for their gear and say, when I called them to let them know they had arrived, "Oh...yeah...I fixed it... don't need the parts anymore." A month later they call again: "Hey, can you fix my rig?" (Click.)

No, it wasn't all bad. I've had guys come in, pick out the most expensive units, never dicker on price, pay me in ones (from every pocket), and depart never to be seen again. That's when you crawl off in a corner muttering to yourself (or isolate yourself in the john with a copy of *MAD* magazine).

Yes, there are days when I miss it. I miss getting to play with all the "goodies" and being up-to-date with the industry. I miss the rumors of who is getting the favoritism and the best buys, and I especially miss getting the news about a new model, not from the maker or importer, but from the magazine ads (the model that's announced before Christmas—the one you order gobs of for the big rush in sales—only to receive maybe one and then get them all a month later when nobody is interested). I miss the double shipments, I miss getting all the accessories for an old model and not the new model. I miss all the trade-ins that blew up in my face. I miss hearing from the government that I didn't send in enough withholding. I miss getting ready for the next big hamfest. Yes, I miss it. The problem is that I couldn't make a living at it. In a sense, any present amateur radio dealer is giving his customers much more than they deserve, or he wouldn't be in business. I was not willing to give that much.

If you have a local dealer, support him even if you don't like him. You may pay a little more for the convenience but, in the long run, you'll find it's worth it. There is no way he can get rich and the only reason he is there is because he loves the hobby —one thing you both have in common. After he is gone, nobody will replace him. My business could have survived by concentrating on mail-order sales, but the profit level would not have matched money-market earnings. I think this is true with any dealer.

I just ordered a new Yaesu receiver. I did as most of you. I looked at the ads, found the "BESPRIZ," called the 800 number, used my charge card, and am now awaiting the brown UPS truck. It's so impersonal. There's no one I can go to locally, no one to bitch about the tax to, no one I can expound my knowledge to, no place I can run into fellow hams to BS with, no dealer I can get irritated with because he's had a bad day and is nasty. Hell, it's no fun at all. I think I'm becoming an "old-timer." I can build a radio out of a safety pin and a razor blade. Can you?

**Jim Beckett WA2KTJ**
**Corning NY**

## CCD ANTENNAS

Cheers to the multitude of you (literally) around the globe who have phoned and written us about your success with the 5-dB-gain W4FD Controlled-Current Distribution multiband dipole (as described in our *73* articles in October '78 and July '81; also see the May '82 issue).

We are pleased that the United States Navy has appropriated monies to construct CCD antennas. (Here is an excellent opportunity for anyone wishing to manufacture, under very reasonable licensing conditions.)

Thanks most of all to this great magazine for bringing our story to you and for granting us permission to reprint the latest construction data. You may have a copy for a small, one-stamp SASE.

**Gene Brizendine W4ATE**
**(800 Hummingbird Dr. SE**
**Huntsville AL 35803)**
**Harry Mills W4FD**

## AMATEUR HIGHWAYS

I wonder what you might think about getting the FCC to rescind the ruling giving extra privileges to the Advanced licensees in that these hams get the private use of the lower 25 kHz in the CW segments of the bands?

My idea on this is related to the use of the highways. Driving the roads and operating in the amateur spectrum are privileges granted by public agencies. Operators must show prudence and abide by the rules and regulations.

The highway privilege is expressed in several classes of licenses: Extra or Advanced for truckers, bus drivers, etc., and

General and beginners for the rest. The Advanced exam is given to help ensure good and safe driving skills. But these Extra class drivers share the highways right along with the General class and even the beginners.

In view of this, why should the ham bands be segregated? It seems to me to be a form of discrimination. The amateur bands are just that for amateurs of all classes. The Advanced or Extras may not think it, but they are still amateurs. Radio operating skill doesn't come with technical knowledge.

QRM keeps increasing with more contests and RTTY stations. By returning these 25 kHz to the majority of amateurs, our privileges would return to us more enjoyment.

**C. M. Johnson W6EOT**
**Lakeside CA**

*C.M., your attempt at reasoning is weird, possibly brought on by having spent too much time in California. In the long run, I favor splitting up our bands the way we all agree they should be split up, with no FCC regulations on this at all. But if you think 25 kHz is going to give you more room to operate, you have another thing coming. That would be swallowed up so fast you would never know it had been there. No, if there is too much interference, we either have to move to bands which are not as crowded (and there are plenty of them) or else start working on communications modes which use our frequencies more efficiently. If you change to RTTY you will be able to communicate about five to fifty times as fast, thus having to be on the air much shorter periods, leaving some spectrum for others to talk. Just by using already known (but not used) techniques, we can communicate at 8,500 words per minute. Should we have a special express lane on your highway for 200 mph cars or do they have to drive at 55 mph along with the trucks and buses?—Wayne.*

**FIJI DX**

As DX of some scarcity, although not really that rare, I must endorse Wayne's comments on pileups.

For DX stations, the first time at the bottom of a pileup is so terrifying that many never come back. On 20, for instance, many keep out of the American phone band for that reason.

My own technique, one which has enabled even the QRP stations to achieve a successful QSO, is somewhat similar to Wayne's. Once a pileup gets going, I go through the call areas in turn, starting with either area 5 or 7, and finish at 6 (6s here are really sounding like the proverbial Californian kilowatt). By asking for the callsign *once* only, and then answering the loudest heard, turnaround is pretty quick. And it gets rid of the tail-enders once and for all. Some doubling does occur, and there is always some QRM, but the beams at the other end seem to sort things out pretty well. And, once there is a successful QSO with just *one* QRP station, other stations in the queue are that much more patient—they know that their turn will surely come. Elbow jolts are far fewer.

A couple of comments for queue jumpers. They are right at the top of my hate parade—if others can wait, so can they. If they can't, *no* QSL.

Inexperienced amateurs wishing to QSL with rare DX should note the following:

Please make sure that your QSL card has all the information needed, and that it is right. I have had cards with the time wrong by hours, or which used local, not UTC, and cards on which the date has been wrong by up to a month (I wonder what they are using for log books—mine is written up as the call is made); there are even some cards here without the name and address of the operator!

For rarer DX, postage is a major expense. I know of some DX stations who will not reply unless some form of postage is included. One IRC will get a surface mail reply from most stations; if more IRCs are needed, "George Washington" may be both cheaper and worth more at the other end. If time is available, ask your DX station. He may prefer one or the other. Of course, many DX stations have a QSL manager. The same courtesies should also be extended to him.

As regards the magazine, when the format changed (with all the emphasis on techniques and a technology that will have little short-term relevance in the South Pacific), I was initially disappointed. However, upon reflection, I say, "go to it!" This is a hobby, with frontiers that the professionals simply do not have the resources to explore. Why, that is where *we* came from in the first place! And, as for my subscription to *73*, why, when I first decided to pay out a week's wages in 1966, when I first became a subscriber, my, it was a big decision. Now, I look upon it as an investment which is still returning great dividends after all this time. In fact, my most useful resource is nearly 16 years of articles on every topic in the hobbyist's field.

**David Bell 3D2DB**
**Suva, Fiji**

*1966? That's the year I visited Suva and got on the air as VR2FD (Fuddy Duddy). I was using a borrowed Heath transceiver and I had a ball. Perhaps one of these days I'll be able to stop off at Fiji again and enjoy the Kava ceremonies, update my call to 3D2FD, and work a few more of the pileups.—Wayne.*

# FUN!

*John Edwards KI2U*
*78-56 86th Street*
*Glendale NY 11385*

**VHF-UHF COMMUNICATION**

I've had a love affair with VHF-UHF radio that stretches back to my earliest days in this hobby. While any appropriately-licensed amateur with a few bucks can talk to the far corners of the Earth on HF, it takes skill—not just money—to work DX on 50 MHz and above.

Perhaps the reason for my fixation with the top frequencies has something to do with the way I entered ham radio. You see, unlike my fellow neophytes, I started my ham career with a Tech license. While I have nothing against either Novices or CW addicts, I've always felt more relief than accomplishment after passing a code test. Indeed, after I passed my Extra, I took all of my code cassettes and recorded music over them.

My proudest moment on VHF came on November 20, 1979. That was the day K7OFT and I (I was WB2IBE then) set the amateur distance record for a two-way A4 facsimile contact (New York City to Seattle, 2,430 miles, 50.250 MHz). Now that the FCC has opened A4 to the HF bands, I'm sure the record will soon be broken. Still, DX is child's play on HF. But experimenting on six meters and up—that's a different world.

**ELEMENT 1—CROSSWORD PUZZLE**
**(Illustration 1)**

**Across**

1) Increases receiver sensitivity
9) Interference type (abbr.)
10) A 6-meter activity (abbr.)
11) Not twice
12) Key maker
13) Circuit type (abbr.)
15) J-pole, for instance
16) Costa Rica prefix
17) Regret or French street
18) VHF-UHF combined antennas
20) Handle
21) Canadian rule-makers (abbr.)
22) The medium (abbr.)
23) Morse "standby"
24) Month after VHF QSO Party (abbr.)
25) A place to skip (abbr.)
27) Haiti prefix
28) Alaska prefix
30) HF rig to VHF rig

**Down**

1) Transmission of energy
2) Transmitter
3) Were you calling...
4) Night (abbr.)
5) After 2 down
6) Operating shot
7) Chip (abbr.)

8) Superhet and superreg
14) Old Novice prefix
19) Beam
21) Noise or connector
22) Sun
23) Hawaii prefix
26) League appointment (abbr.)
27) Top-type antenna
28) West coast city (abbr.)
29) Gate type

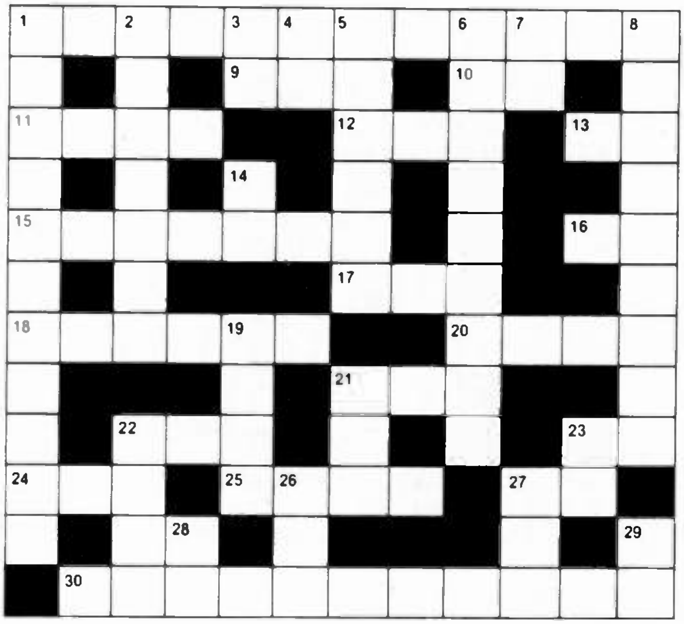


*Illustration 1.*

### ELEMENT 2—FILL-IN

**(Courtesy of Joe Reisert W1JR)**

1) 6 meters: ______ to ______ MHz. The SSB calling frequency is ______ MHz.
2) 2 meters: ______ to ______ MHz. The SSB calling frequency is ______ MHz.
3) 1¼ meters: ______ to ______ MHz. The SSB/CW calling frequency is ______ MHz.
4) 70 centimeters: ______ to ______ MHz. The SSB/CW calling frequency is ______ MHz.
5) 23 centimeters: ______ to ______ MHz.
6) 13 centimeters: ______ to ______ MHz.
7) The two exclusive VHF CW bands are ______ to ______ MHz and ______ to ______ MHz.
8) The highest FCC frequency assignment is ______.
9) The first US station to work Europe on 6 meters was ______.
10) ______ popularized 144 MHz with his low-noise 417 tube converter.
11) ______, ______, ______, ______, ______, all have their calls on 432 yagis.
12) An early pioneer of EME from the W1 call area was ______.
13) The first recipients of 144- and 432-MHz WAS awards: ______, ______.
14) Name the ARRL sections in the W1 call area ______, ______, ______, ______, ______, ______, ______.
15) Name the ARRL sections in the W2 call area ______, ______, ______, ______, ______.
16) The call ______ set the all-time June multi-op contest record.
17) The lowest frequency two-way EME QSO was on ______ MHz and the highest was on ______ MHz.
18) The highest frequency where meteor-scatter QSOs have occurred is ______ MHz.
19) What mode of propagation is possible on 220 MHz, but is still unattained? ______.
20) Typical meteor-scatter QSOs rarely occur beyond ______ miles.
21) 10,000-mile-DX QSOs are possible on EME. True or false? ______.
22) Statistically speaking, the most popular frequency band and mode for VHF communication is: ______, ______.

### ELEMENT 3—SCRAMBLED WORDS

Unscramble these terms relating to VHF-UHF communication:

VEAWGIDEU LIRNDEAH EVAWCRIMO
ISHD PRETREEA TTREACS
EREHPSOPOTR ETASLTILE KLIN
ECRNORTVE

### ELEMENT 4—MULTIPLE CHOICE

1) In which month of the year does the Leonids meteor shower occur?
   1) November
   2) July
   3) August
   4) March
2) If you put all of the VHF bands together (2 through 1¼ meters), how many total Hertz would you have?
   1) 60 MHz
   2) 60 kHz
   3) 16 MHz
   4) 13 MHz
3) In which year did we lose the 5-meter band?
   1) 1928
   2) 1941
   3) 1968
   4) Amateurs never had a 5-meter band.
4) In which year did the first US-Great Britain 6-meter QSO take place?
   1) 1934
   2) 1946
   3) 1969
   4) It's never been done.
5) Which of the following devices can be used to measure VHF frequencies?
   1) Lecher wires
   2) Grid drip-pan meter
   3) VTVM
   4) Frequency multiplier

### THE ANSWERS

*Element 1:*
See Illustration 1A.

*Element 2:*
1—50, 54, 50.110
2—144, 148, 144.2
3—220, 225, 220.1
4—420, 450, 432.1
5—1215, 1300
6—2300, 2450
7—50, 50.1, 144, 144.1
8—300 GHz and up
9—W1HDQ
10—W2AZL
11—W1HDQ, K2RIW, W0EYE, F9FT, N6NB
12—W1FZJ
13—K0MQS, W0YZS
14—NH, ME, VT, RI, CT, EMA, WMA
15—WNY, ENY, NYC/LI, NNJ, SNJ
16—W1FC
17—50, 2304
18—432
19—Es or sporadic E
20—1500
21—True
22—2 meters, FM

*Element 3:*
(Reading from left to right) WAVEGUIDE, HARDLINE, MICROWAVE, DISH, REPEATER, SCATTER, TROPOSPHERE, SATELLITE, LINK, CONVERTER.

*Element 4:*

1—1 I can't figure out why they would name a meteor shower after a Soviet president.

2—4 A lot of real estate. So why is everybody on 2 meters?

3—2 After the war we moved to 6 meters. Some stupid thing called "television" forced the change.

4—4 No 6-meter privileges in the UK.

5—1 There may still be some old-timers using these things instead of frequency counters. Check an old theory book for an explanation of how these devices work.

**SCORING**

*Element 1:*
Twenty-five points for the completed puzzle, or one-half point for each question correctly answered.

*Element 2:*
One-half point for each blank filled.

*Element 3:*
Two and one-half points for each word unscrambled.

*Element 4:*
Five points for each correct answer.

How did you do?

1-20 points—Like 220 at 3 am.
21-40 points—Misdirected beam.
41-60 points—Smart as a QSO on a calling frequency.
61-80 points—Very high IQ.
81-100 + points—Ultra high IQ.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| P | R | E | A | M | P | L | I | F | I | E | R |
| R | | X | | E | M | I | | R | C | | E |
| O | N | C | E | | | N | Y | E | | L | C |
| P | | I | | K | | E | | Q | | | E |
| A | N | T | E | N | N | A | | U | | T | I |
| G | | E | | | | R | U | E | | | V |
| A | R | R | A | Y | S | | | N | A | M | E |
| T | | | | A | | D | O | C | | | R |
| I | | S | I | G | | I | | Y | | A | S |
| O | C | T | | I | O | N | O | | H | H | |
| N | | A | L | | V | | | | A | | O |
| | T | R | A | N | S | V | E | R | T | E | R |

*Illustration 1A.*

**FUN! MAILBOX**

I just received my May issue of *73* and I'm pleased that so many were able to solve the DX puzzle printed in the January issue. On the other hand, I'm sorry, John, about the indignant comments you received. Obviously, the puzzle was submitted as a brain teaser and to have *FUN!*

The *really* sad part is that I have to inform you and the contestants that solution 1 is correct whereas the other two are not!

There are three pertinent time elements in the clues, namely, (1) previously worked, (2) now working, and (3) will work next.

Clue E states, "Jack, who previously worked Taiwan, will not next work Hong Kong." In effect, this clue says that Jack had just worked Taiwan but it doesn't tell who he is working now—only that he will not be working Hong Kong next. From this clue a partial sequence develops, namely, Taiwan to ???? to Hong Kong. Both solutions 2 and 3 show a sequence of Taiwan to Mongolia to Hong Kong, which is invalid. Hence solutions 2 and 3 are incorrect.

To be fair, however, I can now see that clue E might have been clearer if it had stated "...who had just previously worked Taiwan..."

Thanks for running the puzzle, John, and if any of the contestants want a copy of my solution, I'll be pleased to send it to them. An SASE would be appreciated.

**Bob Young W1MXI**
**Belmont MA**

*Will we never find an end to the January DX puzzle? Here I am, getting my woolies ready for another winter, and we have yet another interpretation on that brain-twister. Personally, I think it's all a matter of semantics, and hope readers will take up Bob's offer of corresponding directly with him. As for me, I'm through with this one.—JE.*

# W2NSD/1 NEVER SAY DIE

## editorial by Wayne Green

*from page 8*

new developments to keep us busy trying to keep up for months to come.

Being not completely unknown in the industry, I was taken behind the scenes to see some exciting new products not being shown at the show. As the publisher of four magazines in the micro field, I guess I get a bit too convinced of my visibility and am thus brought down to earth when a new firm gets into the field and I run into a group of people who have never heard of me or my magazines.

I went through this shock recently with the debuts of four DEC computers, two Wang systems, the Sony computer, and the Victor computer. More and more computers are being brought to the market by firms with virtually no knowledge of the microcomputer market. This seems like a recipe for disaster, but perhaps these firms will adapt and succeed.

The proliferation of low-cost computers is exciting. With the price of the Radio Shack Color Computer being dropped to around $300, the prices on the VIC-20 going to around $239, the Sinclair coming out via Timex at $100 (with discounts probably to around $88), the new Panasonic JR-200 at $300, the Commodore Max at around $150, and so on, there is going to be a lot of computing power available in the under $300 range. This means that there are going to be opportunities for programs, accessories, expansions, and so forth for these systems. Look for new businesses to start and soon be raking in millions. We are going to see a lot of new millionaires in the next few years.

After four hectic days of shows and four Eastern trips, it was time for a short vacation, so Sherry and I took Eastern to San Antonio for a visit with her mother in Seguin, Texas. Her father was away on a visit to my folks up in northern New Hampshire, so we missed him. We got a good night's sleep, had one of the fantastic meals Alma makes, and were on our way to the airport again. This time we went to Atlanta and then on to Ft. Lauderdale for the computer show there.

