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73®

Amateur Radio's Technical Journal

A Wayne Green Publication

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W2NSD/1 NEVER SAY DIE

editorial by Wayne Green

THE WORLD'S FAIR—KNOXVILLE

Yes, there is a ham exhibit at the new World's Fair. The local hams got together and managed to get some space in the Knoxville exhibit for the station. It's a good looking exhibit, packed with Ten-Tec gear for the most part. That's not too surprising since Ten-Tec's plant is just a few miles from Knoxville.

The fair isn't large by World's Fair standards. I've only seen a few such fairs, so perhaps I was expecting too much. I am old enough to have spent a good deal of time wandering the New York fair in 1938, watching the early television programs being produced. They had iconoscope cameras in those days, so the lights had to be fierce compared with the later developed image orthocons, which were far more sensitive (and expensive).

They had a lot of entertainment exhibits at that fair. I didn't see much of that at Knoxville. Here the exhibits are almost entirely international and national, with little from our major industrial corporations.

At the Montreal fair, there was a good deal of entertainment, but the lines were so long to watch it that many were discouraged. I know I had to miss most of the highly touted shows because I didn't have a day apiece to devote to line standing. Fortunately, most of the ones that I had to miss at Montreal turned up when San Antonio had their World's Fair, so I eventually saw them.

I'm beginning to recognize that a successful fair means hot weather and long, long lines. I think the line for the Chinese exhibit is almost the length of the whole fair! It reminded me of an illustration by Ripley for an item which said that there were so many Chinese that a column of them four wide could parade by night and day forever, with the newly born keeping up with the pace of the line. The line at the fair seemed endless. Most of the more interesting exhibits had lines, but none compared with the Chinese.

It appears that Knoxville has gotten a bum rap from some of the media. I was there in late May and found little problem in getting hotel accommodations. Even when I went on Sunday to the fair, I was able to park within one block of the fair gate. They have parking lots all around the outskirts of town where you can leave your car and be commuted by a bus.

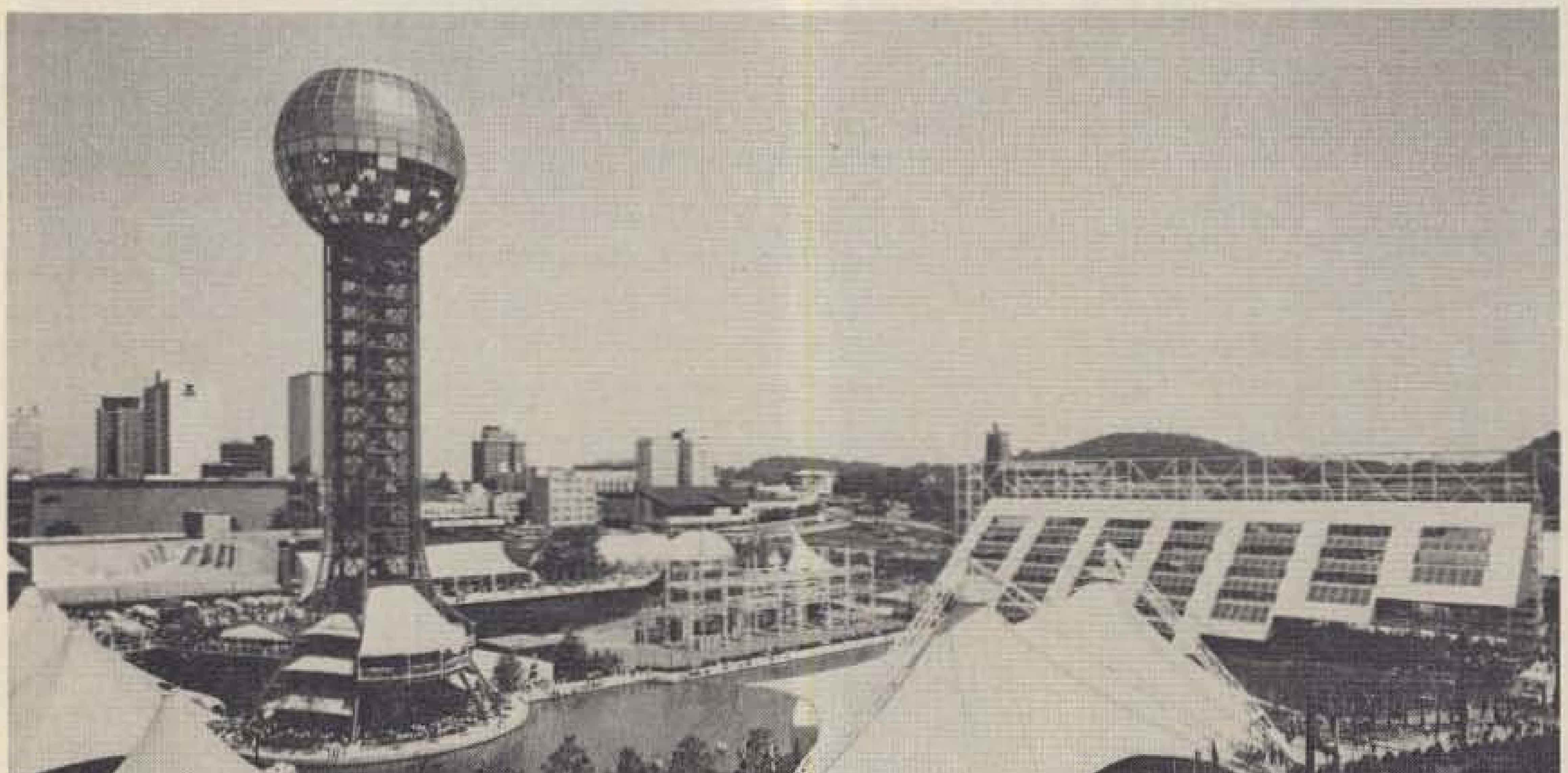
Of course, my favorite subject is food. That was one of my big memories of the New York fair of '38. Montreal was a bust, with most of the food stands selling only buffalo burgers—which are okay, but not exciting.

At San Antonio, I had a great time eating. They had all sorts of fast food services. Knoxville has done the same. They have one of the widest varieties of food of any fair yet. Have you ever seen a cobbler stand? Yep, a choice of apple, cherry, blueberry, or mixed fruit cobbler, with or without soft ice cream. You could also get Belgian waffles, nice and fresh and crisp, with either whipped cream or soft ice cream.

There are plenty of repeaters around Knoxville, so if you decide to drive to the fair you won't have any problem getting talked in. I called in on 146.73 and got route instructions—first to the Knoxville hamfest, then to the fair. No problem getting help.

If you're within driving distance of Knoxville, I'd say it's worth your while to plan on getting down there (or up) this summer. Be sure to check in at the ham exhibit and log in. If you flash your ham license, they'll let you sit down and do some contest-type operating. It seems that World's Fair stations are reasonably rare, so there are pileups for everyone. It's a lot easier than getting down to Swaziland or something. And you can get a taste of quite a bunch of foreign countries by visiting their exhibits.

Speaking of the Knoxville hamfest, while I didn't see anyone there from *Ham Radio* magazine, I did catch a glimpse



Three of the landmark structures of The 1982 World's Fair in Knoxville, Tennessee, form around the three-acre Waters of the World Lake. At left is the Sunsphere, 266 feet high and the "theme structure" of the exposition. The five-level sphere, encased in glass made of 24-karat gold dust, houses a restaurant and two cocktail lounges and observation areas. In the right foreground is the 1,500-seat Tennessee State Amphitheatre. The United States pavilion (at far right) features "talk-back computers," a "national energy debate" utilizing television screens and a new IMAX film, to be shown on a screen seven stories high and 90 feet wide. Downtown Knoxville forms the background at left. (Photo by Mike DuBose)

Power up.

40 W, 15 memories/offset recall, scan, priority, DTMF touch-pad

TR-7850

Kenwood's remarkable TR-7850 2-meter FM mobile transceiver provides all the features you could desire, including a powerful 40 watts RF output. Frequency selection is easier than ever, and the rig incorporates new memory developments for repeater shift, priority, and scan, and includes a built-in autopatch touch-pad (DTMF) encoder. A 25-watt output version, the TR-7800, is also available.

TR-7850 FEATURES:

- **Powerful 40 watts power output**
  Selectable high or low power operation. High 40-watt output provides reliable signal for wide area coverage.
- **15 multifunction memory channels, easily selectable with a rotary control**
  M1-M13 ... memorize frequency and offset (±600 kHz or simplex). M14 ... memorize transmit and receive frequencies independently for nonstandard offset.
  M0 ... priority channel, with simplex, ±600 kHz, or nonstandard offset operation.
- **Internal battery backup for all memories**
  All memory channels (including transmit offset) are retained when four AA NiCd batteries (not Kenwood supplied) are installed in battery holder inside TR-7850. Batteries are automatically charged while transceiver is connected to 12-VDC source.
- **Extended frequency coverage**
  143.900-148.995 MHz, in switchable 5-kHz or 10-kHz steps.
- **Priority alert**
  M0 memory is priority channel. "Beep" alerts operator when signal appears on priority channel. Operation can be switched immediately to priority channel with the push of a switch.
- **Built-in autopatch touch-pad (DTMF) encoder**
  Front-panel touch pad generates all 12 telephone-compatible dual tones in transmit mode, plus four additional DTMF signaling tones (with simultaneous push of REV switch).
- **Front-panel keyboard**
  For frequency selection, transmit offset selection, memory programming, scan control, and selection of autopatch encoder tones.
- **Autoscan**
  Entire band (5-kHz or 10-kHz steps) and memories. Automatically locks on busy channel; scan resumes automatically after several seconds, unless CLEAR or mic PTT button is pressed to cancel scan.
- **Up/down manual scan**
  Entire band (5-kHz or 10-kHz steps) and memories, with UP/DOWN microphone (standard).
- **Repeater reverse switch**
  Handy for checking signals on the input of a repeater or for determining if a repeater is "upside down."
- **Separate digital readouts**
  To display frequency (both receive and transmit) and memory channel.
- **LED bar meter**
  For monitoring received signal level and RF output.
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  To show: +600 kHz, simplex, or -600 kHz transmitter offset; BUSY channel; ON AIR.
- **TONE switch**
  To actuate subaudible tone module (not Kenwood-supplied).
- **Compact size**
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  With quick-release levers.

More information on the TR-7850 is available from all authorized dealers of Trio-Kenwood Communications 1111 West Walnut Street, Compton, California 90220.

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Matching accessory for fixed-station operation:
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Other accessories not shown:
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- SP-40 compact mobile speaker

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of one of the *CQ* chaps. Funny thing, even though this was an official ARRL hamfest, I didn't see any of their officials. Hmmm. Maybe I missed 'em.

The people at Ten-Tec, in addition to supporting the ham exhibit at the World's Fair, also had the most elaborate exhibit at the hamfest. I don't know how they get any work done!

The ham station at the fair was not of enough importance for the FCC to manage a special events call, but the Knoxville chaps were very resourceful. A local club had the call WA4KFS, so they "borrowed" the call for the fair...it representing the Knoxville Fair Station.

I sat down for a few minutes to see how the station was working. Aiming the beam at Europe, I found a relatively clear spot (not bad for Sunday afternoon on 20m) and called CQ. Wouldn't you know that the chap who came back to my call lives a few miles from Peterborough and, when he found out who was operating, mentioned that he drives past my place every day going to work!

Having been on the ham tour to China a year ago, I wasn't ready to face the three-hour or more line to see their exhibit. Then I found out that our press passes not only got us in the fair free, but were also useful for going to the head of lines. Hmmm. It makes good sense since one of the things the fair needs most desperately is some good press. So Sherry and I ambled down to the China exhibit, flashed our press passes, and got right in.

Sherry was disappointed, I think. Sure enough, China had all their stuff there on exhibit... with a lot of the items for sale. But it was pretty much the same as we'd seen at the Canton Trade Fair. We did come close to buying one of their gorgeous rugs. Only the problems of shipping it home slowed us down in Canton...now we had no such excuse. The rugs are spectacular and quite reasonable in price. They're not as inexpensive as in China, of course, but they're still a bargain.

The exhibit was interesting, but would have been a bummer if we'd had to invest much line time. That's probably one of the drawbacks to being into travel.

The worst days as far as lines are concerned are Friday and Saturday. Thursday is the lightest attendance day, with Sunday being second. That's Baptist country, remember, and Sunday is for church. The lines for food were small, if any. Sure, if you really *had* to have a hamburger and wanted it at 12:30, there was a line. But right next to that stand you could get something more interesting with no wait. The Hungarian ex-

Continued on page 139

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

"While we were digging you a deeper ground, we struck oil!"

Reader Service for facing page ✓15→


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Poor Man's Spectrum Analyzer

—another 73 breakthrough

Frank H. Perkins WB5IPM
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Arlington TX 76013

Hams enjoy making all types of electrical measurements. In fact, it's one of our favorite pastimes and topics of conversation. Fortunately, good, low-cost oscilloscopes, DVMs, and other instruments are available to us for measuring voltage, current, power, swr, frequency, and so on.

There is one instrument, however, that has been beyond the reach of most of our budgets—the spectrum analyzer. Commercial versions of this useful rf instrument start at $2500, which is a little steep for most of us. It is possible for you to build a simple spectrum analyzer for about $150 that works with a low-cost oscilloscope. The analyzer can be used to check HF transmitting equipment, among other applications. Its use, theory of operation, and construction are discussed in this article.

Spectrum Analyzer Operation

A spectrum analyzer is a special receiver that allows you to view the frequency components of its input signal on an oscilloscope CRT. The spectrum analyzer repeatedly tunes across the frequency band you have chosen with its center-frequency and frequency-span controls. For example, if you set the center-frequency control for 20 MHz and adjust the frequency-span control for a tuning range from 10 MHz below to 10 MHz above the center frequency, the analyzer will repeatedly tune the 10-MHz-to-30-MHz band.

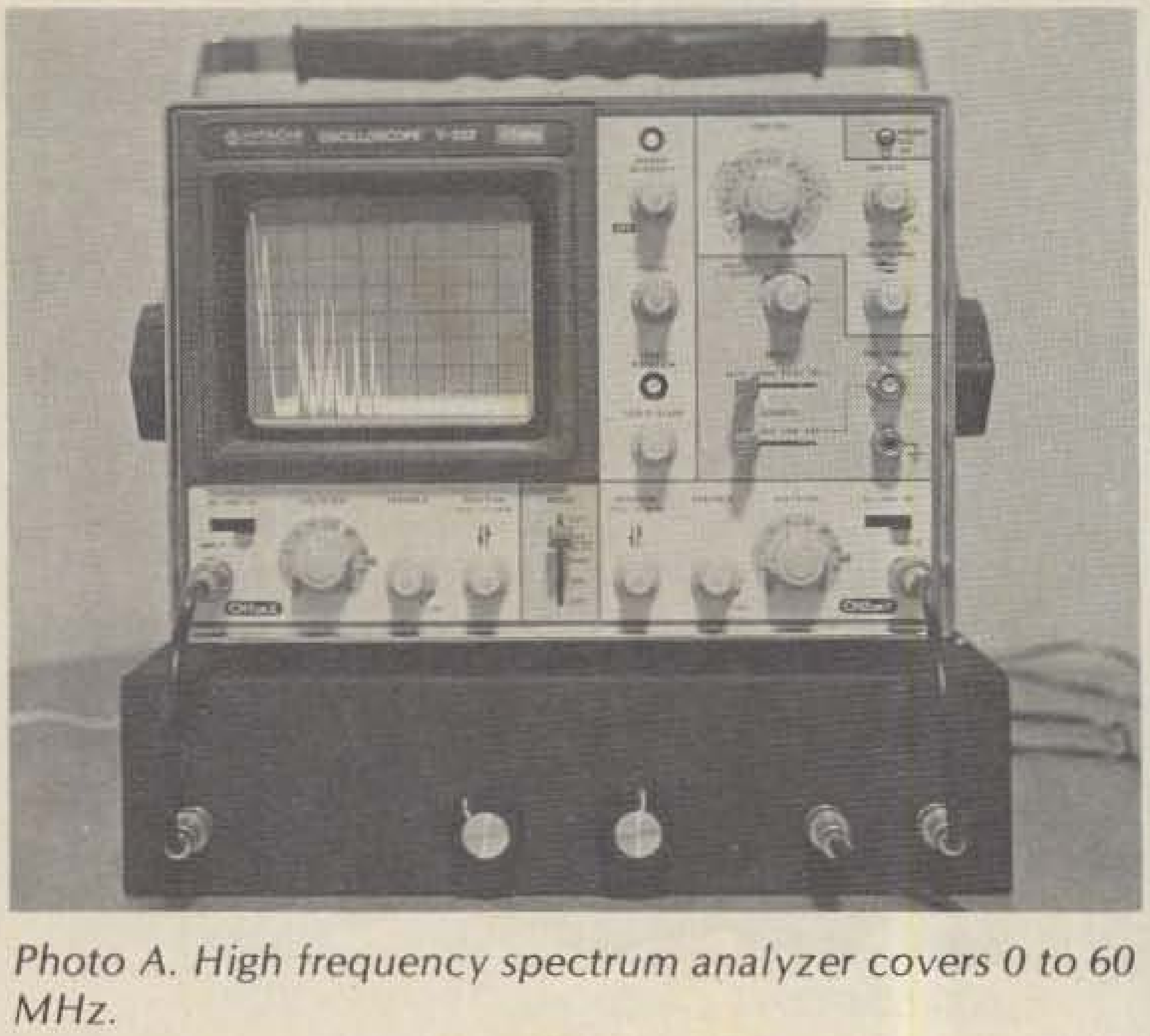


Photo A. High frequency spectrum analyzer covers 0 to 60 MHz.

As the analyzer tunes from the low end to the high end of the band, it moves the CRT trace from left to right. The S-meter output from the analyzer moves the CRT trace upward from the bottom of the CRT screen according to signal strength. A spectrum analyzer display usually looks like a number of spikes. The farther to the right a signal (spike) appears on the CRT, the higher its frequency; the strength of the signal is indicated by its height. There usually appears to be some "grass" along the bottom of the CRT display. This is due to noise. You probably have seen spectrum analyzer displays in ham gear sales literature and some magazine articles.

To appreciate how useful a spectrum analyzer can be, let's first look at Photo B, an rf signal on a normal oscilloscope. To me it looks like a clean sine wave. What do you think?

Now let's look at Photo C, the same rf signal on our spectrum analyzer. The half-spike on the left is our zero-frequency reference. The next signal to the right, which is the tallest, is the fundamental component of our rf signal. The three signals to the right of the fundamental are the 2nd, 3rd, and 4th harmonics.

If the spectrum of our transceiver or linear amplifier output looked the same as this photo, we would not be complying with FCC Regulation 97.73, even though our fundamental signal was properly within an HF amateur band.

To understand what's wrong, compare the height of the 2nd harmonic signal to the fundamental. The second harmonic is about 2.6 CRT divisions shorter than the fundamental. With a 10-dB-per-division vertical calibration, the second harmonic is 26 dB below the fundamental.

FCC Regulation 97.73 re-

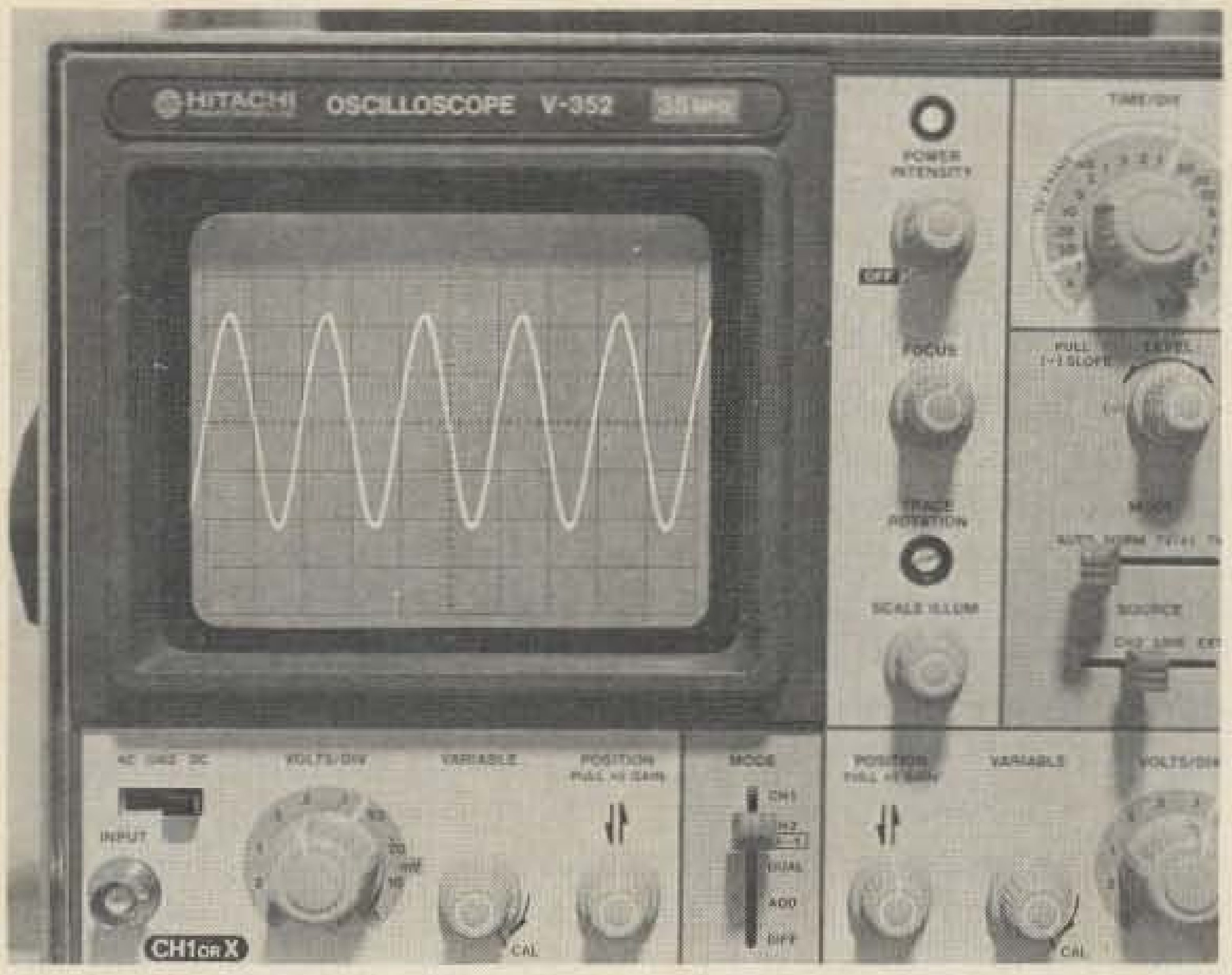


Photo B. Rf signal as viewed on an ordinary oscilloscope. Is this a clean signal?

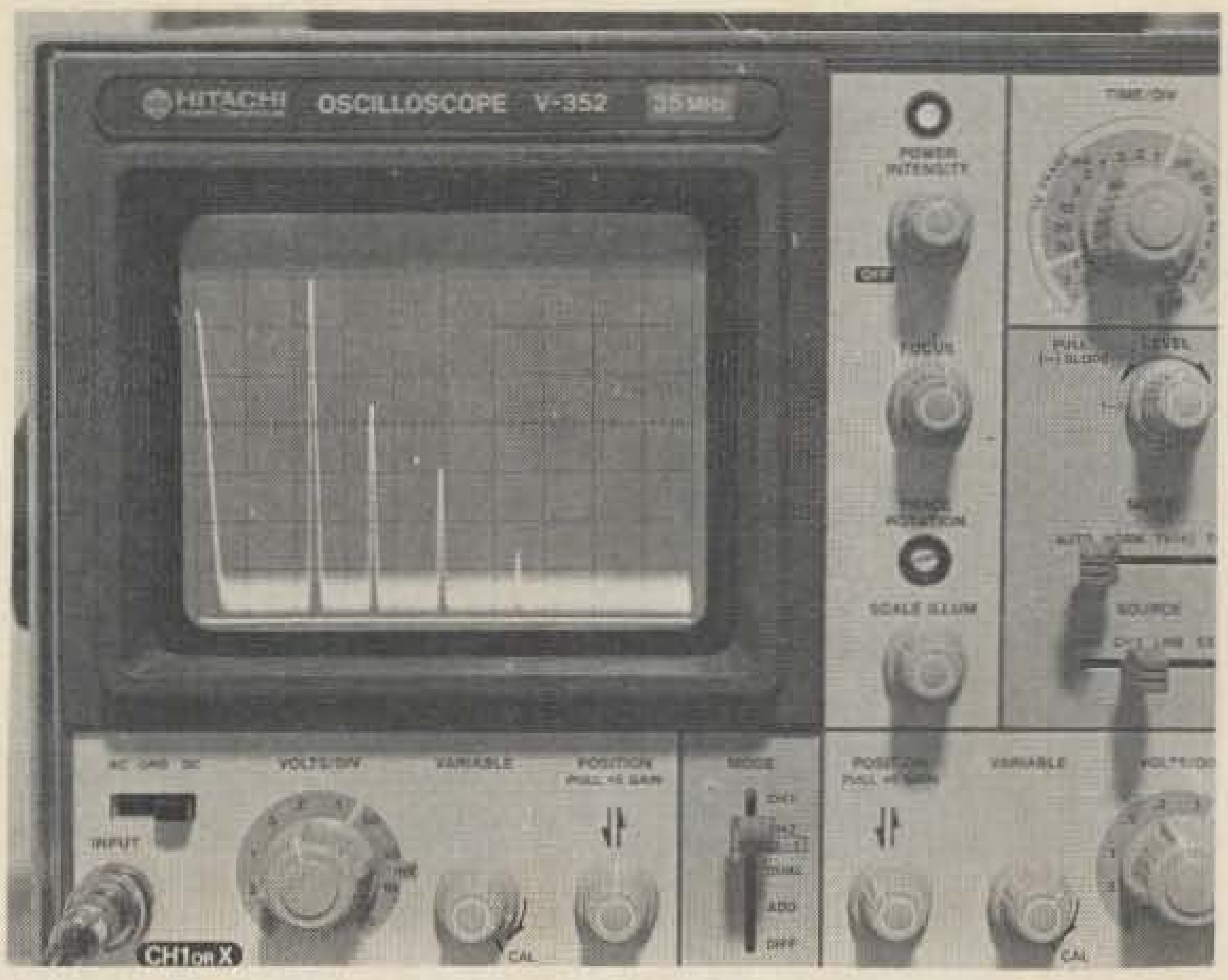


Photo C. Same rf signal on the spectrum analyzer. Second harmonic is only 26 dB below the fundamental. Don't put this signal on the air!

quires low-power transmitters up to 5 Watts to suppress all signal frequency components (spurs) outside the HF band of operation at least 30 dB below the fundamental. For a transmitter from 5 to 500 Watts, this figure is 40 dB. For a 1000-Watt transmitter or linear amplifier, the figure is 43 dB. Checking our photo again, we notice that the 3rd harmonic signal is about 39 dB below the fundamental. We're also going to have a problem with the 3rd harmonic if we are running 5 Watts or more power. The 4th harmonic is no problem since it's about 55 dB below the fundamental.

We can correct the problem by adding a filter between our transceiver or linear and the antenna. However, unless we are able to check the output spectrum of our transmitting equipment, we may never know we have a problem—until our neighbors start complaining or we get a "friendly advisory" from the local FCC monitoring station.

There are many uses for a spectrum analyzer besides monitoring transmitter outputs, but this use alone can make an HF spectrum analyzer construction project worthwhile. If you build one, you'll probably be the first on your block (or in your favorite net or club) to have one of your own!

Spectrum Analyzer Hookup

Fig. 1 shows how to hook up the high frequency spectrum analyzer for monitoring the output spectrum of a transmitter or linear amplifier. Remember, the analyzer is a receiver. It requires a very small sample of power for operation. This is done with an L-pad sampler. The sampler will not interfere with normal transmitting or transceiving operation. The output from the L-pad is further reduced with a step attenuator to match the full-scale input-power requirements of the analyzer (1/4 to 1/10 of a milliwatt). The spectrum is displayed on the oscilloscope being used with the spectrum analyzer.

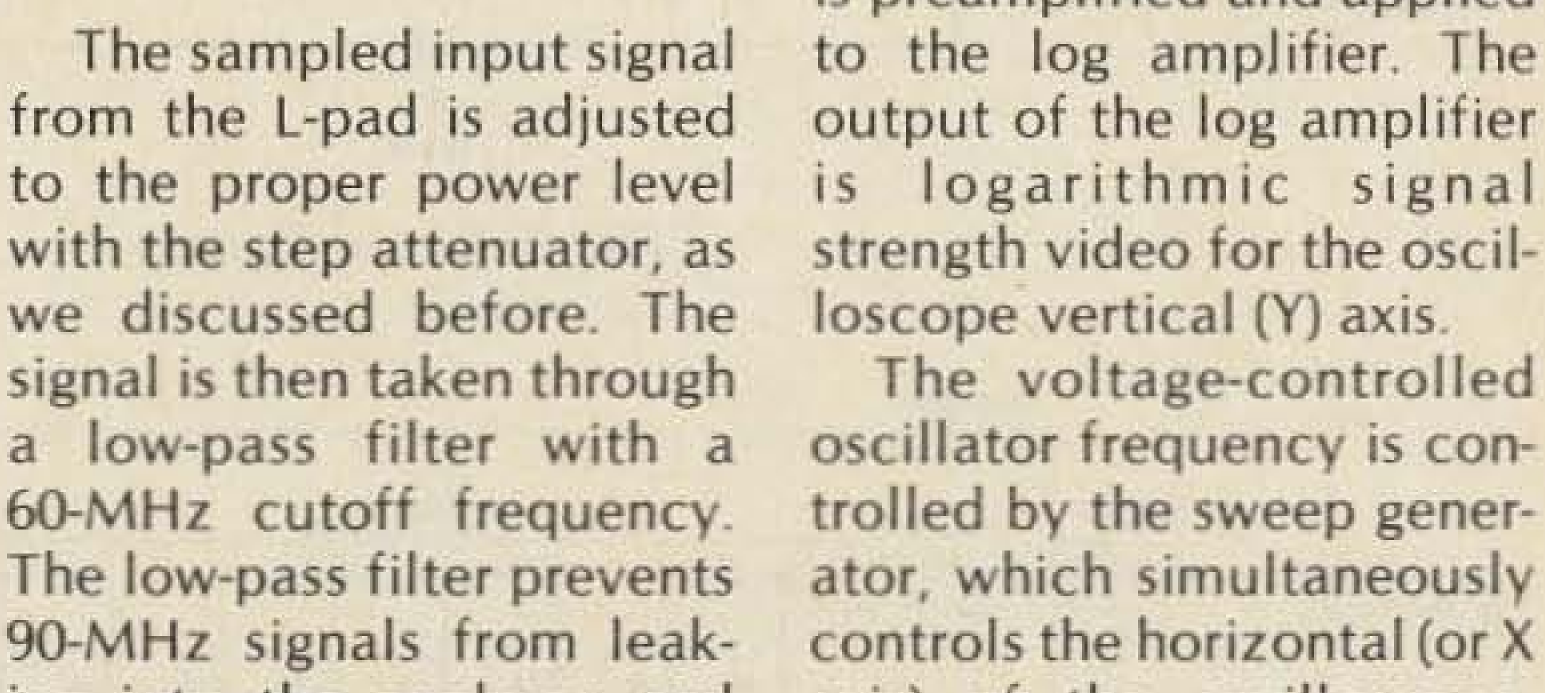
It is important to observe good safety practices when using the L-pad, attenuator, and spectrum analyzer. Be sure all station equipment, the L-pad, attenuator, analyzer, and oscilloscope cases are properly grounded. Use the proper L-pad for your power range. Double-check your hookup before applying power. If the output of a transmitter was directly connected to the analyzer by accident, it would instantly be damaged when the transmitter was keyed.