The show, held at Brower College, had not been as well publicized as one might wish, so the attendance was small. With all due respect, *Infoworld*, while a fine newspaper, is not the best bet for reaching hobbyists and people interested in computer shows. I think my talk cleaned out the exhibit hall completely, with 82 to hear me. Sherry and I

✓See List of Advertisers on page 114

grabbed a nice lunch at the 94th Aero Squadron restaurant before the show. We enjoy that place, though our visits to Ft. Lauderdale are not all that frequent.

The talk over, we rushed back to the airport via Swenson's Ice Cream Parlor and a banana split. This time Eastern took us to Atlanta, but instead of the lounge we headed for town and the Marriott for the Atlanta Hamfestival.

The hamfest didn't seem to draw as large crowds as in many past years. I don't know if this is a reflection on the lack of growth of amateur radio, the economy, or the lack of anything really new and exciting to bring 'em in. Only about half of the exhibit booths had been sold, so most of the industry people weren't there. . . and the computer exhibits had almost completely disappeared. A couple years ago it looked as if the computer exhibits might push out the ham exhibits.

This lack of computer coverage may be a reflection of the turn in interest of the show promoters. A few years ago I worked with them to put on the heat to bring in computer exhibits and computer interested readers. I didn't hear much from them this year, so I didn't do much. Something big is needed to bring this great hamfest back to life.

I'm not fussing with the committee, for they were as cooperative as they could be for me. At the last minute, when I found I had a day between my Ft. Lauderdale talk and a trip to Colombia, Chaz arranged a spot for me to give a talk. . . at 2:00 pm Saturday, the best time. They did everything possible to make my short visit comfortable and fun.

For some reason, Sunday is the big day at Atlanta. Most hamfests only pull about 50% as much traffic on Sunday as Saturday, but Atlanta has historically pulled more on Sunday. They did again. Some of the exhibitors who had been grumbling about the sparse attendance on Saturday perked up as sales boomed on Sunday. Well perhaps "boomed" is an exaggeration. Nobody was buying much in the way of expensive equipment. . . and the flea market was very depressing.

The hotel got on my recommended list with their luncheon. They had a do-it-yourself dessert buffet for $1.95. I think this is the first time I ever beat a restaurant on a buffet. I really did a job on that buffet, starting out with apple cobbler smothered with soft serve ice cream, then going on to sundaes with cherries, strawberries, chocolate, and pineapple. I was not able to get to the baklava, the cream puffs, the chocolate eclairs, and so on. Hmmm, if we can allow a little more time between planes in Atlanta, I wonder if we might. . .?

Saturday night in Atlanta has turned into a ritual. Chuck Martin of Tufts was exhibiting, so his crew joined us on a trip out to Aunt Fanny's Cabin where we did the best we could with fried chicken, Smithfield ham, and all the fixings. Chuck, who had driven down, went back via the Knoxville World's Fair.

On Sunday morning, Sherry and I went back to the airport and Eastern, with a stop off in Miami on the way to Baranquilla. It's not as long a trip as I thought.

Once ensconsed in the Hilton in Cartagena, I began to wonder how I might get in touch with some of the local amateurs. I'd brought a page of the Callbook with me, so I had the addresses of quite a few hams in Cartagena (Car-ta-hey-na). . . but which of them spoke English? Sherry, who knows a dozen or two words of Spanish, tried calling a few of the hams, but never managed to get beyond their housemaids. Then she got the hotel operator to make the calls for us and we were soon in touch with HK1EDM and HK1FA, Victor, the president of the local radio club.

Armando Castillo HK1EDM, a local plastic surgeon, his daughter, with Victor Yacaman HK1FA and his wife picked us up for dinner on Monday. They took the time to drive us around the old walled city and fill us in on the fascinating history of the town. It seems that Cartegena was repeatedly attacked by pirates, often being captured. Some of the pirates were a bit more than we've seen in our movies, arriving with nearly 200 ships and 23,000 troops.

We visited the radio club, where I signed in the log. They have their own club premises, complete with a service bench for repairing ham gear.

While I didn't send ahead for a license since I would be there for only two days, I did have along a Kenwood HT, so I checked out the local repeaters. I had no trouble kerchunking five different repeaters from the hotel on 146.61, 64, 94, 147.06, and 147.24. I heard at least three more, but was unable to kerchunk them. Simplex was going strong on 145.05, 24, 85. You can bet that the next time I manage a day or two in Colombia at the end of a business trip, I'll have a license awaiting me and be busy talking on the repeaters. If I can get away for a couple more days I'll include a side trip to San Andres for some skin diving.

The trip back to Baranquilla was similar to the one down, complete with the singing children and small-town food vendors. The bus was smaller and hotter. Once at the airport, everything settled into routine and in a few hours we were back in Peterborough, New Hampshire, laughing over the problems and the fun of the visit.

The amateurs in Colombia, like amateurs everywhere, are wonderful people. I've never been seriously disappointed in my travels. Of course it helps when I am able to meet hams like Rudolf, who have been reading my editorials and already know me pretty well.

Eastern managed to get most of the Braniff routes to South America, so they've removed Colombia from their special around-the-airline fare. They may be working on a new fare system which will include more of South America. In the past I've found that I could, by putting up with the Atlanta stops, get to a couple of shows cheaper than to just one. . . and then be able to include a stop or two in the Caribbean as a bonus. Sherry and I managed St. Maarten, Martinique, and other such stops this way in the past. It's worth looking into. Eastern keeps inching up the cost of their around-the-system excursion fare, so check it out the next time you have to make a trip somewhere and see if you can't throw in a side trip to Antigua at no extra cost. I've only visited two South American countries so far, so I'm watching for something special from Eastern which could get me to a few more without a lot of cost. NSD stands for Never Spend a Dollar, which is consistent with my Yankee upbringing.

### RADIOAFICIONADOS

Note: if you look in the yellow pages of the phone book under Radioaficionados, you may find a list of the local radio amateurs


106 - Publicidad - Puertos Maritimos y Fluviales - Radioaficionados

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(CONTINUA EN LA PAGINA SIGUIENTE)

✓See List of Advertisers on page 114

listed by name and call in Latin American phone books. The listing in Cartagena was most helpful.

### SUCCESS

A depressing bit of news was in a recent report in the *Wall Street Journal*. Unless they rewrote the study, something I have personally known them to do. . . so I don't give them a lot of creditability, this showed that a high percentage of the teenagers they polled had little interest in success. All they wanted out of life was to have a home, a job, and a family.

I suppose, considering the cost of homes these days, that might seem like an outsized expectation, but I find that I am angry with the schools which are teaching the kids these meager values. Remember, if you will, that many of the people we employ to teach our children. . . the people who are giving them much of their values. . . are failures as far as coping with our economic system is concerned. It is a pity that parents have so little real choice in schools. . . and make this even worse by having virtually no communication with their kids. At home, the television set is on and other studies have shown that the parents will fight almost to the death to keep it on, day and night.

Without much in the way of real communication with the parents, children have to learn from television and school. . . neither of which is inspiring. Are there any TV shows which show successful people accomplishing things? In most of the shows I've seen, the heads of large corporations are busy ordering people killed, stealing formulas, and other skullduggery.

Our school system is set up so as to virtually guarantee failure as far as making any real money is concerned. Pity, for the more money you make the more ability you have to help move the world ahead. The less you make, the less say you have in what is going on. Yet we have our schools set up so as to provide employees for large businesses (no one has ever gotten rich as an executive in a large business. . . according to John Wareham in his *Secrets of a Corporate Headhunter*. . . a superb, if probably disturbing book). If one continues on through the educational process, one finds the goal is teaching, another proven way to stay impoverished.

With little, if any, input to the kid from the parents, I suppose it is no wonder that our kids have no enthusiasm for success. This is something which happens in early schooling, so by the time a kid might get a chance to listen to me it is too late.

This is frustrating, in a way. Here we are in the middle of the computer revolution, with opportunities on every side for youngsters to become incredibly successful, yet most of them don't want to and won't make even a slight effort to try. We've already seen more new millionaires as a result of the microcomputer in the last two or three years than we've had in any similar period in history. . . and this is only the beginning. We are about to enter a computer/communications explosion which will force millions on many more entrepreneurs. It's all there if you want it.

Being, for some reason, an entrepreneur, I see these opportunities opening up on every side. And I see a lack of people with the background it takes to succeed. I'm held back from getting into many more projects by lack of money for growth. . . and a lack of able people to follow up on the work that has to be done. Oh, we're growing at about 40% or so a year, but the opportunities are out there for ten times that in growth. . . if the venture capital and management were available.

Well, enough grousing about my frustrations. If I can organize a pilot model college to provide an entrepreneurial education I think our country would be able to grow faster and cope more successfully with the Japanese. I don't think we will ever do it with big corporations and the type of people they generate.

### EMERGENCIES

Speaking of frustrations, I'm still looking for articles on advanced emergency communications systems which amateur radio could pioneer. Not only does amateur radio need the boost such new systems would provide, but our country needs the safety which such systems could provide. Right now, if the bombs should drop, we'd be in one hell of a fix. A recent disaster novel, *Satan's Hammer*, spells out many of the problems we would face should a major disaster occur. Unfortunately, the authors of the book were unfamiliar with amateur radio, a service which will obviously be of key importance in any calamity.

It is a crime that amateur radio has managed to keep the traffic nets using CW for the last 30 years. When John Williams W2BFD and others showed the simplicity and effectiveness of RTTY back in 1948, it was time to make the change from Morse code to RTTY at 60 or 100 words per minute. Now, with a computer within the reach of anyone (Sinclair, $100), what on Earth are we thinking of trying to send emergency messages with a hand key at ten or twenty words per minute? What do I have to do to get some action, start an Amateur Radioteletype Repeater League to bring us into the last half of the century? Yes, I know that virtually to a man you are about my age. . . which is sixty this year. . . and that you are tired and don't want to try anything new. Well, dammit, stock up on All-Bran and prunes and let's get this old ark a moverin. I want to see some sign of experimentation, even if we have to develop the action in the geriatric set.

In case you have managed to avoid the news programs on television, more and more countries are going atomic. This means that one of these days a little war, such as our recent conflicts in Lebanon, the Falklands, and so on, could escalate into that projected loss of 140 million Americans. Yep, there goes old gloom and doom Wayne again. . . and I admit it this time. Sure, I agree with you that such a thing is so terrible that it is absolutely impossible. But I don't believe that any more than you do.

We both know that it is highly unlikely. . . but the possibility has to be reckoned with. Now if amateur radio could come into the 80s and get some emergency relay systems working. . . automatic relays. . . with high speed digital communications. . . we just might have something left should all hell break loose. If we are going to depend on CB for post-atomic communications, we are not going to have a workable government.

You probably don't have the guts to bring this up at a club meeting and get things started. I don't blame you. No, it's better to get mad at me for bringing it up and do be sure the next time you see me to assure me that you don't always agree with everything I write.

### IONIZED!

The article on negative ions in the July *73* (page 52) left out a very important piece of information that you really should have before you start pouring ions around your house. There's a little side effect of these damned ion generators which they don't tell you about. . . one which can cost you a bundle.

There has been a mystique about negative ions for years. All sorts of claims have been made for them at various times. . . such as that they help you to think better, to feel better, to heal faster, and so on. Articles have pointed to positive ions as bringing on depression and even suicides.

With the government taking a dim view of sales literature promising cures for things where proof is lacking, the brochures for negative ion generators are a marvel of hyperbole without anything really being promised. These ads do not promote confidence in the product.

Yet it seems as if there must be *something* there. I can't help but notice that virtually all of my really brilliant ideas come while I am taking a shower. If I sit in a tub of water nothing much happens. I probably should have a shower attached to my office and pop in and out a dozen times a day. I've read that this is not an unusual occurrence and that it is thought to be the knocking off of positive ions by the shower water which is responsible. This is supposed to build up the negative ions, allowing the brain to function better.

Now, as any of my great army of detractors will vouch, anything which will help me think better should be pursued. So it was only a matter of time until I got sucked in and bought one of those negative ion generators for my office. It was a little one. . . one of those small black ball types I'm sure you've seen advertised. Mail-order item. Well, it arrived and I plugged it in and put it above my desk and awaited flashes of brilliance. Nothing happened.

*See List of Advertisers on page 114*

These gadgets are being sold as smoke-clearing devices. I've seen demonstrations of how they precipitate smoke out of the air almost instantly. Well, that's great for some offices, but I don't smoke. I don't hire anyone who smokes. I don't let anyone smoke in the building, much less my office, so *that* function of the generator isn't very helpful. . . but it does tie in with the disastrous side effect.

A couple months ago I got an ad in the mail for a more powerful ion generator. Hmmm, perhaps that was the trouble, not enough ions. So I sent for this powerhouse ion generator and waited with hopes of being able to keep brilliant thoughts perking day and night.

The contraption arrived. It wasn't a lot larger than the black bomb sitting on the bookshelf over my head. *This* is a powerhouse generator? Oh, well, I put it on the shelf and plugged it in and waited for genius to strike. And I waited.

There must be something wrong with the idea. Here I was awash in negative ions and I felt tired and needed to lie down for a nap. Phooey. So I reached down to unplug the new generator and got zapped. That sucker had zillions of volts jumping out of the power plug. . . I couldn't get near it. Did I have the plug in backwards? I got some insulated foam and changed the plug around. Nope, still the same. . . hot. That's dangerous! There must be 100,000 volts jumping around that wall socket. You know, it's mighty difficult to pull a power plug when you know it is going to give you a dandy shock, even with insulation. I sent the gadget back to the mail-order house and got a refund.

Okay, now the real kicker. After a year of sitting under my black bomb awaiting benefits, I moved some of the boxes of magazines which were on the shelf to another room. For a good ten feet around the generator, every book or box on the shelf had an outline around it printed permanently on the wall. A picture on the wall six feet from the generator was nicely outlined in black. It was as if I had sprayed the wall with dark grey. That damned generator had attracted the dust in the air to the walls of the room. . . and the books, boxes, pictures, and so on. I got a hundred years worth of dust coating my walls in about one year! The office walls are a disaster. Even the ceiling at that end of the room is a much darker grey. The whole room will have to be painted.

I thought you might like to know before you get too enthused over the ion generator in the July issue.

#### HAM PUBLICATIONS

The virtual disappearance of *Ham Radio* magazine from hamfests and conventions has reinforced rumors that publisher Tenney would like to retire. There was some serious talk of that a few months ago, but apparently the chap interested in taking it over thought better of the idea after looking into the economics.

Tenney has been talking about retirement and his recent folding of *Ham Horizons* and getting rid of *Ham Radio Report* would indicate that he is winding down his publishing business. With the loss of editor Fisk, *HR* seems to have no one on the staff qualified to select and edit the more technical articles.

Since magazine publishers do have to take care of their subscribers when they fold their magazines, the usual move is to turn to a similar publication and arrange for them to fulfill the obligation. This is an expensive matter, but hopes of subsequent renewals and thus an eventual recouping of the investment often prevail.

With *HR* reaching the lowest point in advertising in ten years this spring, the losses must be considerable. However, should *HR* fold, you may be sure that ham high-tech articles will not disappear. We're preparing to open a section in *73* on this so that we can provide serious engineering builders the projects they like. We *do* have good technical brains on tap.

The way we keep score in the publishing business is by counting pages of advertising. For instance, to put things into perspective, in May, *73* had 93 pages of ads, *QST* had 91 pages, CQ had 58 pages, and *HR* had 37 pages. That about tells the story. With the break-even point for most magazines being at around 45% advertising these days, when one is only running about 37%, like *HR*, the chances are that money is being lost and something is going to have to change. They've been under 45% for a year, so it's probable that the losses have been mounting. Of course if circulation is kept small, it *is* possible to get by with fewer ads, so that could be their stratagem.

The main problem in the whole ham field is one of lack of growth. This has kept the sale of ham gear down and that, in turn, has limited funds for advertising. Advertisers tend to cut back and advertise only where they know they are getting the most sales, which puts the pinch on specialty publications such as *HR*. Tests often show that advertisers are able to do about the same in sales with or without ads in anything but *73* and *QST*. When sales are brisk and profits large, firms can afford to run ads in smaller magazines as a way of helping them. But when the bottom line starts turning red, these extravagances are reconsidered.

To perhaps put things into a better perspective, let's look at how advertising is going to *73*, *QST*, and *HR* for the first six months of 1982 vs. the same period in 1981.

Pages of ads

| | 1981 | 1982 |
|---|---|---|
| *73* | 426 | 534 |
| *QST* | 571 | 556 |
| *HR* | 301 | 212 |

Thus, in comparable periods, we see *73* advertising up over 25%, *QST* down about 2½%, and *HR* down 30%! Obviously something is happening.

# CONTESTS

*Robert Baker WB2GFE*
*15 Windsor Dr.*
*Atco NJ 08004*

#### EUROPEAN DX CONTEST—PHONE

**Starts: 0000 GMT September 11**
**Ends: 2400 GMT September 12**

Sponsored by the Deutscher Amateur Radio Club (DARC). Only 36 hours of operation out of the 48-hour period are permitted for single-operator stations. The 12 hours of non-operation may be taken in one but not more than three periods at any time during the contest. Operating classes include: single operator, allband and multi-operator, single transmitter. Multi-operator, single-transmitter stations are allowed to change band only one time within a 15-minute period, except for making a new multiplier. Use all amateur bands from 3.5 through 28 MHz. A contest QSO can be established only between a non-European and a European station. Each station can be worked only once per band.

*EXCHANGE:*

Exchange the usual five-digit number consisting of RS and progressive QSO number starting with 001.

*SCORING:*

Each QSO counts 1 point. Each QTC (given or received) counts 1 point. The multiplier for non-European stations is determined by the number of European countries worked on each band. Europeans will use the last ARRL countries list. In addition, each call area in the following countries will be considered a multiplier: JA, PY, VE, VO, VK, W/K, ZL, ZS, and UA9/UA0. The multiplier on 3.5 MHz may be multiplied by 4, on 7 MHz by 3, and on 14 through 28 MHz by 2. The final score is the total QSO points plus QTC points multiplied by the sum total of multipliers.

*QTC TRAFFIC:*

Additional point credit can be realized by making use of the QTC traffic feature. A QTC is a report of a confirmed QSO that has taken place earlier in the contest and later sent back to a European station. It can be sent only from a non-European station to a European station, the general idea being that after a number of European stations have been worked, a list of these stations can be reported back during a QSO with another station. An additional 1-point credit can be claimed for each station reported.

✓See List of Advertisers on page 114

# CALENDAR

| | |
|---|---|
| Sep 11-12 | ARRL VHF QSO Party |
| Sep 11-12 | European DX Contest—Phone |
| Sep 11-12 | Cray Valley RS SWL Contest |
| Sep 18-19 | New Mexico QSO Party |
| Sep 18-19 | CAN-AM Contest—Phone |
| Sep 18-19 | College Scrimmage |
| Sep 18-20 | Washington State QSO Party |
| Sep 25-26 | Maine QSO Party |
| Sep 25-26 | CAN-AM Contest—CW |
| Sep 25-27 | Massachusetts QSO Party |
| Oct 2-3 | California QSO Party |
| Oct 16-17 | ARCI QRP CW QSO Party |
| Oct 16-17 | Pennsylvania QSO Party |
| Oct 16-17 | BSA Jamboree-On-The-Air |
| Oct 23-24 | Maryland-District of Columbia QSO Party |
| Nov 6-7 | ARRL Sweepstakes—CW |
| Nov 13-14 | European DX Contest—RTTY |
| Nov 20-21 | ARRL Sweepstakes—Phone |
| Dec 4-5 | ARRL 160-Meter Contest |
| Dec 11-12 | ARRL 10-Meter Contest |
| Dec 19 | CARF Canada Contest |
| Jan 8 | *73 Magazine* 40-Meter World SSB Championship |
| Jan 9 | *73 Magazine* 80-Meter World SSB Championship |
| Jan 15-16 | *73 Magazine* 160-Meter World SSB Championship |

A QTC contains the time, call, and QSO number of the station being reported, i.e., 1300/DA1AA/134. This means that at 1300 GMT you worked DA1AA and received number 134. A QSO can be reported only once and not back to the originating station. Only a maximum of 10 QTCs to a station are permitted. You may work the same station several times to complete this quota but only the original contact has QSO point value. Keep a uniform list of QTCs sent. QTC 3/7 indicates that this is the 3rd series of QTCs sent and that 7 QSOs are reported. Europeans may keep the list of the received QTCs on a separate sheet if they clearly indicate the station who sent the QTCs.

*AWARDS:*

Certificates to the highest scorer in the each classification in each country, reasonable score provided. Continental leaders will be honored with plaques. Certificates will also be given to stations with at least half the score of the continental leader or with at least 250,000 points. The minimum requirement for a certificate or a trophy is 100 QSOs or 10,000 points.

*ENTRIES:*

Violation of the rules, unsportsmanlike conduct, or taking credit for excessive duplicate contacts will be deemed sufficient cause for disqualification. The decisions of the Contest Committee are final. It is suggested that the log sheets of the DARC or equivalent be used. Send a large SASE to get the wanted number of logs and summary sheets (40 QSOs or QTCs per sheet). SWLs apply the rules accordingly. Entries should be sent no later than October 15th to: DARC DX Awards, PO Box 1328, D-895 Kaufbeuren, Germany.

*EUROPEAN COUNTRY LIST:*

C31, CT1, CT2, DL, DM, EA, EA6, EI, F, FC, G, GC Guer, GC Jer, GD, GI, GM, GM Shetland, GW, HA, HB9, HB0, HV, I, IS, IT, JW Bear, JW, JX, LA, LX, LZ, M1, OE, OH, OH0, OJ0, OK, ON, OY, OZ, PA, SM, S, SV, SV Crete, SV Rhodes, SV Athos, TA1, UA1346, UA2, UB5, UC2, UN1, UO5, UP2, UQ2, UR2, UA Franz Josef Land, YO, YU, ZA, AB2, 3A, 4U1, and 9H1.

## CRAY VALLEY RS SWL CONTEST

**Starts: 1800 GMT September 11**
**Ends: 1800 GMT September 12**

Up to 18 hours of logging may be done during the contest period with a rest period clearly shown. Multi-operator stations may log during the entire contest. The contest is open to anyone in the world, and there will be two sections, phone and CW, each with two categories: single operator and multi-operator. The second category is open to two or more listeners or to clubs and more than one receiver can be used. The 1.8-, 3.5-, 7-, 14-, 21-, and 28-MHz bands may all be used.

Scores should be compiled as follows: one point for each station heard multiplied by the number of different countries heard on each band. A list of countries heard must be furnished and a separate log must be submitted for each band. Illegible logs will not be accepted. The call areas of the USA, Canada, and Australia will each count as a separate country. All other countries will be determined by the official RSGB Countries List. No CQ or QRZ or similar call will be allowed to count for points. If points are claimed for both sides of a QSO, the callsign of each must appear in the station-heard column.

Log sheets are available from Owen Cross G4DFI, 28 Garden Avenue, Bexleyheath, Kent DA7 4LF, England, if you include an SAE and sufficient return postage. If is desirable that entrants use official log sheets, but entries on homemade log sheets will be accepted if the following information is given: date, time, band station heard, station being worked, report at SWL's QTH. Points may be claimed only for stations actually heard and callsigns must be shown in full. Entries should be sent to the Contest Manager, G4DFI, at the above address, to arrive no later than November 1st. Certificates of merit will be awarded at the discretion of the board of the Cray Valley RS and its decision will be final.

## WASHINGTON STATE QSO PARTY

**0100 to 0700 GMT September 18**
**1300 GMT September 18 to 0700 GMT September 19**
**1300 GMT September 19 to 0100 GMT September 20**

The seventeenth annual contest sponsored by the Boeing Employees' Amateur Radio Society (BEARS) is divided into three operating periods as shown. All amateurs are invited to participate. Use all bands and modes, but no CW QSOs are allowed in the phone bands. Stations may be worked once on each band and mode for contact points and more than once each band/mode if they are additional multipliers.

*EXCHANGE:*

QSO number, RS(T), and state, province, country, or Washington county.

*FREQUENCIES:*

Phone—1815, 3925, 7260, 14280, 21380, 28580; CW—1805, 3560, 7060, 14060, 21060, 28160; Novice—3725, 7125, 21150, 28160.

*SCORING:*

Washington stations score 2 points for each phone contact and 3 points for each CW contact, including contacts with other Washington stations. Multiply QSO points by the total number of different states, Canadian provinces, and other foreign countries worked.

All others score 2 points for each phone contact and 3 points for each CW contact with a Washington station. Multiply QSO points by the total number of different Washington counties worked (39 maximum). There will be an extra multiplier of one for each group of 8 contacts with the same Washington county for all non-Washington stations.

*AWARDS:*

Certificates will be awarded to the highest scoring station (both single- and multi-operator) in each state, Canadian province, foreign country, and Wash-

# BIARC BULLETIN

## NEWSLETTER OF THE MONTH

This month's newsletter winner, the *BIARC Bulletin*, is chock-full of useful information. Published by the Big Island Amateur Radio Club, Hilo HI, the newsletter has an activity calendar that lists local, national, and international ham radio events, a directory of nets and bulletins, and even reminders for club members whose licenses are about to expire. The *BIARC Bulletin* also offers a special Hawaiian flavor, making it interesting to read even if you are not a member. Great job, BIARC, and great job, Editor Dean Manley KH6B!

ington county. Additional certificates may be issued at the discretion of the Contest Committee. Worked Five BEARS Awards also are available to anyone working 5 club members before, during, or after the QSO party (unless previously issued). All QSO Party entries will be screened by the Contest Committee for possible Worked Five BEARS Awards. Worked Three BEAR Cubs Awards are also available for working 3 Novice members.

*ENTRIES:*

Logs must show dates/times in GMT, stations worked, exchanges sent and received, bands and modes used, and scores claimed. Include a dupe sheet for entries with more than 200 QSOs. Each entry must include a signed statement that the decision of the Contest Committee will be accepted as final. No logs can be returned. Results of the QSO Party will be mailed to all entrants and an SASE is *not* required. Log sheets and summary sheets must be postmarked no later than October 20th and sent to: Boeing Employees' Amateur Radio Society, c/o Contest Committee, Willis D. Propst K7RS, 18415 38th Avenue South, Seattle WA 98188.

# RESULTS

**1982 VIRGINIA STATE QSO PARTY RESULTS**

| | | | |
|---|---|---|---|
| **Top Score:** | | **Top In State:** | |
| **W4VP/4** | **70,416** | **W4VP/4** | **70,416** |
| **Top Out Of State:** | | **Top Mobile:** | |
| **AE3Y** | **10,400** | **KZ4K** | **6,824** |

| State Results | Call | Points |
|---|---|---|
| Arizona | AK7J | 16 |
| Connecticut | K1BV | 735 |
| Delaware | AE3H | 90 |
| Florida | W8BZY/4 | 238 |
| Georgia | K4VT | 2,346 |
| Idaho | W7GHT | 320 |
| Iowa | WB0UCP | 336 |
| Kansas | N0CLV | 289 |
| Louisiana | W5WG | 2,294 |
| Maryland | AE3Y | 10,400 |
| Massachusetts | W1AQE | 1,440 |
| Michigan | W8YL | 968 |
| New Jersey | W2XQ | 4,465 |
| New York | W2MTA | 5,671 |
| North Carolina | K4JEX | 1,530 |
| Pennsylvania | W3ZE | 1,650 |
| Rhode Island | K1GTI | 460 |
| South Carolina | K4BZD | 1,305 |
| Texas | W5PWG | 1,802 |
| Washington | WA7JUJ | 20 |
| West Virginia | WA8KAN | 748 |
| Wisconsin | K9GDF | 100 |

| Virginia Results | Call | Points |
|---|---|---|
| Accomack | KC4HN | 3,280 |
| Albemarle | WB3HUP/m | 156 |
| Alleghany | WB3HUP/m | 2 |
| Amelia | KZ4K/m | 170 |
| Amherst | WB3HUP/m | 143 |
| Bath | WA4NVD | 20,303 |
| Bland | WB3HUP/m | 8 |
| Botetourt | WB3HUP/m | 99 |
| Buckingham | KZ4K/m | 476 |
| Campbell | WB3HUP/m | 288 |
| Carroll | WB3HUP/m | 770 |
| Charles City | K4JST | 384 |
| Chesterfield | N4BLV | 2,627 |
| Clarke | N4MM | 36 |
| Culpepper | KZ4K/m | 80 |
| Cumberland | KZ4K/m | 396 |
| Dinwiddie | KZ4K/m | 672 |
| Essex | KA3DTE | 1,908 |
| Fairfax | W4NM | 7,579 |
| Fauquier | KZ4K/m | 195 |
| Floyd | WB3HUP/m | 88 |
| Fluvanna | KZ4K/m | 399 |
| Franklin | WB3HUP/m | 192 |
| Frederick | N3OS/4 | 1,628 |
| Giles | WB3HUP/m | 42 |
| Gloucester | KZ4K/m | 16 |
| Grayson | WB3HUP/m | 520 |
| Henrico | WB4URW | 13,542 |
| Henry | WB3HUP/m | 9 |
| Highland | W4VP/4 | 70,416 |
| King George | KZ4K/m | 49 |
| King and Queen | KZ4K/m | 35 |
| King William | KZ4K/m | 42 |
| Lancaster | KZ4K/m | 381 |
| Loudoun | WA4NTP | 17,280 |
| Madison | KZ4K/m | 108 |
| Middlesex | KZ4K/m | 475 |
| Montgomery | WB3HUP/m | 42 |
| Nelson | WB3HUP/m | 90 |
| New Kent | KZ4K/m | 198 |
| Northampton | KA4KOZ | 8,586 |
| Northumberland | KZ4K/m | 110 |
| Nottoway | KZ4K/m | 135 |
| Orange | KZ4K/m | 110 |
| Page | WB3HUP/m | 35 |
| Patrick | WB3HUP/m | 236 |
| Pittsylvania | WB3HUP/m | 132 |
| Portsmouth | W4POX | 42,230 |
| Prince Edward | KZ4K/m | 429 |
| Prince George | KZ4K/m | 240 |
| Pulaski | KX4V | 21,000 |
| Richmond | KZ4K/m | 378 |
| Roanoke | WB3HUP/m | 20 |
| Rockingham | WB3HUP/m | 9 |
| Shenandoah | WB3HUP/m | 154 |
| Smythe | KC4IG | 2,470 |
| Spotsylvania | KZ4K/m | 121 |
| Stafford | WD4KQJ | 2,304 |
| Surry | K4JST | 400 |
| Sussex | K4JST | 168 |
| Warren | K4OD | 6,204 |
| Washington | WB3HUP/m | 210 |
| Westmoreland | KZ4K/m | 999 |
| Wythe | WB3HUP/m | 182 |

## CAN-AM CONTEST

**Starts: Phone—1800 GMT September 18**
**CW—1800 GMT September 25**
**Ends: Phone—1800 GMT September 19**
**CW—1800 GMT September 26**

Sponsored by the Ontario Contest Club and Canadian DX Association to increase the friendship among Canadian and American amateurs and to provide a means of measuring the performance of operating skills and equipment. Categories of competition: single operator—allband, single band and QRP, stations operated by the station licensee; multi-operator, single transmitter—stations operated by more than one operator, or single operator other than the licensee, or club stations; and club competition. Multi-operator stations can operate full 24-hour period, single operator stations can operate maximum 20 hours with one or two rest periods totaling a minimum of four hours which must be clearly marked in the log. Any further rest periods do not need to be logged. For QRP operation, a maximum of 10 Watts input is allowed during the contest.

*FREQUENCIES:*

All SW bands 1.8 through 28 MHz are permitted. US General portion of the bands is recommended for use.

*EXCHANGE:*

Signal report: use RS on phone and RST on CW, plus sequential QSO number starting with 001, plus multiplier area (MX) abbreviation, in that order, i.e., 59001CT, 599021NY. Multiplier area abbreviation is the usual two-letter postal abbreviation for 50 US states, CN for Caribbean (KC4, KG4, KP1, KP2, KP4, KS4, KV4 and their A- and W- prefix equivalents), PC for Pacific (rest of US possessions and Antarctica). Canadians will use: NF for VO1, VO2; NB for VE1 New Brunswick; NS for Nova Scotia; PE for Prince Edward Isl.; SI for Sable and St. Paul Isl.; PQ for VE2; ON for VE3; MB for VE4; SK for VE5; AT for VE6; BC for VE7; NW for VE8 NWT; YU for VY1 Yukon.

*SCORING:*

The final score is the result of the total QSO points from all bands, multiplied by the sum of the multipliers from all bands. Phone and CW sections of the contest are considered separate contests. However, combined score for phone and CW will be used for overall competition. Combined score will be calculated by the contest committee as a result of the addition of phone and CW scores. Points: American to American, and Canadian to Canadian QSOs count for 2 points; American to Canadian and vice versa count for 3 points. The same station can be contacted once on each band and mode. Stations operating from outside of their own call area must sign slash and the area they are operating from, i.e., W6AM/7, NP4A/W4, W7RM/KH6, KH0AH/W6. Multipliers: 50 US states, 2 US possessions (Caribbean, Pacific); 10 Canadian provinces, 2 territories (NWT, YU), 1 islands (Sable, St. Paul). Total of 65 multipliers per band; maximum possible on all 6 bands is 390.

*AWARDS:*

Handsome first-place certificates will be awarded in each multiplier area on both modes in single-operator category. Top five multi-operator stations in each country will receive certificates for high combined phone and CW scores. All scores will be published in *CQ*. Trophies and plaques will be awarded to the Canadian Champion and American Champion in four categories: single operator, combined, single operator, phone, single operator, CW, and multi-operator, combined.

The Club Competition Championship will be awarded to the club having highest score as a result of addition of 5 best scores on phone and 5 best scores on CW made by its members. A club officer must submit the summary showing the callsigns and scores. Each station is eligible for one trophy only. In a case where one station qualifies for another trophy, the less-significant trophy goes to the next eligible station.

Free one-year subscription to *Long Skip*, the CANAD-X bulletin, will be awarded to the top 5 US stations.

*ENTRIES:*

All times must be kept in GMT. Indicate multipliers the first time only on each band. Log must be checked for duplicate contacts, correct QSO points, and multipliers. Do not use separate logs for each band. Rest periods must be clearly marked in the log. Each entry consists of: log sheets, summary sheet showing all scoring information, category of competition, operator's name and callsign, address of the station, and signed declaration. Entries with over 200 QSOs must include check sheets for each band. Official logs, check sheets and summary sheets with multiplier tables area available from the Contest Chairman; a large SASE with Canadian stamps (or US stamps not glued to the envelope) will bring you the samples. Contestants are encouraged to use them; they greatly help with the processing of the entries. Send your log regardless of your score total.

Any band can be selected for the single-band category. All single-band entries will be judged in one category. It is up to the contestant to select the one that could bring him the highest point score for his particular situation.

Violation of national amateur radio regulations or rules of the contest, unsportsmanlike conduct, taking credit for excessive duplicate contacts, or unverifiable QSOs or multipliers will be deemed sufficient cause for disqualification. Incorrectly logged calls will be counted as unverifiable contacts. Actions and decisions of the CAN-AM Contest Committee are official and final.

All entries must be postmarked not later than 30 days after the contest and mailed to: CAN-AM Contest Chairman, VE3BMV, Box 65, Don Mills, Ontario, Canada M3C 2R6.

## COLLEGE SCRIMMAGE

**Starts: 0200 GMT September 18**
**Ends: 0400 GMT September 19**

The idea of this contest is to put long-lost alumni in touch with their alma mater. Entry classes include alumni and college stations (one transmitter only). Exchange name of college, junior college, or university you last attended and the last year you graduated or will graduate. Club stations substitute "amateur radio club" for number. Non-collegians substitute "high school" for college name. Stations may be worked once per band on SSB only. Multiply total QSOs times number of different colleges, junior colleges, and universities worked. Logs should be sent to Penn State ARC, K3CR, 202 Engineering Unit E, University Park PA 16802. Please include an SASE for results.

## NEW MEXICO QSO PARTY

**Starts: 1800 GMT September 18**
**Ends: 2100 GMT September 19**

Sponsored by the Albuquerque DX Association. Each station may be worked once on each band and each mode.

*EXCHANGE:*

RS(T); QSO number starting with 001; and state, province, DX country, or NM county.

*SCORING:*

Count 2 points for each phone/SSB QSO and 3 points for each CW QSO. NM stations multiply total QSO points by total number of states, provinces, and DX countries worked. All others, multiply total QSO points by the total number of NM counties worked each band, each mode.

*AWARDS:*

Plaques will be presented to the top score from outside NM and the highest NM single operator and portable. Certificates awarded top scorers from each state, province, and DX country. Certificates will also be awarded to each station submitting a score of more than 100 total points.

*ENTRIES:*

Entries must be postmarked no later than October 15th and addressed to: K5QQ, 1005 Morina Court NE, Albuquerque NM 87112. Include an SASE for complete results.

## 1982 MAINE QSO PARTY

**Starts: 2300Z September 25**
**Ends: 2359Z September 26**

The Maine QSO Party is sponsored by the Portland Amateur Wireless Association. Exchange signal report, serial number, and QTH (county for Maine stations; state, province, or country for others). Stations may be worked once on CW and once on phone for each band. Count three points per QSO and multiply by number of Maine counties worked for final score. (Maine stations multiply by Maine counties, states, provinces, and countries.) Suggested frequencies: CW—1805 and 60 kHz up from low end of band; phone—1815, 3930, 7280, 14280, 21380, 28580 kHz; Novice—3720, 7120, 21120, 28120.

Certificates will be awarded to top scorers in each state, province, country, or Maine county. Mail entries by December 1st to PAWA, Box 1605, Portland ME 04104. Applications for the Worked All Maine Counties Award may go to the same address.

## MASSACHUSETTS QSO PARTY

**Starts: 1600 GMT September 25**
**Ends: 0200 GMT September 27**

Sponsored by the Greater New Bedford Contesters. A station may be worked once per band. Phone and CW are separate bands. No crossband or repeater contacts permitted. Mobiles and portables may be counted as new contacts each time a county change takes place.

*EXCHANGE:*

RS(T) and state, province, or Massachusetts county.

*FREQUENCIES:*

Phone—1820, 3960, 7260, 14290, 21380, 28590, 50.110; CW—1810, 3560, 7060, 7120, 14060, 21060, 21120, 28060, 28120. Use of FM simplex is encouraged. Remember to use CW in CW bands only.

*SCORING:*

All stations count 2 points for each completed SSB exchange and 4 points for each CW exchange. Massachusetts stations multiply QSO points by total number of states, provinces, and Massachusetts counties worked. DX stations worked only count for QSO points. Outside Massachusetts, multiply QSO points times total number of Massachusetts counties worked. As a bonus, add 100 points to the total score for each sponsor worked (KA1GG, N1AVA, K1KJT). Note that they can only be worked once for bonus points.