Overall Circuit Operation

Let's first discuss Fig. 2, the spectrum analyzer block diagram. We will then look at the circuits in each block in detail. Notice that the analyzer block diagram looks similar to that of a single-conversion superheterodyne receiver. The i-f frequency of the spectrum analyzer is 90 MHz.

The sampled input signal from the L-pad is adjusted to the proper power level with the step attenuator, as we discussed before. The signal is then taken through a low-pass filter with a 60-MHz cutoff frequency. The low-pass filter prevents 90-MHz signals from leaking into the analyzer and "confusing" it. The input is next mixed with the 90-MHz to 150-MHz voltage-controlled oscillator (vco) in the double-balanced mixer. The difference output from the mixer, which is the desired i-f signal, is then filtered by the 90-MHz bandpass filter. The bandpass filter provides the necessary selectivity for the spectrum analyzer. The 90-MHz signal from the bandpass filter is preamplified and applied to the log amplifier. The output of the log amplifier is logarithmic signal strength video for the oscilloscope vertical (Y) axis.

The voltage-controlled oscillator frequency is controlled by the sweep generator, which simultaneously controls the horizontal (or X axis) of the oscilloscope. Note that when the vco is



Note 1. Never hook transmitter or linear directly to step attenuator or analyzer. Always use L-pad sampler of the proper power rating.
Note 2. Be sure transmitter, linear, L-pad, attenuator, analyzer, and scope are grounded.

Fig. 1. Typical HF spectrum analyzer hookup.

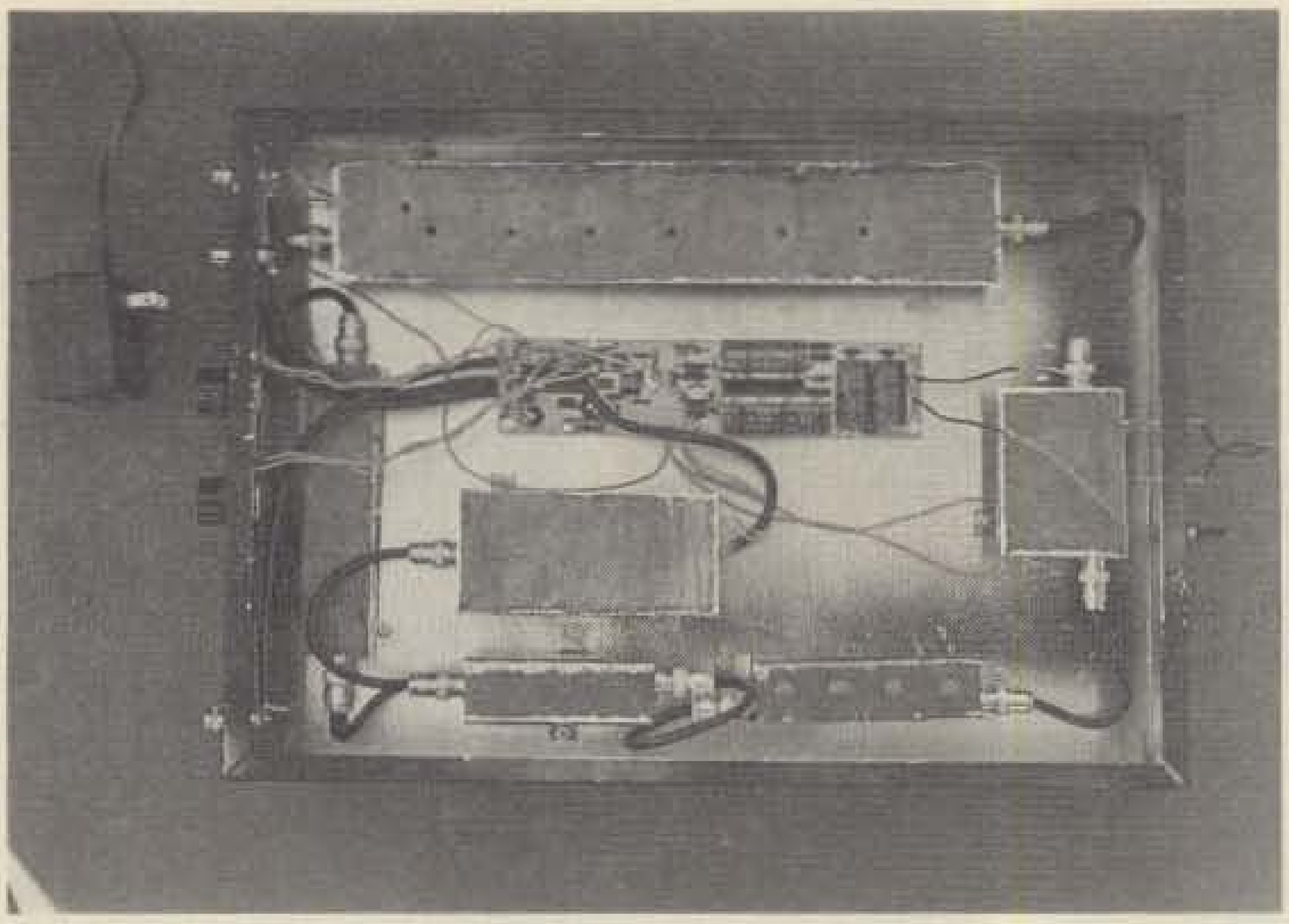


Photo D. Bottom view of spectrum analyzer chassis. Log amplifier is at the top. Power supply and sweep generator board is directly below the log amplifier. Vco is next. The mixer is directly below the vco. The mixer connects to the low-pass filter at the left. The bandpass filter is at the lower right. Preamplifier is on the middle right.

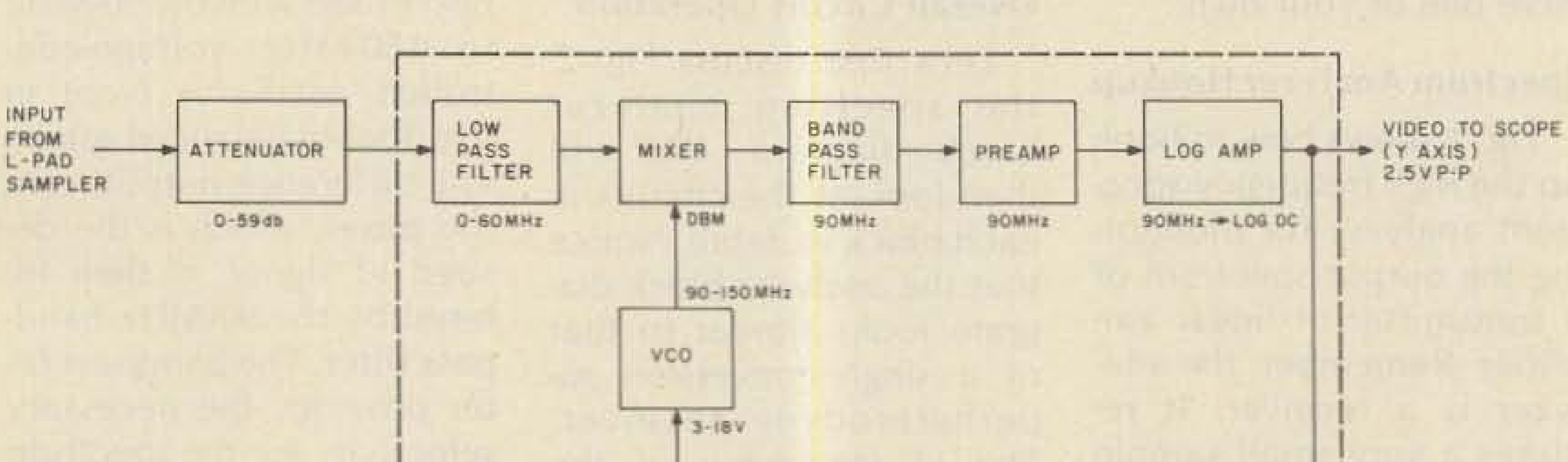
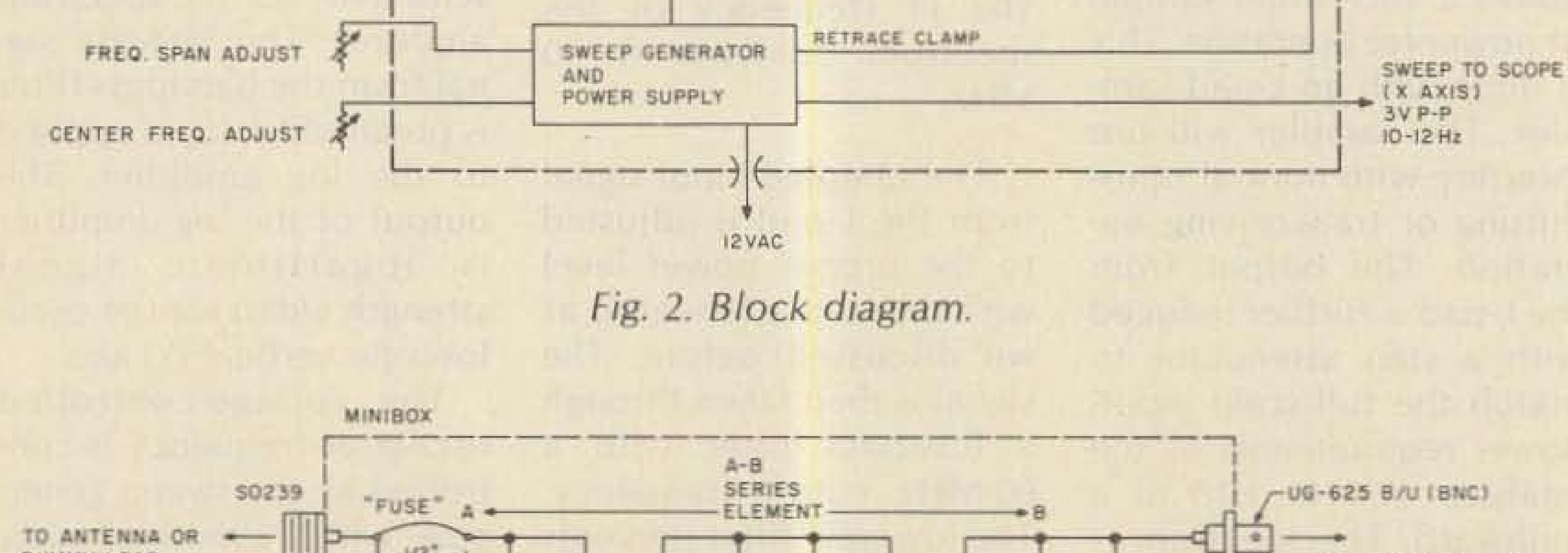


Fig. 2. Block diagram.



Note 1. Carbon composition (noninductive) resistors.
Note 2. "Fuse" is single, hair-thin copper strand from ac "zip" cord.
Note 3. Connect SO-239 connectors with RG-8 center conductor wire.
Note 4. Test-run sampler before connecting to attenuator.
Note 5. Keep BNC connector 3" away from SO-239s; space resistor sets 3/8" minimum; "fuse" is 1/2" to 3/4" long.

Fig. 3. L-pad power samplers.

tuned to 90 MHz, the analyzer is tuned to zero MHz. When the vco is tuned to 120 MHz, the analyzer is tuned to 30 MHz. With the vco at 150 MHz, the analyzer is tuned to 60 MHz.

The tuning range of the analyzer is adjusted with the center-frequency and frequency-span controls on the sweep generator. The sweep generator automatically tunes the analyzer across its tuning range about 10 times each second. The sweep generator clamps or "shorts out" the video during the retrace between each sweep to avoid a confusing oscilloscope display. This eliminates the need for an oscilloscope with a Z-axis (blanking) input. The power supply provides +24 V dc, +12 V dc, and −6 V dc for the spectrum analyzer circuitry. The power supply operates from 12 V ac supplied by a wallplug transformer.

L-Pad

Fig. 3 shows the schematic of a 100-to-1000-Watt L-pad sampler, with alternate circuitry for a 10-to-100-Watt sampler, a 1-to-10-Watt sampler, and a 0.25-to-1-Watt sampler. Four pairs of 4.7k, 1-Watt resistors form the series element of the 100-to-1000-Watt sampler. A 51-Ohm, 1/2-Watt resistor forms the shunt element. The L-pad resistors are rated for continuous operation. A single hair-thin strand from an old "zip" cord provides some fusing protection in the event of a component failure or circuit fault. The series elements for the other power ratings are shown in Fig. 3.

0-to-59-dB Step Attenuator

Fig. 4 shows the step attenuator schematic. Five pi-style resistive attenuators are switched in or out as necessary to achieve the proper attenuation. Switches are double-pole, double-throw. Resistors may be 1/2 Watt or 1/4 Watt, although 1/4-Watt resistors are easier to work with. Note the shielding between sections. Resistors must be 5% tolerance. (The resistor values for each attenuator came from Reference 1.)

Low-Pass Filter, Mixer, and Vco

Fig. 5 shows the details of these circuits. The low-pass filter consists of three pi-sections, separated by shielding. The cutoff frequency of the filter is about 60 MHz. Three sections are used to give a high attenuation at the 90-MHz i-f frequency and above.

Each port of the double-balanced mixer is padded with 50-Ohm attenuators to

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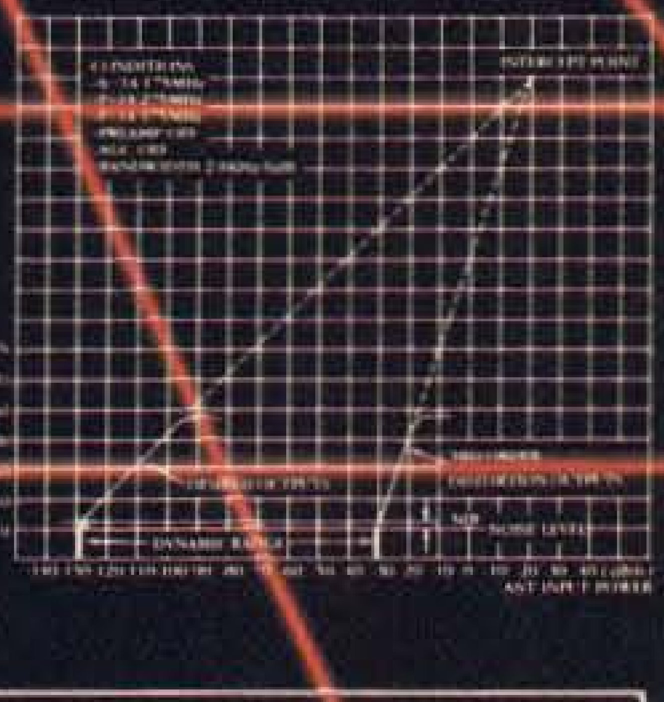

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encourage good mixer performance (low mixer spurs) at the expense of extra conversion loss. Mini-Circuits SRA-1 and SBL-1 are good commercial mixers. It is quite possible to build a suitable double-balanced mixer from small ferrite toroids and hot carrier diodes, if you have trouble finding these commercial units. (Consult Reference 1 for details.)

The vco consists of an MRF901 Colpitts oscillator coupled to a wideband 2N5179 amplifier. The MRF901 was eventually chosen for the oscillator transistor because of its well-behaved phase-shift characteristics between 90 MHz and 150 MHz. The two MV109 hyper-abrupt Epicap diodes act as tuning capacitors and account for the oscillator's wide tuning range. A small pick-up loop near the oscillator coil provides an output for checking frequency and doing other tests. The oscillator is also lightly coupled to the 2N5179 vco amplifier. The output of this amplifier drives the local oscillator port of the mixer. A diode-capacitor rf detector provides a dc output for checking amplifier output power. The wideband amplifier design is based on data from Reference 1. The oscillator design is based on third-attempt desperation! Note the use of the feedthrough capacitors and shielding. These are as much a part of the circuit as the MRF901.

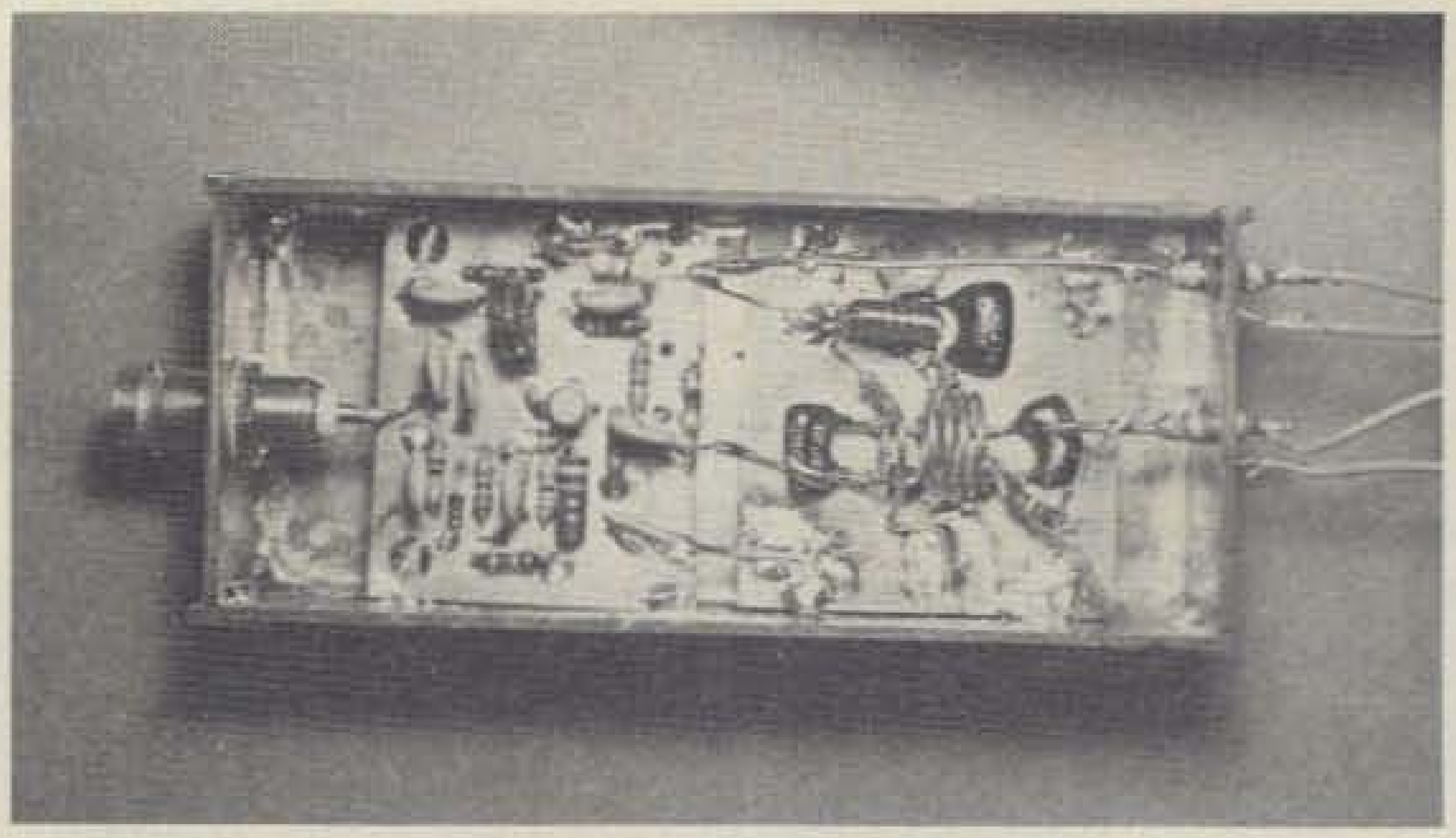
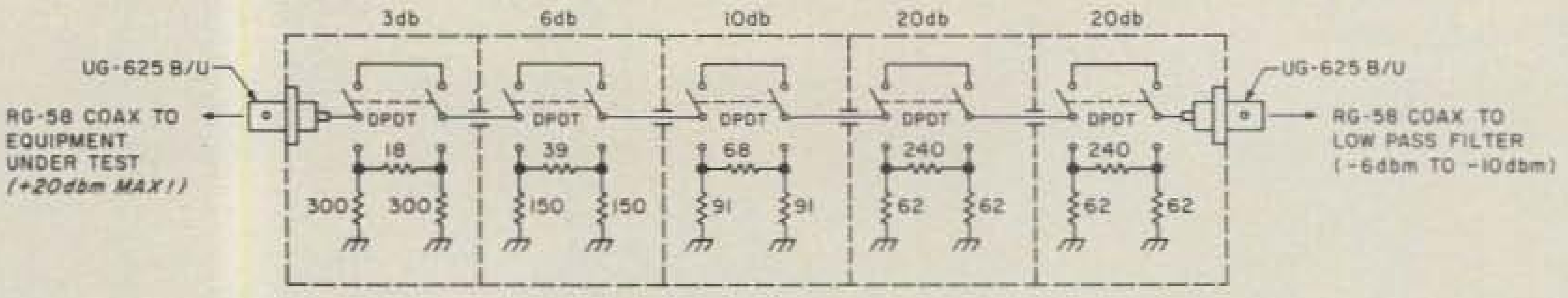


Photo E. Vco layout. Oscillator is near the feedthroughs.

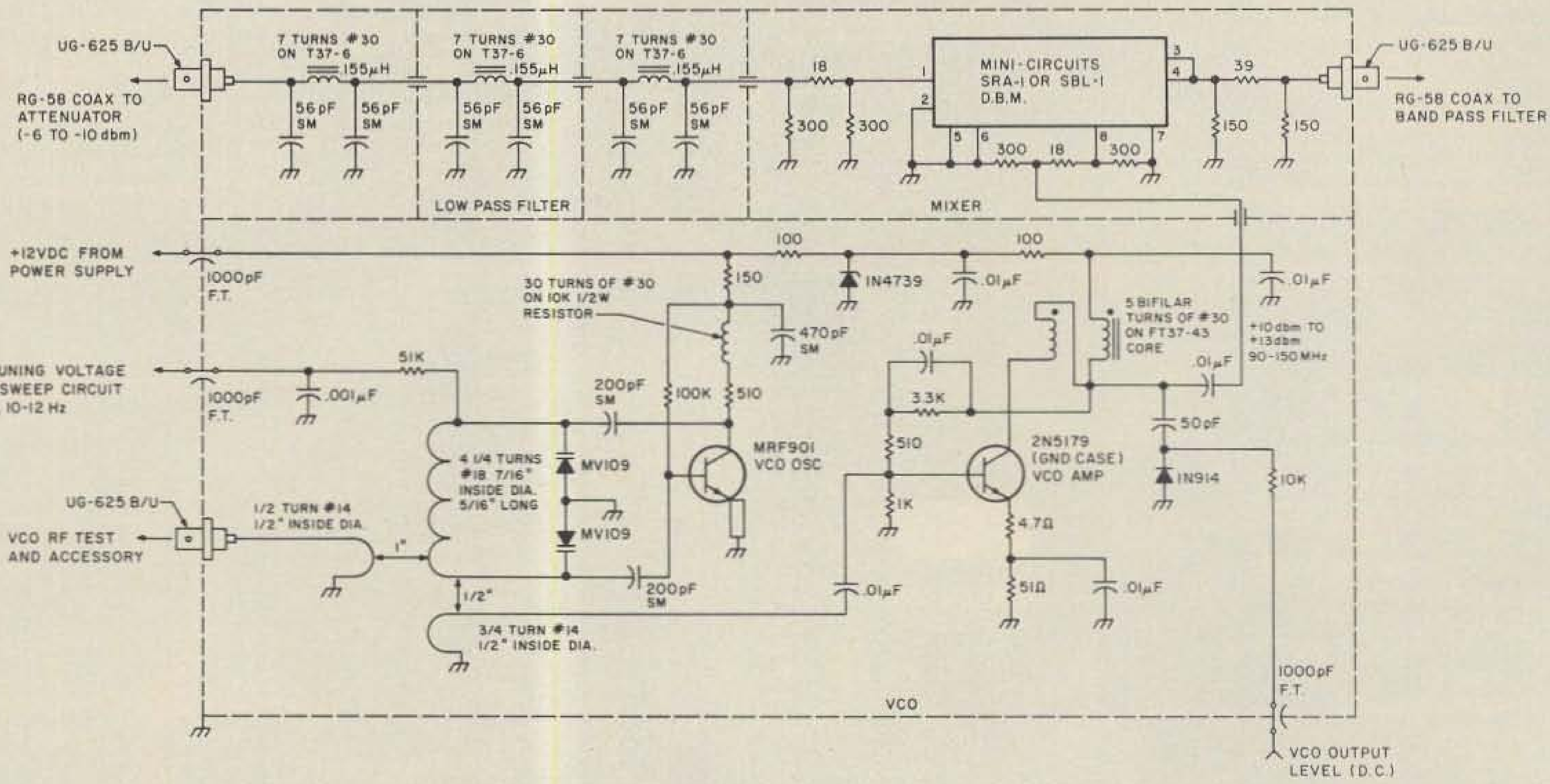
Bandpass Filter

The bandpass filter is detailed in Fig. 6. It consists of four relatively small helical resonators. The input and output resonators are tap-coupled to the input and output connectors. The four resonators are aperture-coupled to each other. The two center resonators are slightly stagger-tuned to give the filter bandpass a sharp "nose." The 3-dB



Note 1. DPDT toggle switch—Radio Shack 275-1546 or equivalent.
Note 2. BNC receptacle—Radio Shack 278-105 or Amphenol 31-236.
Note 3. Resistors 1/2 or 1/4 W, 5% noninductive.
Note 4. Attenuator box made from single- and double-sided G-10 circuit board plus copper shim stock.

Fig. 4. 0-59-dB step attenuator.



Note 1. Resistors are 1/4 W, 5%; unspecified capacitors are 50-V ceramic.
Note 2. Capacitors marked "SM" are ±5% silver mica.
Note 3. 1000-pF feedthrough capacitors available from Alaska Microwave.
Note 4. MV-209s or MV-309s may be substituted for MV-109s (contact Motorola distributor).
Note 5. Box built from single- and double-sided G-10 circuit board plus copper shim stock.

Fig. 5. Low-pass filter, mixer, and vco.

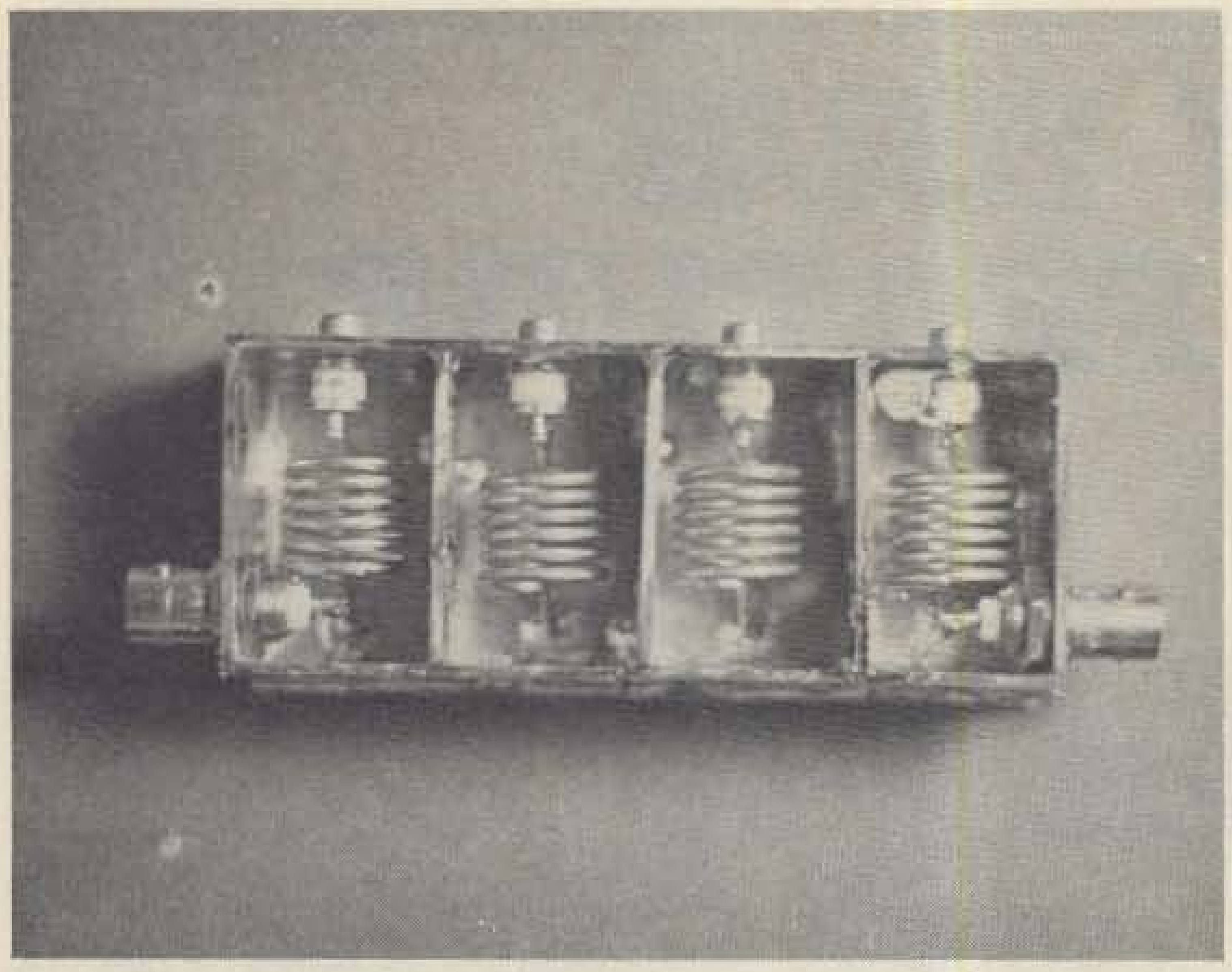


Photo F. Bandpass filter layout.

bandwidth of the filter is about 220 kHz. Insertion loss is somewhat high, but is acceptable for this application.

Preamplifier and Log Amplifier

The schematics of the preamplifier and log amplifier are shown in Fig. 7. The preamplifier consists of two wideband 2N5179 amplifiers. The log amplifier consists of six tuned 90-MHz i-f stages. Each stage uses the friendly 40673 dual-gate FET. The input stage acts as a buffer amplifier. The next five stages form the logarithmic signal-strength video detector. The log amplifier may remind you of an i-f strip in an FM receiver. In fact, it uses the limiter principle in its operation.

Notice that each stage in the log amplifier has an rf detector across its output consisting of a 50-pF capacitor, a 1N914 diode, and a 10k resistor. The rf detector on the buffer stage is just a tuning aid. The outputs of the rf detectors on the 1st through 5th log amp stages are tied to a common 1k resistor (in parallel with a 150-pF capacitor). Because of its relatively low value, the detector outputs are more or less summed across the 1k resistor.

A small input signal is amplified by all five log amp stages. Only the 5th stage will develop enough signal to provide an output from its detector. As the input signal is made larger, the 4th stage detector also will begin contributing to the output. As the output is made still larger, the 5th stage will saturate or limit. From this point it will contribute no additional voltage across the 1k output resistor. At about this same signal level, the 3rd log amp stage will begin to contribute some output, and so on. Each log amp stage provides a gain of about 12 dB until it saturates. The gain of the i-f strip, from the 1k resistor's point of view, then drops 12 dB. It is this successive limiting and dropping off of i-f stages that creates the logarithmic video output characteristic. Note that when the 1st log amp stage saturates, the log amplifier reaches its full-scale output.

I was surprised how accurately the logarithmic amplifier does track a logarithmic curve. Using my commercial step attenuator as a reference, the calibration of my logarithmic amplifier was within 1 dB. The sensitive i-f system must be shielded to prevent interference from commercial FM stations.