*AWARDS:*

Certificates will be awarded to first through third place winners in each Massachusetts county as well as each state. Two special awards will be given out for the radio club with the highest aggregate score in Massachusetts (min. of 3 logs) and to the Massachusetts station submitting the all-time highest number of QSOs. The current record is held by K1GSK (1483 QSOs in the 1979 contest). Additionally, a certificate will be given stations working all three sponsors.

*ENTRIES:*

Logging must include date/time, band, mode, callsign, state and province worked, and exchange RS(T). Submit separate summary sheet along with logs. Summary sheet information should include your name, call, mailing address, club affiliation for aggregate score, total QSO points, multipliers claimed, and total score. Deadline for mailing is October 31. For awards and results, send $.50 postage (no envelope) to Ed Peters K1KJT, 29 Greenbrier Drive, New Bedford MA 02745.

✓See List of Advertisers on page 114

# SATELLITES

Amateur Satellite Reference Orbits

| Date | | OSCAR 8 UTC | OSCAR 8 EQX | RS-5 UTC | RS-5 EQX | RS-6 UTC | RS-6 EQX | RS-7 UTC | RS-7 EQX | RS-8 UTC | RS-8 EQX | Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sep | 1 | 0055 | 88 | 0135 | 225 | 0146 | 230 | 0053 | 216 | 0026 | 206 | 1 |
| | 2 | 0059 | 89 | 0130 | 225 | 0131 | 228 | 0043 | 215 | 0023 | 207 | 2 |
| | 3 | 0103 | 90 | 0124 | 225 | 0115 | 226 | 0034 | 214 | 0020 | 208 | 3 |
| | 4 | 0108 | 91 | 0119 | 226 | 0100 | 223 | 0024 | 213 | 0017 | 209 | 4 |
| | 5 | 0112 | 92 | 0114 | 226 | 0044 | 221 | 0014 | 212 | 0014 | 209 | 5 |
| | 6 | 0117 | 94 | 0108 | 226 | 0029 | 219 | 0005 | 211 | 0012 | 210 | 6 |
| | 7 | 0121 | 95 | 0103 | 226 | 0014 | 216 | 0154 | 240 | 0009 | 211 | 7 |
| | 8 | 0125 | 96 | 0058 | 226 | 0157 | 244 | 0145 | 239 | 0006 | 212 | 8 |
| | 9 | 0130 | 97 | 0052 | 226 | 0141 | 241 | 0135 | 238 | 0003 | 213 | 9 |
| | 10 | 0134 | 98 | 0047 | 227 | 0126 | 239 | 0125 | 238 | 0000 | 213 | 10 |
| | 11 | 0139 | 99 | 0041 | 227 | 0111 | 237 | 0116 | 237 | 0157 | 244 | 11 |
| | 12 | 0000 | 75 | 0036 | 227 | 0055 | 234 | 0106 | 236 | 0154 | 245 | 12 |
| | 13 | 0004 | 76 | 0031 | 227 | 0040 | 232 | 0056 | 235 | 0152 | 246 | 13 |
| | 14 | 0009 | 77 | 0025 | 227 | 0025 | 230 | 0047 | 234 | 0149 | 247 | 14 |
| | 15 | 0013 | 78 | 0020 | 228 | 0009 | 227 | 0037 | 233 | 0146 | 248 | 15 |
| | 16 | 0017 | 79 | 0015 | 228 | 0152 | 255 | 0027 | 232 | 0143 | 248 | 16 |
| | 17 | 0022 | 81 | 0009 | 228 | 0137 | 253 | 0018 | 231 | 0140 | 249 | 17 |
| | 18 | 0026 | 82 | 0004 | 228 | 0122 | 250 | 0008 | 230 | 0138 | 250 | 18 |
| | 19 | 0031 | 83 | 0158 | 258 | 0106 | 248 | 0158 | 259 | 0135 | 251 | 19 |
| | 20 | 0035 | 84 | 0153 | 259 | 0051 | 246 | 0148 | 259 | 0132 | 252 | 20 |
| | 21 | 0039 | 85 | 0148 | 259 | 0035 | 243 | 0138 | 258 | 0129 | 252 | 21 |
| | 22 | 0044 | 86 | 0142 | 259 | 0020 | 241 | 0129 | 257 | 0126 | 253 | 22 |
| | 23 | 0048 | 87 | 0137 | 259 | 0005 | 239 | 0119 | 256 | 0123 | 254 | 23 |
| | 24 | 0052 | 89 | 0132 | 259 | 0148 | 266 | 0110 | 255 | 0121 | 255 | 24 |
| | 25 | 0057 | 90 | 0126 | 260 | 0133 | 264 | 0100 | 254 | 0118 | 256 | 25 |
| | 26 | 0101 | 91 | 0121 | 260 | 0117 | 261 | 0050 | 253 | 0115 | 257 | 26 |
| | 27 | 0106 | 92 | 0116 | 260 | 0102 | 259 | 0041 | 252 | 0112 | 257 | 27 |
| | 28 | 0110 | 93 | 0110 | 260 | 0046 | 257 | 0031 | 251 | 0109 | 258 | 28 |
| | 29 | 0114 | 94 | 0105 | 260 | 0031 | 254 | 0021 | 251 | 0107 | 259 | 29 |
| | 30 | 0119 | 96 | 0100 | 260 | 0016 | 252 | 0012 | 250 | 0104 | 260 | 30 |
| Oct | 1 | 0123 | 97 | 0054 | 261 | 0000 | 250 | 0002 | 249 | 0101 | 261 | 1 |
| | 2 | 0128 | 98 | 0049 | 261 | 0144 | 277 | 0152 | 278 | 0058 | 261 | 2 |
| | 3 | 0132 | 99 | 0043 | 261 | 0128 | 275 | 0142 | 277 | 0055 | 262 | 3 |
| | 4 | 0136 | 100 | 0038 | 261 | 0113 | 273 | 0132 | 276 | 0052 | 263 | 4 |
| | 5 | 0141 | 101 | 0033 | 261 | 0057 | 270 | 0123 | 275 | 0050 | 264 | 5 |
| | 6 | 0002 | 77 | 0027 | 262 | 0042 | 268 | 0113 | 274 | 0047 | 265 | 6 |
| | 7 | 0006 | 78 | 0022 | 262 | 0027 | 266 | 0103 | 273 | 0044 | 266 | 7 |
| | 8 | 0011 | 79 | 0017 | 262 | 0011 | 263 | 0054 | 273 | 0041 | 266 | 8 |
| | 9 | 0015 | 80 | 0011 | 262 | 0155 | 291 | 0044 | 272 | 0038 | 267 | 9 |
| | 10 | 0020 | 81 | 0006 | 262 | 0139 | 288 | 0034 | 271 | 0036 | 268 | 10 |
| | 11 | 0024 | 83 | 0001 | 263 | 0124 | 286 | 0025 | 270 | 0033 | 269 | 11 |
| | 12 | 0028 | 84 | 0155 | 293 | 0108 | 284 | 0015 | 269 | 0030 | 270 | 12 |
| | 13 | 0033 | 85 | 0150 | 293 | 0053 | 281 | 0006 | 268 | 0027 | 270 | 13 |
| | 14 | 0037 | 86 | 0144 | 293 | 0038 | 279 | 0155 | 297 | 0024 | 271 | 14 |
| | 15 | 0042 | 87 | 0139 | 293 | 0022 | 277 | 0145 | 296 | 0021 | 272 | 15 |

## ISKRA II

By the time you read this, the ISKRA II satellite placed into orbit by cosmonauts aboard the Salyut VII space station probably will have reentered the atmosphere and met its fiery fate. The projected lifetime of ISKRA II was only six weeks from the time of its launch on May 17.

ISKRA II was unique in being the first amateur satellite to carry an HF-to-HF transponder. It received signals on 15 meters and retransmitted them on 10 meters.

## FUN WITH RS TELEMETRY

With rare exceptions, a satellite orbiting the Earth is beyond the reach of direct human observation. We can't see it, except perhaps as a bright dot in the night sky. If it misbehaves, we can't put it on the test bench to determine what ails it. In fact, the only way we have any idea of the condition of an orbiting satellite is by means of the telemetry data it constantly beams to Earth.

In the excitement over the communications opportunities offered by the six RS satellites launched last December by the Soviet Union, the interesting telemetry beacons of these spacecraft have largely been overlooked. Monitoring these beacons can be an interesting activity that does not require any special equipment. You need only the ability to receive signals at the high end of the 10-meter band.

The RS satellites send their telemetry in Morse code at 15-25 words per minute on the beacon frequencies shown in Table 1. Each frame of telemetry consists of seven items of information, and consecutive frames are separated by the name of the satellite. Thus, a telemetry frame from RS3 might read: RS3 K00 D12 O72 G00 U21 S79 W90. The letter prefix designates the parameter being measured, while the two-digit number represents the measured value. Often, the number must be inserted into a simple equation to translate the measurement into standard units.

A given satellite may send up to 28 different telemetry items, organized into 4 frames, before it repeats the entire sequence. Most items have a two- instead of one-letter prefix ahead of the number. Two-letter items with the same first letter are always sent as part of the same frame.

Table 2 contains a list of the telemetry prefixes so far monitored from the RS satellites, along with equations and other information.

By interpreting the telemetry data, you can learn a great deal about the environment aboard the RS satellites. It's one way to take an active part in the amateur space program even if you're not equipped for two-way satellite communications. Shortwave listeners can participate, too. Give it a try!

| Satellite | Beacon Frequencies (MHz) |
|---|---|
| RS3 | 29.321, 29.401 |
| RS4 | 29.360, 29.403 |
| RS5 | 29.331, 29.452 |
| RS6 | 29.411, 29.453 |
| RS7 | 29.341, 29.501 |
| RS8 | 29.461, 29.502 |

*Table 1. RS beacon frequencies.*

| Prefix | Interpretation |
|---|---|
| K | 0.2 x N = output power of transponder in mW |
| D | N x 0.2 = voltage of main power source |
| O | 20 x (100 – N) = charge current in mA |
| G | telemetry baseline; should be zero (00) |
| U | gas pressure of sealed system; equation unknown |
| S | N = temp. of voltage regulator (Celsius) |
| W | N = temp. of transmitter cooling fins (Celsius) |
| IK or SK | same as K |
| ID or SD | telemetry baseline; should be zero (00) |
| IO or SO | 0.2 x N = output power of beacon in mW |
| IG or SG | when N = 10 ± 1, a 10-dB attenuator is in line with main receiver front end |
| IU or SU | 0.1 x (N – 10) = S-meter reading of 1st receiver |
| IS or SS | same as above for "robot" receiver |
| IW or SW | same as above for 2nd receiver |
| NK or RK | same as K |
| AK or UK | same as K |
| AD or UD | 0.1 x N = voltage of transponder 9-volt line |
| AO or UO | " = voltage of transponder 7.5-volt line |
| AG or UG | " = voltage at first 9-volt stabilizer |
| AU or UU | " = voltage at first 7.5-volt stabilizer |
| AS or US | " = voltage at second 9-volt stabilizer |
| AW or UW | " = voltage at second 7.5-volt stabilizer |
| MK or WK | same as K |
| MD or WD | N = # of QSOs made by robot (occasionally reset to zero by ground controllers) |
| MO or WO | N x 0.1 = power consumption of heating system in Watts |
| MG or WG | N x 20 = input power of robot transmitter in mW |
| MU or WU | N x 20 = input power of service channel in mW |
| MS or WS | when N = 10 ± 1, a 10-dB attenuator is in line with the robot receiver front end |
| MW or WW | when N = 10 ± 1, a 10-dB attenuator is in line with the service receiver front end |

*Table 2. RS telemetry channel prefixes and their meanings. N is the two-digit number sent after the prefix. Where two prefixes are given, the first is used when the transponder aboard the satellite is inactive; the second is used when the transponder is active. The definitions of other prefixes are not yet known.*

# CORRECTIONS

"Coherent CW for VHF," which appeared in the July, 1982, issue, was based on a paper given at the 27th Annual VHF Conference, Western Michigan University, Kalamazoo MI, on Oct. 17, 1981.

**Tim Daniel N8RK**
***73 Magazine* Staff**

Following the publication of "The Very, Very Best CW Filter?" (*73 Magazine*, July, '82), some builders have written me to tell of oscillation in the output of this filter. This is probably due to an "induced" feedback to the input of the very sensitive op amp used in the circuit.

Rather than rearrange the components, it is easiest to control this oscillation by putting a small amount of positive bias on the input. Connect pin 2 of the LM324 to the positive voltage through a resistor of about 200k Ohms. The exact size of the resistor is best determined by experimentation. If the resistor is too small, the sensitivity of the unit will suffer; if the resistance is too large, some oscillation may remain.

**Jim Hyde WB4TYL**
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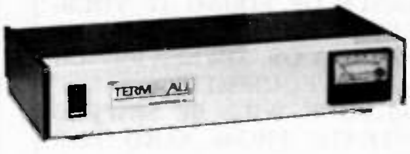


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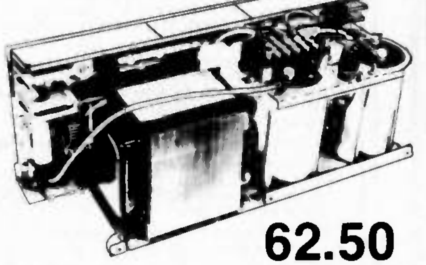

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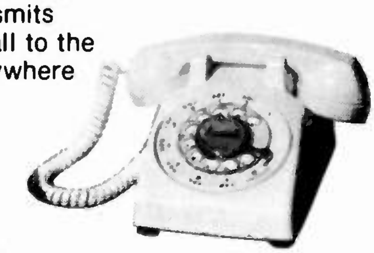

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| 4-400C/6775 | 95.00 | 5675/A | 25.00 | 7843 | 58.00 |
| 4-1000A/8166 | 300.00 | 5721 | 200.00 | 7854 | 83.00 |
| 4B32 | 22.00 | 5768 | 85.00 | 7868 | 5.00 |
| 4E27A/5-125B | 155.00 | 5836 | 100.00 | 7894 | 12.00 |
| 4CS250R | 146.00 | 5837 | 100.00 | 8072 | 65.00 |
| 4X150A/7034 | 30.00 | 5861/EC55 | 110.00 | 8117A | 130.00 |
| 4X150D/7035 | 40.00 | 5876A | 25.00 | 8121 | 60.00 |
| 4X150G/8172 | 100.00 | 5881/6L6W | 6.00 | 8122 | 100.00 |
| 4X250B | 30.00 | 5893 | 45.00 | 8236 | 30.00 |
| 4CX250B/7203 | 45.00 | 5894/A | 50.00 | 8295/PL172 | 506.00 |
| 4CX250F/G/8621 | 55.00 | 5894/B | 60.00 | 8462 | 100.00 |
| 4CX250K/8245 | 100.00 | 5946 | 258.00 | 8505A | 73.50 |
| 4CX250R/7580W | 69.00 | 6080 | 10.00 | 8533W | 92.00 |
| 4CX300A/8167 | 140.00 | 6083/AX9909 | 89.00 | 8560/A | 65.00 |
| 4CX350A/8321 | 83.00 | 6098/6AK6 | 14.00 | 8560AS | 90.00 |
| 4CX350F/J/8904 | 95.00 | 6115/A | 110.00 | 8608 | 34.00 |
| 4X500A | 282.00 | 6146 | 7.00 | 8637 | 38.00 |
| 4CX600J/8809 | 607.00 | 6146A | 7.50 | 8643 | 100.00 |
| 4CW800F | 625.00 | 6146B/8298A | 8.50 | 8647 | 123.00 |
| 4CX1000A/8168 | 340.00 | 6146W | 14.00 | 8737/5894B | 60.00 |
| 4CX1500B/8660 | 397.00 | 6156 | 66.00 | 8873 | 260.00 |
| 4CX5000A/8170 | 932.00 | 6159 | 15.00 | 8874 | 260.00 |
| 4CX10000D/8171 | 990.00 | 6161 | 233.00 | 8875 | 260.00 |
| 4CX15000A/8281 | 1260.00 | 6291 | 125.00 | 8877 | 533.00 |
| 4PR60A | 100.00 | 6293 | 12.00 | 8908 | 12.00 |
| 4PR60B/8252 | 175.00 | 6360 | 5.00 | 8930/651Z | 71.00 |
| 4PR400A/8188 | 192.00 | 6524 | 53.00 | 8950 | 12.00 |
| 5CX1500A | 569.00 | 6550 | 10.00 | | |

| | | | | | |
|---|---|---|---|---|---|
| 6BK4C | 6.00 | 6JM6 | 6.00 | 6LQ6 (Sylvania) | 7.50 |
| 6DQ5 | 5.00 | 6JN6 | 6.00 | 6LU8 | 6.00 |
| 6FW5 | 6.00 | 6JS6B | 6.00 | 6LX6 | 6.00 |
| 6GE5 | 6.00 | 6KG6/EL505 | 6.00 | 6ME6 | 6.00 |
| 6GJ5 | 6.00 | 6KM6 | 6.00 | 12BY7A | 4.00 |
| 6HS5 | 6.00 | 6KN6 | 6.00 | 12JB6A | 6.00 |
| 6JB5/6HE5 | 6.00 | 6LF6 | 6.00 | 6KD6 | 6.00 |
| 6JB6A | 6.00 | 6LQ6 (GE) | 6.00 | 6JT6A | 6.00 |
| | | | | 6KD6 | 6.00 |

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**MHz electronics**

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

| TEKTRONIX OSCILLOSCOPES | PRICE |
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| **MODEL 454A Portable 150 MHz** Dual Trace. | $2000.00 |
| **MODEL 455 Portable 50 MHz** Dual Trace. | $1800.00 |
| **MODEL 475 Portable 200 MHz** Dual Trace. | $2640.00 |
| **MODEL 475A Portable 250 MHz** Dual Trace. | $2940.00 |
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| **MODEL 577D1 Storage Curve Tracer** with a 177 adapter. | $3233.00 |
| **MODEL 577D2 Curve Tracer** with a 177 adapter. | $2796.00 |
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| With a 1A1 Dual Trace. | $ 722.50 |
| With a 1A2 Dual Trace. | $ 637.50 |
| With a 1A4 Quad Trace. | $ 872.50 |
| With a 1A5 Differential. | $ 722.50 |
| With a 1A6 Differential. | $ 612.50 |
| or with 1 of each above. | $1667.50 |
| **MODEL 545 30 MHz Bench Scope** with a CA Dual Trace. | $ 412.50 |
| **MODEL 545A 30 MHz Bench Scope** with a CA Dual Trace. | $ 437.50 |
| **MODEL 544 50 MHz Bench Scope** with a CA Dual Trace. | $ 650.50 |
| **MODEL 543A 33 MHz Bench Scope** with a CA Dual Trace. | $ 475.50 |

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|---|---|
| **MODEL 180A Main Frame.** | $ 675.00 |
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| **MODEL 181A Main Frame.** | $1000.00 |
| **MODEL 182A Main Frame.** | $ 900.00 |
| **MODEL 183A Main Frame.** | $1000.00 |
| **MODEL 180 SERIES PLUG-INS** | |
| 1801A Dual Trace 50 MHz. | $ 495.00 |
| 1803A Differential. | $ 775.00 |
| 1804A Quad Trace 50 MHz | $ 795.00 |
| 1807A Dual Trace 50 MHz | $ 375.00 |
| 1815A TDR/Sampler with a 1816A DC to 4 GHz. | $1500.00 |
| 1821A Time Base & Delay Generator. | $ 495.00 |
| 1822A Time Base & Delay Generator. | $ 525.00 |
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| **DUMONT MODEL 1062** Oscilloscope Dual Trace 65 MHz portable. | $ 750.00 |
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| **MODEL RM565 Dual Beam Oscilloscope** 10 MHz with a 3A6 Dual Trace and a 3A72 Dual Trace. | $1107.50 |
| **MODEL 549 Storage Oscilloscope** Bench 50 MHz with a CA Dual Trace. | $1000.00 |
| **MODEL 647A Oscilloscope** Bench 100 MHz with a 10A2 Dual Trace and a 11B2A Time Base. | $1200.00 |

## ORDERING INSTRUCTIONS

**DEFECTIVE MATERIAL:** All claims for defective material must be made within sixty (60) days after receipt of parcel. All claims must include the defective material (for testing purposes), our invoice number, and the date of purchase. All returns must be packed properly or it will void all warranties.

**DELIVERY:** Orders are normally shipped within 48 hours after receipt of customer's order. If a part has to be backordered the customer is notified. Our normal shipping method is via First Class Mail or UPS depending on size and weight of the package. On test equipment it is by Air only, FOB shipping point.

**FOREIGN ORDERS:** All foreign orders must be prepaid with cashier's check or money order made out in U.S. Funds. We are sorry but C.O.D. is not available to foreign countries and Letters of Credit are not an acceptable form of payment either. Further information is available on request.

**HOURS:** Monday thru Saturday: 8:30 a.m. to 5:00 p.m.

**INSURANCE:** Please include 25¢ for each additional $100.00 over $100.00, United Parcel only.

**ORDER FORMS:** New order forms are included with each order for your convenience. Additional forms are available on request.

**POSTAGE:** Minimum shipping and handling in the US, Canada, and Mexico is $2.50 all other countries is $5.00. On foreign orders include 20% shipping and handling.

**PREPAID ORDERS:** Order must be accompanied by a check.

**PRICES:** Prices are subject to change without notice.

**RESTOCK CHARGE:** If parts are returned to MHZ Electronics due to customer error, customer will be held responsible for all extra fees, will be charged a 15% restocking fee, with the remainder in credit only. All returns must have approval.

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OUR 800 NUMBER IS STRICTLY FOR ORDERS ONLY
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**FAIRCHILD VHF AND UHF PRESCALER CHIPS**

| | | PRICE |
|---|---|---|
| 95H90DC | 350MC Prescaler divide by 10/11 | $ 8.50 |
| 95H91DC | 350MC Prescaler divide by 5/6 | 8.50 |
| 11C90DC | 650MC Prescaler divide by 10/11 | 15.50 |
| 11C91DC | 650MC Prescaler divide by 5/6 | 15.50 |
| 11C06DC | UHF Prescaler 750MC D Type Flip Flop | 12.30 |
| 11C05DC | 1GHz Counter Divide by 4 (Regular price $75.00) | 50.00 |
| 11C01FC | High Speed Dual 5/4 Input NO/NOR Gate | 15.40 |
| 82S90 | Presettable High Speed Decade/Binary Counter used with the 11C90/91 or the 95H90/91 Prescaler can divide by 100. (Signetics) | 5.00 |
| 11C24DC | This chip is the same as a Motorola MC4024/4324 Dual TTL Voltage Control Multivibrator. | 3.37 |
| 11C44DC | This chip is the same as a Motorola MC4044/4344 Phase Frequency Detector. | 3.37 |

**GENERAL ELECTRIC CO. GUNN DIODE MODEL Y-2167**
Freq. Gap (GHZ) 12 to 18, Output (Min.) 100mW, Duty (%) CW, Typ. Bias (Vdc) 8.0, Type. Oper. (MAdc) 550, Max. Thres. (mAdc) 1000, Max. Bias (Vdc) 10.0. **$39.99**

**VARIAN GALLIUM ARSENIDE GUNN DIODES MODEL VSX-9201S5**
Freq. Coverage 8 to 12.4GHz, Output (Min.) 100mW, Bias Voltage (Max.) 14vdc, Bias current (mAdc) Operating 550 Typ. 750 Max., Threshold 850 Tup. 1000 Max. **$39.99**

**VARI-L Co. Inc. MODEL SS-43 AM MODULATOR**
Freq. Range 60 10 150MC, Insertion Loss 13dB Nominal, Signal Port Imp. 50ohms Nominal, Signal Port RF Power +10dBm Max., Modulation Port BW DC to 1KHZ, Modulation Port Bias 1ma. Nominal. **$24.99**

**AVANTEK CASCADABLE MODULAR AMPLIFIERS**

| | Model UTO-504 | UTO-511 |
|---|---|---|
| Frequency Range | 5 to 500 MHz | 5 to 500 MHz |
| Gain | 6dB | 15dB |
| Noise Figure | 11dB | 2.3dB to 3dB |
| Power Output | +17dB | −2dB to −3dB |
| Gain Flatness | 1dB | 1dB |
| Input Power Vdc | +24 | +15 |
| mA | 100 | 10 |
| | PRICE $70.00 | PRICE $75.00 |

**HEWLETT PACKARD MIXERS MODELS**

| | 10514A | 10514B |
|---|---|---|
| Frequency Range | 2MHz to 500MC | 2MHz to 500MC |
| Input/Output Frequency L & R | 200KHz to 500MC | 200KHz to 500MC |
| X | DC to 500MC | DC to 500MC |
| Mixer Conversion Loss (A) | 7dB | 7dB |
| (B) | 9dB | 9dB |
| Noise Performance (SSB) (A) | 7dB | 7dB |
| (B) | 9dB | 9dB |
| PRICE | $49.99 | PRICE $39.99 |

**FREQUENCY SOURCES, INC MODEL MS-74X MICROWAVE SIGNAL SOURCE**
MS-74X: Mechanically Tunable Frequency Range (MHz) 10630 to 11230 (10.63 to 11.23GHz) Minimum Output Power (mW) 10, Overall Multiplier Ratio 108, Internal Crystal Oscillator Frequency Range (MHz) 98.4 to 104.0, Maximum Input Current (mA) 400.

The signal source are designed for applications where high stability and low noise are of prime concern. these sources utilize fundamental transistor oscillators with high Q coaxial cavities, followed by broadband stable step recovery diode multipliers. This design allows single screw mechanical adjustment of frequency over standard communications bands. Broadband sampling circuits are used to phase lock the oscillator to a high stability reference which may be either an internal self-contained crystal oscillator, external primary standard or VHF synthesizer. This unique technique allows for optimization of both FM noise and long term stability. List Price is $1158.00 (THESE ARE NEW) **Our Price—$289.**

**HEWLETT PACKARD 1N5712 MICROWAVE DIODE**
This diode will replace the MBD101, 1N5711, 5082-2800, 5082-2835 ect. This will work like a champ in all those Down Converter projects. **$1.50 or 10/$10.00**

**MOTOROLA MHW1172R LOW DISTORTION WIDEBAND AMPLIFIER MODULE.**
Frequency Range: 40 to 300 MHz., Power Gain at 50MHz 16.6min. to 17.4max., Gain Flatness ±0.1 Typ. ±0.2 Max. dB., DC Supply Voltage −28vdc, RF Voltage Input +70dBmV **PRICE $29.99**

**GENERAL ELECTRIC AA NICADS**
Model #41B905HD11-G1
Pack of 6 for $5.00 or 60 Cells, 10 Packs for $45.00
These may be broken down to individual cells.

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**CREDIT CARDS:** **WE ACCEPT MASTERCARD VISA AND AMERICAN EXPRESS.**

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✓See List of Advertisers on page 114

# 7400

**Number of Pins of each I.C. for easy Socket purchase

| Part No. | **Pins | Price |
|---|---|---|
| SN7400N | 14 | .19 |
| SN7401N | 14 | .19 |
| SN7402N | 14 | .25 |
| SN7403N | 14 | .25 |
| SN7404N | 14 | .25 |
| SN7405N | 14 | .25 |
| SN7406N | 14 | .29 |
| SN7407N | 14 | .29 |
| SN7408N | 14 | .25 |
| SN7409N | 14 | .25 |
| SN7410N | 14 | .25 |
| SN7411N | 14 | .25 |
| SN7412N | 14 | .35 |
| SN7413N | 14 | .35 |
| SN7414N | 14 | .49 |
| SN7416N | 14 | .25 |
| SN7417N | 14 | .25 |
| SN7420N | 14 | .19 |
| SN7421N | 14 | .35 |
| SN7422N | 14 | .45 |
| SN7423N | 16 | .59 |
| SN7425N | 14 | .29 |
| SN7426N | 14 | .29 |
| SN7427N | 14 | .25 |
| SN7428N | 14 | .49 |
| SN7430N | 14 | .25 |
| SN7432N | 14 | .29 |
| SN7437N | 14 | .25 |
| SN7438N | 14 | .29 |
| SN7439N | 14 | .59 |
| SN7440N | 14 | .19 |
| SN7441N | 16 | .89 |
| SN7442N | 16 | .45 |
| SN7443N | 16 | .99 |
| SN7444N | 16 | .99 |
| SN7445N | 16 | .89 |
| SN7446N | 16 | .69 |
| SN7447N | 16 | .69 |
| SN7448N | 16 | .69 |
| SN7450N | 14 | .19 |
| SN7451N | 14 | .19 |
| SN7453N | 14 | .19 |
| SN7454N | 14 | .19 |
| SN7459A | 14 | .25 |
| SN7460N | 14 | .19 |
| SN7470N | 14 | .29 |

| Part No. | **Pins | Price |
|---|---|---|
| SN7472N | 14 | .29 |
| SN7473N | 14 | .35 |
| SN7474N | 14 | .35 |
| SN7475N | 16 | .45 |
| SN7476N | 16 | .35 |
| SN7479N | 14 | 4.95 |
| SN7480N | 14 | .69 |
| SN7482N | 14 | 1.19 |
| SN7483N | 16 | .59 |
| SN7485N | 16 | .59 |
| SN7486N | 14 | .35 |
| SN7489N | 16 | 2.25 |
| SN7490N | 14 | .39 |
| SN7491N | 14 | .59 |
| SN7492N | 14 | .39 |
| SN7493N | 14 | .39 |
| SN7494N | 14 | .69 |
| SN7495N | 14 | .49 |
| SN7496N | 16 | .49 |
| SN7497N | 16 | 2.75 |
| SN74100N | 24 | 1.49 |
| SN74104N | 14 | .89 |
| SN74105N | 14 | .89 |
| SN74107N | 14 | .29 |
| SN74109N | 16 | .39 |
| SN74116N | 24 | 1.49 |
| SN74121N | 14 | .39 |
| SN74122N | 14 | .55 |
| SN74123N | 16 | .49 |
| SN74125N | 14 | .45 |
| SN74126N | 14 | .45 |
| SN74132N | 14 | .49 |
| SN74136N | 14 | .69 |
| SN74141N | 16 | .69 |
| SN74142N | 16 | 2.95 |
| SN74143N | 24 | 2.95 |
| SN74144N | 24 | 2.95 |
| SN74145N | 16 | .59 |
| SN74147N | 16 | 1.49 |
| SN74148N | 16 | 1.19 |
| SN74150N | 24 | 1.19 |
| SN74151N | 16 | .59 |
| SN74152N | 14 | .59 |
| SN74153N | 16 | .59 |
| SN74154N | 24 | 1.25 |
| SN74155N | 16 | .59 |

| Part No. | **Pins | Price |
|---|---|---|
| SN74156N | 16 | .59 |
| SN74157N | 16 | .59 |
| SN74160N | 16 | .69 |
| SN74161N | 16 | .69 |
| SN74162N | 16 | .69 |
| SN74163N | 16 | .69 |
| SN74164N | 14 | .69 |
| SN74165N | 16 | .69 |
| SN74166N | 16 | .89 |
| SN74167N | 16 | 2.79 |
| SN74170N | 16 | 1.29 |
| SN74172N | 24 | 4.95 |
| SN74173N | 16 | .69 |
| SN74174N | 16 | .69 |
| SN74175N | 16 | .69 |
| SN74176N | 14 | .69 |
| SN74177N | 14 | .69 |
| SN74179N | 16 | 1.49 |
| SN74180N | 14 | .69 |
| SN74181N | 24 | 1.95 |
| SN74182N | 16 | .89 |
| SN74184N | 16 | 1.95 |
| SN74185N | 16 | 1.95 |
| SN74190N | 16 | .69 |
| SN74191N | 16 | .69 |
| SN74192N | 16 | .69 |
| SN74193N | 16 | .69 |
| SN74194N | 16 | .69 |
| SN74195N | 16 | .69 |
| SN74196N | 14 | .89 |
| SN74197N | 14 | .89 |
| SN74198N | 24 | 1.19 |
| SN74199N | 24 | 1.19 |
| SN74221N | 16 | 1.19 |
| SN74251N | 16 | .79 |
| SN74276N | 20 | 1.95 |
| SN74279N | 16 | .79 |
| SN74283N | 16 | 1.49 |
| SN74284N | 16 | 2.95 |
| SN74285N | 16 | 2.95 |
| SN74365N | 16 | .55 |
| SN74366N | 16 | .55 |
| SN74367N | 16 | .55 |
| SN74368N | 16 | .55 |
| SN74390N | 16 | 1.49 |
| SN74393N | 14 | 1.49 |

## 74LS

| Part No. | **Pins | Price |
|---|---|---|
| 74LS00 | 14 | .25 |
| 74LS01 | 14 | .25 |
| 74LS02 | 14 | .25 |
| 74LS03 | 14 | .25 |
| 74LS04 | 14 | .29 |
| 74LS05 | 14 | .29 |
| 74LS08 | 14 | .29 |
| 74LS09 | 14 | .29 |
| 74LS10 | 14 | .29 |
| 74LS11 | 14 | .35 |
| 74LS12 | 14 | .35 |
| 74LS13 | 14 | .39 |
| 74LS14 | 14 | .59 |
| 74LS15 | 14 | .35 |
| 74LS20 | 14 | .29 |
| 74LS21 | 14 | .29 |
| 74LS22 | 14 | .29 |
| 74LS26 | 14 | .29 |
| 74LS27 | 14 | .29 |
| 74LS28 | 14 | .35 |
| 74LS30 | 14 | .29 |
| 74LS32 | 14 | .35 |
| 74LS33 | 14 | .55 |
| 74LS37 | 14 | .35 |
| 74LS38 | 14 | .35 |
| 74LS40 | 14 | .29 |
| 74LS42 | 16 | .55 |
| 74LS47 | 16 | .75 |
| 74LS48 | 16 | .75 |
| 74LS49 | 16 | .75 |
| 74LS51 | 14 | .25 |
| 74LS54 | 14 | .29 |
| 74LS55 | 14 | .29 |
| 74LS73 | 14 | .39 |
| 74LS74 | 14 | .39 |
| 74LS75 | 16 | .39 |
| 74LS76 | 16 | .39 |
| 74LS78 | 14 | .39 |
| 74LS83 | 16 | .65 |
| 74LS85 | 16 | .69 |
| 74LS86 | 14 | .39 |
| 74LS90 | 14 | .55 |

| Part No. | **Pins | Price |
|---|---|---|
| 74LS92 | 14 | .55 |
| 74LS93 | 14 | .55 |
| 74LS95 | 14 | .79 |
| 74LS96 | 16 | .89 |
| 74LS107 | 14 | .39 |
| 74LS109 | 16 | .39 |
| 74LS112 | 16 | .39 |
| 74LS113 | 14 | .39 |
| 74LS114 | 14 | .39 |
| 74LS122 | 14 | .49 |
| 74LS123 | 16 | .79 |
| 74LS125 | 14 | .49 |
| 74LS126 | 14 | .49 |
| 74LS132 | 14 | .59 |
| 74LS133 | 16 | .59 |
| 74LS136 | 14 | .39 |
| 74LS138 | 16 | .59 |
| 74LS139 | 16 | .59 |
| 74LS151 | 16 | .59 |
| 74LS153 | 16 | .59 |
| 74LS154 | 24 | .99 |
| 74LS155 | 16 | .69 |
| 74LS156 | 16 | .69 |
| 74LS157 | 16 | .69 |
| 74LS158 | 16 | .59 |
| 74LS160 | 16 | .69 |
| 74LS161 | 16 | .69 |
| 74LS162 | 16 | .69 |
| 74LS163 | 16 | .69 |
| 74LS164 | 14 | .69 |
| 74LS165 | 16 | 1.19 |
| 74LS168 | 16 | 1.19 |
| 74LS169 | 16 | 1.19 |
| 74LS170 | 16 | 1.49 |
| 74LS173 | 16 | .69 |
| 74LS174 | 16 | .59 |
| 74LS175 | 16 | .59 |
| 74LS181 | 24 | 2.49 |
| 74LS190 | 16 | .89 |
| 74LS191 | 16 | .89 |

| Part No. | **Pins | Price |
|---|---|---|
| 74LS192 | 16 | .79 |
| 74LS193 | 16 | .79 |
| 74LS194 | 16 | .69 |
| 74LS195 | 16 | .69 |
| 74LS197 | 14 | .79 |
| 74LS221 | 16 | .89 |
| 74LS240 | 20 | 1.09 |
| 74LS241 | 20 | 1.09 |
| 74LS242 | 14 | 1.09 |
| 74LS243 | 14 | 1.09 |
| 74LS244 | 20 | 1.09 |
| 74LS245 | 20 | 1.49 |
| 74LS247 | 16 | 1.09 |
| 74LS248 | 16 | 1.09 |
| 74LS249 | 16 | 1.09 |
| 74LS251 | 16 | .59 |
| 74LS253 | 16 | .59 |
| 74LS257 | 16 | .59 |
| 74LS258 | 16 | .59 |
| 74LS260 | 14 | .59 |
| 74LS266 | 14 | .69 |
| 74LS273 | 20 | 1.49 |
| 74LS279 | 16 | .49 |
| 74LS283 | 16 | .69 |
| 74LS290 | 14 | .89 |
| 74LS293 | 14 | .89 |
| 74LS298 | 16 | .89 |
| 74LS352 | 16 | 1.29 |
| 74LS353 | 16 | 1.29 |
| 74LS365 | 16 | .49 |
| 74LS366 | 16 | .49 |
| 74LS367 | 16 | .49 |
| 74LS368 | 16 | .49 |
| 74LS373 | 20 | 1.29 |
| 74LS374 | 20 | 1.29 |
| 74LS375 | 16 | .69 |
| 74LS386 | 14 | .45 |
| 74LS393 | 14 | 1.19 |
| 74LS399 | 16 | 1.49 |
| 74LS670 | 16 | 1.49 |
| 81LS95 | 20 | 1.49 |
| 81LS97 | 20 | 1.49 |