Power Supply and Sweep Generator Circuits

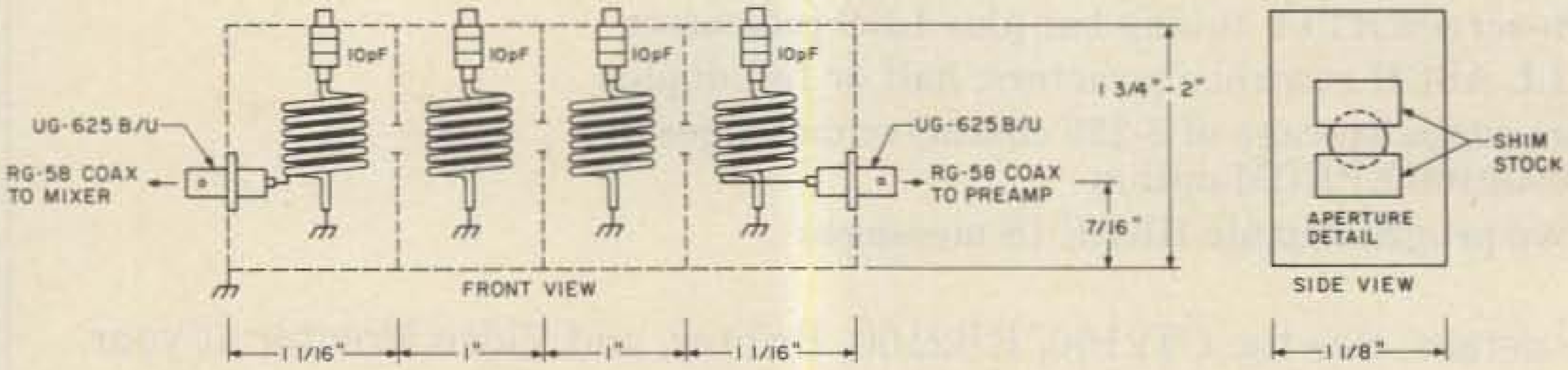
These circuits are shown in Fig. 8. The power supply is straightforward, providing +12 V dc, +24 V dc, and −6 V dc. Note the feedthrough capacitors used to filter out any rf picked up by the 12-V-ac power leads.

The heart of the sweep generator is the 555 IC timer. The two 2N2907s act as current sources. Each generates linear ramp voltages across 10-uF tantalum capacitors. The 555 synchronizes the ramps. The ramps are set at a 10-Hz-to-12-Hz repetition rate. One ramp is fed through a dc-restoring capacitor-diode clamp to the output connector for the oscilloscope horizontal (X) axis. The second ramp is fed to the 5k frequency-span potentiometer through an inverting operational amplifier buffer. The output from the frequency-span pot is summed with the output of the 5k center-frequency pot in the vco-tuning voltage amplifier. The output of this amplifier is fed to the vco-tuning voltage input.

When the ramps are reset by the 555, pin 3 of the 555 also trips the retrace VMOS clamp transistor through the retrace comparator amplifier. This shorts the logarithmic amplifier video output to ground during retrace. Otherwise, the video is fed to the output connector for the oscilloscope vertical (Y) axis. The 4th amplifier in the TL084C quad-operational-amplifier IC is used simply as a 6-V-dc reference by the other three amplifiers.

Shielded Enclosure Construction

All circuits in the high frequency spectrum analyzer except the sweep generator and the power supply must be installed in shielded enclosures. I built each enclosure for my analyzer using 1/16-inch, G-10 epoxy circuit board stock. Enclosure base plates are made from single-sided or double-sided stock. Double-sided stock must be used for the enclosure sides, ends, and partitions. (See Fig. 9 for construction details.)



Note 1. Coils are 6 turns of #12, 1/2" inside diameter, 5/8" long, taps at 1/4 turn.

Note 2. 10-pF piston trimmer, Sprague-Goodman GGP8R500 or equivalent; alternate, air-variable, Johnson 189-564-1.

Note 3. Filter box made from single- and double-sided G-10 circuit board plus copper shim stock.

Note 4. Filter box is 1-1/8" deep.

Note 5. Mount BNC connectors near front side.

Note 6. Coupling apertures are 3/8" × 3/16". Drill 3/8"-diameter holes in compartment wall pieces and then solder copper shim strips across tops and bottoms to narrow apertures.

Fig. 6. Bandpass filter.

Note the brass "cap strips." These provide a base for soldering on the thin copper (shim stock) enclosure tops. I use this method for mounting the tops so that they can be peeled back easily when I need to modify or repair circuitry. Use a 40-Watt soldering iron for soldering the enclosures together. Solder the tops on with a 25-Watt iron. Be sure the solder seams have no gaps.

Don't let the need for shielded enclosures discourage you. There are several easy, accurate ways to cut circuit board material. Beg, borrow, or buy a copy of *Printed Circuits Handbook* (Reference 4). This book does a good job of showing how to cut circuit board stock. Alternatively, make friends with a ham who owns or works at a commercial circuit board shop! Anyway, making shielded enclosures is easier than it first appears.

My original analyzer used quite a few BNC connectors. The number of connectors can be reduced by building the low-pass filter, mixer, and vco enclosures together on one base plate. Look at the schematic, Fig. 5, for shield partitioning details. Likewise, the preamplifier and log amplifier enclosures can be built together (Fig. 7). The bandpass filter should be built by itself, as should the attenuator. This arrangement allows the analyzer to be tuned up with very little test equipment.

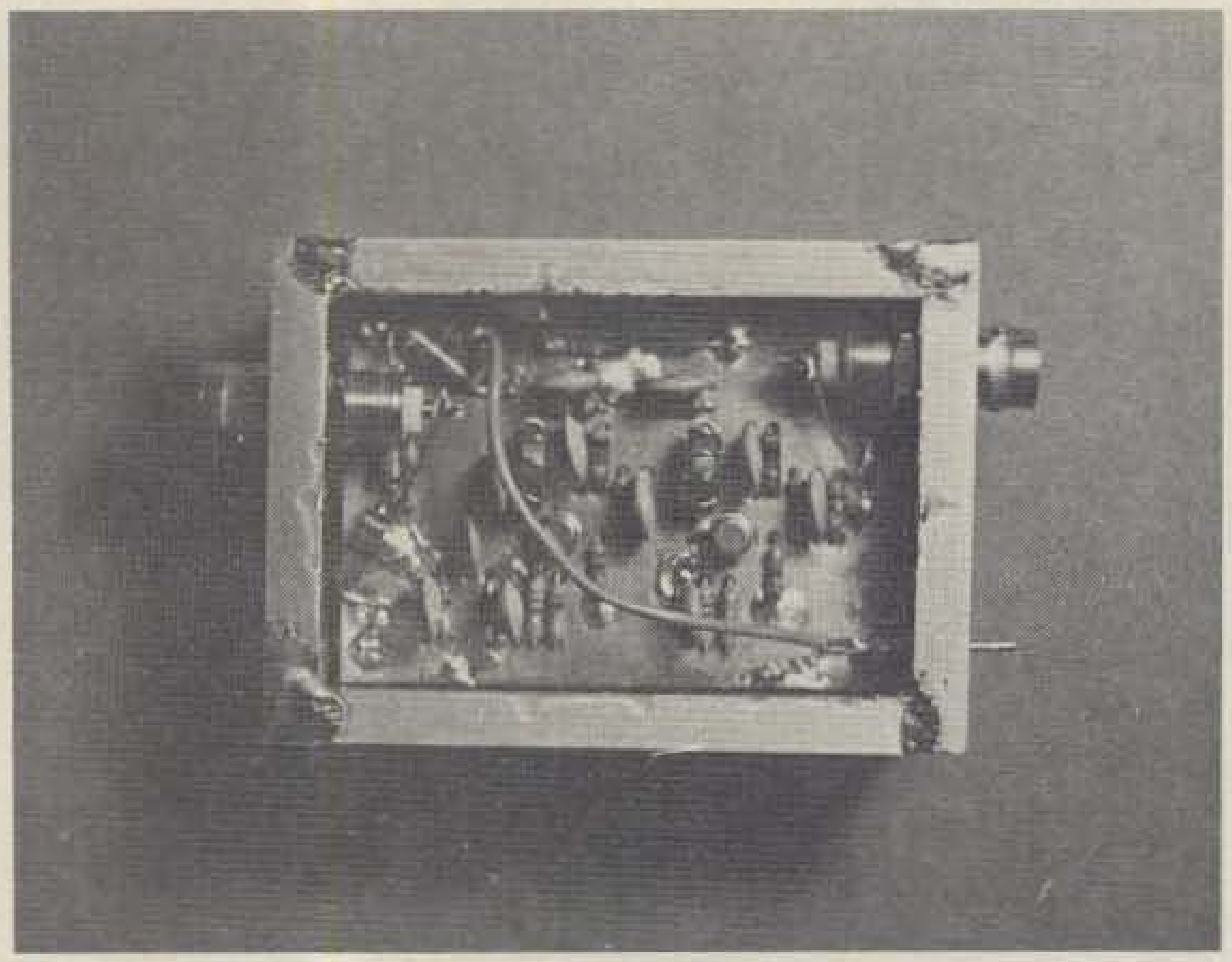


Photo G. Preamplifier layout. Note that the brass "cap strips" have been installed.

Circuit Board Layout and Construction

There are a lot of possible component substitutions for the spectrum analyzer. Some of the components you use in your analyzer will no doubt be different from the ones I used—at least in physical size. This makes standard circuit boards impractical. It is easy to lay out your circuitry for construction on single-sided circuit board stock. The copper is on the top side. It acts as a ground plane and helps stabilize the circuitry. All analyzer circuitry built in this manner was built on 1.8-inch-wide circuit board strips—lengths as needed. The low-pass filter, bandpass filter, and attenuator are built "in the air" inside their shielded enclosures. They don't need a circuit board.

Get some drafting vellum with a light blue, 1/10-inch grid on it. After you have all the parts for a circuit, you can begin developing its circuit board layout. After mulling over the schematic, lay the actual components on the grid paper and think through their interconnections. Juggle them as needed into a neat arrangement. Remember that all ground connections are going to be made on the top.

After you have the layout and interconnections visualized in an area, pick up each component and sketch in its outline on the vellum. Show its connection to other components (under the board) with dotted lines. You will be surprised how fast this goes. Remember to keep the input and output components of each rf stage separated. This is aided by using circuit board strips. Check the photos of my layout for ideas (minor circuit changes were made after some of the photos).

Once the layout is complete, tape it to your circuit board blank. Drill through the layout into the circuit board each place where a component or wire lead goes through the board. Use a #55 drill bit. After all holes are drilled, lightly countersink with a 1/8-inch drill bit all holes that are not going to be a ground connection. This keeps the leads going through these holes from shorting to the ground plane. Drill 1/8-inch holes in each corner of the board. 4-40 × 1/2-inch screws are put in these holes to act as legs for the board. Begin installing components. They are interconnected under the board by their leads and/or bus wire. Remember to keep connections as short as possible.

The vco oscillator circuit is built totally on top of the circuit board ground plane so that leads can be very short. Follow the layout in the photo carefully. The vco amplifier is built in the normal way.

I used brass tubes (bought at a hobby shop) for coil-winding mandrels. Where wiring goes through a partition on the schematics, use a 1/8-inch hole drilled in the partition wall.

After you double-check your wiring, install the circuit boards in their shielded enclosures. Tack-solder the ground plane of the circuit to one side of the enclosure. Do not install the tops of the enclosures yet—we have testing to do!

Because of the power involved, build the L-pad sampler carefully. The circuit board used to mount the resistors has no copper on either side except at the corner on the far side of the SO-239 connectors. This small piece of ground plane is covered with masking tape before the copper is etched with ferric chloride. The 51-Ohm resistor is grounded here. A ground wire is then taken from here to a lug at the BNC connector (make the lug from copper shim stock).

Mount the board using 4-40 × 3/4-inch screws. Use 5/16-inch-diameter × 1/2-inch-long aluminum tubing slipped over each 4-40 screw to stand the circuit board off. Be sure the resistor pairs are separated from each other by 3/8 of an inch. The physical layout of the resistors should look like the schematic in Fig. 3. The "fuse" wire, which is a single, hair-thin strand of copper wire from an old "zip" cord, must be at least 1/2 inch long. The L-pad is built in a medium-size minibox.

I mounted the shielded enclosures and the sweep generator/power-supply board in a 3-inch-high × 12-inch-wide × 18-inch-deep aluminum chassis. (Refer to Photo D for typical mounting.) Individual circuits are tested before final mounting and installation of the enclosure tops.

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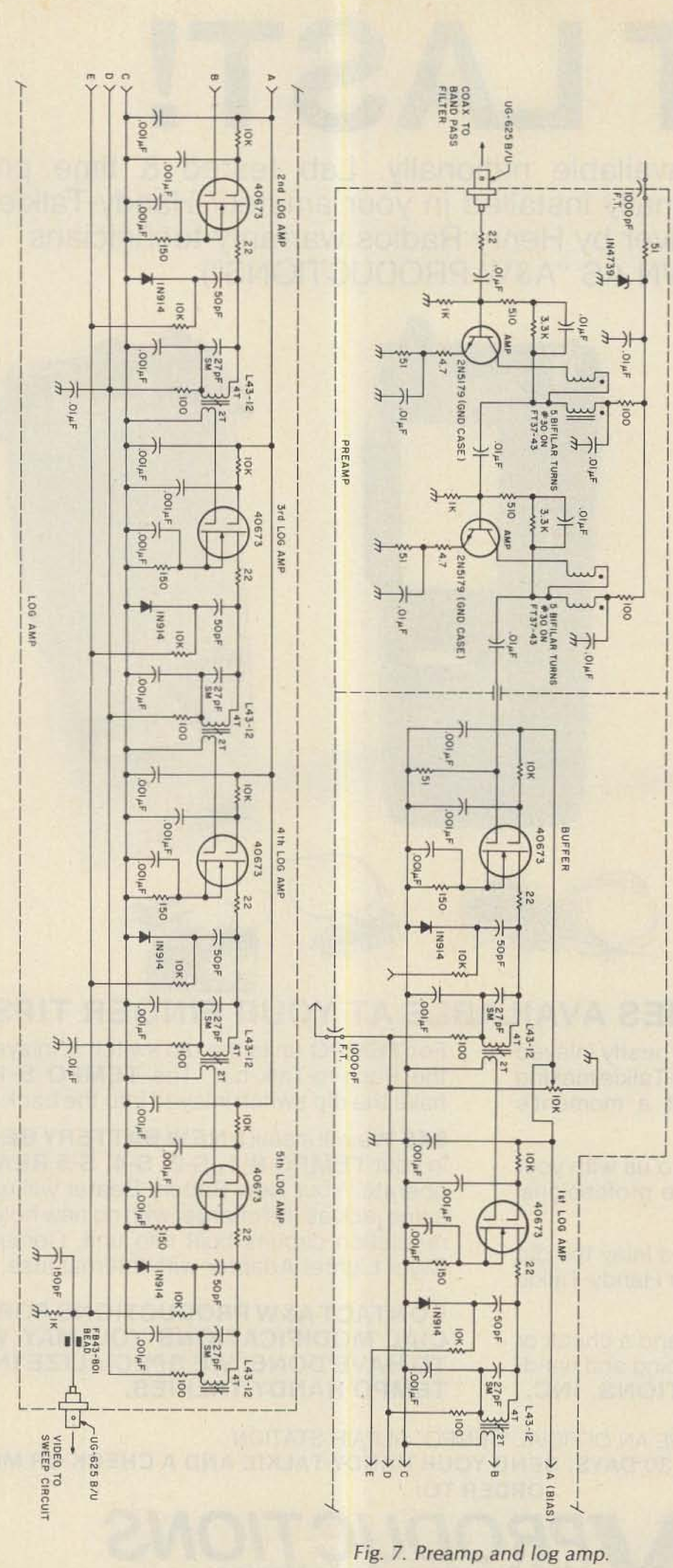
Power Supply Testing. Check the resistance between the primary and secondary of the wallplug transformer before use. It should show an open circuit. Check the secondary ac voltage. It should be 12 V ac to 15 V ac with no load. Hook the 12 V ac to the power supply and check the 12 V dc, 24 V dc, and −6 V dc outputs. They should be within 1/2 volt.

Sweep Generator Testing. Connect the power supply to the sweep generator and turn the power supply on. Check pin 2 of the 555 IC with your oscilloscope. You should find a 10-Hz-to-12-Hz ramp waveform. The bottom of the waveform should be at 4 volts and the top of the waveform at 8 volts. The front of the ramp (long slope) should appear straight. You should find a similar ramp at the X-axis output connector. This ramp will be between −0.6 volts and 3.4 volts.

Check pin 8 of the TL084C op amp. You should find a pulse train with a 10-Hz-to-12-Hz repetition rate. The pulse train should



Note 1. Resistors are 1/4 W, 5%; unspecified capacitors are 50-V ceramic.
Note 2. Capacitors marked "SM" are ± 5% silver mica.
Note 3. L43-12 rf transformers and FT37-43 toroids are available from Amidon.
Note 4. Shielded box made from single- and double-sided G-10 circuit board plus copper shim stock.

Fig. 7. Preamp and log amp.

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be high (20 volts) about 20% of the time and low (−3 volts) about 80% of the time.

Turn the frequency-span pot fully clockwise (no ramp) and set the center-frequency pot mid-range. You should find 6 V dc to 12 V dc on pin seven of the TL084C op amp (vco-tuning voltage). Vary the setting of the center-frequency pot. The vco-tuning voltage should vary from −3 volts to 21 volts. Set the center-frequency pot for a 10-volt output. Turn the frequency-span pot counterclockwise until you have a ramp waveform from 2 volts to 20 volts (readjust the center-frequency pot as needed). This completes preliminary sweep generator testing.

If your sweep generator fails to act as above, recheck component values and circuit hookup for problems. Refer to the theory of operation for additional hints.

Vco Testing. Connect the vco-tuning voltage from the sweep generator to the vco. Ground the RG-58 shield at the vco enclosure. Connect 12 V dc from the power supply to the vco power input. Disconnect one side of the oscillator coil for a moment. Power up and check the MRF901 collector voltage. It should be about 6 V dc to 8 V dc. If it is too high, reduce the value of the 100k bias resistor. If it is too low, increase the value of the bias resistor. You can't use a pot here! Once the collector voltage is verified, power down and reconnect the coil.

Power up and connect your counter to the vco rf test jack. Turn the frequency-span pot fully clockwise (no ramp) and adjust the center-frequency pot for a 3-volt output. Your counter should read about 90 MHz. Adjust the vco coil spacing to get the vco in the 89.5-MHz-to-90.5-MHz range. Check the dc output from the rf detector of the vco amplifier output for a 0.8-V-dc-to-1.3-V-dc level. Adjust the spacing between the vco coil and the amplifier pick-up loop, if necessary, to obtain the proper detector output.

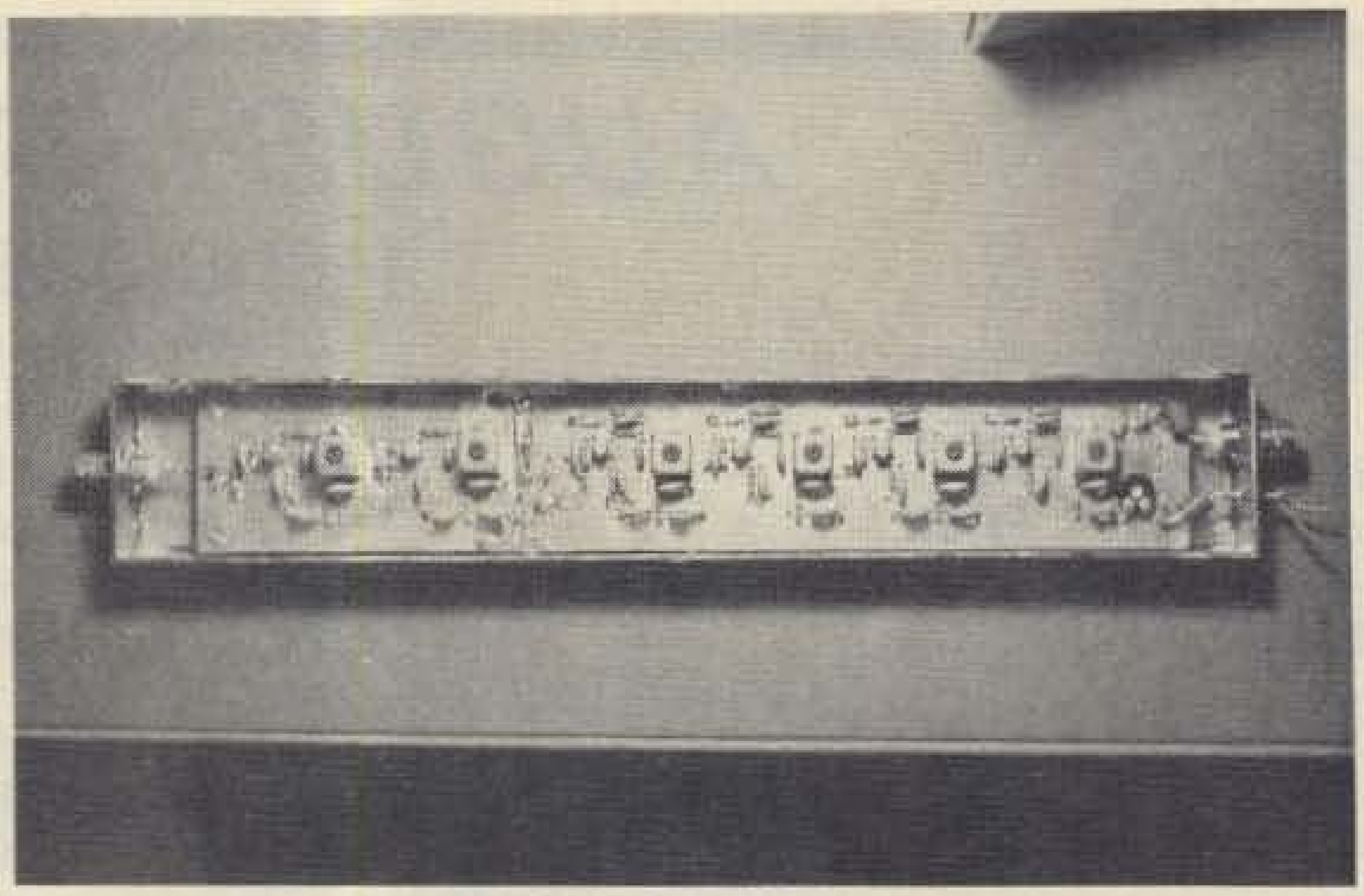


Photo H. Log amplifier layout. Note strip design.

Set the center-frequency pot for a 150-MHz oscillator output. You should have a tuning voltage of about 18 V dc. Check the rf-detector output voltage again to be sure it's still between 0.8 V dc and 1.3 V dc. Monitoring the dc voltage from the rf detector with your scope, tune the center-frequency pot back and forth between 3 volts and 18 volts. The detector output voltage may smoothly vary some but should not "jump." An abrupt voltage change indicates a parasitic oscillation. If this should occur, work with your oscillator layout (very short leads) to get rid of it.

A tuning voltage of less than 1 V dc may cause the oscillator output to be erratic in frequency and amplitude. This is not a problem. Once the vco oscillator and amplifier are operating properly, install the vco enclosure top.

Preamplifier and Log Amplifier Testing. Connect 12 V dc to the preamplifier and log amplifier circuits and power up. Turn the frequency-span pot fully clockwise (ramp off) and adjust the center-frequency pot for 90 MHz at the vco rf test jack. Disconnect the frequency counter. Hook the attenuator box to the vco rf test jack with a two-foot RG-58 cable. Hook the output of the attenuator to the input of the preamplifier with another two-foot cable.

Set the bias pot on the log amplifier about mid-range. Monitor the dc output of the rf detector on the log amplifier buffer. Tune the buffer transformer slug for peak output. Use the attenuator to set the detector output to 0.2 V dc. Now adjust the bias pot of the log amplifier for peak output. Adjust the attenuator for a just-detectable output at the log amplifier buffer. If all seems well with the preamplifier, install the top on its enclosure. Prepare the top for the log amplifier section. Drill 1/8-inch-diameter holes in the top over each i-f transformer location and over the bias pot. (Use drafting vellum as a template.)

Hook the oscilloscope to the video output of the log amplifier. Adjust the slugs in each log amplifier stage for peak video output. The tuning of each stage should be smooth, and the tuning of the bias pot should also be smooth. If the video output from the log amplifier jumps suddenly while tuning, you may have a self-oscillation in the log amplifier. If this happens, carefully work with your layout. Ferrite beads, extra bypass capacitors, and small copper shim stock shields can be used to eliminate the problem. My i-f strip was quite stable, so I do not think you will have a problem.

If you live near a commercial FM station, it may interfere with your tuning efforts. Tape the shield top on the log amplifier during initial tuning to help eliminate this problem. As soon as it appears that the log amplifier is working, solder on the top. Once the top is soldered on, it will totally eliminate the interference.

Bandpass Filter Tuning

Set the vco to 90 MHz. Hook the attenuator between the vco rf test jack and the bandpass filter input. Hook the bandpass filter output to the preamplifier and log amplifier. Monitor the video output of the log amplifier on your oscilloscope. With the tops off the bandpass sections, you should get some signal. If not, temporarily bridge the input and output sections with a 1-pF capacitor tack-soldered at the input and output tap points. Tune the input and output stages for peak response. Remove the 1-pF capacitor if used. Now peak the two middle stages. You probably will get an overcoupled response (double-hump). Just center the tuning between the humps.

Now install the shield tops, one at a time. Tune all bandpass stages after each top is installed. Tuning will become very sharp, especially if you are using air-variable tuning capacitors instead of piston trimmers. When the last top is installed, carefully peak all stages.

Set up your oscilloscope for X-Y operation, using the X-axis output of the sweep generator for the oscilloscope horizontal input and the log amplifier video output for the vertical input. Gradually turn the frequency-span control counterclockwise until you get a sweep display of the filter

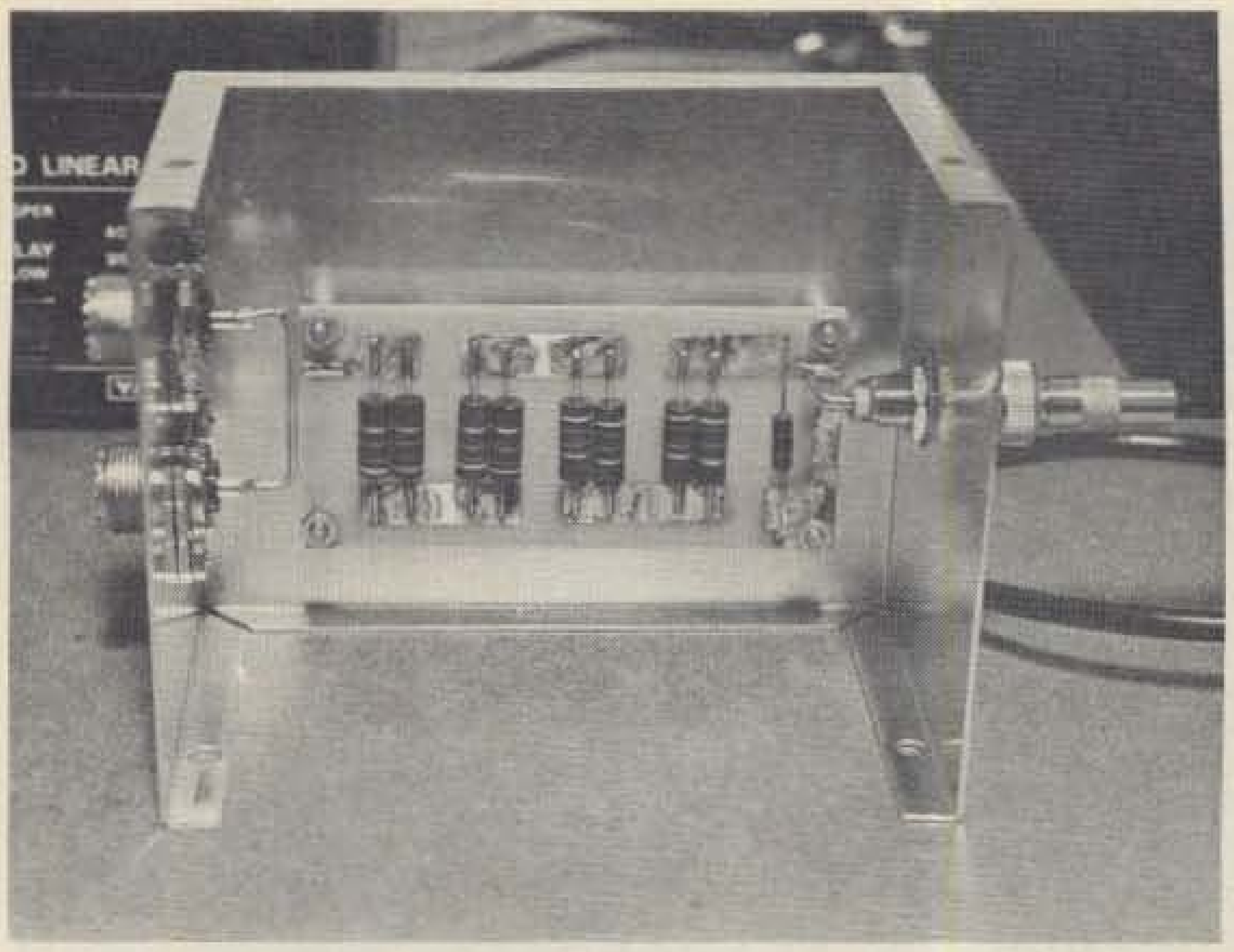


Photo I. L-pad sampler.

bandpass. Make fine adjustments for a smooth bandpass shape. Stagger-tune the two middle bandpass filter sections just a bit to sharpen the nose of the filter. Be sure to put in enough attenuation to keep the video output from the log amplifier under two volts during the bandpass filter tuning procedure.

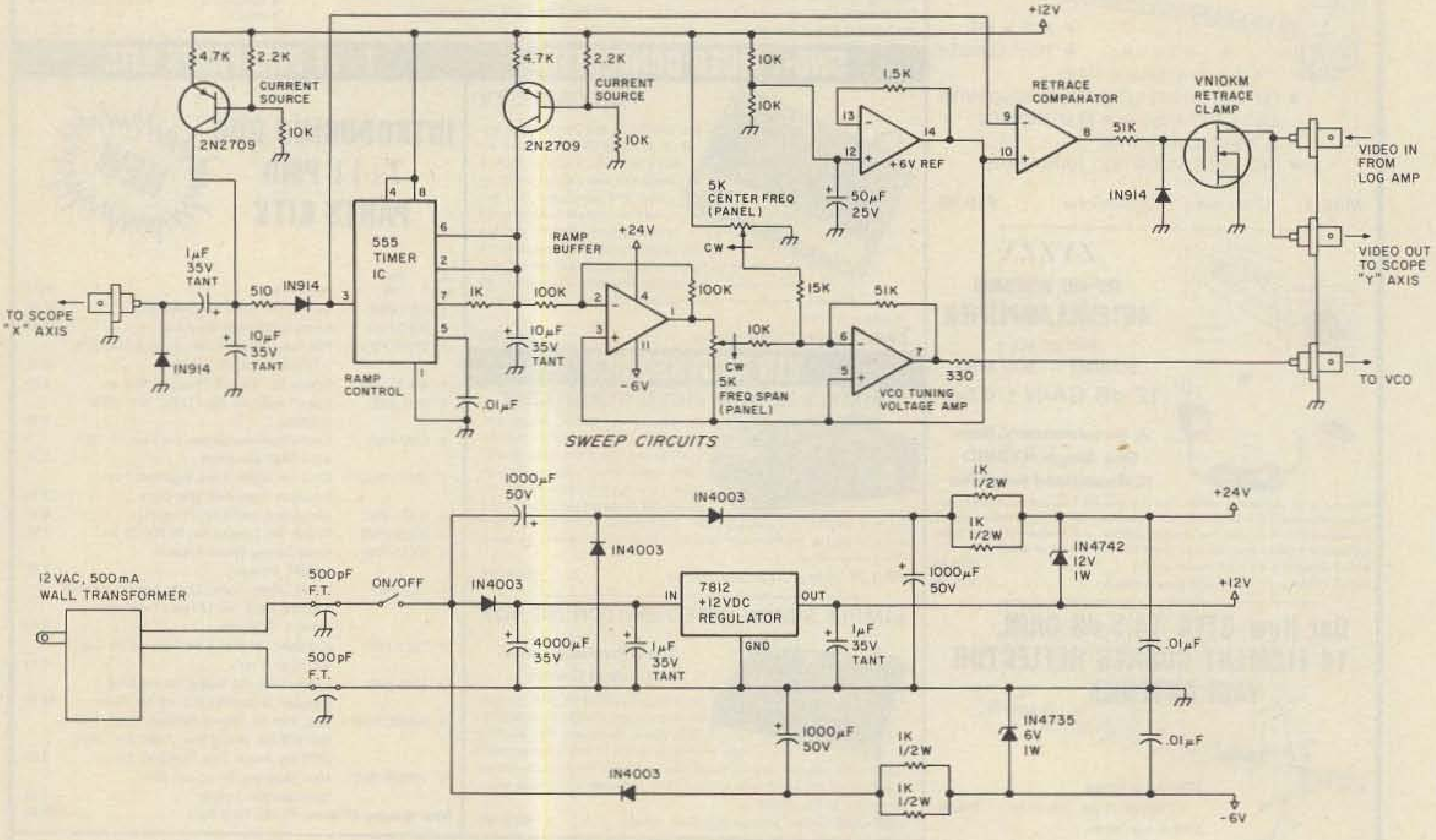
If it seems that you have an over-coupled response in your filter, narrow the aperture between the two middle bandpass filter sections. If the filter tunes sharply but exhibits high loss, then widen the aperture between the two middle sections.