## 74S/PROMS*

| Part No. | **Pins | Price |
|---|---|---|
| 74S00 | 14 | .35 |
| 74S02 | 14 | .35 |
| 74S03 | 14 | .35 |
| 74S04 | 14 | .45 |
| 74S05 | 14 | .45 |
| 74S08 | 14 | .39 |
| 74S09 | 14 | .39 |
| 74S10 | 14 | .35 |
| 74S11 | 14 | .35 |
| 74S15 | 14 | .35 |
| 74S20 | 14 | .35 |
| 74S22 | 14 | .35 |
| 74S30 | 14 | .35 |
| 74S32 | 14 | .45 |
| 74S38 | 14 | .89 |
| 74S40 | 14 | .39 |
| 74S51 | 14 | .35 |
| 74S64 | 14 | .39 |
| 74S65 | 14 | .39 |
| 74S74 | 14 | .55 |
| 74S86 | 14 | .55 |
| 74S112 | 16 | .55 |
| 74S113 | 16 | .55 |
| 74S114 | 14 | .55 |

| Part No. | **Pins | Price |
|---|---|---|
| 74S124 | 16 | 2.95 |
| 74S133 | 16 | .45 |
| 74S134 | 16 | .50 |
| 74S135 | 14 | .89 |
| 74S136 | 14 | 1.39 |
| 74S138 | 16 | .89 |
| 74S139 | 16 | .89 |
| 74S140 | 14 | .55 |
| 74S151 | 16 | .99 |
| 74S153 | 16 | .99 |
| 74S157 | 16 | .99 |
| 74S158 | 16 | .99 |
| 74S160 | 16 | 2.49 |
| 74S174 | 16 | .99 |
| 74S175 | 16 | .99 |
| 74S188* | 16 | 1.49 |
| 74S194 | 16 | 1.49 |
| 74S195 | 16 | 1.49 |
| 74S196 | 14 | 1.49 |
| 74S240 | 20 | 2.25 |
| 74S241 | 20 | 2.25 |
| 74S242 | 14 | 2.49 |

| Part No. | **Pins | Price |
|---|---|---|
| 74S243 | 14 | 2.49 |
| 74S244 | 20 | 2.49 |
| 74S251 | 16 | 1.19 |
| 74S253 | 16 | 1.19 |
| 74S257 | 16 | 1.19 |
| 74S258 | 16 | 1.19 |
| 74S260 | 14 | .79 |
| 74S280 | 14 | 1.95 |
| 74S287* | 16 | 1.95 |
| 74S288* | 16 | 1.95 |
| 74S373 | 20 | 2.49 |
| 74S374 | 20 | 2.49 |
| 74S387* | 16 | 1.95 |
| 74S471* | 20 | 5.95 |
| 74S472* | 20 | 4.95 |
| 74S473* | 20 | 4.95 |
| 74S474* | 24 | 4.95 |
| 74S475* | 24 | 4.95 |
| 74S570* | 16 | 2.95 |
| 74S571* | 16 | 2.95 |
| 74S572* | 18 | 4.95 |
| 74S573* | 18 | 4.95 |
| 74S940 | 20 | 2.49 |
| 74S941 | 20 | 2.49 |

## CA—LINEAR

| Part No. | **Pins | Price |
|---|---|---|
| CA3010H | | .99 |
| CA3013H | | 2.15 |
| CA3023H | | 3.25 |
| CA3035H | | 5.95 |
| CA3039H | | 1.35 |
| CA3046N | 14 | .89 |
| CA3059N | 14 | 3.25 |
| CA3060N | 16 | 3.25 |
| CA3080H | | 1.25 |
| CA3081N | 16 | 1.49 |
| CA3082N | 16 | 1.49 |
| CA3083N | 16 | 1.49 |
| CA3086N | 14 | .69 |
| CA3089N | 16 | 1.69 |
| CA3096N | 16 | 1.19 |
| CA3130H | | 1.95 |
| CA3140H | | 1.49 |
| CA3160H | | 1.95 |
| CA3401N | 14 | .59 |
| CA3600N | 14 | 3.95 |

## CD—CMOS

| Part No. | **Pins | Price |
|---|---|---|
| CD4000 | 14 | .29 |
| CD4001 | 14 | .29 |
| CD4002 | 14 | .29 |
| CD4006 | 14 | .89 |
| CD4007 | 14 | .29 |
| CD4009 | 16 | .39 |
| CD4010 | 16 | .39 |
| CD4011 | 14 | .29 |
| CD4012 | 14 | .15 |
| CD4013 | 14 | .39 |
| CD4014 | 16 | .79 |
| CD4015 | 16 | .39 |
| CD4016 | 14 | .39 |
| CD4017 | 16 | .75 |
| CD4018 | 16 | .79 |
| CD4019 | 16 | .39 |
| CD4020 | 16 | .75 |
| CD4021 | 16 | .79 |
| CD4022 | 16 | .79 |
| CD4023 | 14 | .29 |
| CD4024 | 14 | .69 |
| CD4025 | 14 | .23 |
| CD4026 | 16 | 2.49 |
| CD4027 | 16 | .45 |
| CD4028 | 16 | .69 |
| CD4029 | 16 | .79 |
| CD4030 | 14 | .39 |
| CD4034 | 24 | 1.95 |
| CD4035 | 16 | .89 |

| Part No. | **Pins | Price |
|---|---|---|
| CD4040 | 16 | .79 |
| CD4041 | 14 | .79 |
| CD4042 | 16 | .69 |
| CD4043 | 16 | .79 |
| CD4044 | 16 | .79 |
| CD4046 | 16 | .89 |
| CD4047 | 14 | .89 |
| CD4048 | 16 | .39 |
| CD4049 | 16 | .39 |
| CD4050 | 16 | .39 |
| CD4051 | 16 | .79 |
| CD4052 | 16 | .79 |
| CD4053 | 16 | .79 |
| CD4056 | 16 | 2.95 |
| CD4059 | 24 | 7.95 |
| CD4060 | 16 | .89 |
| CD4066 | 14 | .39 |
| CD4068 | 14 | .39 |
| CD4069 | 14 | .29 |
| CD4070 | 14 | .39 |
| CD4071 | 14 | .29 |
| CD4072 | 14 | .29 |
| CD4073 | 14 | .29 |
| CD4075 | 14 | .29 |
| CD4076 | 16 | .79 |
| CD4078 | 14 | .49 |
| CD4081 | 14 | .29 |
| CD4082 | 14 | .29 |
| CD4093 | 14 | .49 |

| Part No. | **Pins | Price |
|---|---|---|
| CD4098 | 16 | 1.95 |
| CD4506 | 16 | 1.19 |
| CD4507 | 14 | .39 |
| CD4508 | 24 | 3.95 |
| CD4510 | 16 | .89 |
| CD4511 | 16 | .89 |
| CD4512 | 16 | .89 |
| CD4514 | 24 | 1.79 |
| CD4515 | 24 | 1.79 |
| CD4516 | 16 | .99 |
| CD4518 | 16 | .99 |
| CD4519 | 16 | .39 |
| CD4520 | 16 | .79 |
| CD4526 | 16 | 1.19 |
| CD4528 | 16 | 1.19 |
| CD4529 | 16 | 1.19 |
| CD4543 | 16 | 1.19 |
| CD4562 | 14 | 6.95 |
| CD4566 | 16 | 1.39 |
| CD4583 | 16 | 2.49 |
| CD4584 | 14 | .75 |
| CD4723 | 16 | 1.19 |
| CD4724 | 16 | 1.19 |
| MC14409 | 16 | 13.95 |
| MC14410 | 16 | 13.95 |
| MC14411 | 24 | 11.95 |
| MC14412 | 16 | 13.95 |
| MC14419 | 16 | 7.95 |
| MC14433 | 24 | 13.95 |
| MC14538 | 16 | 1.19 |
| MC14541 | 14 | 1.19 |

# MICROPROCESSOR COMPONENTS

## STATIC RAMS

| Part No. | **Pins | | Price |
|---|---|---|---|
| 1101 | 16 | 256x1 (650ns) | 1.49 |
| 2101 | 22 | 256x4 (450ns) 8101 | 2.49 |
| 2102 | 16 | 1024x1 (350ns) | .89 |
| 21L02 | 16 | 1024x1 (450ns) L.P. | 1.49 |
| 2111 | 18 | 256x4 (450ns) 8111 | 2.95 |
| 2112 | 16 | 256x4 (450ns) MOS | 2.95 |
| 2114 | 18 | 1024x4 (450ns) | 2.25 — 8/14.95 |
| 2114L | 18 | 1024x4 (450ns) L.P. | 2.49 — 8/16.95 |
| 2114-2 | 18 | 1024x4 (200ns) | 2.49 — 8/16.95 |
| 2114L-2 | 18 | 1024x4 (200ns) L.P. | 2.95 — 8/19.95 |
| 2141-3 | 18 | 4096x1 (150ns) | 3.95 |
| 2147 | 18 | 4096x1 (70ns) | 4.95 |
| 2148 | 18 | 1024x4 (70ns) | 8.95 |
| TMS4044 | 18 | 4096x1 (450ns) | 3.95 |
| TMS4045 | 18 | 1024x4 (450ns) | 3.95 |
| 5101 | 22 | 256x4 (450ns) CMOS | 4.95 |
| MM5257 | 18 | 4096x1 (450ns) 4044 | 4.95 |
| HM6116-4 | 24 | 2048x8 (200ns) CMOS | 7.95 |
| HM6116LP-4 | 24 | 2048x8 (200ns) L.P. CMOS | 8.95 |
| 7489 | 16 | 16x4 (50ns) 3101 | 2.25 |
| 74C920 | 22 | 256x4 (250ns) CMOS (6551) | 3.95 |
| 74C921 | 18 | 256x4 (250ns) CMOS | 3.95 |
| 74C929 | 16 | 1024x1 (250ns) CMOS (6501) | 3.95 |
| 74C930 | 16 | 1024x1 (250ns) CMOS (6518) | 3.95 |
| 74S189 | 16 | 16x4 (35ns) 93405 | 1.95 |
| 74S200 | 16 | 256x1 (80ns) 93410 | 3.95 |
| 74S206 | 16 | 256x1 (60ns) 93411 | 3.95 |
| 74S289 | 16 | 16x4 (35ns) 3101 | 2.25 |
| 82S10 | 16 | 1024x1 (50ns) O.C. (93415) | 3.95 |
| 82S25 | 16 | 16x4 (50ns) O.C. (74S289) | 2.25 |

## EPROMS

| Part No. | **Pins | | Price |
|---|---|---|---|
| 1702A | 24 | 256x8 (1us) | 4.95 |
| 2708 | 24 | 1024x8 (450ns) | 3.95 |
| 2708-5 | 24 | 1024x8 (550ns) SM00246 | 2.95 |
| TMS2516 | 24 | 2048x8 (450ns) 2716 | 6.95 |
| TMS2532 | 24 | 4096x8 (450ns) NMC2532 | 9.95 |
| TMS2564 | 28 | 8192x8 (450ns) | 29.95 |
| TMS2716 | 24 | 2048x8 (450ns) 3 voltage | 7.95 |
| 2716 | 24 | 2048x8 (450ns) | 5.95 |
| 2732 | 24 | 4096x8 (450ns) | 9.95 |
| 27580 | 24 | 1024x8 (450ns) single +5V | 2.95 |
| MM2764 | 28 | 8192x8 (450ns) | 29.95 |

## MICROPROCESSOR CHIPS

| Part No. | **Pins | | Price |
|---|---|---|---|
| Z80 (780C) | 40 | CPU (MK3880N) (2MHz) | 5.95 |
| Z80A (780-1) | 40 | CPU (MK3880N-4) (4MHz) | 6.95 |
| CDP1802 | 40 | CPU | 9.95 |
| 2650 | 40 | MPU | 14.95 |
| IDM2901ADC | 40 | CPU—4-bit slice (Com. Temp. Gr.) | 19.95 |
| MCS6502 | 40 | MPU w/Clock (65K bytes mem.) | 9.95 |
| INS8035N-6 | 40 | MPU—8-bit (6MHz) | 5.95 |
| INS8039N-6 | 40 | CPU-Sgl. chip 8-bit (128 bts. Ram) | 6.95 |
| INS8040N-6 | 40 | CPU (256 bytes RAM) | 14.95 |
| INS8070N | 40 | CPU (64 bytes RAM) | 19.95 |
| INS8073N | 40 | CPU w/Basic Micro Interpreter | 24.95 |
| P8085 | 40 | CPU | 5.95 |
| TMS9900JL | 64 | MPU — 16-bit | 39.95 |

## MICROPROCESSOR MANUALS

| Part No. | | Price |
|---|---|---|
| M-Z80 | User Manual | 7.50 |
| M-CDP1802 | User Manual | 7.50 |
| M-2650 | User Manual | 5.00 |

## 6800/6800 SUPPORT DEVICES

| Part No. | **Pins | | Price |
|---|---|---|---|
| MC6800 | 40 | MPU | 4.95 |
| MC6802CP | 40 | MPU with clock and RAM | 7.95 |
| MC6810APl | 24 | 128x8 Static RAM | 3.95 |
| MC6821 | 40 | Peripheral Inter. Adapt (MC6820) | 4.95 |
| MC6828 | 24 | Priority Interrupt Controller | 15.95 |
| MC6830L8 | 24 | 1024x8-bit ROM (MC68A30-8) | 10.95 |
| MC6850 | 24 | Asynchronous Comm. Adapter | 4.95 |
| MC6852 | 24 | Synchronous Serial Data Adapter | 5.75 |
| MC6860 | 24 | 0-600bps Digital MODEM | 9.95 |
| MC6862 | 24 | 2400bps Modulator | 12.95 |
| MC6880A | 16 | Quad 3-state bus. trans. (MC8T26) | 2.25 |

## 8080/8080A SUPPORT DEVICES

| Part No. | **Pins | | Price |
|---|---|---|---|
| INS8080A | 40 | CPU | 3.95 |
| DP8212 | 24 | 8-bit Input/Output | 2.25 |
| DP8214 | 24 | Priority Interrupt Control | 3.95 |
| DP8216 | 16 | Bi-Directional Bus Driver | 2.25 |
| DP8224 | 16 | Clock Generator/Driver | 2.25 |
| DP8226 | 16 | Bus Driver | 2.25 |
| DP8228 | 28 | System Controller/Bus Driver | 3.49 |
| DP8238 | 28 | System Controller | 4.49 |
| INS8243 | 24 | I/O Expander for 48 Series | 5.95 |
| INS8250 | 40 | Asynchronous Comm. Element | 10.95 |
| DP8251 | 28 | Prog. Comm. I/O (USART) | 4.49 |
| DP8253 | 24 | Prog. Interval Timer | 6.95 |
| DP8255 | 40 | Prog. Peripheral I/O (PPI) | 4.49 |
| DP8257 | 40 | Prog. DMA Control | 7.95 |
| DP8259 | 28 | Prog. Interrupt Control | 6.95 |
| DP8275 | 40 | Prog. CRT Controller | 29.95 |
| DP8279 | 40 | Prog. Keyboard/Display Interface | 8.95 |
| DP8303 | 20 | System Timing Element | 3.95 |
| DP8304 | 20 | 8-bit Bi-Directional Receiver | 2.49 |
| DP8307 | 20 | 8-bit Bi-Directional Receiver | 2.49 |
| DP8308 | 20 | 8-bit Bi-Directional Receiver | 2.49 |
| DP8310 | 20 | Octal Latched Peripheral Driver | 4.95 |
| DP8311 | 20 | Octal Latched Peripheral Driver | 4.95 |

## DYNAMIC RAMS

| Part No. | **Pins | | Price |
|---|---|---|---|
| 1103 | 18 | 1024x1 (300ns) | .99 |
| 4027 | 16 | 4096x1 (250ns) | 2.49 |
| 4116N-2 | 16 | 16,384x1 (150ns) | 2.25 — 8/16.95 |
| 4116N-3 | 16 | 16,384x1 (200ns) | 1.95 — 8/14.95 |
| 4116N-4 | 16 | 16,384x1 (250ns) | 1.49 — 8/10.95 |
| 4164N-2 | 16 | 65,536x1 (200ns) | 9.95 |
| MM5261 | 18 | 1024x1 (300ns) | .49 — 8/1.95 |
| MM5262 | 22 | 2048x1 (365ns) | .49 — 8/1.95 |
| MM5270 | 18 | 4096x1 (250ns) MK4096 | 2.95 |
| MM5280 | 22 | 4096x1 (200ns) 2107 | 3.95 |
| MM5290-2 | 16 | 16,384x1 (150ns) | 2.25 — 8/16.95 |
| MM5290-3 | 16 | 16,384x1 (200ns) | 1.95 — 8/14.95 |
| MM5290-4 | 16 | 16,384x1 (250ns) | 1.49 — 8/10.95 |
| MM5298-3 | 16 | 8192x1 (200ns) | 1.69 |

## PROMS

| Part No. | **Pins | | Price |
|---|---|---|---|
| 74S188 | 16 | 32x8 PROM O.C. (6330-1) | 1.49 |
| 74S287 | 16 | 256x4 PROM T.S. (6301-1) | 1.95 |
| 74S288 | 16 | 32x8 PROM T.S. (6331-1) | 1.95 |
| 74S387 | 16 | 256x4 PROM O.C. (6300-1) | 1.95 |
| 74S471 | 20 | 256x8 PROM T.S. (6309-1) | 5.95 |
| 74S472 | 20 | 512x8 PROM T.S. (6349-1) | 4.95 |
| 74S473 | 20 | 512x8 PROM O.C. (6348) | 4.95 |
| 74S474 | 24 | 512x8 PROM T.S. (DM87S296N) | 4.95 |
| 74S475 | 24 | 512x8 PROM O.C. (6340) | 4.95 |
| 74S478 | 24 | 1024x8 PROM T.S. (TBP28S86) | 8.95 |
| 74S570 | 16 | 512x4 PROM O.C. (6305) | 2.95 |
| 74S571 | 16 | 512x4 PROM T.S. (6306) | 2.95 |
| 74S572 | 18 | 1024x4 PROM O.C. (6352) | 4.95 |
| 74S573 | 18 | 1024x4 PROM T.S. (82S137) | 4.95 |
| 82S23 | 16 | 32x8 PROM O.C. (27S18) | 2.95 |
| 82S115 | 24 | 512x8 PROM T.S. (27S15) | 9.95 |
| 82S123 | 16 | 32x8 PROM T.S. (27S19) | 2.95 |
| 82S126 | 16 | 256x4 PROM O.C. (27S20) | 3.95 |
| 82S129 | 16 | 256x4 PROM T.S. (27S21) | 3.95 |
| 82S130 | 16 | 512x4 PROM O.C. (27S12) | 5.95 |
| 82S185 | 18 | 2048x4 PROM T.S. (TBP24S81) | 9.95 |
| DM87S180N | 24 | 1024x8 PROM O.C. (82S180) | 9.95 |
| DM87S181N | 24 | 1024x8 PROM T.S. (82S181) | 9.95 |
| DM87S184N | 18 | 2048x4 PROM O.C. (82S184) | 9.95 |
| DM87S185N | 18 | 2048x4 PROM T.S. (82S185) | 9.95 |
| DM87S190N | 24 | 2048x4 PROM O.C. (82S190) | 19.95 |
| DM87S191N | 24 | 2048x8 PROM T.S. (82S191) | 19.95 |

## ROM'S

| Part No. | **Pins | | Price |
|---|---|---|---|
| 2513 (2140) | 24 | Character Generator (Upper Case) | 9.95 |
| 2513 (3021) | 24 | Character Generator (Lower Case) | 9.95 |

## NMOS READ ONLY MEMORIES

| Part No. | **Pins | | Price |
|---|---|---|---|
| MCM66710P | 24 | 128x9x7 ASCII Shifted w/Greek | 13.50 |
| MCM66740P | 24 | 128x9x7 Math Symbol & Pictures | 13.50 |
| MCM66750P | 24 | 128x9x7 Alpha. Control Char. Gen. | 13.50 |

## DATA ACQUISITION

| Part No. | **Pins | | Price |
|---|---|---|---|
| DC10 | | Mostek DC/DC Convert. +5V to -9V | 2.95 |
| MC3470P | 18 | Floppy Disk Read AMP System | 4.95 |
| MC1408L7 | 16 | 7-bit D/A Converter (DAC0807LCN) | 2.49 |
| MC1408L8 | 16 | 8-bit D/A Converter (DAC0808LCN) | 2.95 |
| AF100-1CN | 16 | Universal Active Filter 2.5% | 5.95 |
| AF121-1CJ | 24 | Touch Tone Low Band Filter | 19.95 |
| AF122-1CJ | 24 | Touch Tone High Band Filter | 19.95 |
| LM308CH | | Super Gain Op Amp | 1.15 |
| LM334Z | | Constant Current Source | 1.30 |
| LM335Z | | Temperature Transducer | 1.40 |
| LF356N | 8 | JFET Input Op Amp | 1.10 |
| LF398N | 8 | Sample & Hold Amplifiers | 3.95 |
| LM399H | | Temp Comp. Prec. Ref. (.5ppm/C°) | 5.00 |
| ADC0804 | 20 | 8-bit A/D Converter (1 LSB) | 3.49 |
| DAC0806 | 16 | 8-bit D/A Converter (0.78% Lin.) | 1.95 |
| ADC0809 | 28 | 8-bit A/D Converter (8-Ch. Multi.) | 4.49 |
| ADC0817 | 40 | 8-bit A/D Converter (16-Ch. Multi.) | 9.95 |
| DAC1000 | 24 | 10-bit D/A Conv. Micro. Comp. (0.05%) | 13.95 |
| DAC1008 | 20 | 10-bit D/A Conv. Micro. Comp. (0.20%) | 7.95 |
| DAC1020 | 16 | 10-bit D/A Converter (0.05% Lin.) | 8.49 |
| DAC1022 | 16 | 10-bit D/A Converter (0.20% Lin.) | 5.95 |
| DAC1222 | 18 | 12-bit D/A Converter (0.20% Lin.) | 6.95 |
| CD4051N | 16 | 8 Channel Multiplexer | .79 |
| AY-5-1013 | 40 | 30K BAUD UART | 3.95 |

## SPECIAL FUNCTION

| Part No. | **Pins | | Price |
|---|---|---|---|
| DS0025CN | 8 | Dual MOS Clock Driver (5MZ) | 2.49 |
| DS0026CN | 8 | Dual MOS Clock Driver (5MZ) | 1.95 |
| INS1771N-1 | 40 | Floppy Disk Controller | 16.95 |
| INS2651N | 28 | Communication Chip | 8.95 |
| MM58167N | 24 | Microprocessor Real Time Clock | 8.95 |
| MM58174N | 16 | Micro. Compatible Time Clock | 7.95 |
| COP402N | 40 | Microcontroller w/64 digit RAM and Direct LED Drive | 5.95 |
| COP402MN | 40 | Microprocessor w/64-digit RAM & Direct LED Drive w/N Buss Int. | 5.95 |
| COP470N | 20 | 32-seg. VAC Fluor. Drvr. (20-pin pkg.) | 3.25 |

## TELEPHONE/KEYBOARD CHIPS

| Part No. | **Pins | | Price |
|---|---|---|---|
| AY-5-9100 | 18 | Push Button Telephone Dialer | 14.95 |
| AY-5-9200 | 16 | Repertory Dialer | 14.95 |
| AY-5-9500 | 14 | CMOS Clock Generator | 4.95 |
| AY-5-2376 | 40 | Keyboard Encoder (88 keys) | 9.95 |
| HD0165-5 | 24 | Keyboard Encoder (16 keys) | 9.95 |
| 74C922 | 18 | Keyboard Encoder (16 keys) | 4.49 |
| 74C923 | 20 | Keyboard Encoder (20 keys) | 4.95 |
| MM53130N | 18 | Touch Tone Dialer | 5.95 |
| MM53190N | 20 | Push Button Pulse Dialer | 4.49 |

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# CONNECTORS

### 25 Pin — D Subminiature (meets RS232)

| Part No. | Description | Price |
|---|---|---|
| DB25P | PLUG (RS232) | 2.95 |
| DB25S | SOCKET (RS232) | 3.50 |
| DB25PF-179 | PLUG (RS232) Wire Wrap style | 4.95 |
| DB51226-1 | CABLE COVER for DB25P or DB25S | 1.75 |
| DB25P-831 | PLUG — Right Angle — PC Mount | 4.95 |
| DB25S-831 | SOCKET — Right Angle — PC Mount | 5.25 |
| D20418-2 | Screw Lock for DB25 Series Connectors (Locks connector to panel) | 2/.99 |

### Solder Eyelet/Wire Wrap Edge Card

| Part No. | Contacts | Sp. | Description | Price |
|---|---|---|---|---|
| 15/30SE | 15/30 | .156 | Solder Eyelet | 1.95 |
| 18/36SE | 18/36 | .156 | Solder Eyelet | 2.49 |
| 22/44SE | 22/44 | .156 | Solder Eyelet | 2.95 |
| 22/44PC | 22/44 | .156 | PC type (no mtg. ears) | 1.49 |
| 50/100SE | 50/100 | .125 | Solder Eyelet | 9.95 |
| 22/44WW | 22/44 | .156 | Wire Wrap - Level 3 | 7.95 |
| 67031-5 | 22/44 | .156 | WW (Pns .0625x.03x.75) | 3.95 |
| R681-1 | 50/100 | .125 | Wire Wrap - Level 3 | 12.95 |
| R681-2 | 50/100 | .125 | Wire Wrap - Level 3 | 12.95 |

# IC SOCKETS

For Socket Required, See Column After The IC Part No.

### LOW PROFILE (TIN) SOCKETS

| | 1-24 | 25-49 | 50-100 |
|---|---|---|---|
| 8 pin LP | .17 | .16 | .15 |
| 14 pin LP | .20 | .19 | .18 |
| 16 pin LP | .22 | .21 | .20 |
| 18 pin LP | .29 | .28 | .27 |
| 20 pin LP | .34 | .32 | .30 |
| 22 pin LP | .37 | .36 | .35 |
| 24 pin LP | .38 | .37 | .36 |
| 28 pin LP | .45 | .44 | .43 |
| 36 pin LP | .60 | .59 | .58 |
| 40 pin LP | .63 | .62 | .61 |

— Soldertail Standard Tin & Gold Also Available —

### WIRE WRAP (GOLD) SOCKETS LEVEL #3

| | 1-24 | 25-49 | 50-100 |
|---|---|---|---|
| 8 pin WW | .59 | .54 | .49 |
| 10 pin WW | .69 | .63 | .58 |
| 14 pin WW | .79 | .73 | .67 |
| 16 pin WW | .85 | .77 | .70 |
| 18 pin WW | .99 | .90 | .81 |
| 20 pin WW | 1.19 | 1.08 | .99 |
| 22 pin WW | 1.49 | 1.35 | 1.23 |
| 24 pin WW | 1.39 | 1.26 | 1.14 |
| 28 pin WW | 1.69 | 1.53 | 1.38 |
| 36 pin WW | 2.19 | 1.99 | 1.79 |
| 40 pin WW | 2.29 | 2.09 | 1.89 |

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9/82

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# INTERSIL

* Evaluation Kits

| Part No. | **Pins | Function | | Price |
|---|---|---|---|---|
| 7045IPI | 28 | C.OS Precision Timer | | 14.95 |
| 7045EV/Kit* | 28 | Stopwatch Chip, XTL | | 19.95 |
| 7106CPL | 40 | 3½ Digit A/D (LCD Drive) | | 9.95 |
| 7106EV/Kit* | 40 | IC, Circuit Board, Display | | 34.95 |
| 7107CPL | 40 | 3½ Digit A/D (LED Drive) | | 11.95 |
| 7107EV/Kit* | 40 | IC, Circuit Board, Display | | 29.95 |
| 7116CPL | 40 | 3½ Digit A/D LCD Dis. HLD. | | 16.95 |
| 7117CPL | 40 | 3½ Digit A/D LED Dis. HLD. | | 15.95 |
| 7201IUS | | Low Battery Volt Indicator | | 2.25 |
| 7205IPG | 24 | CMOS LED Stopwatch/Timer | | 12.95 |
| 7205EV/Kit* | 24 | Stopwatch Chip, XTL | | 14.95 |
| 7206CJPE | 16 | Tone Generator | | 4.95 |
| 7206CEV/Kit* | 16 | Tone Generator Chip, XTL | | 7.95 |
| 7207AIPD | 14 | Oscillator Controller | | 5.95 |
| 7207AEV/Kit* | 14 | Freq. Counter Chip, XTL | | 7.95 |
| 7208IPI | 28 | Seven Decade Counter | | 15.95 |
| 7209IPA | 8 | Clock Generator | | 3.95 |
| 7215IPG | 24 | 4 Func. CMOS Stopwatch CKT | | 13.95 |
| 7215EV/Kit* | 24 | 4 Func. Stopwatch Chip, XTL | | 14.95 |
| 7216AIJI | 28 | 8 Digit Univ. Counter C.A. | | 29.95 |
| 7216CIJI | 28 | 8 Digit Freq. Counter C.A. | | 24.95 |
| 7216DIPI | 28 | 8 Digit Freq. Counter C.C. | | 19.95 |
| 7217IJI | 28 | 4 Digit LED Up/Down Counter C.A. | | 10.95 |
| 7217AIPI | 28 | 4 Digit LED Up/Down Counter C.C. | | 14.95 |
| 7224IPL | 40 | LCD 4½ Digit Up Counter DRI | | 10.95 |
| 7226AIJL | 40 | 8 Digit Univ. Counter | | 29.95 |
| 7226AEV/Kit* | 40 | 5 Function Counter Chip, XTL | | 74.95 |
| 7240IJE | 16 | CMOS Bin Prog. Timer/Counter | | 4.95 |
| 7242IJA | 8 | CMOS Divide-by-256 RC Timer | | 2.25 |
| 7250IJE | 16 | CMOS BCD Prog. Timer/Counter | | 6.00 |
| 7260IJE | 16 | CMOS BCD Prog. Timer/Counter | | 5.25 |
| 7555IPA | 8 | CMOS 555 Timer | | 1.45 |
| 7556IPD | 14 | CMOS 556 Timer | | 2.20 |
| 7611BCPA | 8 | CMOS Op Amp Comparator | .5MV | 2.25 |
| 7612BCPA | 8 | CMOS Op Amp Ext. Cmvr. | .5MV | 2.95 |
| 7621BCPA | 8 | CMOS Dual Op Amp Comp. | .5MV | 3.95 |
| 7631CCPE | 16 | CMOS Tri Op Amp Comp. | 10MV | 6.35 |
| 7641CCPD | 14 | CMOS Quad Op Amp Comp. | 10MV | 7.50 |
| 7642CCPD | 14 | CMOS Quad Op Amp Comp. | 10MV | 7.50 |
| 7660CPA | 8 | Voltage Converter | | 2.95 |
| 8038CCPD | 14 | Waveform Generator | | 3.95 |
| 8048CCPE | 16 | Monolithic Logarithmic Amp | | 19.95 |
| 8069CCQ | | 50ppm Band—GAP Volt Ref. Diode | | 2.50 |
| 8211CPA | 8 | Volt Ref/Indicator | | 2.95 |
| 8212CPA | 24 | Volt Ref/Indicator | | 2.95 |

## 74C—C/MOS

| Part No. | **Pins | Price |
|---|---|---|
| 74C00 | 14 | .35 |
| 74C02 | 14 | .35 |
| 74C04 | 14 | .29 |
| 74C08 | 14 | .35 |
| 74C10 | 14 | .35 |
| 74C14 | 14 | .59 |
| 74C20 | 14 | .35 |
| 74C30 | 14 | .35 |
| 74C32 | 14 | .39 |
| 74C42 | 16 | 1.39 |
| 74C48 | 16 | 1.95 |
| 74C73 | 14 | .79 |
| 74C74 | 14 | .69 |
| 74C85 | 16 | 1.95 |
| 74C86 | 14 | .39 |
| 74C89 | 16 | 5.95 |
| 74C90 | 14 | 1.19 |
| 74C93 | 14 | 1.19 |

| Part No. | **Pins | Price |
|---|---|---|
| 74C95 | 14 | 1.39 |
| 74C107 | 14 | .89 |
| 74C151 | 16 | 2.49 |
| 74C154 | 24 | 3.49 |
| 74C157 | 16 | 2.25 |
| 74C160 | 16 | 1.19 |
| 74C161 | 16 | 1.19 |
| 74C162 | 16 | 1.19 |
| 74C163 | 16 | 1.19 |
| 74C164 | 14 | 1.49 |
| 74C173 | 16 | .79 |
| 74C174 | 16 | 1.19 |
| 74C175 | 16 | 1.19 |
| 74C192 | 16 | 1.49 |
| 74C193 | 16 | 1.69 |
| 74C195 | 16 | 1.39 |

| Part No. | **Pins | Price |
|---|---|---|
| 74C221 | 16 | 1.95 |
| 74C240 | 20 | 1.95 |
| 74C244 | 20 | 1.95 |
| 74C373 | 20 | 2.49 |
| 74C374 | 20 | 2.49 |
| 74C901 | 14 | .39 |
| 74C903 | 14 | .39 |
| 74C906 | 14 | .39 |
| 74C911 | 28 | 8.95 |
| 74C912 | 28 | 8.95 |
| 74C915 | 18 | 1.19 |
| 74C917 | 28 | 8.95 |
| 74C922 | 18 | 4.49 |
| 74C923 | 20 | 4.95 |
| 74C925 | 16 | 5.95 |
| 74C926 | 18 | 5.95 |
| 80C95 | 16 | .39 |
| 80C97 | 16 | .39 |

## LINEAR

| Part No. | **Pins | Price |
|---|---|---|
| LH0002CN | 10 | 5.95 |
| LM10CLH | | 3.95 |
| LM11CLH | | 3.95 |
| LH0070OH | | 4.95 |
| TL071CP | 8 | .49 |
| TL072CP | 8 | .59 |
| TL074CN | 14 | 1.49 |
| LH0082CD | | 29.95 |
| TL082CP | 8 | .59 |
| TL084CN | 14 | .59 |
| LH0094CD | | 24.95 |
| LM300H | | .99 |
| LM301CN | 8 | .35 |
| LM302H | | 1.95 |
| LM304H | | 1.95 |
| LM305H | | .99 |
| LM307CN | 8 | .45 |
| LM308CN | 8 | .69 |
| LM309H | | 1.95 |
| LM309K | | 1.25 |
| LM310CN | 8 | 1.75 |
| LM311CN | 8 | .69 |
| LM312H | | 2.49 |
| LM317MP | | 1.15 |
| LM317T | | 1.19 |
| LM317K | | 3.95 |
| LM318CN | 8 | 1.95 |
| LM319N | 14 | 1.95 |
| LM320K-5 | | 1.35 |
| LM320K-12 | | 1.35 |
| LM320K-15 | | 1.35 |
| LM320T-5 | | .89 |
| LM320T-12 | | .89 |
| LM320T-15 | | .89 |
| LM323K | | 5.95 |
| LM324N | 14 | .59 |
| LM329DZ | | .65 |
| LM331N | 8 | 3.95 |
| LM334Z | | 1.19 |
| LM335Z | | 1.40 |
| LM336Z | | 1.19 |
| LM337T | | 1.95 |
| LM337MP | | 1.15 |
| LM338K | | 6.95 |
| LM339N | 14 | .69 |
| LM340K-5 | | 1.35 |
| LM340K-12 | | 1.35 |
| LM340K-15 | | 1.35 |

| Part No. | **Pins | Price |
|---|---|---|
| LM340T-5 | | .79 |
| LM340T-12 | | .79 |
| LM340T-15 | | .79 |
| LM341P-5 | | .75 |
| LM341P-12 | | .75 |
| LM341P-15 | | .75 |
| LM342P-5 | | .69 |
| LM342P-12 | | .69 |
| LM342P-15 | | .69 |
| LM348N | 14 | .99 |
| LM350K | | 4.95 |
| LF351N | 8 | .60 |
| LF353N | 8 | 1.00 |
| LF355N | 8 | 1.10 |
| LF356N | 8 | 1.10 |
| LM358N | 8 | .69 |
| LM359N | 14 | 1.79 |
| LM370N | 14 | 4.49 |
| LM373N | 14 | 3.95 |
| LM377 | 14 | 1.95 |
| LM380N | 14 | .89 |
| LM381N | 14 | 1.79 |
| LM382N | 14 | 1.39 |
| LM384N | 14 | 1.79 |
| LM386N-3 | 8 | .89 |
| LM387N | 8 | .89 |
| LM389N | 18 | 1.19 |
| LM392N | 8 | .69 |
| LF398N | 8 | 3.95 |
| LM399H | | 5.00 |
| TL494CN | 16 | 2.95 |
| TL496CP | 8 | 1.19 |
| NE510A | 14 | 4.95 |
| NE529A | 14 | 2.95 |
| NE531V | 8 | 2.95 |
| NE536H | | 6.00 |
| NE540H | | 4.95 |
| NE544N | 14 | 2.95 |
| NE550A | 14 | 1.95 |
| NE555V | 8 | .35 |
| LM556N | 14 | .69 |
| NE564N | 16 | 2.95 |
| LM565N | 14 | 1.19 |
| LM566CN | 8 | 1.49 |
| LM567V | 8 | .89 |
| NE570N | 16 | 3.95 |

| Part No. | **Pins | Price |
|---|---|---|
| NE571N | 16 | 2.95 |
| LM703CN | 8 | 1.19 |
| LM709N | 14 | .49 |
| LM710N | 14 | .69 |
| LM711N | 14 | .79 |
| LM723N | 14 | .55 |
| LM733N | 14 | 1.00 |
| LM739N | 14 | 1.95 |
| LM741CN | 8 | .35 |
| MC1741SCG | | 2.95 |
| LM747N | 14 | .69 |
| LM748N | 8 | .59 |
| LM1014N | 18 | 1.19 |
| LM1310 | 14 | 1.49 |
| LM1458CN | 8 | .59 |
| LM1488N | 14 | .69 |
| LM1489N | 14 | .69 |
| LM1496N | 14 | 1.95 |
| LM1556V | 8 | 1.75 |
| LM1800N | 16 | 1.49 |
| LM1871N | 18 | 1.95 |
| LM1872N | 18 | 2.49 |
| LM1877N-9 | 14 | 1.95 |
| LM1889N | 18 | 1.95 |
| LM1896N | 14 | 2.95 |
| LM2002T | | 1.49 |
| LM2877P | | 1.95 |
| LM2878P | | 2.25 |
| LM2896P-1 | | 1.59 |
| LM3189N | 16 | 1.59 |
| LM3900N | 14 | .59 |
| LM3905CN | 8 | 1.19 |
| LM3909N | 8 | .99 |
| LM3914N | 18 | 3.49 |
| LM3915N | 18 | 3.49 |
| LM3916N | 18 | 3.49 |
| RC4136N | 14 | 1.25 |
| RC4151NB | 8 | 1.95 |
| RC4194TK | | 3.95 |
| RC4195TK | | 3.95 |
| LM4500A | 16 | 1.95 |
| ICL8038B | 14 | 3.95 |
| LM13080N | 8 | 1.19 |
| LM13600N | 16 | 1.19 |
| 75138N | 16 | 1.95 |
| 75450N | 14 | .59 |
| 75451CN | 8 | .39 |
| 75492 | 14 | .69 |