Final Setup

Install all circuitry in your chassis and complete all wiring and coaxial cable hookup. Set the analyzer upside down in front of your scope. Connect your oscilloscope to the analyzer X- and Y-axis outputs. Set up the oscilloscope again for X-Y operation. Turn the analyzer on (no signal). Turn the frequency-span pot fully clockwise (no ramp). Using your frequency counter at the vco rf test jack, set the vco for 90 MHz operation with the center-frequency pot. You should see two horizontal lines about 2 volts apart. Rotate the frequency-span pot counterclockwise a little. You should see the bandpass-filter response again. This is due to mixer leakthrough and is normal.

Set the retrace line (lower straight line) under the bandpass response curve at the bottom of the CRT screen. Widen the trace with the oscilloscope controls to reach across the screen. Turn the frequency-span pot fully clockwise again. Set the vco frequency to 120 MHz. Now turn the span pot counterclockwise until the zero-frequency half-spike appears on the left side of the screen. There should also be some grass above the retrace line along the bottom on the screen. The analyzer should now be scanning 0 to 60 MHz.

Feed a small 30-MHz signal from a grid-dip oscillator (use a pick-up loop as shown in Photo J) or a low-power-signal generator to the analyzer through the attenuator. You should now see the 30-MHz signal spike about mid-screen. You may also see the 2nd harmonic of the 30-MHz signal on the right edge of the screen. Adjust the attenuator so that the 30-MHz signal is about



Note 1. Wall transformer available from Jameco.
Note 2. Other devices available from Radio Shack.
Note 3. TL084C is quad op amp.
Note 4. 500-pF threaded feedthroughs available from Alaska Microwave.

Fig. 8. Power supply and sweep circuits.

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Both Systems Provide

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You won't find as much well thought out programming, circuitry, and features anywhere, at any price! The ATR-6800 combines the best of both worlds, an easy to use video system for CW/RTTY/SSTV with automatic station control and a stand-alone computer with expandable memory & full instruction set in Motorola assembly language. Add the BASIC language option package and you'll have the unique combination of an RFI proof computer and ultimate RTTY/CW HAM station. And don't forget "easy to use." All of us at Microlog are RADIO ACTIVE on RTTY, so there's a lot of personal attention to detail and ease of operation. "Stick-on" command listing and video status display will get you on the air quick and sounding like a pro.

There's a certain thrill to using efficient, reliable digital communications equipment on the air. That's the fun of RTTY. Spice up your Amateur Radio operation with the silent video system that does it all, the Microlog ACT-1. Even if you own a home computer and are considering an outboard interface/program, remember, we've put it all in one RFI tight enclosure that's ready to go as soon as you power up. And, with the "Battery-backed" memory option, you won't even lose your pre-programmed messages if there's a "blink" in the A.C. The ACT-1 has features that the competition doesn't even have on the drawing board! Check for yourself, you could spend a lot more and still come up short.

ATR-6800 vs ACT-1

The most often asked question we hear is "What's the difference between the ATR & the ACT-1?" The ACT-1 is a dedicated system for RTTY/CW/SSTV. It provides all the functions and features you need for a multi-mode station. Along with this superior "ON-the-AIR" performance, the ATR-6800 extends your operation into the realm of automatic station control and computer programming. Plug-in applications modules expand the ATR's memory to add new HAM oriented programs which are enabled by simple keyboard commands. By adding the BASIC option package, you'll have pre-programmed full community mailbox, contest dupe sheet, personal station log, message editor, BASIC computer language and 16k of battery-backed (non-volatile) memory. We also provide a subroutine list so that you can write programs to directly control the ATR-6800 in easy to use BASIC language. The ATR-6800 then is the expandable, "do everything" system where your imagination is the only limit! The ACT-1 is designed for the HAM who needs the essentials of a complete video system for digital communications.

TECHNICAL SPECIFICATIONS ATR-6800 & ACT-1

INPUTS

Speaker Audio	100mv min.
Digital	TTL, Keyer, Hand Key
**RS232	± 12V, 330 Ohm Source

OUTPUT TO TRANSMITTER FOR CW/RTTY/SSTV

+ Voltage Keying	+ 40VDC @ 300ma Max.
– Voltage Keying	-150VDC @ 50ma Max.
**Mercury Relay	200VDC or 2 amp (20VA Max.) N.O. & N.C.
T/R Change Over	ATR — Relay ± 30V @ 2 amp N.O. & N.C. ACT-1 — Transistor + 12VDC @ 300 ma. GND on XMT
AFSK Tones, Range	Keyboard Programmable 500 Hz to 3000 Hz
AFSK Tones, Level	Mic Compatible 30-50mv Audio
Slow Scan	Mic Compatible Audio. Sync 1200 Hz, Black-1500 Hz, White-2300 Hz

MISCELLANEOUS CONNECTIONS

RS 232	± 12VDC, 330 Ohm Source Impedance, Negative Mark
Printer Driver	ATR — • Hi-speed RS-232 upto 2400 Baud • Slo-speed Baudot & ASCII Floating Relay for Current Loop Switching ACT-1 — • Slo-speed Baudot & ASCII Transistor Switch + 40VDC @ 100 ma. • Optional Hi-speed ASCII RS232 @ 2400 Baud.
Tape Recorder "Brag Tape"	Mike = 100 mv Audio Speaker = 200 mv Audio
Scope	Horizontal and Vertical Outputs to Scope for RTTY Tuning Aid
Morse Speed Tracking	Automatic or Speed Lock

VIDEO OUTPUT

1 Volt Peak to Peak, Negative Sync Composite Video (American Standard) European standard available upon request.

VIDEO FORMAT

Normal	24 lines, 40 characters per line
Zoom	12 lines, 20 characters per line
Black on White or White on Black	Keyboard selectable
Display Split Screen	Any location Line 0 (Off) to Line 20, Keyboard selectable
SSTV	3 lines, 6 characters per line + graphics

TEST MESSAGES: Quick Brown Fox and RYRY's in Baudot, U*U* in ASCII, VVV in Morse.

SYNC: Transmits "Blank-Fill" in RTTY and BT in Morse when Text Buffer is empty and unit is in transmit. Keyboard command on/off.

UN-SHIFT on Space: Automatically shifts back to "LETTERS" upon receipt or transmission of space. Keyboard command on/off.

REAL-TIME CLOCK: Keyboard set, always on screen display, hours, minutes, seconds. Can also be inserted in transmit text buffer by keyboard command.

WORD WRAP AROUND: Prevents splitting words at the end of a line. Works in receive as well as transmit.

CODE PRACTICE: Random 5 char generator sends at any speed you set via the keyboard. Hand-Key input allows use in code practice oscillator that will also read your sending!

STATUS DISPLAY can be called up to show the condition and control commands for 20 programmable parameters, such as AFSK tone freqs, UNOS, printer, etc. Useful as a "HELP" command in case you misplace the manual. There's also a constant "TOP-LINE" display of Time, Mode, Speed, & Code in use.

DETECTION MODES

Direct	Phase correlation detector with AGC controlled bandpass filter (100 Hz nominal width — 800 Hz center frequency)
Demodulator	Computer program enhanced dual tone demod. Primary tones fixed @ 2125/2295 Hz. Secondary tones variable @ 500 — 3000 Hz.
**Terminal	RS232 compatible half duplex or full duplex up to 9600 Baud

DATA RATES

Morse	5-199 WPM Keyboard selectable in 1 WPM steps. Auto speed tracking or speed on receive
Baudot	All standard 45, 50, 57, 74, 100 Baud (60, 66, 75, 100 and 132 WPM)
ASCII	110 & 300 Baud normal & synclock using internal Modem. ATR adds speeds up to 9600 Baud.
Slow Scan	8 seconds per frame

OUTPUT OPERATING MODES

Symbol	Character ouputs when typed
Word	Words sent after "Space Bar"
Line	Line sent after "Return"
Buffer	Send entire contents of text buffer

TUNING INDICATORS

Audio Ref. Tone	800 Hz Keyed Regenerated
Visual	LED on Mark (Keydown)
Scope	Tuning ellipse for RTTY

PROGRAMMABLE MEMORIES

Here is:	10-40 character messages (400 total) or *10-80 character messages (800 total) battery backed
ID:	15 characters maximum in standard ID and 17 in RTTY ID
WRU:	Up to 15 characters
Selective Call:	ATR — 4 memories, up to 15 characters each. ACT-1 — 2 memories for printer on and printer off

****COMPUTER CAPABILITY**

Memory	Standard unit has 4000 bytes of RAM for user program. Basic package adds 16K.
Language	Basic or Motorola M6800
Commands	Input; Output; Load; Go with Break Point; or Normal Basic
Tape Interface	Store Programs on Audio Cassette

POWER

115 VAC, 60 Hz 60 VA Max, Act-1, 30 VA Max (230 VAC, 50 Hz optional)
12 volt version available
External input for charging expanded battery backed memory. 6-15VDC @ 10 ma. max.

MECHANICAL

ATR-6800:	
Size	14⅜"W x 12⅛"D x 4"H
Weight	15 lb.
ACT-1:	
Size	17.8 W x 3H x 9.5D
Weight	7 lb.
ATR-6800 & ACT-1:	
Color	Beige Top, Black Base
Material	AL5052 Aluminum Alloy

*Standard on ATR, Optional on ACT-1
**Standard on ATR, Not available on ACT-1

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the same height as the zero-frequency half-spike. If things have gone well so far, you are getting a signal through the low-pass filter and mixer, so you can now install their enclosure tops.

Set the frequency-span control so that the 30-MHz signal spike is about two scope divisions wide. Now fine-tune the bandpass filter again and re-peak the log amplifier. Switch the 10-dB attenuator section in and out while adjusting the vertical gain of the oscilloscope so that the signal height changes one CRT division. Now switch a 20-dB section in and out. Signal height should change two CRT divisions. Readjust the frequency span control for a 0-to-60-MHz analyzer tuning range.

Increase signal strength until the first small spike pops out of the grass between the 0- and 30-MHz signals. This is slightly above the overload point of the analyzer. The 30-MHz signal spike should be near the top of the CRT screen (8th vertical division). Full-scale inputs should be the next (7th) CRT division down. Touch up the oscilloscope controls if necessary. The zero-frequency half-spike will be about six divisions tall. Switch all attenuation out and reduce the signal generator output so that the 30-MHz test signal is seven divisions tall. Check the vertical calibration of the analyzer over the attenuator's 59-dB range.

Using your signal generator and frequency counter, take notes on the horizontal calibration of your analyzer. This is done by centering a signal from your signal generator on each CRT horizontal division (vertical line) and recording its frequency. Your analyzer is now ready for use. But first, test the L-pad carefully!

Hook up your L-pad to your transmitting equipment. Be sure everything is grounded properly. I suggest mounting the L-pad and attenuator on an aluminum plate which is in turn wall-mounted. Ground the plate! Do not connect the attenuator to the L-pad yet. Connect your transmitter to an swr meter, the swr meter to the L-pad, and the L-pad to your dummy load. The L-pad should introduce little, if any, swr. Starting with low power (100 Watts or less), key down for 30 seconds. Power down your transmitter completely and quickly inspect the inside of your L-pad. The "fuse" should be OK and nothing should be hot. Continue testing to full station power.

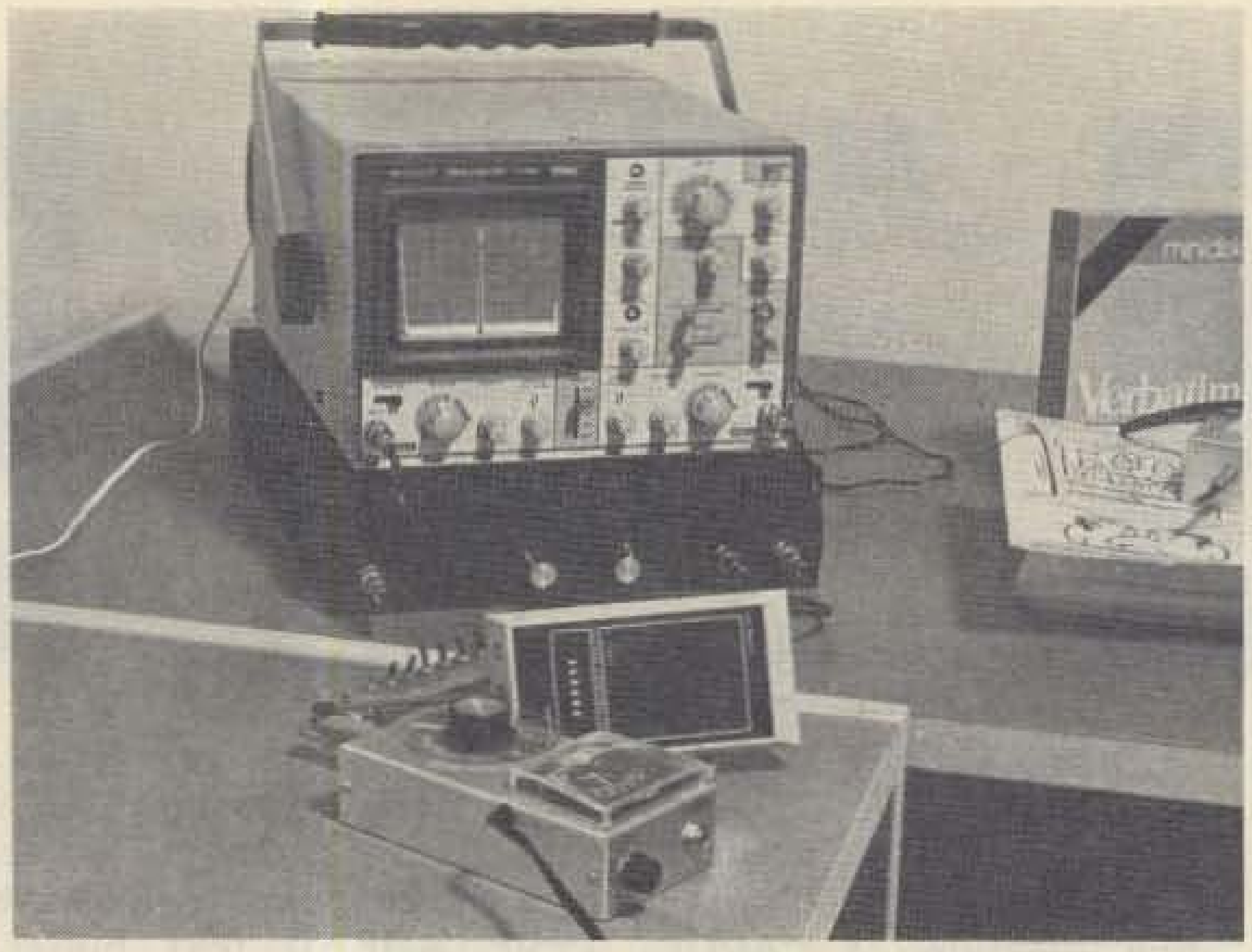
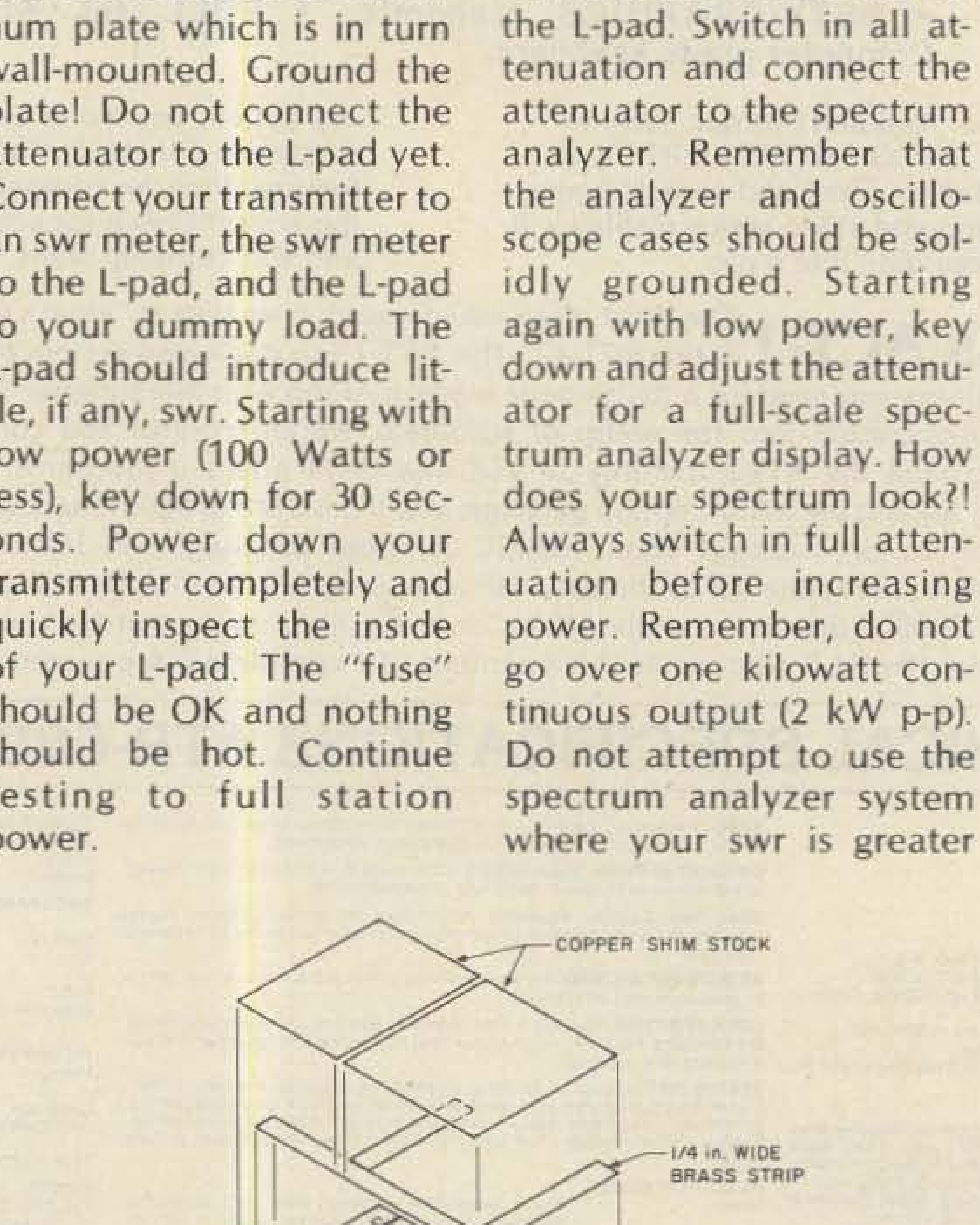


Photo J. The spectrum analyzer can easily be tuned up with simple test equipment.

If everything has gone well, then power down your transmitter completely and connect the attenuator to the L-pad. Switch in all attenuation and connect the attenuator to the spectrum analyzer. Remember that the analyzer and oscilloscope cases should be solidly grounded. Starting again with low power, key down and adjust the attenuator for a full-scale spectrum analyzer display. How does your spectrum look?! Always switch in full attenuation before increasing power. Remember, do not go over one kilowatt continuous output (2 kW p-p). Do not attempt to use the spectrum analyzer system where your swr is greater than 2:1. Always be sure you are using an L-sampler with a high enough power rating!



Note 1. Solder G-10 circuit board and brass strips with 40-W iron.
Note 2. Solder copper shim stock with 25-W iron.

Fig. 9. Shielded box construction detail.

Component Sources and Substitutions

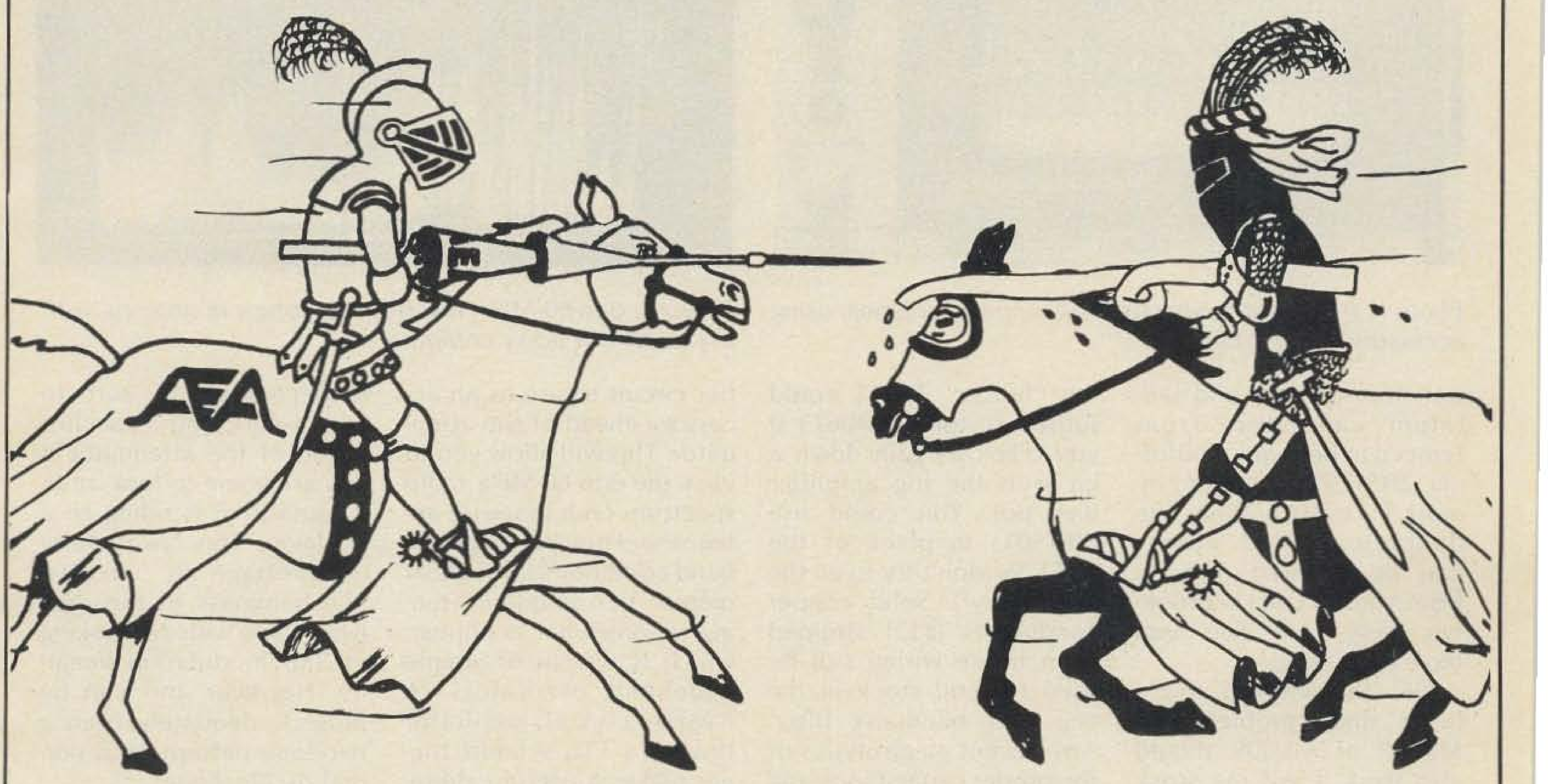
It often is lamented that home-brewing projects is difficult these days because of poor component availability. I started seriously experimenting with electronics 20 years ago in the good old days of component availability. The difference between now and then is that we have about a thousand times more components to experiment with!

It's simply a matter of motivation and tenacity. You can get any component that you need. True, Mom and Pop's local TV component place doesn't carry everything, but they may be able to order it for you. Don't be afraid to contact a manufacturer or a big distributor like Hall-Mark, Arrow, Allied, etc. They are usually glad to work with you (although order minimums can be an occasional problem). Best of all, look at the ads in this magazine. There are several dozen mail-order distributors which market primarily to the experimenter.

On specifics: You can get circuit board stock, chemicals, drill and router bits, etc., from Kepro in Fenton, Missouri. You can get MRF901s, 40673s, 500-pF and 1000-pF feedthrough capacitors from Alaska Microwave Labs in Anchorage, Alaska. You can get ferrite beads, toroids, and i-f transformers from Amidon Associates in N. Hollywood, California. Small air-variable capacitors for the bandpass filter are available from Radiokit in Greenville, New Hampshire. You can get resistors, capacitors, 555 ICs, TL084C quad op amps, VMOS transistors, and many of the parts discussed above from Radio Shack. You can get

50 db GAIN

OVER A 1/4 WAVE WET NOODLE!



It sounds ridiculous..doesn't it? Amateur Radio advertising is not exempt from exaggeration. When facts are distorted by fabrication you may be induced to buy a product that ultimately is incapable of meeting the performance claimed by the manufacturer. Caveat Emptor (buyer beware)!

The **AEA IsoPole™** antenna has 3 db gain over a dipole in free space. This is an honest and supportable claim. Yet other manufacturers claim as much as a 7 db gain for their antennas using no reference standard or a 1/4 wave antenna as reference. The 1/4 wave is not a recognized reference used by **reputable** antenna engineers because it is most difficult to properly decouple in a repeatable fashion.

The **IsoPole** antennas offer **the maximum gain attainable** for the length of antenna. This is a bold statement and one we know we can stand behind!

For any linear array antenna to outperform the **IsoPole** by 3 db or more on-the-horizon gain, it would have to be at least 20 feet long! Anything less and you can bet that advertising deception is being used.

Before you buy a VHF or UHF base station antenna, get some good **honest** facts about VHF antenna design. Send for your **FREE** copy of "Facts About Proper VHF Vertical Antenna Design" by Professor D.K. Reynolds, K7DBA. You'll be glad you did.

In the meantime, we would like to expose you to some of the comments we have received from customers that are using the **IsoPole**.

Seattle, WA — Compact & easy to install, quality & keeps XYL happy -looks good!!

Half Moon Bay, CA — Found repeaters I only heard about before from my QTH — Excellent. Amazed at light weight and low cost...

Sturgis, SD — The Isopole Antenna has exceeded my expectations.

Lumberton, NC — You really do what you say! The best 2 mtr. antenna I have ever owned!

La Habra, CA — Hooked up today, and it was a perfect match throughout the entire band. For the money, you can not go wrong.

Tok, AK — Truly a fine antenna, working better than the five element yagi it replaced.

Sacramento, CA — Assembly was remarkably easy, I needed an efficient, low profile antenna & your product fit the bill to a "T".

Warsaw, IND — AMAZED!!! Antenna ground mounted on required mast & outperforming a (R.R.) at 55' on top of tower.

Loris, SC — I'm a commercial radio salesman, and the Isopole is THE antenna I recommend.

Seattle, WA — Works well — excellent. Had (R.R.) at 80'. With the Isopole at 20 ft. I now hear repeaters and simplex I never heard with (R.R.) The Isopole will soon be at 80'.

Freehold, NJ — It is everything your ad says and more.

Great Neck, NY — Amazing difference between (R.R.), 10 db or better, raise rept. never heard before — SUPER, 73 and thanks.

Richfield, OH — Works extremely well, broke a repeater at 100 mi using 150 mw !

Vernon, TX — (The dealer) said the antenna WAS THE BEST ON MARKET and I AGREE! It IS AN EXCELLENT antenna & works to specs -Thanks.

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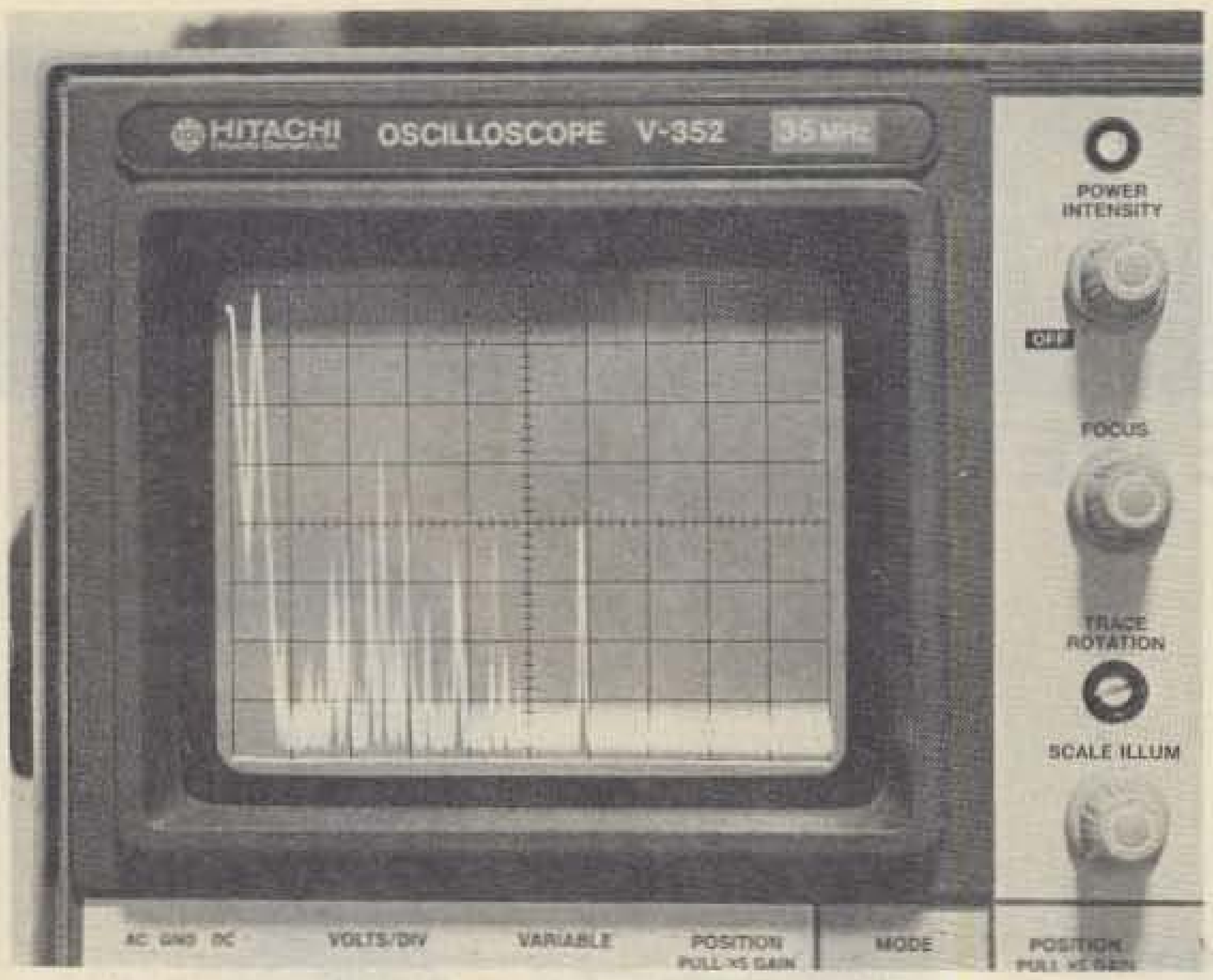

Photo K. 0-to-60-MHz spectrum on longwire antenna, using accessory preamplifier.