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### 50 VOLT CERAMIC DISC CAPACITORS

| Value | 1-9 | 10-99 | 100+ | Value | 1-9 | 10-99 | 100+ |
|---|---|---|---|---|---|---|---|
| 10 pf | .08 | .06 | .05 | .001µF | .08 | .06 | .05 |
| 22 pf | .08 | .06 | .05 | .0047µF | .08 | .06 | .05 |
| 47 pf | .08 | .06 | .05 | .01µF | .08 | .06 | .05 |
| 100 pf | .08 | .06 | .05 | .022µF | .09 | .07 | .06 |
| 220 pf | .08 | .06 | .05 | .047µF | .09 | .07 | .06 |
| 470 pf | .08 | .06 | .05 | .1µF | .15 | .12 | .10 |

### 100 VOLT MYLAR FILM CAPACITORS

| Value | 1-9 | 10-99 | 100+ | Value | 1-9 | 10-99 | 100+ |
|---|---|---|---|---|---|---|---|
| .001mf | .12 | .10 | .07 | .022mf | .13 | .11 | .08 |
| .0022mf | .12 | .10 | .07 | .047mf | .21 | .17 | .13 |
| .0047mf | .12 | .10 | .07 | .1mf | .27 | .23 | .17 |
| .01mf | .12 | .10 | .07 | .22mf | .33 | .27 | .22 |

### +20% DIPPED TANTALUMS (Solid) CAPACITORS

| Value | 1-9 | 10-99 | 100+ | Value | 1-9 | 10-99 | 100+ |
|---|---|---|---|---|---|---|---|
| .1/35V | .39 | .34 | .29 | 1.5/35V | .41 | .37 | .29 |
| .15/35V | .39 | .34 | .29 | 2.2/35V | .51 | .45 | .34 |
| .22/35V | .39 | .34 | .29 | 3.3/25V | .53 | .47 | .37 |
| .33/35V | .39 | .34 | .29 | 4.7/25V | .63 | .56 | .45 |
| .47/35V | .39 | .34 | .29 | 6.8/25V | .79 | .69 | .55 |
| .68/35V | .39 | .34 | .29 | 15/25V | 1.39 | 1.25 | .95 |
| 1.0/35V | .39 | .34 | .29 | 22/6V | .79 | .69 | .55 |

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| Axial | 1-99 | 100-499 | 500+ | Radial | 1-99 | 100-499 | 500+ |
|---|---|---|---|---|---|---|---|
| .47/50V | .16 | .14 | .10 | .47/25V | .15 | .13 | .12 |
| 1.0/50V | .19 | .16 | .12 | .47/50V | .16 | .14 | .13 |
| 3.3/50V | .17 | .15 | .11 | 1.0/16V | .15 | .13 | .12 |
| 4.7/25V | .18 | .15 | .11 | 1.0/25V | .16 | .14 | .13 |
| 10/25V | .18 | .15 | .11 | 1.0/50V | .17 | .15 | .14 |
| 10/50V | .19 | .16 | .12 | 4.7/16V | .15 | .13 | .12 |
| 22/25V | .19 | .16 | .12 | 4.7/25V | .16 | .14 | .13 |
| 22/50V | .24 | .20 | .18 | 4.7/50V | .17 | .15 | .14 |
| 47/25V | .25 | .21 | .19 | 10/16V | .15 | .13 | .12 |
| 47/50V | .29 | .25 | .23 | 10/25V | .16 | .14 | .13 |
| 100/25V | .28 | .24 | .22 | 10/50V | .17 | .15 | .14 |
| 100/50V | .41 | .37 | .34 | 47/50V | .25 | .21 | .19 |
| 220/25V | .39 | .34 | .33 | 100/16V | .21 | .17 | .14 |
| 220/50V | .49 | .45 | .41 | 100/25V | .25 | .23 | .21 |
| 470/25V | .54 | .49 | .45 | 100/50V | .37 | .34 | .31 |
| 1000/16V | .79 | .69 | .61 | 220/16V | .25 | .21 | .19 |
| 2200/16V | .89 | .79 | .69 | 470/25V | .35 | .31 | .27 |

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# PROPAGATION


*J. H. Nelson*
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## EASTERN UNITED STATES TO:

| GMT: | 00 | 02 | 04 | 06 | 08 | 10 | 12 | 14 | 16 | 18 | 20 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALASKA | 14 | 14 | 7A | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 |
| ARGENTINA | 21 | 14A | 14 | 14 | 7 | 14 | 14A | 21 | 21A | 21A | 21A | 21 |
| AUSTRALIA | 21 | 14 | 14 | 7B | 7B | 7B | 7B | 14B | 14B | 14 | 21 | 21A |
| CANAL ZONE | 21 | 14 | 14 | 14 | 7 | 7 | 14 | 21 | 21 | 21A | 21A | 21A |
| ENGLAND | 7A | 7 | 7 | 7 | 7 | 7A | 14 | 21 | 21 | 21 | 14 | 14 |
| HAWAII | 21 | 14 | 7 | 7 | 7 | 7 | 7 | 7 | 14 | 21 | 21 | 21 |
| INDIA | 14 | 14 | 7B | 7B | 7B | 7B | 14 | 14 | 14 | 14 | 14 | 14 |
| JAPAN | 14A | 14 | 7B | 7B | 7B | 7B | 7B | 7 | 7B | 7B | 14 | 14 |
| MEXICO | 14A | 14 | 14 | 7 | 7 | 7 | 7A | 14 | 14A | 21 | 21 | 21 |
| PHILIPPINES | 14 | 14 | 7B | 7B | 7B | 7B | 7B | 14B | 14 | 14 | 14 | 14A |
| PUERTO RICO | 14A | 14 | 14 | 7 | 7 | 7 | 14 | 14A | 21 | 21A | 21A | 21 |
| SOUTH AFRICA | 14 | 7A | 7B | 7B | 14B | 14 | 21A | 21A | 21A | 21A | 21 | 21 |
| U.S.S.R. | 7 | 7 | 7 | 7 | 7B | 7B | 14 | 14 | 14A | 14A | 14 | 7B |
| WEST COAST | 21 | 14 | 7A | 7 | 7 | 7 | 7 | 14 | 21 | 21 | 21A | 21A |

## CENTRAL UNITED STATES TO:

| GMT: | 00 | 02 | 04 | 06 | 08 | 10 | 12 | 14 | 16 | 18 | 20 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALASKA | 14 | 14 | 14 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14 |
| ARGENTINA | 21 | 14A | 14 | 14 | 7 | 7 | 14 | 21 | 21A | 21A | 21A | 21 |
| AUSTRALIA | 21A | 21 | 14 | 7B | 7B | 7B | 7B | 14B | 14B | 14 | 21 | 21A |
| CANAL ZONE | 21 | 14 | 14 | 14 | 7 | 7 | 14 | 21 | 21 | 21A | 21A | 21A |
| ENGLAND | 7 | 7 | 7 | 7 | 7 | 7 | 14 | 14 | 21 | 21 | 14 | 14 |
| HAWAII | 21 | 14A | 14 | 7 | 7 | 7 | 7 | 7 | 14 | 21 | 21 | 21 |
| INDIA | 14 | 14 | 7B | 7B | 7B | 7B | 7B | 14B | 14 | 14 | 14 | 14 |
| JAPAN | 14A | 14 | 14B | 7B | 7B | 7B | 7 | 7 | 7 | 7A | 14 | 14 |
| MEXICO | 14 | 14 | 14 | 7 | 7 | 7 | 7 | 14 | 14A | 21 | 21 | 21 |
| PHILIPPINES | 14A | 14 | 14B | 7B | 7B | 7B | 7B | 14B | 14 | 14 | 14 | 14A |
| PUERTO RICO | 14A | 14 | 14 | 7 | 7 | 7 | 14 | 14A | 21 | 21A | 21A | 21 |
| SOUTH AFRICA | 14 | 7A | 7B | 7B | 7B | 7B | 14A | 21 | 21A | 21A | 21 | 21 |
| U.S.S.R. | 7 | 7 | 7 | 7 | 7B | 7B | 14B | 14 | 14A | 14A | 14 | 7B |

## WESTERN UNITED STATES TO:

| GMT: | 00 | 02 | 04 | 06 | 08 | 10 | 12 | 14 | 16 | 18 | 20 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ALASKA | 14 | 14 | 14 | 7 | 7 | 7 | 7 | 7 | 7A | 14 | 14 | 14 |
| ARGENTINA | 21 | 14A | 14 | 14 | 7A | 7 | 7 | 14A | 21A | 21A | 21A | 21 |
| AUSTRALIA | 21A | 21A | 21 | 14 | 14 | 14 | 14B | 14B | 14B | 14 | 21 | 21A |
| CANAL ZONE | 21 | 14 | 14 | 14 | 7 | 7 | 14 | 21 | 21 | 21A | 21A | 21A |
| ENGLAND | 7 | 7 | 7 | 7 | 7 | 7 | 7B | 14B | 14 | 14A | 14 | 14 |
| HAWAII | 21A | 21 | 14A | 14 | 14 | 7A | 7 | 7 | 14 | 21 | 21A | 21A |
| INDIA | 14 | 14A | 14 | 7B | 7B | 7B | 7B | 7B | 14 | 14 | 14 | 14 |
| JAPAN | 21 | 14A | 14 | 14B | 7B | 7 | 7 | 7 | 7 | 14 | 14 | 14 |
| MEXICO | 21 | 14 | 14 | 7 | 7 | 7 | 7 | 14 | 14A | 21 | 21 | 21 |
| PHILIPPINES | 21 | 14 | 14 | 14B | 7 | 7 | 7 | 7 | 14 | 14 | 14 | 14A |
| PUERTO RICO | 21 | 14 | 14 | 7A | 7 | 7 | 14 | 14A | 21 | 21A | 21A | 21 |
| SOUTH AFRICA | 14 | 7A | 7B | 7B | 7B | 7B | 7B | 14 | 21 | 21A | 21A | 21 |
| U.S.S.R. | 7B | 7B | 7 | 7 | 7B | 7B | 7B | 14B | 14 | 14A | 14 | 7B |
| EAST COAST | 21 | 14 | 7A | 7 | 7 | 7 | 7 | 14 | 21 | 21 | 21A | 21A |

**A = Next higher frequency may also be useful.**
**B = Difficult circuit this period.**

**First letter = night waves. Second = day waves.**
**G = Good, F = Fair, P = Poor. * = Chance of solar flares.**
**# = Chance of aurora.**

NOTE THAT NIGHT WAVE LETTER NOW COMES FIRST.

## SEPTEMBER

| SUN | MON | TUE | WED | THU | FRI | SAT |
|---|---|---|---|---|---|---|
| | | | 1 F/G | 2 F/G | 3 F/F | 4 P/F |
| 5 F/G | 6 G/G | 7 G/G | 8 G/G | 9 G/G | 10 G/G | 11 G/G |
| 12 F/F* | 13 P/F* | 14 F/G | 15 G/G | 16 G/G | 17 F/F* | 18 F/F* |
| 19 F/F | 20 F/F | 21 G/G | 22 G/G | 23 F/G | 24 F/F | 25 F/F |
| 26 F/G | 27 F/G | 28 F/G | 29 F/G | 30 G/G | | |




Reader Service for facing page ✓83→

# New Yaesu FT-102 Series
## *Transceiver of Champions!*


**The long-awaited new generation of Yaesu HF technology has arrived! New research in improved receiver filtering and spectral purity is brought to bear in the competition-bred FT-102, the HF transceiver designed for active Amateurs on today's intensely active bands!**

### Unique Cascaded Filter System
The FT-102 utilizes an advanced 8.2 MHz and 455 kHz IF system, capable of accepting as many as three filters in cascade. Optional filters of 2.9 kHz, 1.8 kHz, 600 Hz, and 300 Hz may be combined with the two stock 2.9 kHz filters for operating flexibility you've never seen in an HF transceiver before now!

### All New Receiver Front End
Utilizing husky junction field-effect transistors in a 24 volt, high-current design, the FT-102 front end features a low-distortion RF preamplifier that may be bypassed via a front panel switch when not needed.

### IF Notch and Audio Peak Filter
A highly effective 455 kHz IF Notch Filter provides superb rejection of heterodynes, carriers, and other annoying interference appearing within the IF passband. On CW, the Audio Peak Filter may be switched in during extremely tight pile-up conditions for post-detection signal enhancement.

### Variable IF Bandwidth with IF Shift
The FT-102's double conversion receiver features Yaesu's time-proven Variable Bandwidth System, which utilizes the cascaded IF filters to provide intermediate bandwidths such as 2.1 kHz, 1.5 kHz, or 800 Hz simply by twisting a dial. The Variable Bandwidth System is used in conjunction with the IF Shift control, which allows the operator to center the IF passband frequency response without varying the incoming signal pitch.

### Wide/Narrow Filter Selection
Depending on the exact combination of optional filters you choose, a variety of wide/narrow operating modes may be selected. For example, you may set up 2.9 kHz in SSB/WIDE, 1.8 kHz in SSB/NARROW, then select 1.8 kHz for CW/WIDE, and 600 Hz or 300 Hz for CW/NARROW. Or use the Variable Bandwidth to set your SSB bandwidth, and use 600 Hz for CW/WIDE and 300 Hz for CW/NARROW! No other manufacturer gives you so much flexibility in selecting filter responses!

### Variable Pulse Width Noise Blanker
Ignition noise, the "Woodpecker," and power line noise are modern-day enemies of effective Amateur operation. The FT-102 Noise Blanker offers improved blanking action on today's man-made noise sources (though no blanker can eliminate all forms of band noise) for more solid copy under adverse conditions.

### Low Distortion Audio/IF Stage Design
Now that dynamic range, stability, and AGC problems have been largely eliminated thanks to improved technology, Yaesu's engineers have put particular attention on maximizing intelligence recovery in the receiver. While elementary filter cascading schemes often degrade performance, the FT-102's unique blend of crystal and ceramic IF filters plus audio tone control provides very low phase delay, reduced passband ripple, and hence increased recovery of information.

### Heavy Duty Three-Tube Final Amplifier
The FT-102 final amplifier uses three 6146B tubes for more consistent power output and improved reliability. Using up to 10 dB of RF negative feedback, the FT-102 transmitter third-order distortion products are typically 40 dB down, giving you a studio quality output signal.

### Dual Metering System
Adopted from the new FT-ONE transceiver, the Dual Metering System provides simultaneous display of ALC voltage on one meter along with metering of plate voltage, cathode current, relative power output, or clipping level on the other. This system greatly simplifies proper adjustment of the transmitter.

### Microphone Amplifier Tone Control
Recognizing the differences in voice characteristics of Amateur operators, Yaesu's engineers have incorporated an ingenious microphone amplifier tone control circuit, which allows you to tailor the treble and bass response of the FT-102 transmitter for best fidelity on *your* speech pattern.

### RF Speech Processor
The built-in RF Speech Processor uses true RF clipping, for improved talk power under difficult conditions. The clipping type speech processor provides cleaner, more effective "punch" for your signal than simpler circuits used in other transmitters.

### VOX with Front Panel Controls
The FT-102 standard package includes VOX for hands-free operation. Both the VOX Gain and VOX Delay controls are located on the front panel, for maximum operator convenience.

### IF Monitor Circuit
For easy adjustment of the RF Speech Processor or for recording both sides of a conversation, an IF monitor circuit is provided in the transmiter section. When the optional AM/FM unit is installed, the IF monitor may be used for proper setting of the FM deviation and AM mic gain.

### WARC Bands Factory Installed
The FT-102 is factory equipped for operation on all present and proposed Amateur bands, so you won't have to worry about retrofitting capability on your transceiver. An extra AUX band position is available on the bandswitch for special applications.

### Full Line Of Accessories
For maximum operating flexibility, see your Authorized Dealer for details of the complete line of FT-102 accessories. Coming soon are the FV-102DM Synthesized VFO, SP-102 Speaker/Audio Filter, a full line of optional filters and microphones, and the AM/FM Unit.

Price And Specifications Subject To
Change Without Notice Or Obligation

YAESU
*The radio.*

**YAESU ELECTRONICS CORP., 6851 Walthall Way, Paramount, CA 90723 ● (213) 633-4007**
**YAESU Eastern Service Ctr., 9812 Princeton-Glendale Rd., Cincinnati, OH 45246 ● (513) 874-3100**

# "Comm-packed."

## BIG performance... small size... smaller price!!!

# TR-2500


**The TR-2500 is a compact 2 meter FM handheld transceiver featuring an LCD readout, 10 channel memory, lithium battery memory back-up, memory scan, programmable automatic band-scan, Hi/Lo power switch and built-in sub-tone encoder.**

### TR-2500 FEATURES:

- **Extremely compact size and light weight**
  Measures 66 (2-5/8) W x 168 (6-5/8) H x 40 (1-5/8) D, mm (inches). Weighs 540 grams (1.2 lbs) with Ni-Cd pack.
- **LCD digital frequency readout**
  Shows frequencies and memory channels, four "Arrow" indicators.
- **Ten channel memory**
  Nine memories for simplex or ±600 kHz offset. "M0" memory for non-standard split frequency repeaters.
- **Lithium battery memory back-up**
  (Estimated 5 year life.) Maintains memory when Ni-Cd pack is fully discharged or removed.


- **HI/LOW power selection**
  2.5 watts or 300 mw.
- **Memory scan**
  Scans only channels in which frequency data is stored.
- **Programmable automatic band scan**
  Upper and lower frequency limits and scan steps of 5-kHz and larger.
- **UP/DOWN manual scan**
- **Built-in tuneable sub-tone encoder**
  Tuneable (variable resistor) to desired CTCSS tone.
- **Built-in 16-key autopatch encoder**
- **"SLIDE-LOC" battery pack**
- **Repeater reverse switch**
- **Keyboard frequency selection**
- **Extended frequency coverage**
  Covers 143.900 to 148.995 MHz in 5-kHz steps.
- **Optional power source**
  Using optional MS-1 mobile or ST-2 AC charger/power supply, radio may be operated while charging. (Automatic drop-in connections.)

Actual size

- **High impact plastic case**
- **Battery status indicator**
- **Two lock switches**
  Prevent accidental frequency change and accidental transmission.

**Standard accessories include:**
- Flexible antenna with BNC connector
- 400 mAH Ni-Cd battery pack
- AC charger

**Optional accessories:**
- ST-2 Base station power supply/charger (approx. 1 hr.)
- MS-1 13.8 VDC mobile stand/charger/power supply


# TR-3500

### 70 CM FM Handheld

- 440-449.995 MHz in 5-kHz steps
- TX OFFSET switch keyboard programmable ±5 kHz to ±9.995 MHz
- 1.5 W/300 mW HI/LOW power switch
- Auto. squelch position on squelch control
- Tone switch for TU-35B optional programmable CTCSS encoder
- Other features include 10 memories, lithium battery memory back-up, programmable automatic band scan, memory scan, UP/DOWN manual scan, repeater reverse, 16-key autopatch, keyboard frequency selection, slide-lock battery.

*Subject to FCC approval.*

- VB-2530 2-M 25 W RF power amp., w/cables, mtg. brkt. (TR-2500 only)
- TU-1 Programmable CTCSS encoder (TR-2500 only)
- TU-35B Programmable CTCSS encoder (mounts inside TR-3500 only)
- PB-25 Extra 400 mAH Ni-Cd battery
- PB-25H Heavy-duty 490 mAH Ni-Cd battery
- BT-1 Battery case for manganese/alkaline AA cells
- SMC-25 Speaker-microphone
- LH-2 Deluxe leather case
- BH-2A Belt hook
- WS-1 Wrist strap
- EP-1 Earphone

More information on the TR-2500 and TR-3500 is available from all authorized dealers of Trio-Kenwood Communications, 1111 West Walnut Street, Compton, California 90220.

**KENWOOD**
*...pacesetter in amateur radio*

*Specifications and prices are subject to change without notice or obligation.*