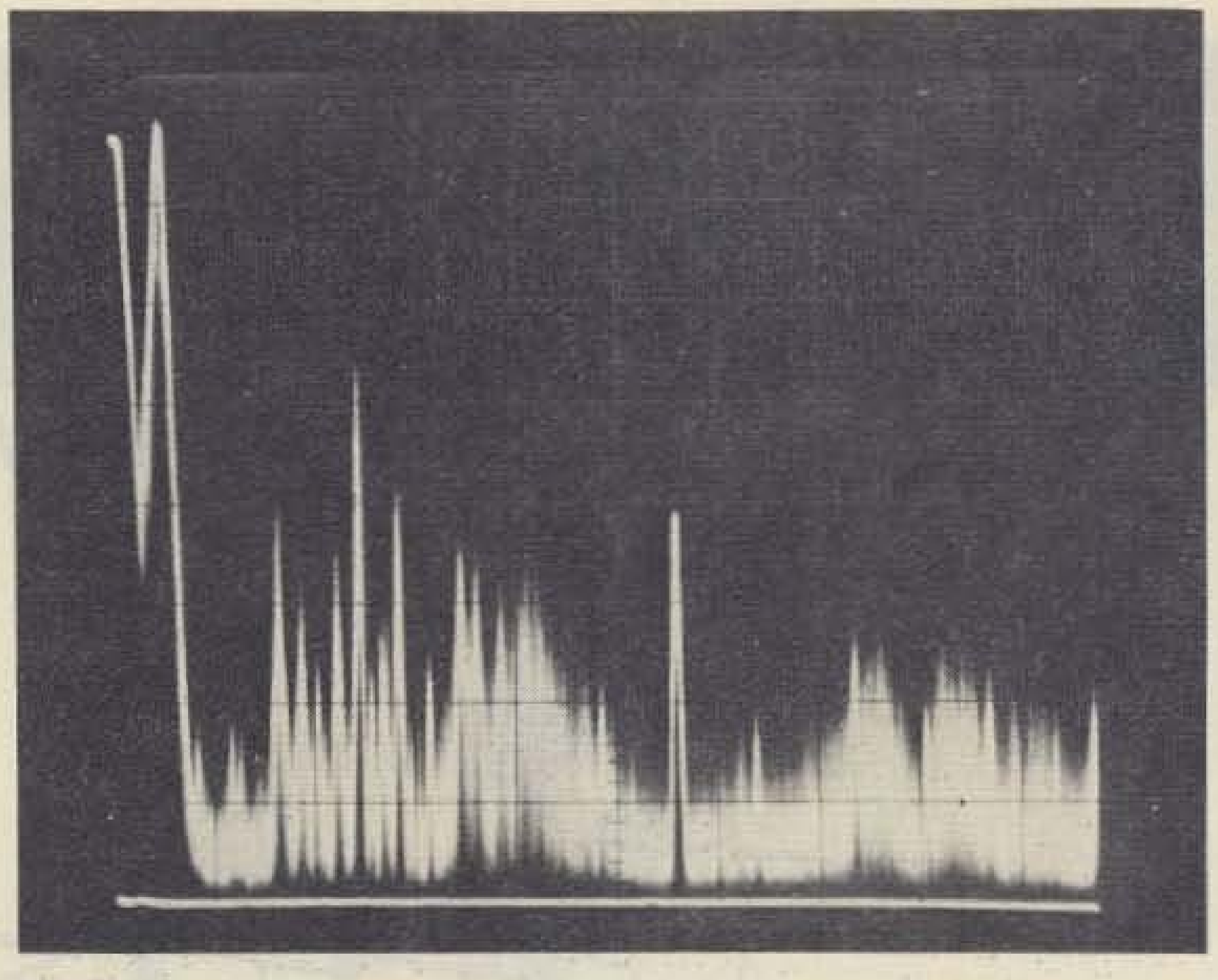

Photo L. 0-to-60-MHz spectrum on longwire antenna with my trusty but noisy computer on.

wall transformers and tantalum capacitors from Jameco in Belmont, California. 2N5179s are carried by most TV parts houses. The double-balanced mixers can be ordered directly from Mini-Circuits in Brooklyn, New York. See, you have no excuse!

OK, the MV109s might be a slight problem. An MV209 or MV309 should also work. I got my stock from Hall-Mark. If you run into a problem getting these diodes, pick up the phone and call Motorola Semiconductor in Phoenix, Arizona, for help.

The high frequency spectrum analyzer should be fairly tolerant of component substitutions except in the vco oscillator circuit and the L-pad. For example, the "hotter" 3N211 could substitute for the 40673 if you crank its gain down a bit with the log amplifier bias pot. You could use MRF901s in place of the 2N5179s (don't try to go the other way!). Solid copper conductors (#12) stripped from house wiring can be used for coil stock in the vco and bandpass filter. Any decent electrolytics of the proper capacitance and voltage rating can be used in the power supply and sweep generator circuits. Electrolytics could also be used in place of the tantalum capacitors in a pinch. Try to get close-tolerance parts in this case.

Useful Accessories

You can duplicate the 2-stage wideband-preamplifier circuit to use as an accessory ahead of the attenuator. This will allow you to view the 0-to-60-MHz radio spectrum on a longwire antenna and quickly judge the band conditions through six meters. Vco frequency-tuning is somewhat nonlinear, which is typical of simple wideband oscillators. A 6-MHz crystal oscillator driving a TTL Schmitt trigger makes a useful calibrator. The output of the TTL gate contains every harmonic through 60 MHz. Lightly couple the TTL gate to the spectrum analyzer input with an insulated wire antenna placed near the analyzer input connector. A momentary-on push-button can be used to activate the calibrator.

Specifications for HF Spectrum Analyzer

Frequency range	0 to 60 MHz
3-dB bandwidth	220 kHz
30-dB bandwidth	1,100 kHz
3:30-dB shape factor	1:5
Dynamic range	60 dB
Spurious responses	60 dB below full-scale
Noise floor	65 dB below full-scale
Full-scale input	−8 dBm ±2 dBm
Y-axis output	0 to 2.5 volts
X-axis output	−0.5 to +3.5 volts
Y-axis calibration	10 dB/division
X-axis calibration	6 MHz/division (approximate)
0 to 8 MHz	4 MHz ± 0.75 MHz/division
8 to 24 MHz	8 MHz ± 1 MHz/division
24 to 60 MHz	6 MHz ± 1 MHz/division

Analyzer Applications

We have talked about using the HF spectrum analyzer to monitor transmitting equipment. This was the primary application I had in mind when I designed the analyzer. It is especially useful to hams who are home-brewing their own HF transmitters or linears. It is also useful for checking low-pass filter performance and band conditions. I'm sure you will find other applications.

The analyzer has a 50-Ohm input impedance and is dc-coupled. Be sure to add a blocking capacitor ahead of the attenuator if you are going to look at an rf signal that is riding on a dc level. Stay away from high-voltage dc circuits. The bandpass of this analyzer is too wide for looking at SSB modulation linearity. However, this can be judged adequately from a two-tone pattern on a normal oscilloscope.

From Here

This project demonstrates that a useful spectrum analyzer can easily be built from relatively common and inexpensive components. Avid experimenters should treat this design as a starting-off point. Meanwhile, let's get those transmitter spectrums cleaned up! If you would like to ask me a question about the analyzer project, please send an SASE. 73! ■

References

1. *Solid State Design for the Radio Amateur*, by Wes Hayward and Doug DeMaw, ARRL Publications.

2. *Hewlett-Packard Electronic Instruments and Systems*, by Hewlett-Packard, Palo Alto, California, 1981.

3. "High Performance Spectrum Analyzer," Wayne Ryder, *Ham Radio*, June, 1977.

4. *Printed Circuits Handbook*, 2nd Edition, by Clyde F. Coombs, McGraw-Hill.

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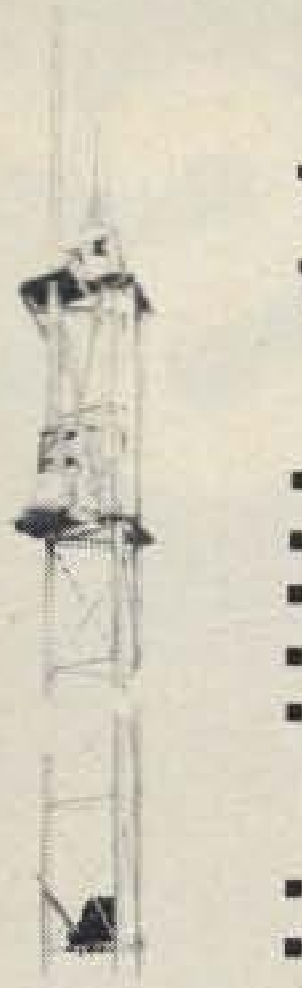

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NOVAX II

NOW TWO MODELS TO SERVE YOU BETTER

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NOVAX interfaces your standard 2 meter; 220; 450; etc. Base station and telephone, using a high speed scan switching technique so that you can direct dial from your automobile or with your HT from the backyard or poolside — Automatically ... Easy installation transceivers, featuring solid state switching, offer best results ... Available interfaced with an ICOM 22U.

FEATURES	NOVAX I	NOVAX II
• 3 min. Call duration timer	YES	YES
• Up to 45 sec. activity timer	YES	YES
• Single digit Access Control	YES	NO
• DTMF (Touch Tone)* phone connection	YES	YES
• 4 digit Access Control	NO	YES
• Toll Restrict	NO	YES
• LED Digital Display	NO	YES
• Vinyl covered alum. case size	5" x 6" x 2"	10" x 8" x 1¾"
• Directly Interfaces with Repeater	NO	YES
• Rotary Dial System (incl. Last digit dial)	NO	YES—"Option"—$49.95
• Ring Back (reverse autopatch) "Option"	YES—$39.95; Kit $29.95	YES—Wired—$39.95
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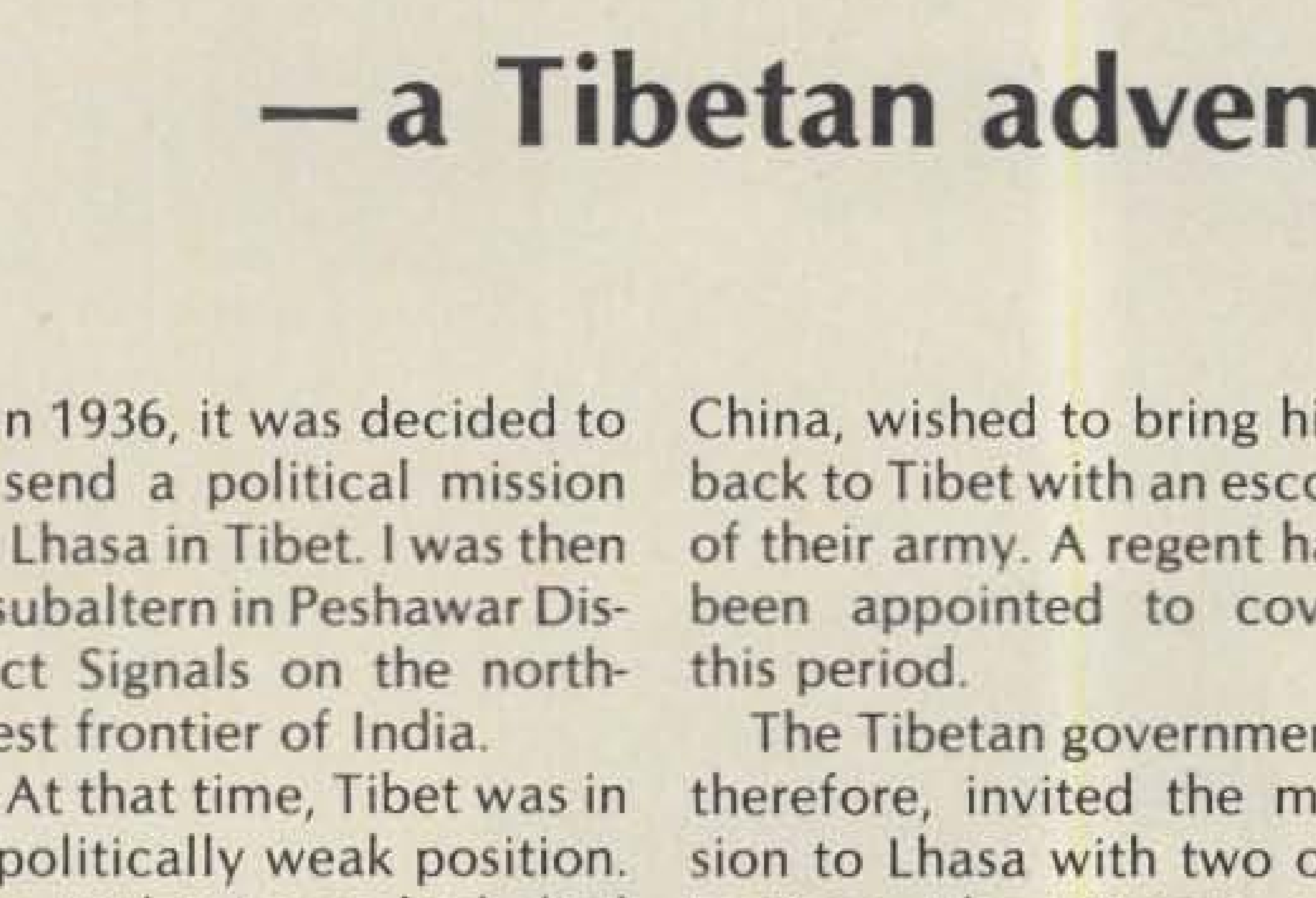
The AC4YN Story

—a Tibetan adventure, circa 1936–1937

In 1936, it was decided to send a political mission to Lhasa in Tibet. I was then a subaltern in Peshawar District Signals on the northwest frontier of India.

At that time, Tibet was in a politically weak position. The Dalai Lama had died and his reincarnation had not yet been found. The Tashi Lama was on a visit to China, and the Chinese, who had always considered Tibet to be a province of China, wished to bring him back to Tibet with an escort of their army. A regent had been appointed to cover this period.

The Tibetan government, therefore, invited the mission to Lhasa with two objectives. The primary one was to persuade the Tashi Lama to return to Lhasa, to march out beyond Lhasa, meet him, and bring him back to Lhasa in triumph without an escort of the Chinese army. The second objective was for us to review the Tibetan army and advise on its improvement with a view to making Tibet a more effective buffer state between the northeast frontier of India and China.



G5YN (ex-AC4YN, VUQ, VU2YN, LA9YC, VS1YN, DL2YN) at home.

The political side of the mission was handled by the leader, the late Sir Basil Gould, who, at that time, was B. J. Gould, Esq., political officer, Sikkim, and by H. E. Richardson, Esq., British trade agent, Gyantse, the late Col. Freddy Spencer Chapman, personal assistant to Gould, and Rai Bahardur Norbhu, a high-ranking English-speaking Tibetan.

The health of the mission was in the hands of Captain W. S. Morgan of the Indian Medical Service. While the mission was in Lhasa, he also did a great deal of work for the Tibetans. He held many clinics and carried out many successful operations for cataracts under what, by modern standards, would have been considered very primitive conditions.

Military matters were in the hands of Brigadier Philip Neame VC DSO, and communications were looked after by Lieut. Sidney Dagg and myself.

Communications in Tibet were rudimentary. The Indian Posts and Telegraphs operated as far as Gyantse, where the British trade agent had his post supported by a squadron of Indian mounted infantry. Beyond Gyantse, the mail was carried by mounted runners. A telegraph line operated as far as Lhasa. It was a single strand of galvanized iron wire supported on light wooden poles with no special insulation. It operated single-current simplex earth return. One could tap in not only at Gyantse, but also at each rest house along the route. Mounted linemen patrolled the route re-erecting any poles that were blown down and repairing breaks in the line.

If we went beyond Lhasa, we would no longer have access to this circuit. It would therefore be necessary for us to take transportable wireless with which we could send back our diplomatic traffic. Another important reason for taking wireless on the mission was to outface the Chinese. They had a transmitter at Lhasa although I never heard it. As it happened, we never went beyond Lhasa. The Tashi Lama died before we succeeded in persuading the Chinese not to send an escort of their army.

The responsibility for producing radio equipment was given to Northern Command Signals; Lieut. Sidney Dagg of that regiment was given the task. As no suitable service equipment was available, he had a transmitter and receiver built in the regimental workshops at Rawalpindi. It must be remembered that everything was carried on pack animals—ponies or yaks—in panniers two to an animal, each one not weighing more than one maud (80 lbs.).

Dagg produced the following equipment:

- The main transmitter, consisting of a self-excited push-pull Colpitts oscillator using two AT-50 triodes with an input of 100 Watts.
- A balanced Collins coupler to couple the transmitter to the open-wire aerial feeders.
- An Eddystone "All World Four" (1-V-2) battery receiver.
- A rotary transformer to convert 12 volts dc to 1000 volts dc at up to 100 milliamps.
- A Phillips record player—turntable, pick-up, and amplifier—operating on 230 volts ac.
- Two twelve-inch moving-coil loudspeakers. (We had baffles made locally on arrival.)
- One transverse-current carbon microphone.
- One 12-volt dc to 230-volt ac rotary converter.
- One 550-Watt Stuart Turner charging engine.
- Four six-volt, 120-Ampere-hour batteries.
- Two 36-foot steel sectional masts.
- Lots of aerial wire, insulators, and Eddystone 4-inch feeder separators.

I brought a few things of my own from Peshawar:

- A 1-V-1 receiver which I had built myself. This covered 10 to 550 meters using Eddystone plug-in coils. The tuning control was a Utility 100:1 slow-motion dial. The receiver proved much more efficient than the All World Four. The tuning and reaction controls were much smoother and the signal/noise ratio very much better. Much to my sorrow, I was made to leave it behind when I left the mission.

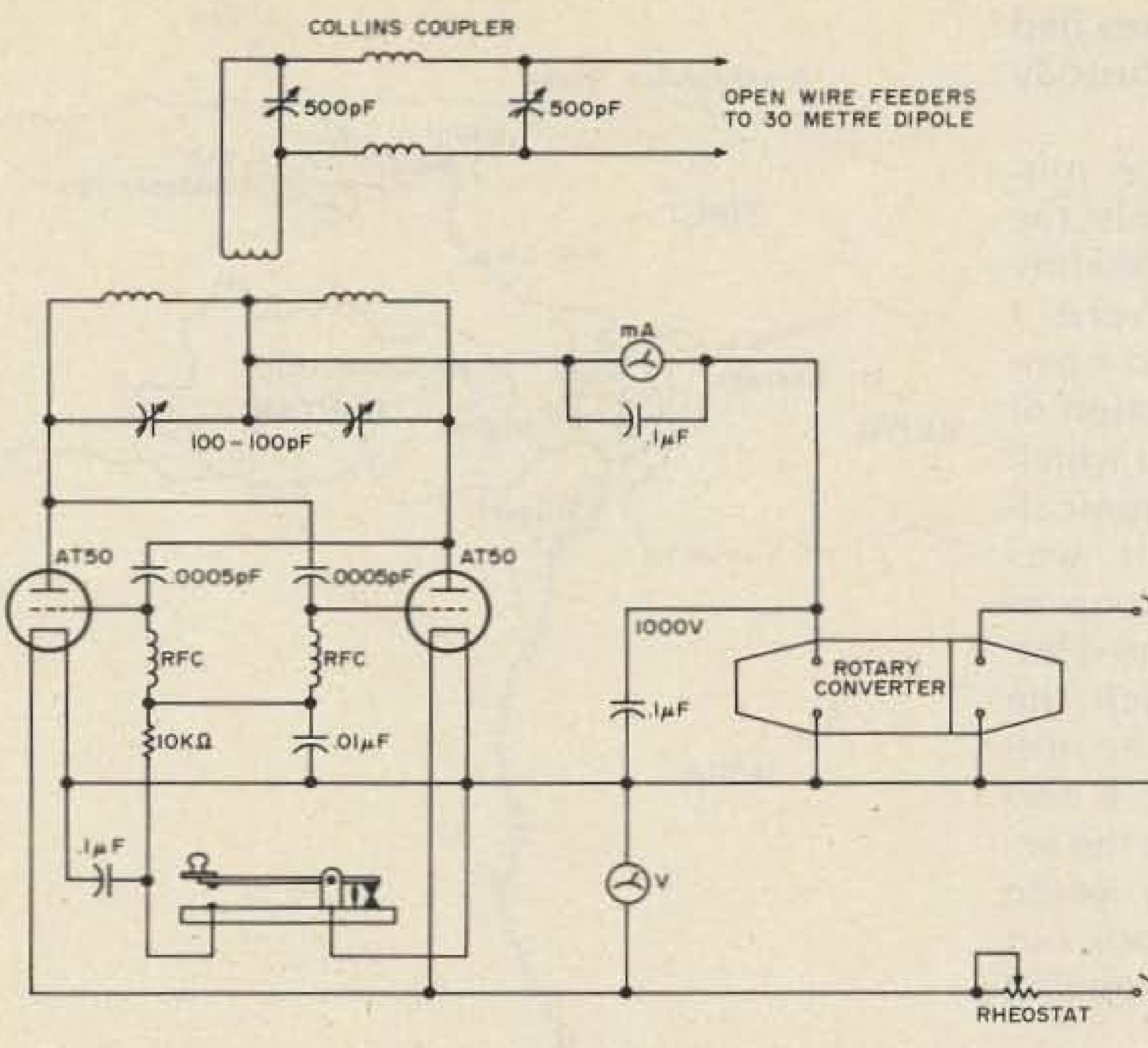


Fig. 1. AC4YN transmitter.

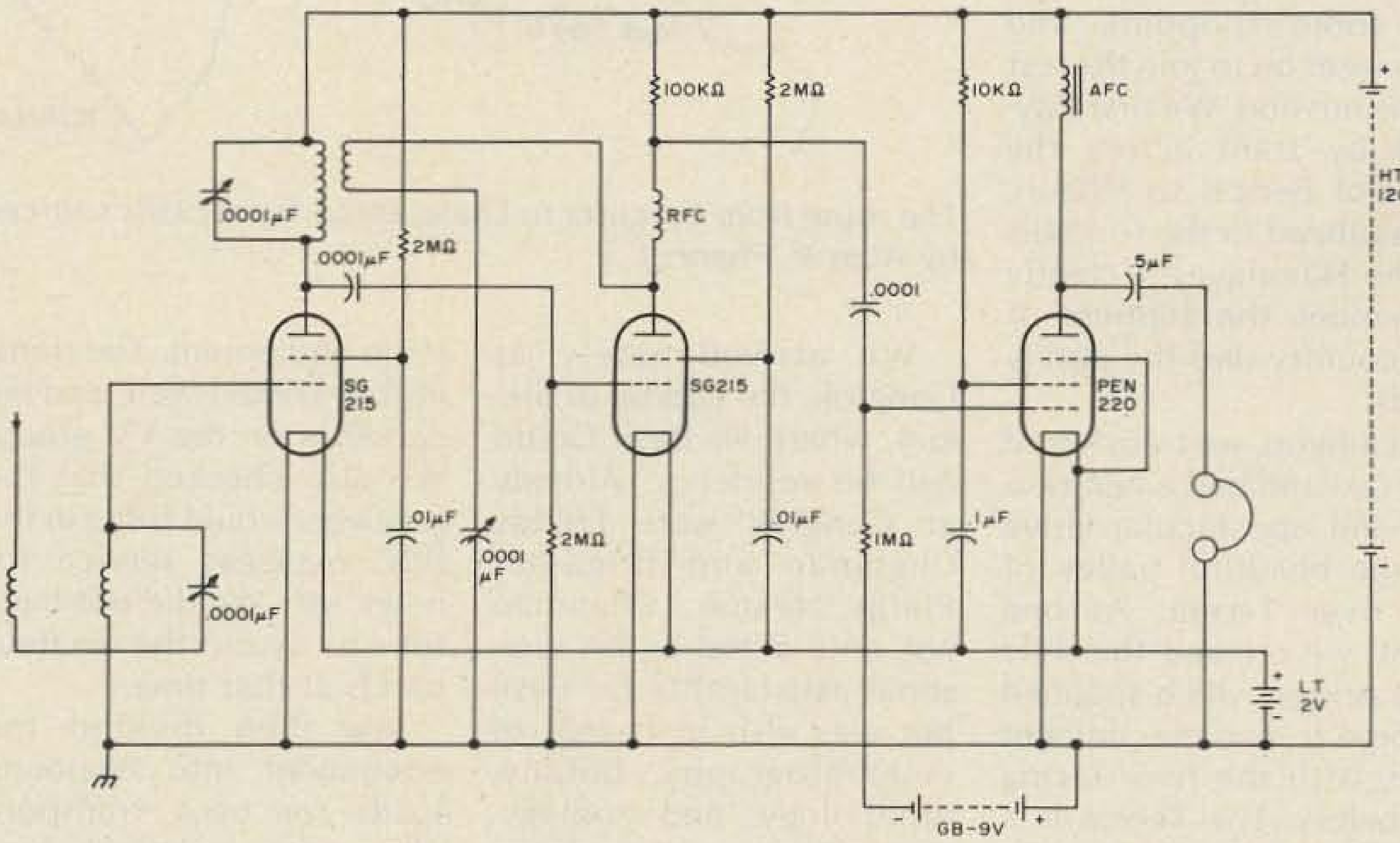


Fig. 2. AC4YN receiver.

- A simple audio amplifier ending in two PX-4 triodes in push-pull to enable my receiver to operate a loudspeaker for broadcast reception.
- 45 feet of duralumin tubular mast in 5-foot sections, the property of Peshawar District Signals. I had to leave this behind also, much to the fury of my commanding officer.
- My own key, a pair of headphones, and a small box of bits and pieces. Unfortunately, I no longer have this key as the Post Of-

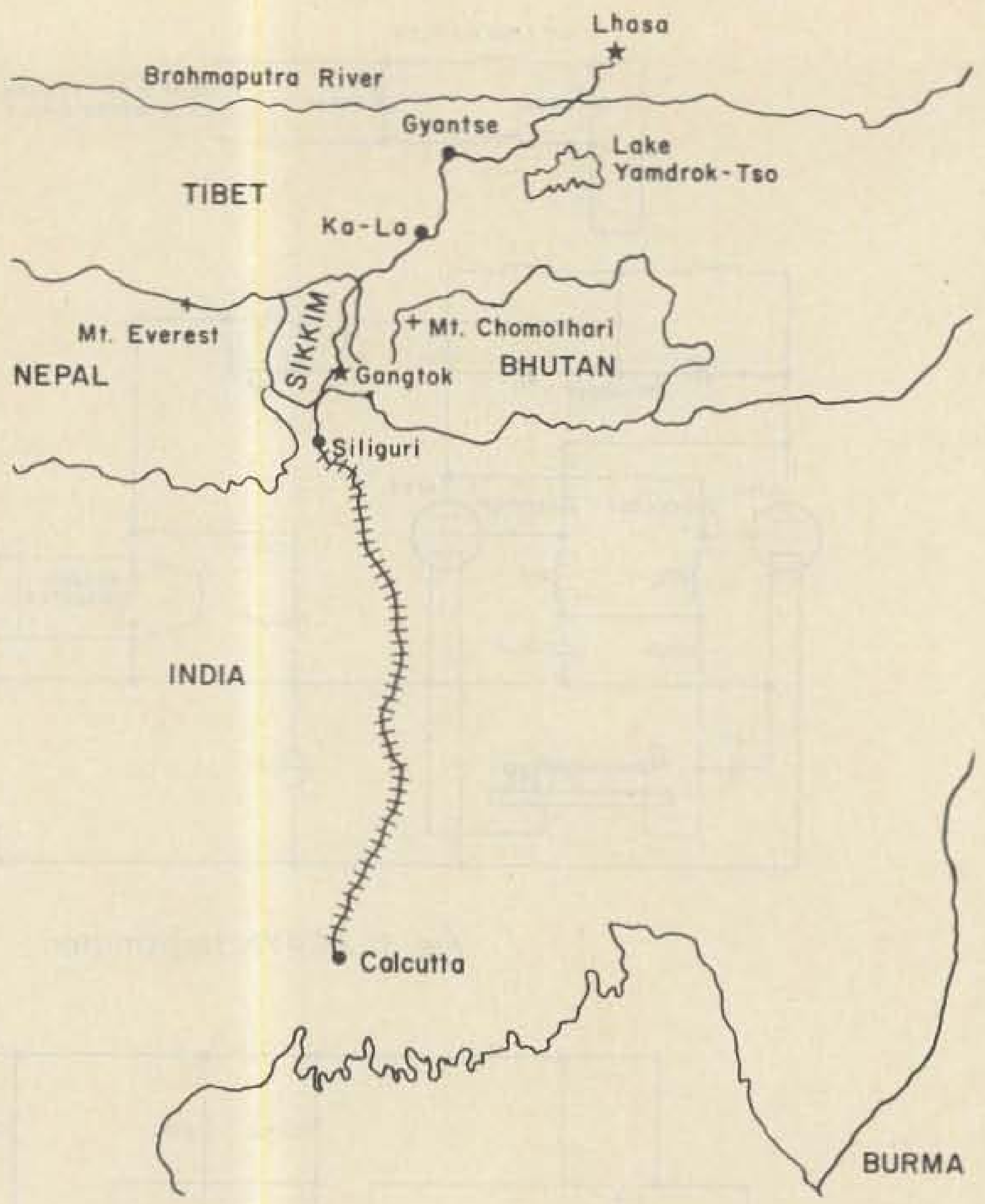
View from roof of rest house at Phari Village and jong in middle distance. Himalayas in background.

fice "lost" it when they had my equipment in custody during the last war.

Before joining the mission, I was sent to Simla, the summer hill station of army headquarters. There I gained experience in operating the control station of the army group with which we would be communicating from Lhasa. It was known as the VV group as all stations had a three-letter callsign, of which the first two were VV. The mission call was VUQ. I also was briefed to check the accuracy of *The Army Route Book of Tibet* and look out for any possible landing grounds.

From Simla, I travelled across India to Calcutta where I joined Dagg. We did some shopping and then went on to join the rest of the mission. We first traveled by train across the Plain of Bengal to Siliguri, the railhead in the foothills of the Himalayas. I chiefly remember the flatness of the country and the paddy fields.

At Siliguri, we transferred to a taxi and had a hair-raising and spectacular drive up the beautiful valley of the river Teesta. At one point, we crossed the river by a bridge which spanned a gorge in one magnificent arch, with the river racing far below. The Teesta is a tributary of the Brahmaputra.



The route from Calcutta to Lhasa. (Map from 1930s sources by Alan R. Phenix.)

We arrived safely at Gangtok, the capital of Sikkim, where Sir Basil Gould had his residency. Already at Gangtok were Freddy Chapman and Brigadier Philip Neame. Chapman not only acted as PA [personal assistant] to Sir Basil but was also in charge of cinematography, botany, ornithology, and zoology. Here, Dagg and I took the opportunity to check our radio equipment. The transmitter worked well, and we called in on the VV group. We also checked that the receivers would bring in the BBC overseas service for news, etc. We did not have time to try out the amateur bands at that time.

We then divided the equipment into 80-pound loads for back transport. The most awkward load was the charging engine, which weighed 120 lbs. In the Army, this was carried as a top load on a Class I mule. However, we had no proper pack saddles and the ponies would not have been strong enough. Finally, it was lashed to two stout bamboo poles and carried by four coolies.

When we set off, our entourage down to the last servant and sweeper was 50 strong, including 25 pack animals and their drivers. These were ponies at first and yaks later. In those days, the motor road ended at Gangtok, so from then on we either walked or rode.

As far as the halfway point, Gyantse, there were good rest houses at each stage in which we could spend the night in comfort. The first day's journey was through rain forest, where rhododendrons grew in thirty-foot trees and leeches abounded. The first halt was at Karponang at 9,500 feet, just short of the Tibetan border. I remember suffering from mountain sickness here, but it passed off in about half an hour.

Next day, we crossed into Tibet by the Natu La Pass at 14,600 feet and dropped down into the Chumbi Valley. Over the pass it was much dryer as the monsoon drops most of its moisture on the southern slopes of the Himalayas, leaving Tibet a comparatively dry country with only a few inches of snow despite a very hard winter.

Lieut. Dagg unpacks and tests record player at an intermediate halt. Freddy Chapman at right.

How the charging engine traveled to Lhasa.

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In the valley, we spent three nights, one at Champitung, 13,350 feet, another at Yatung, 9,950 feet, and a third at Gautsa, 12,600 feet. At Yatung there was a detachment of Indian mounted infantry. The next day we climbed up out of the valley on to the main Tibetan plain at 14,300 feet. We stopped the night at Phari, which was a small town with a fort, or jong, and a good rest house.

At each of these halts, Dagg and I set up a receiver to check on the VV group and take down news broadcasts from the BBC. It was a year after sunspot maxima, so HF propagation was good and there was nothing unexpected about what we heard. The only embarrassment was the charging engine. Dagg had been given no chance to test it at high altitude, and as we gained height, it developed less and less power due to shortage of oxygen. At 6,000 feet it would just work. At 10,000 feet it would start and run when cold. As soon as it warmed up it stalled, and that was that.

We sent a signal home to Stuart Turners who, in due course, sent out a pair of variable-jet carburetors. They did not arrive until after I had left the mission, but I was told that when they were fitted the engine ran very well, developing more than its rated power.

Tibetans working the hand charger.

The transmitter, receiver, and Collins coupler installed in the barracks at Gyantse.

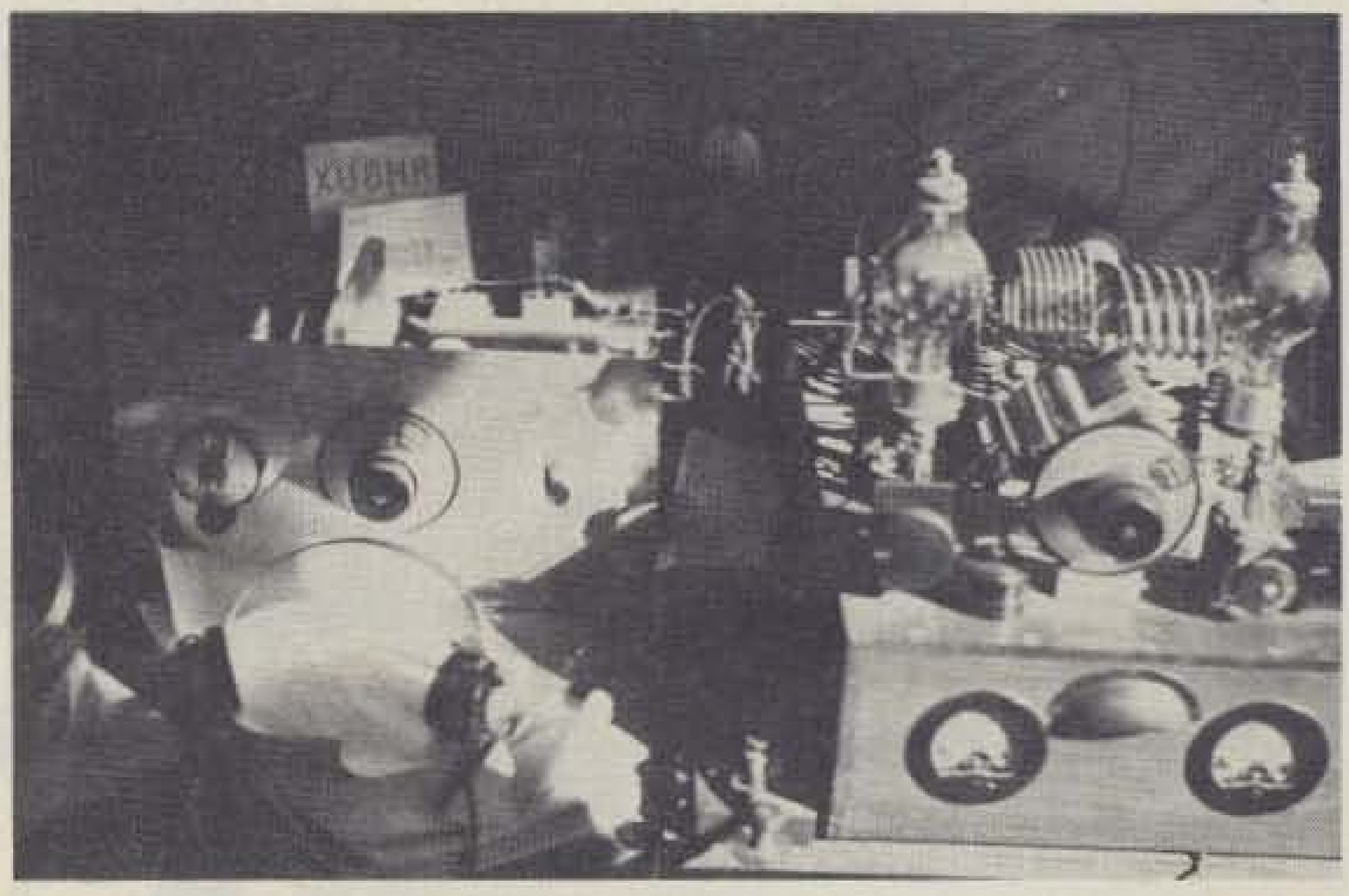
While Dagg and I were dealing with radio matters, Chapman was studying the local fauna and flora. In due course, he sent back a magnificent collection of seeds and pressed flowers to Kew Gardens.

There were six more night halts before reaching our major intermediate halt at Gyantse: Tuna, 15,000 feet, Dochen, 14,900 feet, Kala, 14,850 feet, Samada, 14,100 feet, Kangmar, 13,900 feet, and Saugang at 13,000 feet. Gyantse itself was at 13,100 feet. The way was mainly over a stony plain with mountains rising to 20,000 feet in the distance. Sometimes we passed through rocky gorges and occasionally by streams. We passed close under Mt. Chomolhari, a beautiful snow-covered cone rising to 24,000 feet.

Gyantse is a fair-sized town with monasteries, a jong, the headquarters of the British trade agent, and barracks for a company of Indian mounted infantry, at that time the 2/7 Rajputana Rifles. Here several official receptions took place. For instance, we had to time our arrival carefully so as to be three miles from the town at 11:00 am. We were met here by Raja Tering, a cousin of the Maharajah of Sikkim. Half a mile further on, we were met by Mr. Richardson (the British trade agent), Capt. Salomons, an escort of mounted infantry, and Capts. Guthrie and Morgan of the IMS, the Army surgeons. Captain Morgan accompanied us for the rest of the mission. A mile further on, the eastern and western jongpens met us, and finally the Tibetan trade agent and the Abbot of Gyantse Gompa. This order of precedence is very strict. The most senior official meets you nearest your destination and the most junior farthest out. On each occasion, ceremonial scarves of white natural silk are exchanged.

Here, Dagg and I were able to have a thorough sort-out of our gear. We cut

View of my tent, home of AC4YN, in the garden of the Dekiy Langka at Lhasa.



The transmitter and receiver, VUQ/AC4YN, in my tent at Lhasa.

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Using the PA equipment. The monk who enjoyed singing.

The Regent inspects the record player/PA equipment.

a dipole for the Army HQ group wavelength of 30 meters. Each half of the dipole was 25 feet long, and the open-wire feeders were 40 feet long. We set up the transmitter and receiver in a room in the barracks. We were lucky enough to find here a home-made charging machine which had been built to charge the battery of a broadcast receiver. It was built around a six-volt car dynamo driven by a wondrous contrivance of wooden pulleys and flapping leather belts. Cranked by coolies, it managed to produce enough charge to enable us to maintain short schedules with the VV group, but not enough to spare to enable us to make any transmission on the amateur bands.

It was now decided that Dagg should go back to Calcutta and have a new handcharger built. It had been hoped that a charging engine used by a recent Everest expedition might still be available at Katmandu, but enquiries showed that it had been disposed of. Dagg eventually rejoined us in Lhasa with a most efficient gear-driven device. It used a Ford 12-volt dynamo and had two large crank handles. Four coolies managed to produce 6 Amps through 12 volts of batteries. This rate of work is only about 1/10th HP, so they can't have been working very hard!

The political part of the mission went ahead to Lhasa, leaving me behind with the radio gear and the Bell and Howell 35mm projector. There was no point in taking these on up to Lhasa until power was available.

Ringang.

In due course, I was summoned to join the main party.

Now, Lhasa had an electric light plant. It worked on the dc three-wire system with 440 volts of batteries having the center tap earthed. The supply was, therefore, 220 volts. Those on one wire had positive earth, those on the other had negative earth. The cells were charged by a motor generator. The motor ran at 3 kV ac. The ac was generated by a small hydroelectric plant in the foothills of the 20,000-foot mountains which rose from the 12,000-foot Lhasa plain about three miles away.

The insulation of the transmission line was a bit rudimentary, and on damp evenings there were impressive brush discharges. The stream driving the turbine froze at night during the winter so that charging could be carried out only by day.

You will realize that this was a considerable engineering achievement when you remember that every item had to be carried up from the road head by coolies and pack animals. Great credit also is due to the Tibetan official who assembled and commissioned it with only unskilled labor at his disposal and who was responsible for running it. His name was Ringang. He was one of the four Tibetans who, as boys, were sent to England and educated at Rugby. He was also responsible for the official ciphers. He arranged for our batteries to be charged by connecting them in parallel with the end cells of the 440-volt battery.

The mission was accommodated in a nice villa in a garden called the Dekiy Langka. There were not enough rooms for us all to sleep inside, so I had a tent in the garden in which I also set up the transmitter and receiver. The aerial was supported at one end on a forty-foot mast consisting of five of the eight-foot sections of duralumin. The other end was supported on one section set up on the flat roof of the house. Regular contact was kept with the control station of the VV group at Army headquarters, Simla, in the summer, and with New Delhi in the winter. All the outstations at various army stations in India and the one in Hong Kong were worked on the 30-meter wave.

Once this was organized, I looked around for the 20-meter amateur band. This was soon found and the transmitter tuned to the band by netting on to the receiver. You will remember that each half of the dipole was 25 feet and the feeders were 40 feet, making the overall length of each half 65 feet, so there was no problem in loading it up via the Collins coupler.

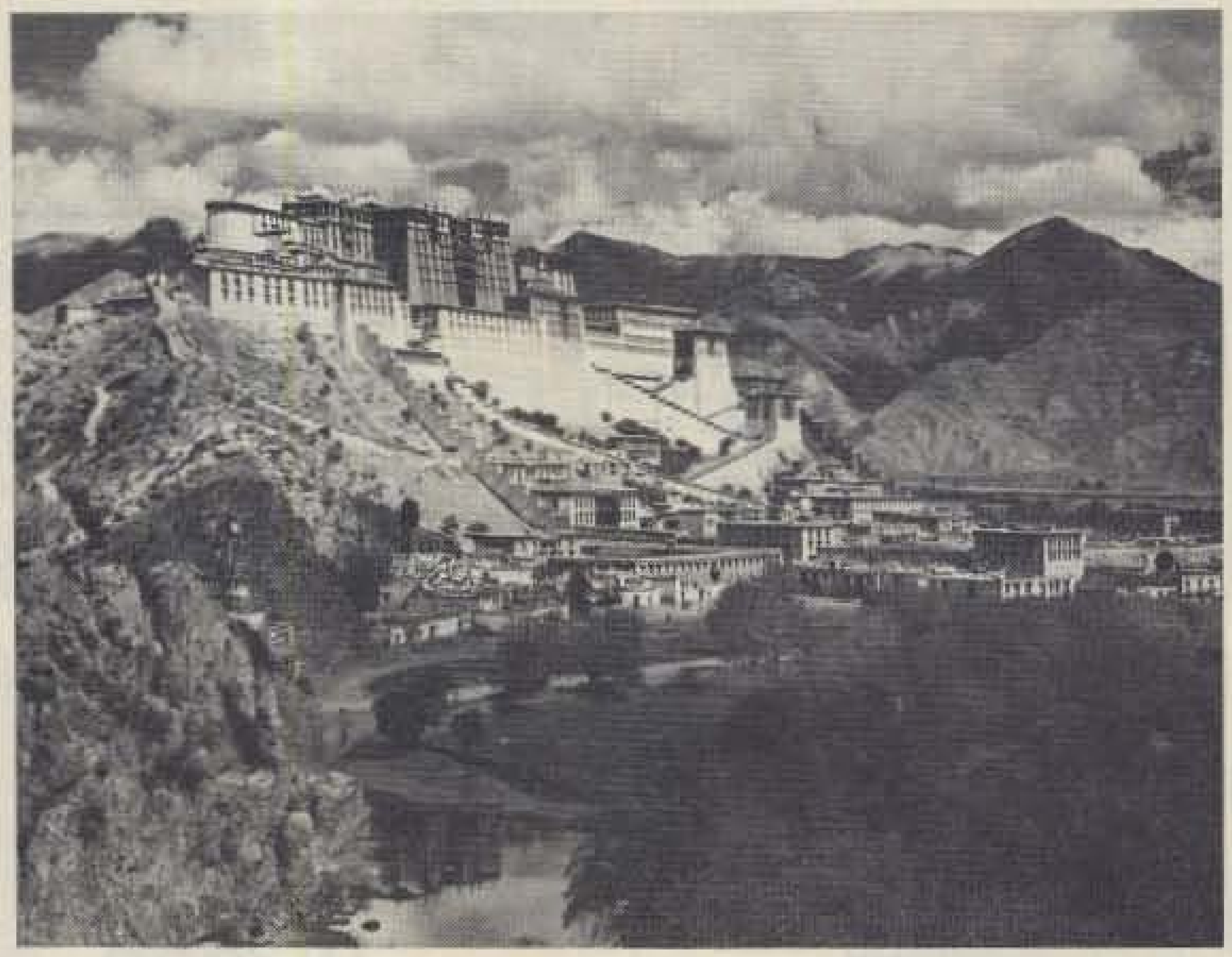
The first people to respond to that historical call, "CQ de AC4YN," were VU2 amateurs. Before the Chinese invasion, the intermediate for Tibet was AC4. There was no licensing authority, so I created the call by adding the two letters of my own callsign to the intermediate. Unfortunately, I did not make a copy of the log for my own records, so I have no recollection of individual callsigns worked.

The first DX to be worked was VK and ZL. They were so reliable that we regarded them as locals. This was very useful, as the political officer had relations in New Zealand. We were able to pass Christmas greetings between the two parties via amateur radio, earning considerable kudos both for amateur radio and Royal Signals.

As the year progressed, our signals seemed to reach further and further west until, in December, I raised my first G station. In my excitement, I asked him if he would relay messages to my family. However, I must have scared him off as he did not come back to me again.

I was not able to spend much time on the air as I had to join in a great number of the business and social activities of the mission. We attended and gave many official parties. There were visits to the Potala, the three huge monasteries (Sera, Drepung, and Kundun), the cathedral, and various temples. Although the Tibetans are Buddhists, there were still traces of ancestor and devil worship. It was always considered wise to placate any gods, spirits, or devils that may be around. One such temple was dedicated to snakes.

Besides these places, we also visited the mint, the arsenal, and the Norbu Lingha, the Dalai Lama's summer palace and gardens. Some of my time also was taken up helping Freddy Chapman with cipher work and photography. On some evenings, we gave cinema performances. These were always packed, not only with our own staff and friends, but also by as many locals as could squeeze into the room. Some of the films were old comics we had rented from a film library and brought with us. Of these, the most popular were those starring Rin Tin Tin, since they reminded locals of their own shepherd dogs.



The Potala.

What they enjoyed most were films taken by Chapman which had been sent down to Calcutta for processing and returned to us. The appearances of themselves and their friends on the screen were greeted with loud applause. Another thing which amused them was talking into the microphone and hearing their own voices, amplified by the record player amplifier, booming out over the loudspeakers.

All too soon, the time came when I had to leave Lhasa, the mission, and all the good friends I had made up there. A frontier war had started and my commanding officer demanded my return to the regiment. So, about mid-December, I set off back with my Pathan bearer and a couple of pack ponies. Traveling light, I did double stages. Chapman came with me as far as the Yamdrok So, a vast lake between Lhasa and Gyantse, to study bird life and gather wild flowers. I crossed the upper reaches of the Brahmaputra in coracles, came back over the 16,600-foot Karo La, and went down to Gyantse. In winter, it is very cold at these heights, and a strong wind blows all day raising dust storms. If Tibetans have to travel in the winter, they do so at night when the wind drops.

I continued these double stages back to Gangtok, and then went by taxi to Siliguri and by train to Calcutta. I had to call in at New Delhi for debriefing before returning to my regiment in Peshawar.

In order to keep the radio in operation after my departure, Reg Fox, who was ex-Royal Signals, was sent up from Calcutta. He did not arrive until after I left, so I did not have the pleasure of meeting him. When the mission closed in the spring, he stayed on in Lhasa and married a Tibetan girl. He remained until the Chinese invasion, when he escaped to India where he died. Whether any of his records, logs, or equipment have survived, I do not know.

To those who are interested in reading about the mission, I recommend F. Spencer Chapman's book *Lhasa, The Holy City*, published by Chatto and Windus, London, 1938. The political officer in Sikkim's letter no. 4(7)-P.37 to the Foreign Office (dated 30th April 1937) and his diary of events are probably available from the Public Record Office, London. ■

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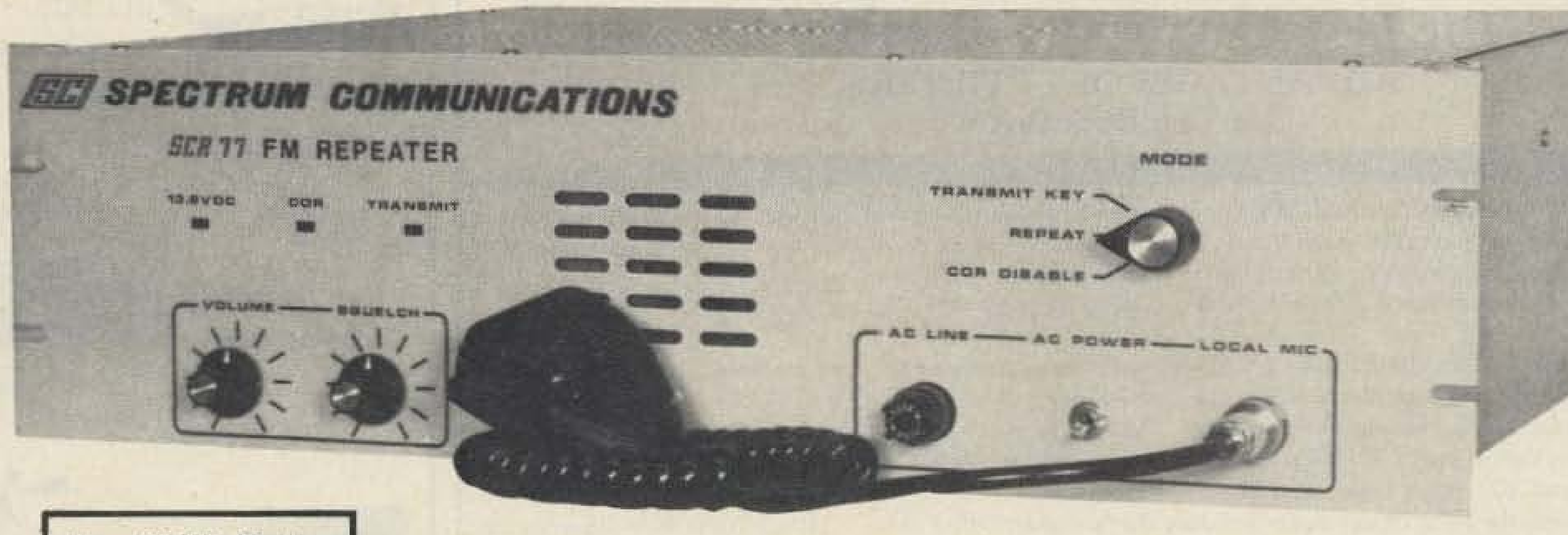

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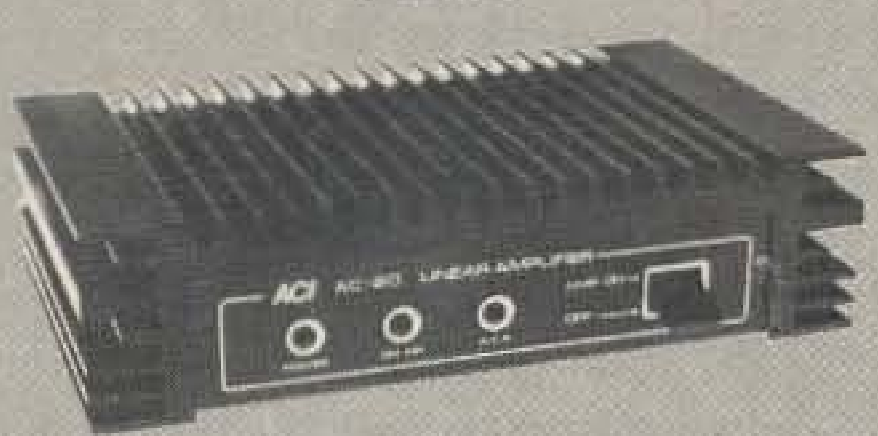

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"Smart" Squelch for SSB

Editor's Note: W9MKV and W9YAN's "Smart Squelch" overwhelmed the competition to win the first *73 Magazine* Home-Brew Contest. The authors received a $250 prize in addition to the normal article payment. You can build this trend-setting project; W9MKV offers a PC board for $7.00 and a complete parts kit is available from Radiokit, Box 411, Greenville NH 03048, for $49.95. Congratulations to W9MKV and W9YAN for a job well done.

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PO Box 5283
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David A. Link W9YAN
213 Western Drive
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This circuit detects the human voice but ignores noise, steady tones, and the Russian woodpecker HF radar pulses. It requires no receiver modification and works even when voice signals are below the noise level.

A squelch turns off receiver audio to eliminate annoying background noise when there is no signal. Squelch circuits in AM and FM receivers are carrier-operated. On single sideband, which has no carrier, squelching is more difficult. Most SSB rigs with squelch, e.g., the popular 2-meter multimode transceivers, use agc (S-meter) voltage to open squelch in SSB mode. Agc-operated squelch is adequate for strong signals on relatively quiet channels. Agc and VOX-type squelches open for any noise or heterodyne that exceeds a preset level. Weak signals often are missed because the threshold must be set above the noise level.

White noise sometimes can make you imagine tiny voices in the noise, but it won't fool the Smart Squelch. Detecting unreadably-weak signals is worthwhile if a change of antenna direction or receiver control settings will make them usable.

The audio-operated squelch circuit described here is similar in principle to Motorola's "Constant Sinad" squelch, a discrete-component circuit with 22 transistors.

Photo A. Squelch unit is attached to the right side of the HF SSB transceiver. Rectangular LEDs above the control knob indicate circuit status. (Photo by KA9FJS)

Discriminating the Human Voice

People normally speak about three syllables per second. The squelch works by detecting voice-band energy (500-3000 Hz) which is varying in frequency at a *rate* of 0.5 to 3.25 Hz.

The circuit is a type of FM detector. It is insensitive to amplitude variations throughout the range where the input stage is not driven to saturation but background noise is strong enough to saturate the limiter. The squelch works properly with most speaker-level signals. You can connect it directly to the receiver's detector output, adjusting gain of input buffer amplifer U1A as necessary.

Performance

A receiver tuned to WWV provides a good demonstration of the circuit's capabilities. Squelch opens for voice announcements and ignores the rest of the transmissions.

The squelch can turn on well within the first spoken syllable. Speed of response depends mostly upon the rise-time of active low-pass filter U3A. The receiver is muted one second after the last voice detection. The beginning of a steady tone

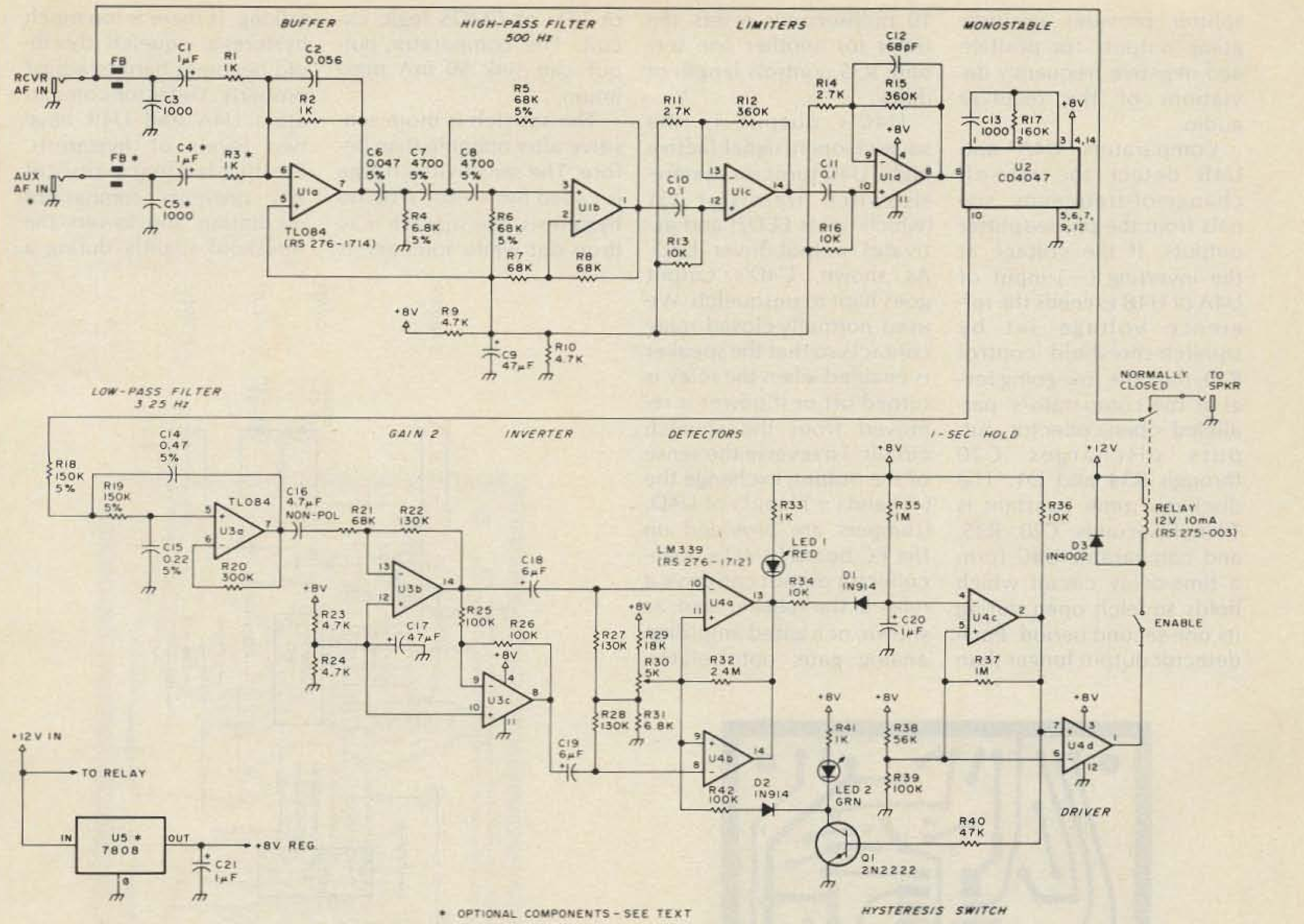

Fig. 1. Schematic diagram.

opens the squelch only momentarily. It opens intermittently on music. Response to CW depends on code speed and tone.

A single squelch circuit can control multiple receivers, unsquelching them all when any receiver detects a voice signal. (We like to monitor HF aircraft and marine frequencies plus 144.2 MHz—the 2-meter SSB calling frequency.)

The squelch is useful when rf radiation from computer systems overwhelms the normal squelch in a VHF FM receiver. It's also good for monitoring VHF/UHF mobile-telephone channels in systems where a constant idle tone is transmitted while no call is in progress. The circuit has other applications as a "smart" VOX (voice-operated switch) for transmitters, recorders, intercoms, security systems, remote-base systems, and repeater equipment.

Circuit Description

U1A is a unity-gain summing amplifier, input buffer, and low-pass filter with 3-kHz cutoff. U1A drives U1B, a third-order high-pass active filter with 3-dB cutoff at 500 Hz. We chose high-performance FET-input operational amplifiers so that active filters could use high resistances and small capacitors. The TL084 quad op-amp chip is equivalent to the National LF357.

U1C and U1D are limiter amplifiers with a combined gain of 85 dB. U1D's output is voice-band audio turned into constant-amplitude square waves. The square waves trigger CMOS monostable multivibrator U2. Output of U2 is a train of .33-millisecond pulses, one for each audio cycle. The *average* voltage of U2's output is proportional to the input *frequency*. U2 and the following low-pass filter form a frequency-to-voltage converter, i.e., FM detector, somewhat similar to an automobile tachometer circuit.

Active low-pass filter U3A cuts off at 3.25 Hz, the best compromise between noise-falsing and the rate at which people speak syllables.[2] Note that U3A has no bias network even though the amplifier uses a single-polarity power supply. U2's averaged pulses keep the output of U3A at 5 to 6 volts with normal noise input from the receiver. R17, which sets U2's period, can be varied to keep U3A's quiescent output voltage near the center of its range.

On very quiet channels there may not be enough pulses from U2 to keep U3A properly biased. False detects may occur as U3A's output goes in and out of its linear range. You can inject extra noise or low-level tone into the squelch circuit's auxiliary input to achieve the desired results for your particular application.

U3A's output is ac-coupled to U3B, which amplifies with a gain of 2, and thence to U3C, a unity-gain inverter. U3B and U3C together form a phase splitter with a gain of 2. The phase splitter provides positive-going outputs for positive *and* negative frequency deviations of the receiver audio.

Comparators U4A and U4B detect the rate-of-change-of-frequency signals from the phase-splitter outputs. If the voltage at the inverting (−) input of U4A *or* U4B exceeds the reference voltage set by squelch-threshold control R30, then the low-going level at the comparators' paralleled open-collector outputs discharges C20 through R34 and D1. The discharge time constant is 10 milliseconds. C20, R35, and comparator U4C form a time-delay circuit which holds squelch open during its one-second period. Each detector output longer than 10 milliseconds resets the timer for another one second. R35 controls length of delay.

U4C's output is the squelch-open signal (active high). U4C turns on hysteresis-switch transistor Q1 (which lights LED2) and activates output-driver U4D. As shown, U4D's output goes high to unsquelch. We used normally-closed relay contacts so that the speaker is enabled when the relay is turned off or if power is removed from the squelch circuit. To reverse the sense of the output, exchange the (+) and (−) inputs of U4D. (Jumpers are provided on the PC board.) U4D's open-collector output can drive a relay in the speaker lead, as shown, or a gated amplifier, analog gate, optoisolator, or TTL or CMOS logic circuit. The comparator output can sink 50 mA maximum.

The squelch is more sensitive *after* opening than before. The sensitivity change is called *hysteresis*. With no hysteresis, the squelch may drop out while someone is talking. If there is too much hysteresis, squelch threshold becomes hard to adjust properly. Detector comparators U4A and U4B have two levels of hysteresis. Positive-feedback resistor R32 prevents comparator oscillation and lowers the threshold slightly during a

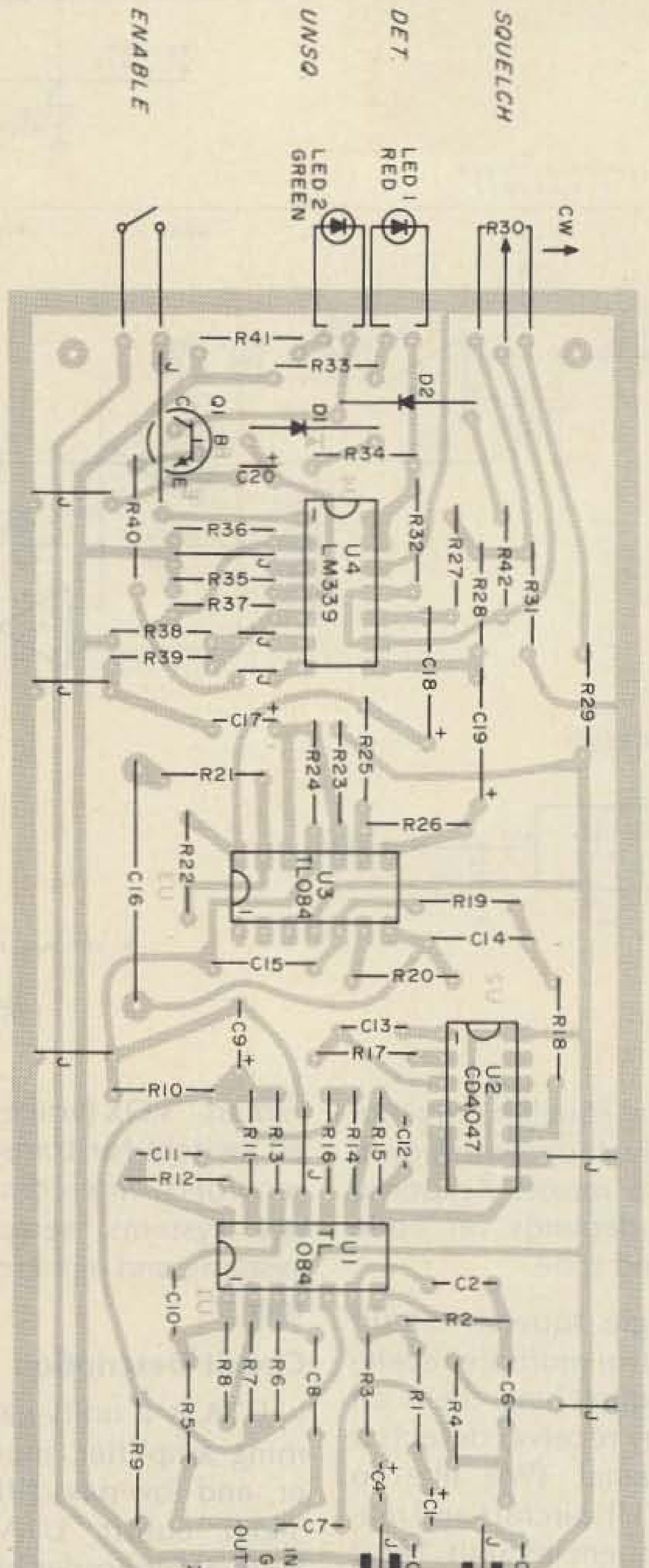

Fig. 3. Component layout.

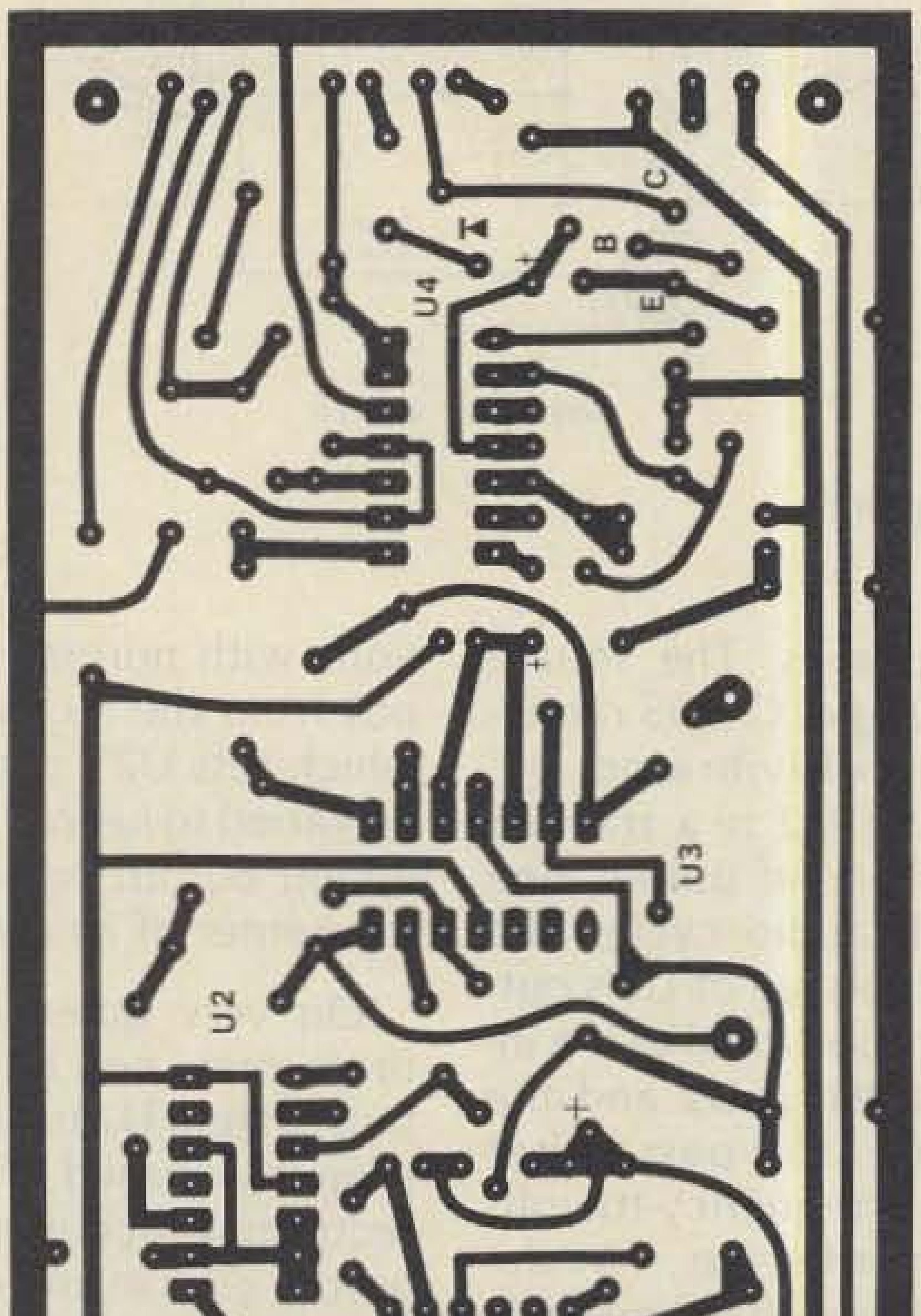

Fig. 2. PC board (foil side).

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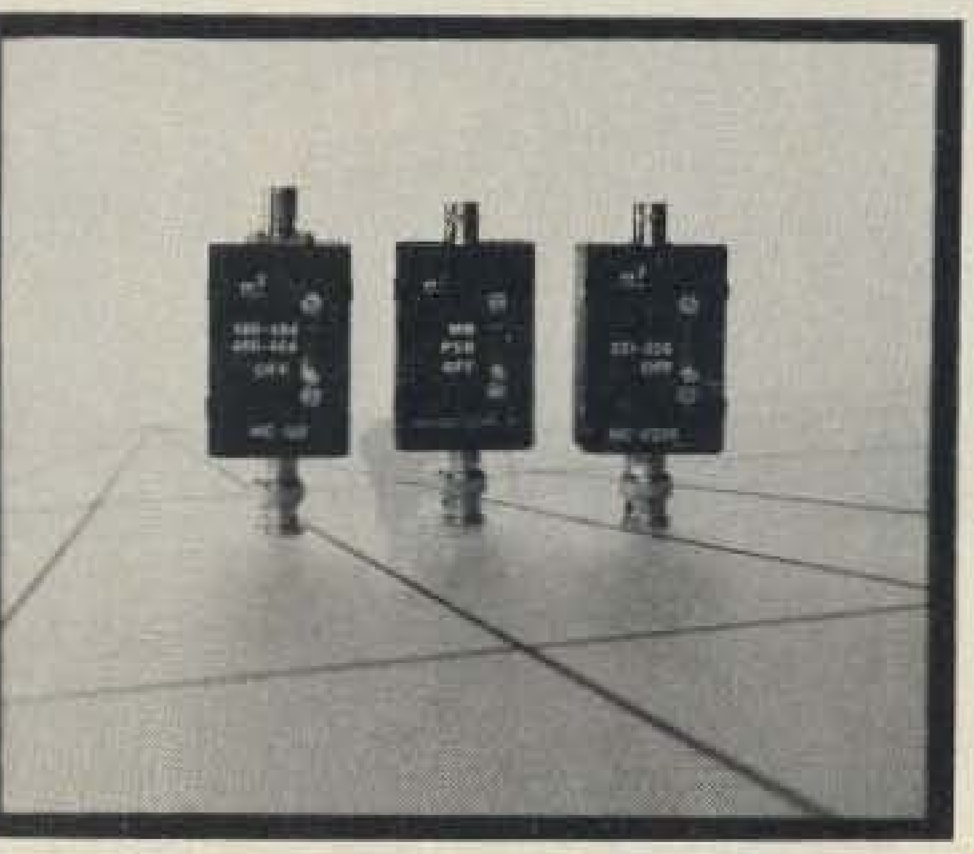

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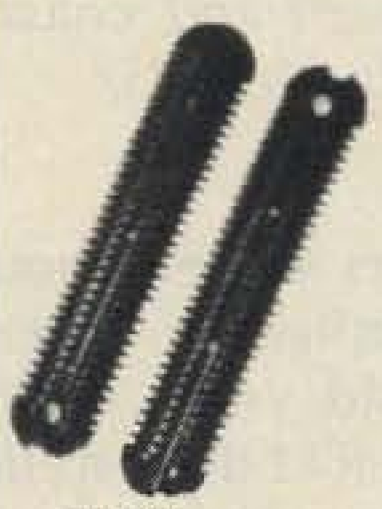

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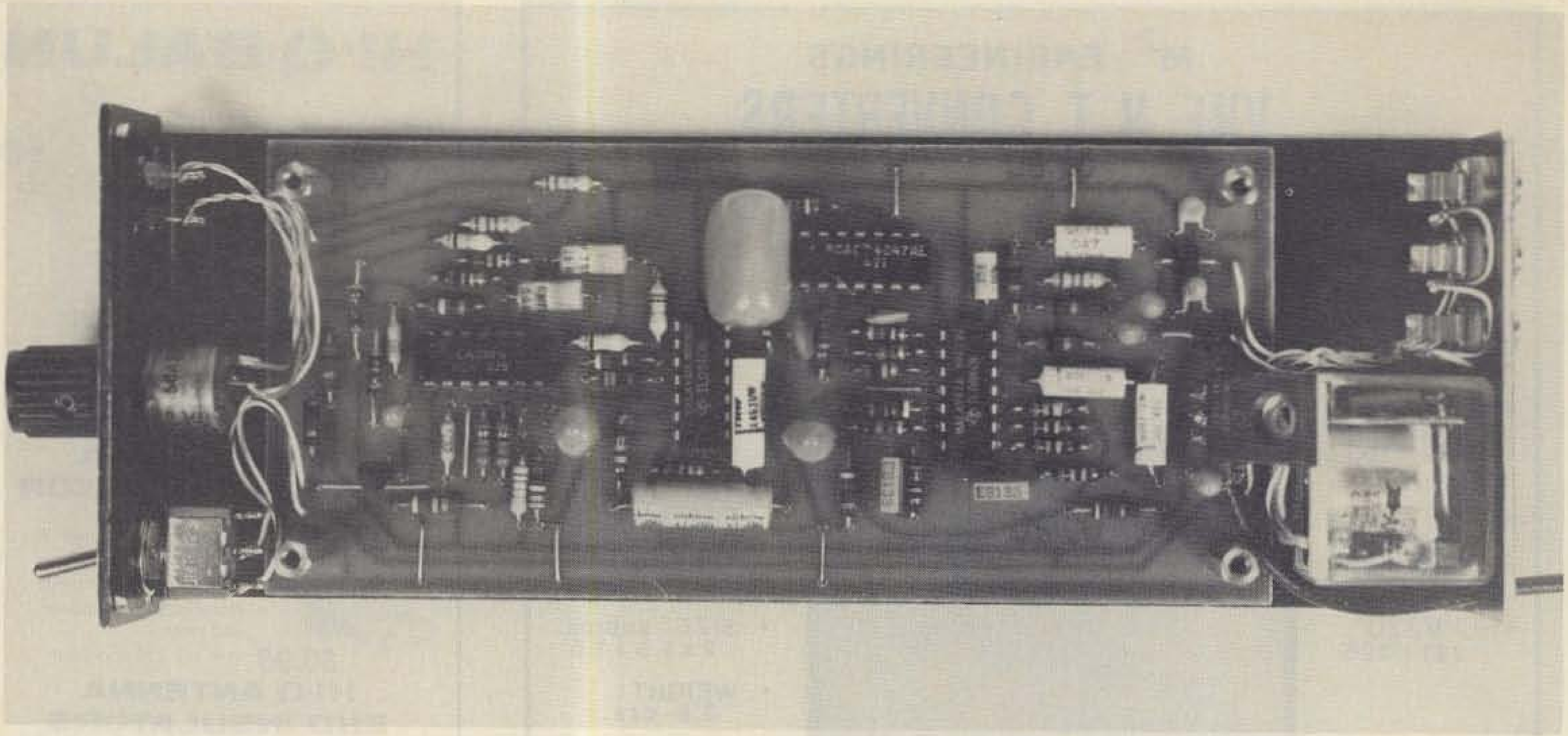

Photo B. Circuit board and chassis detail. The only external connections required are receiver audio, speaker, and 12 volts dc. (Photo by KA9FJS)

detect. Q1 conducts while squelch is open, further reducing the threshold voltage via R42 and D2. R42 determines the amount of hysteresis. The 100k value shown for R42 provides smooth squelch operation.

The circuit uses 25-30 mA plus relay current. The eight-volt-regulator IC, U5, should be used for mobile operation. Otherwise, the entire circuit can run from a well-regulated 12-volt supply. (Omit U5 and add a jumper between input and output pins of U5 on the PC board.)

Adjustment

LED1 lights whenever the detector is active. Listen to a voice signal and adjust the threshold control until LED1 blinks for every spoken syllable, then make fine adjustments as necessary for noise conditions. The *enable* switch allows you to adjust the squelch before activating the relay and allows you to unsquelch without disturbing the threshold setting. Scale markings around the control knob make it easier to reset an often-used level.

Construction

All-new parts cost about $40, using referenced items from Radio Shack and ECG. Resourceful hams can build

Parts List

Semiconductors

U1, U3	TL084C quad BIFET op amp	2	$ 5.98
U2	CD4047 CMOS multivibrator (ECG 4047)	1	1.49
U4	LM339 quad comparator	1	1.50
U5	7808 8-volt regulator (optional—see text)	1	.99
Q1	2N2222 or equiv. silicon NPN transistor	1	.15
D1, D2	1N914 or equiv. silicon diode	2	.20
D3	1N4002 or equiv. silicon diode	1	.10
LED1	Red LED (rectangular)	1	.49
LED2	Green LED (rectangular)	1	.49

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C15	0.22 uF, 5%	1	.40
C14	0.47 uF, 5%	1	.40
C1, C4, C20, C21	1 uF, electrolytic	4	1.60
C16	4.7 uF, non-polarized (RS 272-998)	1	.99
C18, C19	6 uF, electrolytic	2	2.36
C9, C17	47 uF, electrolytic	2	2.00

Resistors (All ¼ Watt; * = 5%)

R1, R2, R3, R33, R41	1k	5
R11, R14	2.7k	2
R9, R10, R23, R24	4.7k	4
R4*, R31	6.8k	2
R30	5k, linear pot	1
R13, R16, R34, R36	10k	4
R29	18k	1
R40	47k	1
R38	56k	1
R5*, R6*, R7, R8, R21	68k	5
R25, R26, R39, R42	100k	4
R22, R27, R28	130k	3
R18*, R19*	150k	2
R17	160k (see text)	1
R20	300k	1
R12, R15	360k	2
R35, R37	1M	2
R32	2.4M	1

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Other

Ferrite beads	2	.10
Miniature earphone jacks	3	1.29
Relay, 12-volt SPDT (RS 275-003)	1	2.99
Switch, miniature toggle SPST	1	1.49
Control knob	1	.49
Hardware, PC board, chassis		10.00
Parts Total		$40.85

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the circuit for substantially less.

We built several prototypes on universal printed-circuit cards. The only critical area is U1, where high limiter-amplifier gain can cause feedback oscillation in some layouts. Keep component leads as short as possible. Use 5% tolerance or better for frequency-determining components in active filters. The Radio Shack relay's frame must be insulated from ground. Mounting the relay on a rubber pad quiets its clicking and isolates it from vibration.

Conclusion

Although squelch effectiveness may diminish on very crowded amateur bands, a sensitive, discriminating squelch is very useful for net operations and scheduled contacts, especially with modern digitally-tuned receivers which can be preset to precise frequencies.

This circuit can be a starting point for many experiments. You could, for example, insert an analog delay device between audio input and output. If the delay were longer than the squelch response time, then squelch would open *before* the first spoken syllable reaches the loudspeaker.

Digital techniques could perform the function of the analog circuit described here, perhaps with improvements such as adaptive threshold and program-controlled time constants. We are experimenting with a microprocessor-based voice detector which may be the subject of a future 73 article.■

References

[1]Don Lancaster, *Active Filter Cookbook*, Howard W. Sams & Co., Inc., 1975.

[2]Motorola *Micom* HF SSB Transceiver Service Manual, 1975.

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The Ultimate Fuse

— ac overload protection

Neil Johnson W2OLU
PO Box 585
South Orleans MA 02662

Recently, while working on the design for a new power supply, I managed to blow over a dozen fuses. My regular ham buddy was on a weekend fishing trip, so I kept making the same, simple error. After the trouble was located and corrected, it somehow struck me: There's got to be a better way!

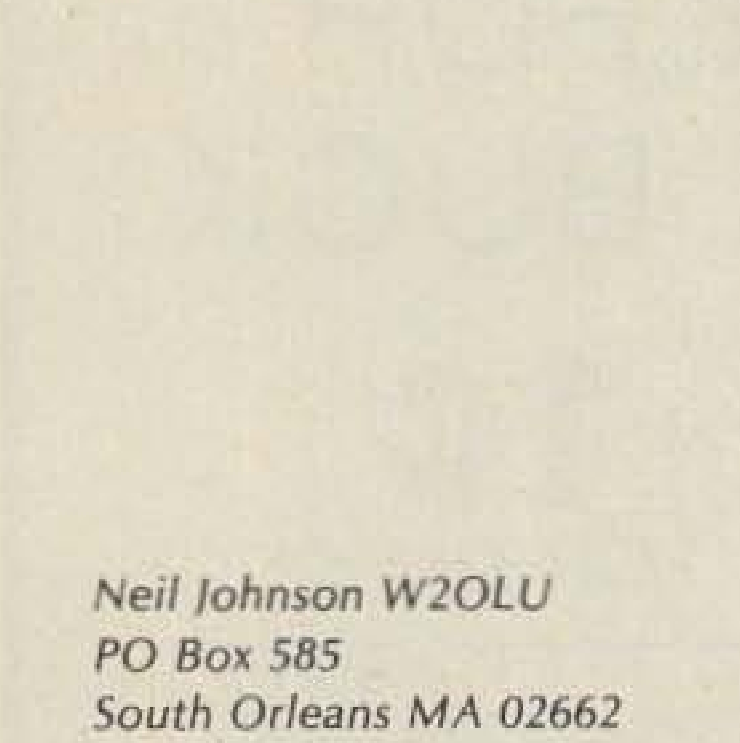


Fig. 1. The early circuity was fairly simple, but half-wave rectification from the 120-volt winding caused the setup to be less sensitive than desired. Added components shown connected with dotted lines are needed to keep the relay locked up after an overload has caused the circuit to be broken. (Note: Relay shown at rest, i.e., non-energized.)

In the past, hams who built their own power supplies could depend on manufacturers to offer several different types of relays, some with manual reset capabilities and some with electrical reset features, but such items are no longer available to the amateur builder. In view of this deficiency, a few years ago I offered a homely solution to the dc overload-relay problem: how to homebrew what you can no longer purchase.[1]

It is common practice for commercial and military installations to provide circuitry to protect their power supplies, both as to input and output. Dc overload relays are properly installed in the output of the rectifier or filter circuits, and ac overload relays are installed in the primary circuits of the various power supplies, and so on. But I had yet to see how an amateur experimenter might put together a suitable substitute for an ac overload relay.

In an earnest effort to devise some sort of simple circuitry for such a need, it came to mind that several factors had to be taken into consideration. The system had to be simple, foolproof, and, above all else, inexpensive. There is no logic in providing an expensive method for the sort of thing which a typical amateur might wish to protect. The setup to be described satisfies all of the foregoing.

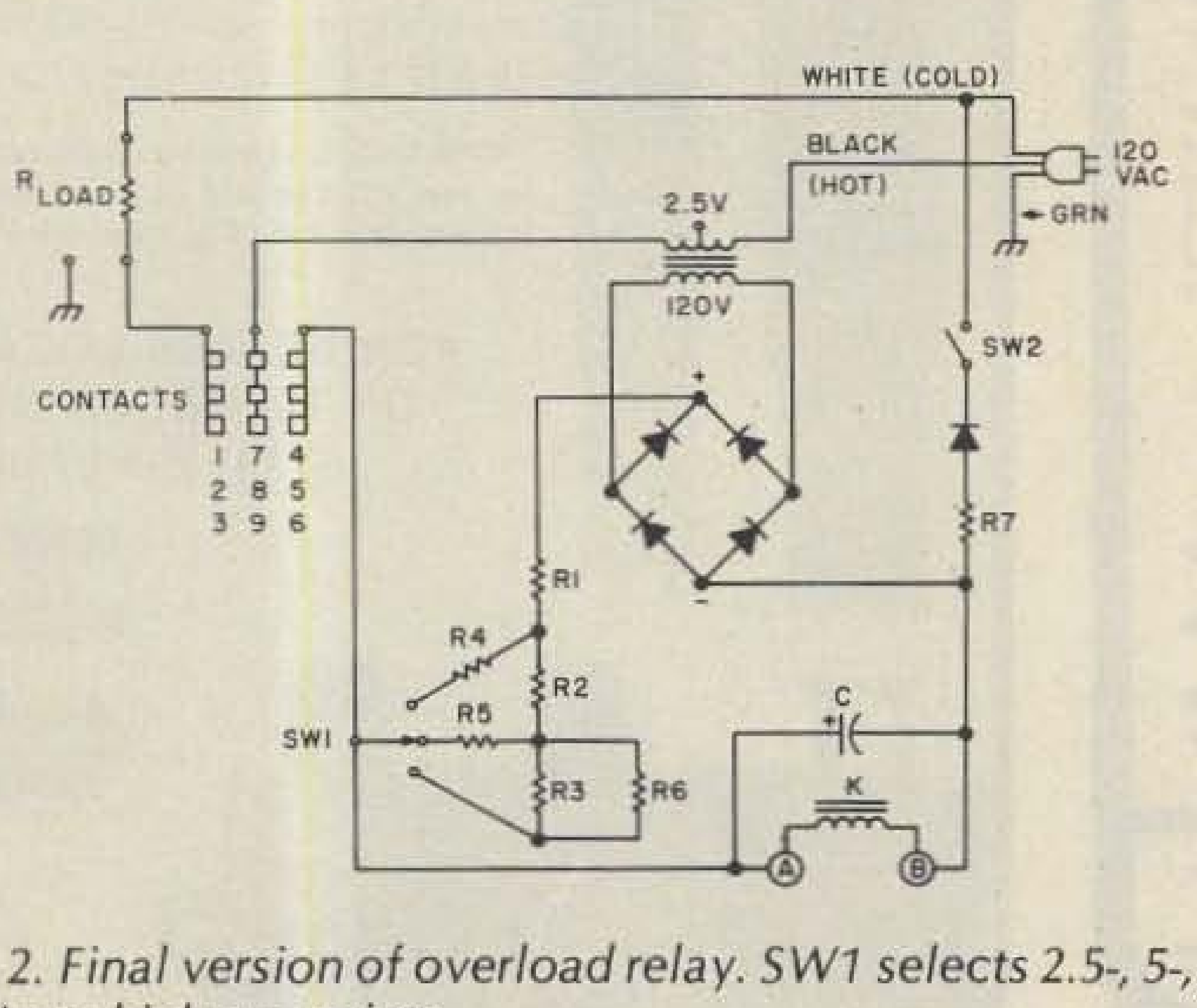


Fig. 2. Final version of overload relay. SW1 selects 2.5-, 5-, or 10-Amp kickout points.

The heart of the protective circuit lies in the utilization of a surplus 24-volt dc relay. These are widely available at low cost. If such a relay can be incorporated into a simple circuit, then we should end up with a satisfactory combination for taking care of ac overloads.

Refer to Fig. 1. Note that we have incorporated a surplus 2.5-volt filament transformer of 10-Ampere rating. Since silicon diodes came into play as substitutes for mercury-vapor tubes, such transformers have become a drug on the market. But a suitable transformer of similar ratings should serve; that is, a low-voltage secondary and rather high current rating.

Preliminary experiments

led me to develop the most elementary circuitry to fulfill the concept. When current is passed through the 2.5-volt winding a current will be induced into the 120-volt winding (now the secondary). After rectifying and filtering, the dc voltage is used to actuate the 24-volt dc relay. The variable resistor, R, can be adjusted to allow various ac currents to pass before the relay will trip and open the ac circuit.

This will not completely suffice, however, since the relay will buzz back and forth between on and off unless some form of lock-up is provided. The added components, shown by dotted lines, attend to this function. Lock-up is obtained with lower current than is required for pull-in, and simple half-wave rectification will serve. Reset is furnished by opening the switch, which is normally closed.

The system that finally evolved is shown in Fig. 2. The full-wave bridge rectifier furnished more voltage than the original half-wave circuit and allows the relay to trip out at a lower current. In a thorough search for a relay of better suitabilities, over a dozen relays were checked out experimentally. Finally, it was decided to opt for a relatively sensitive unit which has the added advantage of having three sets of contacts, all rated at 10 Amperes. To be on the safe side, these are wired in parallel.

My thoughts then were directed to the feasibility of obtaining a suitable variable resistor, in order to enable the relay to actuate at various current settings. Easier said than done!

The three principal calibrating resistors are used in place of a "nice to have" 3000-Ohm, 10-Watt wirewound potentiometer. The 5-Watt, 1000-Ohm size is a fairly common item in all stores which cater to radio and TV servicemen. Additional resistors were added to cause the setup to kick out at 2.5, 5, and 10 Amperes. This 4-to-1 range is in line with what the commercial makers of such relays—Westinghouse for example—design into their products.

Other design factors worth mentioning are:
(a) The 100-uF electrolytic capacitor seems to be about right in this setup. A lower value may cause the dc relay to buzz, and a higher value can cause a time delay to take place—definitely undesirable in any form of protective circuitry where high power is involved; and (b) Avoid carbon resistors in the 1000-Ohm positions. Careful checks show that a 1000-Ohm, 2-Watt carbon resistor will be dissipating 1.6 Watts or 80% of its full value. This will cause upward change in the resistance, and, indirectly, "calibration creep" in the finished instrument.

Random thoughts at this juncture: Others have asked me whether simpler devices, such as the thermal overload units commonly found on the back of TV sets, would suffice. These have been tried and their use cannot be justified since the time delay is intolerable where an expensive unit requires protection. Personally, I almost lost a very nice Powerstat® while attempting to live with such protection.

Perhaps solid-state devices might be designed to furnish the same function? I would be disinclined to depend upon such a setup in view of the relatively high-voltage spikes which are encountered when a highly inductive component—such as the power transformer in a large amateur rig—needs to have its primary circuit interrupted. For that reason, I chose 1000-volt silicon diodes, type 1N4007, for service in this unit.

Parts List

T— 2.5-volt, 10-A filament transformer
D— all diodes type 1N4007
C— 100 µF, 35 volts
S1— Rotary switch with 3 positions
S2— Momentary-contact switch, wired for normally-closed operation (Radio Shack 275-619)
K— Potter & Brumfield type KUP 14D15 (Fair Radio Sales, Lima, Ohio, $2.50)
R1-R3—1000 Ohms, 5-Watt, wirewound
R4, R5—330 Ohms, 1-Watt
R6—15k Ohms, 1-Watt
R7—2700 Ohms, 2-Watt
Small cabinet or chassis, 3-wire ac cord, and 5-way output terminals

So we have an ac overload relay which is simple, inexpensive, and dependable. Furthermore, it can be calibrated to kick out at several different amperages at the flick of a switch. I have yet to see such a simple item described in print, and I thought it would be nice to share this knowledge with other members of the amateur fraternity. So, why not try this out and experiment at ease, without blowing box after box of fuses?

All of the foregoing calibrations were obtained with ac loads consisting of non-inductive heater coils. If your circuit to be protected is highly reactive, you may find the relay kickout points to be slightly different. ■

Reference

1. "Son of the Overload Relay," *73 Magazine*, January, 1977, p. 140.

✓See List of Advertisers on page 114

Bob Roehrig K9EUI
314 S. Harrison Street
Batavia IL 60510

Multi-Purpose Peak Adapter

— don't settle for being average

This adapter was originally designed to be used with a Bird 43 wattmeter, using the standard plug-in elements; however, this same unit can be modified for use with almost any rf detector or swr bridge. Circuits can be easily added to provide an adjustable peak output indicator and/or an alc output for transmitter control. The peak adapter circuit also can be used with an FM receiver as a peak-deviation meter. Easily-obtainable parts are used and while I built mine in a separate box, you might be able to build it into your meter enclosure. The ICs must be kept away from high rf levels, however. The peak adapter circuit is shown in Fig. 1.

The unit must be powered from a bipolar supply of ±6 to ±15 volts or from a pair of 9-volt batteries. If extended use of the adapter is anticipated, the ac supply shown in Fig. 2 should be used. Regulation is not totally necessary, but does ensure minimum offsets and prevents transients from entering critical circuits.

The main purpose of the peak detector circuit is to overcome the main fault of a meter when trying to indicate peaks: the mass of the movement damps the response time such that variations of the applied current are *averaged* out. The more sensitive the movement, the worse the damping effect. The Bird 43 uses a 30-μA movement and most swr bridges use a 50- to 200-μA meter.

Even with the peak detector, the meter will still

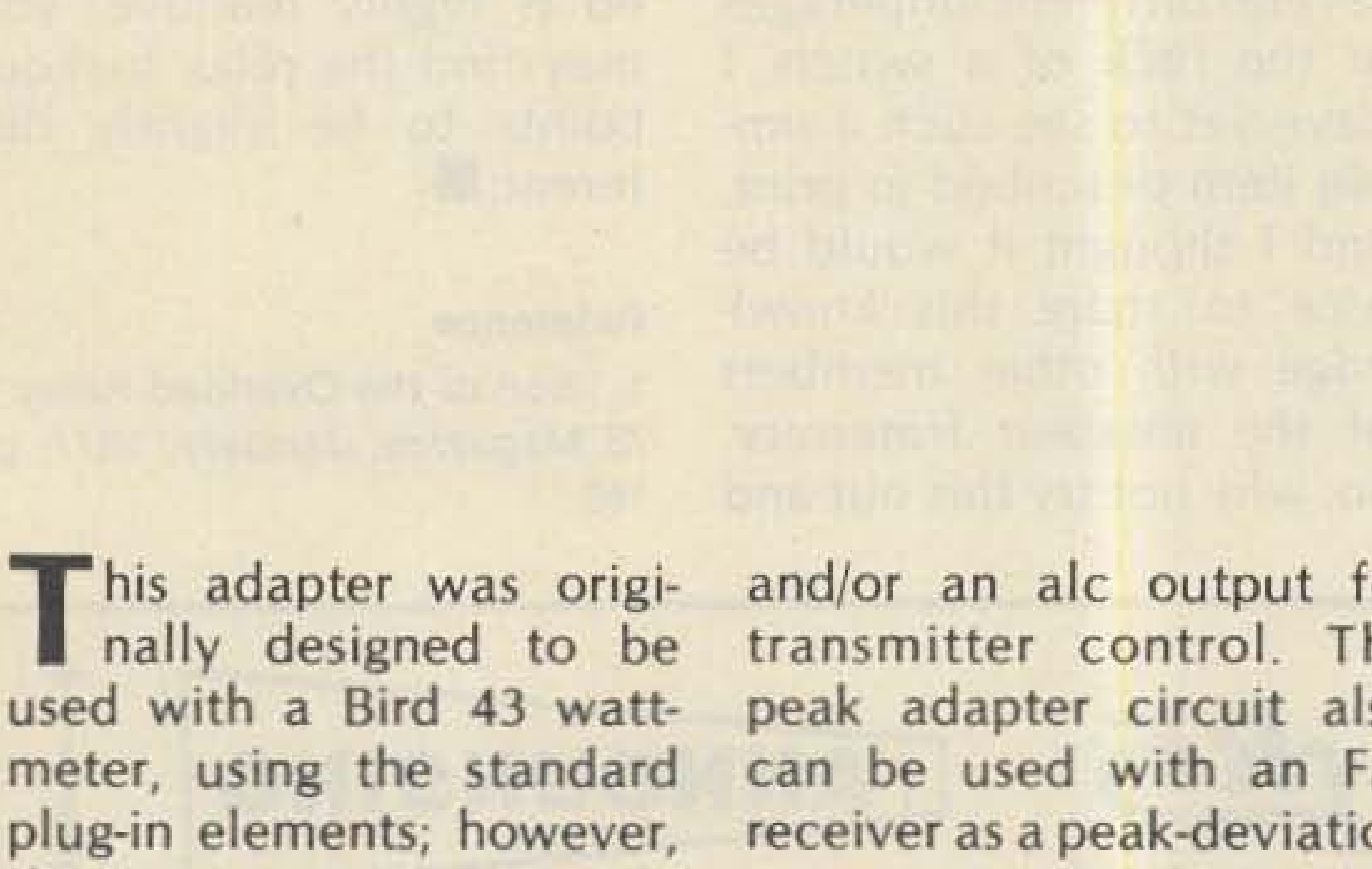


Fig. 1. Peak adapter. All ICs are MC1458 dual op amps (Radio Shack 276-038); resistors are 1/4-Watt; S1 is a DPDT miniature toggle; P1 is a Radio Shack 274-139.

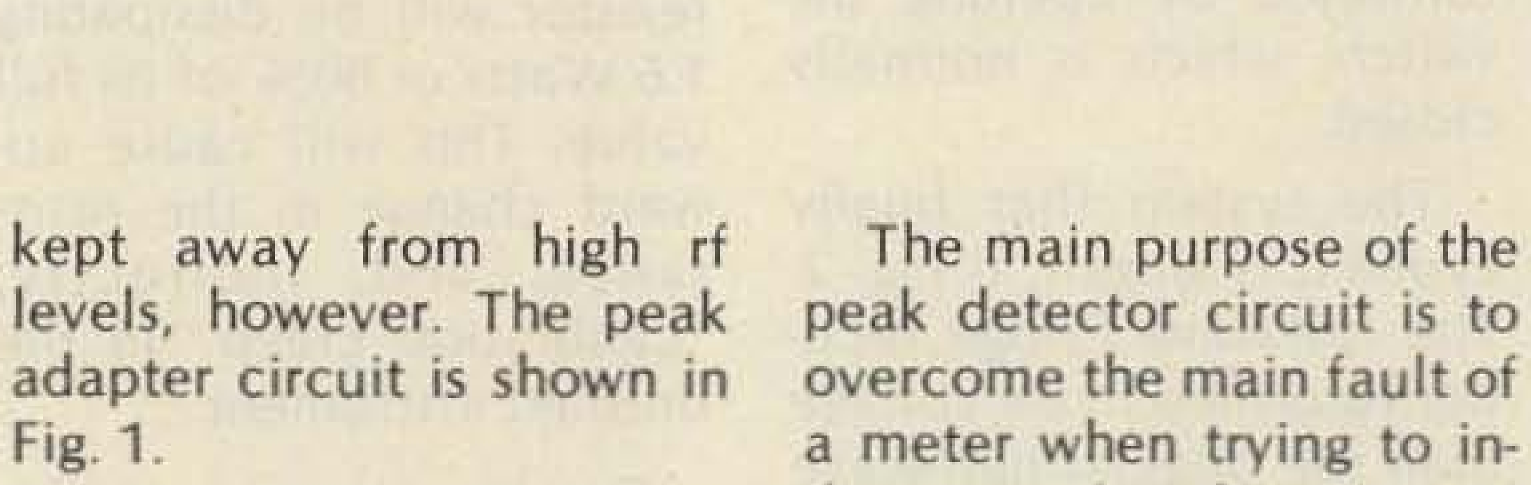
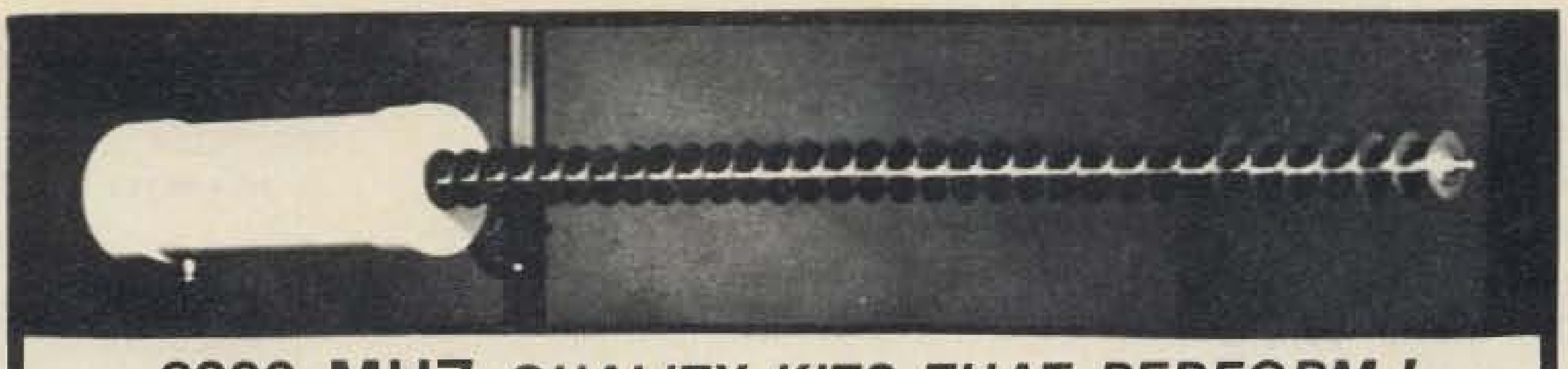


Fig. 2. Power supply schematic. CR1 = Radio Shack 276-1171; CR2,3 = RS 276-562; C1,2 = RS 272-1018; C3,4 = RS 272-135.



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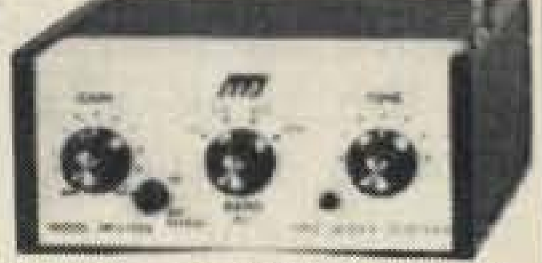

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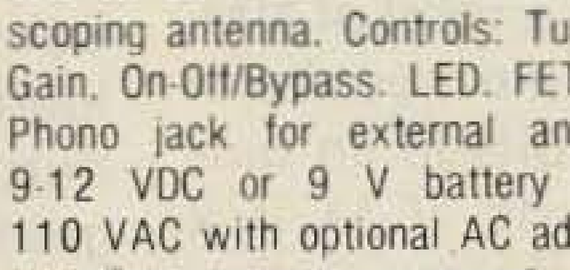

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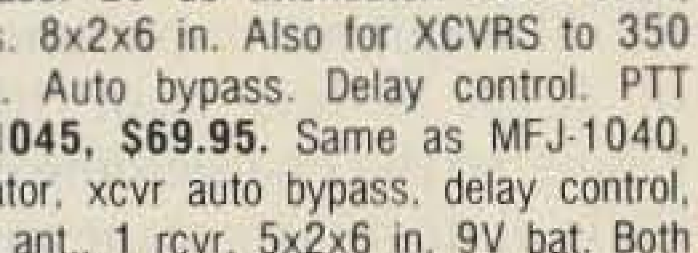

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take the same amount of time to respond to its highest level, but the circuit has a long enough time constant to ensure that the pointer will remain at the peak level long enough to be observed. The Bird 43 elements contain a half-wave detector (+ output) and a small capacitor to bypass the rf. Internal resistance of the 30-μA meter is 1500 Ohms, so to ensure proper linearity, the input of the peak adapter presents a 1500-Ohm load to the element.

Circuit Description

The first two stages are standard inverting dc amplifiers. Each stage has a gain of 10 for a total of 100. Thus, a full-scale input level of 45 mV results in an output of 4.5 V dc. IC2A is a unity-gain half-wave detector. The diode's placement in the feedback loop eliminates the error due to its 600-mV drop. The input impedance of IC2A is high, so the discharge time constant is essentially determined by R7. The output impedance of IC2A is less than 100 Ohms, so the charge time of C1 is almost instantaneous. IC2B is a unity-gain follower configuration used to isolate the load from C1. Amplifying the input signal by 100 ensures overcoming any low-level non-linearity in CR1. R8 and R9 divide the output back down to a level required to feed the meter.

Fig. 3(a) shows the original circuit in the Bird 43. The meter connects directly to the output of the directional coupler through a length of coax cable. The length is not critical and is supplied as a convenience to permit remote mounting of the directional coupler.

Fig. 3(b) shows the jack added to the Bird meter to permit connecting the peak adapter. I mounted the jack on the right side of the case. (Remove the meter movement before drilling the 3/8" hole!) The jack is a 3-conductor, ¼"-type with shorting contacts (Radio Shack part number 274-139). The shorting contacts connect the meter to the coupler when the remote plug is removed, so no switch is necessary. Use the "ring" connection for the meter and the "tip" for the coupler output. Break the connection at the positive lug of the meter. Even though the jack is grounded to the case, it is a good idea to run a wire from the negative meter terminal to the "sleeve" connection of the jack.

Calibration is easily accomplished by connecting the meter between the transmitter and a 50-Ohm load. Measure the power output with a steady carrier (preferably at least half-scale). Switch on the peak detector circuit and adjust R9 for a reading of 1.4 times the first reading. The meter now is calibrated to read peak power output (with a load impedance of 50 Ohms).

PEP output is defined as the peak-to-peak level of the output signal. It is not practical to have the meter read this since it would be necessary to change to the next higher element. R9 could be adjusted so the PEP would be read on the next higher scale using the same element; however, damage to the element could occur since it would be used outside its normal range.

When observing a voice-produced SSB signal, you will have to talk for several seconds to allow time for the meter movement to respond. A longer "hang" time can be obtained by increasing the value of C1.

The output of an swr bridge is similar to the Bird elements but the load impedance is usually higher. To use the peak detector with an swr bridge, or a detector like the one in the Heath Cantenna®, change the circuit of IC1A to that shown in Fig. 4. You will have to calibrate the meter at several different power levels. The dc output voltage of a bridge detector, and the detector in the Cantenna, drops with a decrease in frequency, so calibration at several frequencies in each band is desired. Calibration must be done with the aid of a borrowed wattmeter, an rf ammeter or voltmeter, or a wideband scope that has a vertical amplifier response flat to at least 30 MHz.

When using the peak adapter with a device like the Cantenna, you will have to furnish a meter for the adapter. Any movement up to 5 mA can be used or a VOM on the 2.5- or 3-volt dc range. Just be sure that the VOM you use will not detect rf by itself. If you use a 1-mA meter, you can eliminate R9 and use a 3.9k resistor for R8. Calibration can be done with R19. A typical swr bridge circuit is shown in Fig. 5.

At a power of 100 Watts rms into the Cantenna, I obtained the following readings from the Cantenna's detector:

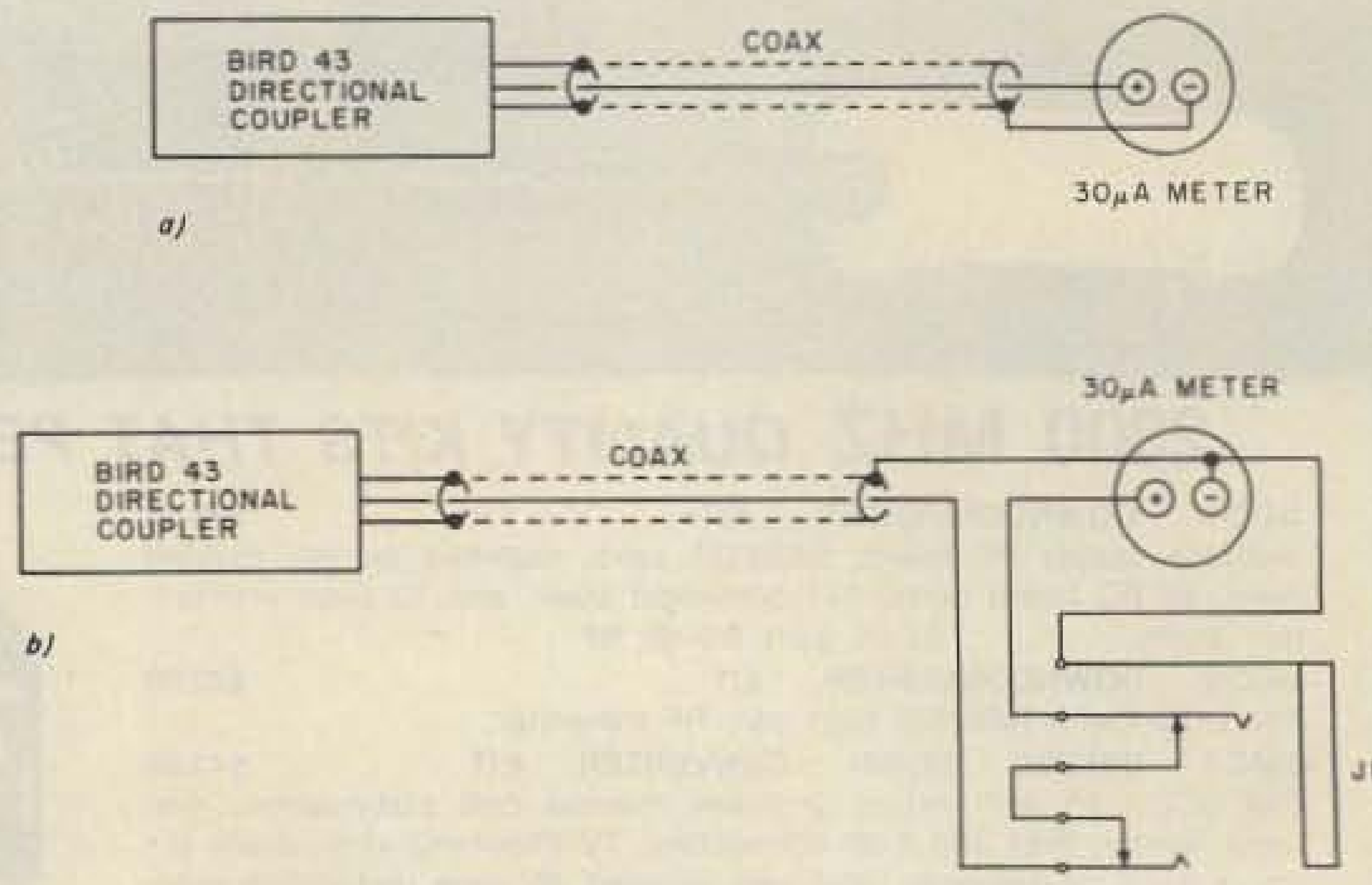

Fig. 3. (a) Original Bird 43 hookup. (b) Modified hookup using Radio Shack 274-277 for J1.

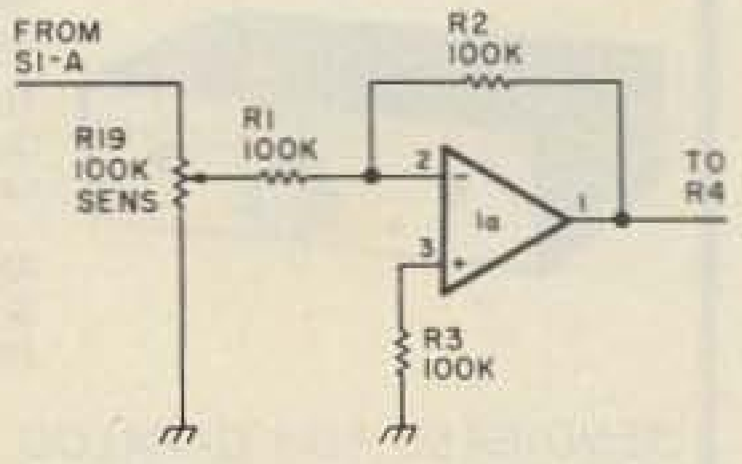

Fig. 4. High-impedance peak adapter.

Band	Dc Volts
160	0.8
80	1.0
40	1.4
20	2.0
15	2.5
10	3.0

The circuit of Fig. 6 is a peak-indicator driver with adjustable threshold control. R10 is adjusted with a steady carrier to light the LED at the desired power level.

Alc voltage can be applied to most mixers or intermediate stages in a transmitter to reduce the rf level before the output stage is driven into the non-linear region. The alc voltage can be developed by adding the circuit in Fig. 7. It even can be useful for transmitters that already have alc because gain reduction can be

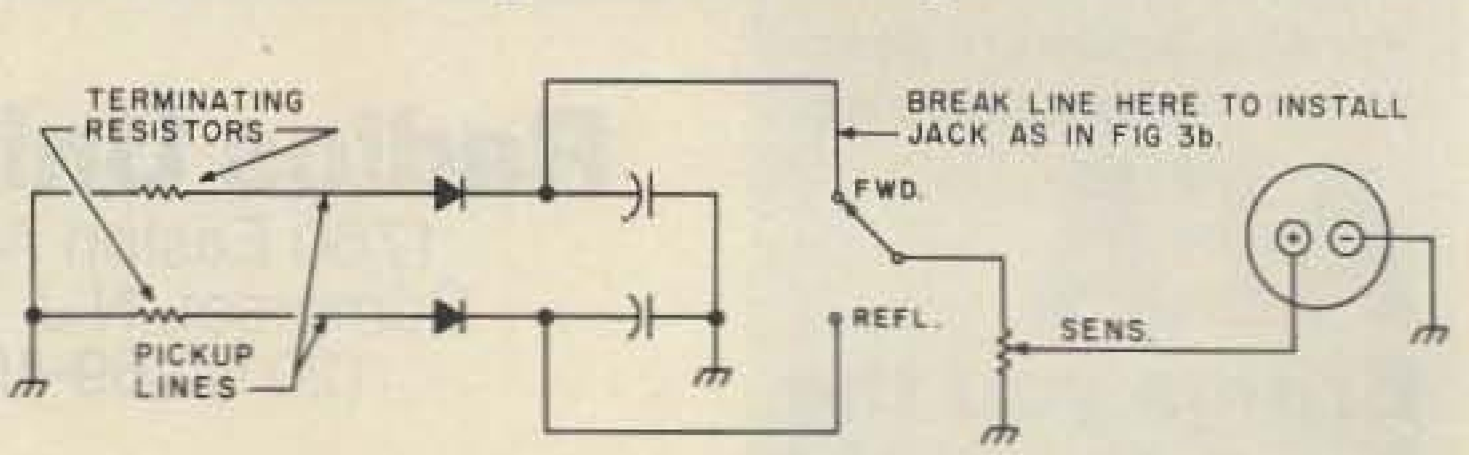

Fig. 5. Typical swr bridge.

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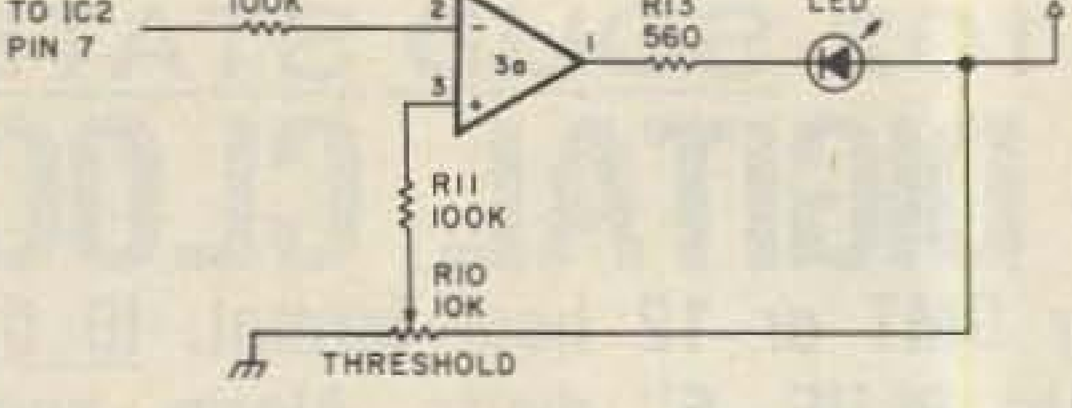

Fig. 6. Visual peak indicator.

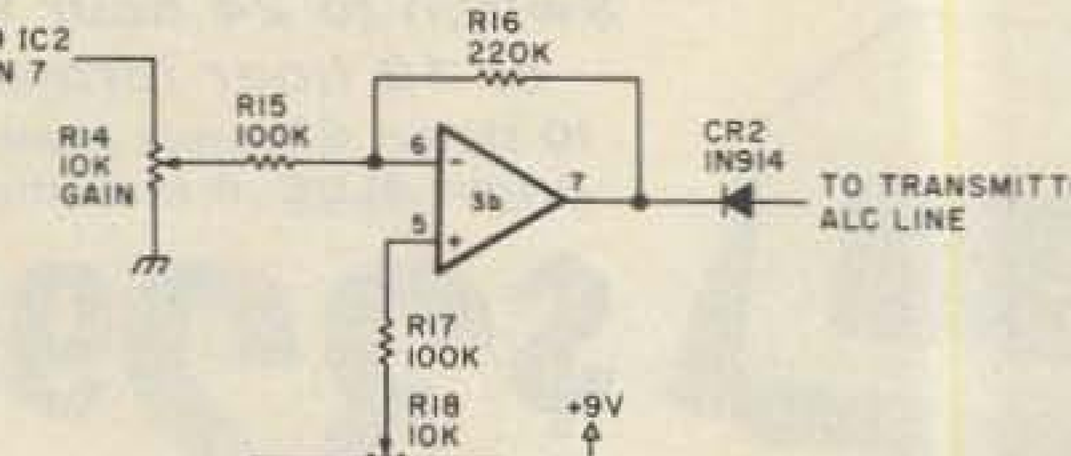

Fig. 7. Alc detector.

had at a lower level. (Many transmitters develop alc voltage when grid current is drawn, at which point distortion is already occurring.) With R18 at the ground end, alc will be developed as soon as there is rf input. R14 determines the amount of voltage output. Increasing R18 towards +V permits a higher rf level before alc starts to develop. CR2 keeps any positive voltage from reaching the alc line.

Both the circuits of Fig. 6 and 7 can be connected to IC2 simultaneously without any interaction. Again, change the value of C1 if you wish to change the time constant. Most likely, you will want to reduce C1 to 0.2 to 0.5 μF for alc purposes. A switch may be added to Fig. 1 to select various values for C1.

Another use for the peak detector circuit is to use it in conjunction with an FM receiver as a peak-deviation meter. Using the Fig. 4 modification, connect R19 to the output of the discriminator through a 0.1-μF capacitor. Calibration can be done best using a signal generator with calibrated FM modulation. If C1 is switched out of the circuit, the meter will then read average deviation. This may be useful to show how much the transmitted audio is limited in the peak clipper. In any case, the readings will only be correct if the received signal is full quieting. A scope may be connected to the output of IC1B for viewing the audio signal.

If you have looked at the proposed rewrite of the amateur rules, you noticed that the FCC is trying to come up with a different way to determine transmitter power, other than the present dc-input method. This peak adapter can be an invaluable aid, should power determination need to be in terms of peak power. Personally, I would like the rules to be changed to power output measurements, as is done commercially. This could then permit less efficient transmitters to run at a higher input power. We also would have a better idea of the efficiency of our equipment which would indicate when the finals are getting "soft."

This circuit can make your wattmeter into a more useful instrument at a fraction of the cost of a ready-made peak-reading unit and serve other purposes as well. ■

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The $100 TVRO Receiver

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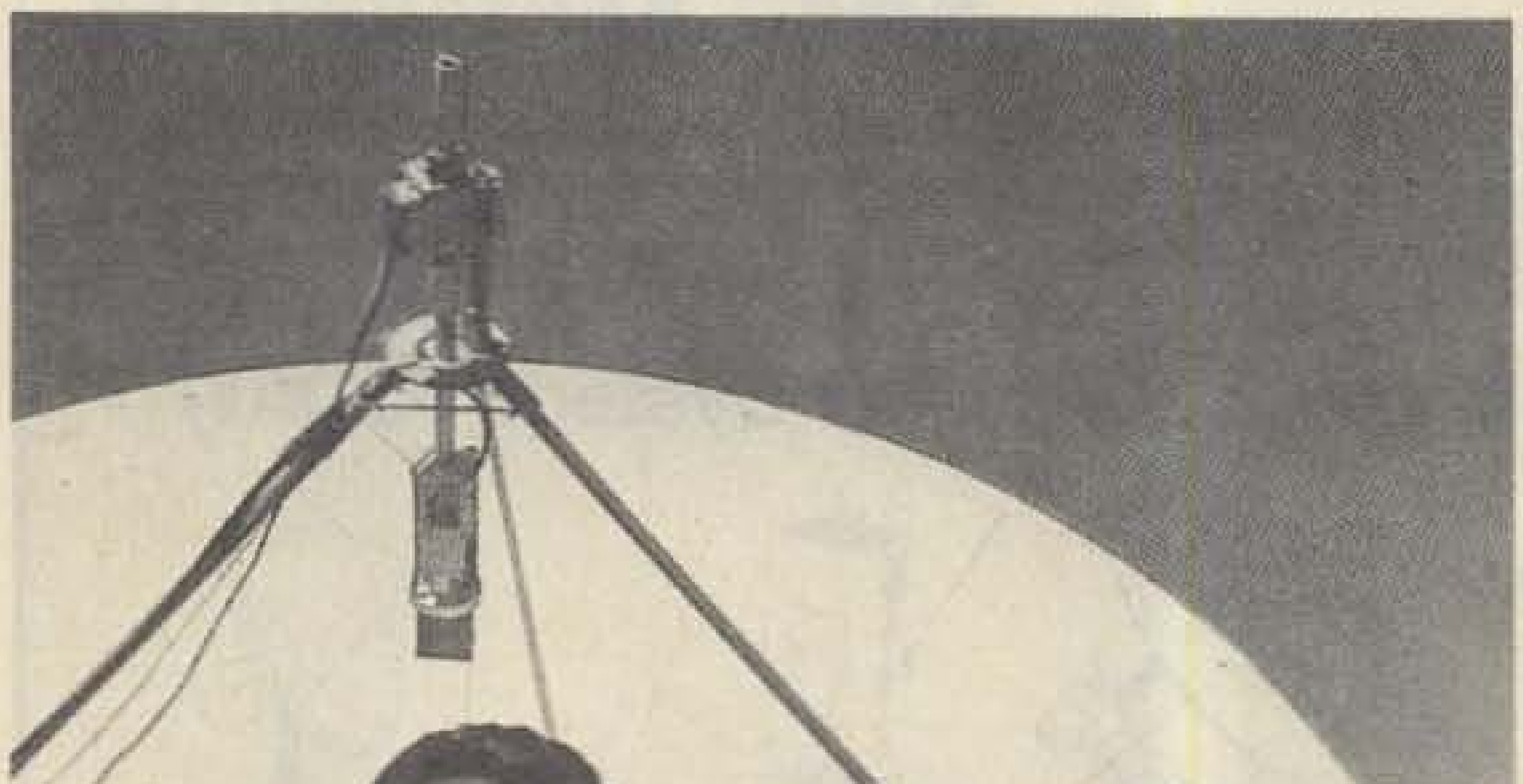


Dwight "Rex" Rexroad with his Cheap Trick receiver.

"See first run movies, sporting events, and nightclub acts as secret network feeds!" That's the sort of ballyhoo you read about satellite television nowadays. But the price for even a kit setup can run sky high! The only way to cut the cost is for you to do it all yourself.

But those build-it-yourself pitfalls can leave you wishing you'd never tried. For one thing, you're on your own with only plans that are vague or, even worse, a set of PC boards that won't work. So, being first on your block seems to carry its own set of problems. What you need is a "Cheap Trick"!

In the December, 1981, "Satellite Central," I wrote a brief overview of TVRO receiver design. If you priced some of the components, you know that a receiver, especially a dual-conversion job, will cost $500 to $700 to build. And, if you want real quality you'd better plan on spending more. So how can something any good cost less? As a matter of fact, just a voltage-tuned oscillator (VTO) runs a hundred bucks! So who's kidding whom?

But hold on there. Just when you think it isn't possible, along comes a very clever engineer like Dwight (Rex) Rexroad who does it with a flair that shows that hobbyist thinking and ingenuity hasn't stagnated after all. "The secret here," says Rex, "is to make the design non-critical and to use parts that anyone can find with ease. Nothing in this design is weird. Everything is off the shelf." Out of Rex's unique approach comes "Cheap Trick," the ham's answer to a TVRO receiver you can build for under $100!

Cheaper Is Better

Look at the diagram in Fig. 1(a); Rex downconverts all twelve transponders on a satellite (3.7 to 4.2 GHz) to the 500- to 1000-MHz region where he can use cheaper components. He uses a fixed-frequency local oscillator (LO), a mixer, and a broadband amplifier, all of which may be mounted at the dish in a small box. The advantage to this arrangement is that the lower-frequency signals can be passed into your house via RG-59 or RG-6 rather than expensive cable needed for piping 4-GHz signals.

No tuning is done in the first conversion—see Fig. 1(b). Instead, tuning is applied at the second conversion by another cheap trick, a UHF TV tuner. The saving is enormous, especially since the tuner needs very few changes to make it pass 30-MHz-wide signals to a 70-MHz bandpass filter and intermediate frequency (i-f) amplifier. Despite its reduced performance at 70 MHz, Rex uses a typical TV i-f IC, the MC1350. It's a logical choice for the i-f amplifier because of its low price and easy availability. Razor-sharp tuning is easily accomplished using just two op amps with a solid afc thrown in to boot.

The amplified 70-MHz i-f signals are halved to 30 MHz by a divide-by-two circuit and applied to an MC1357 quadrature detector IC which, with suitable input, can deliver pictures that may exceed in excellence those of a PLL-type detector. The detected video is clamped and de-emphasized before output to your TV monitor or modulator. The sound demodulator uses circuitry similar to that found in most television sets.

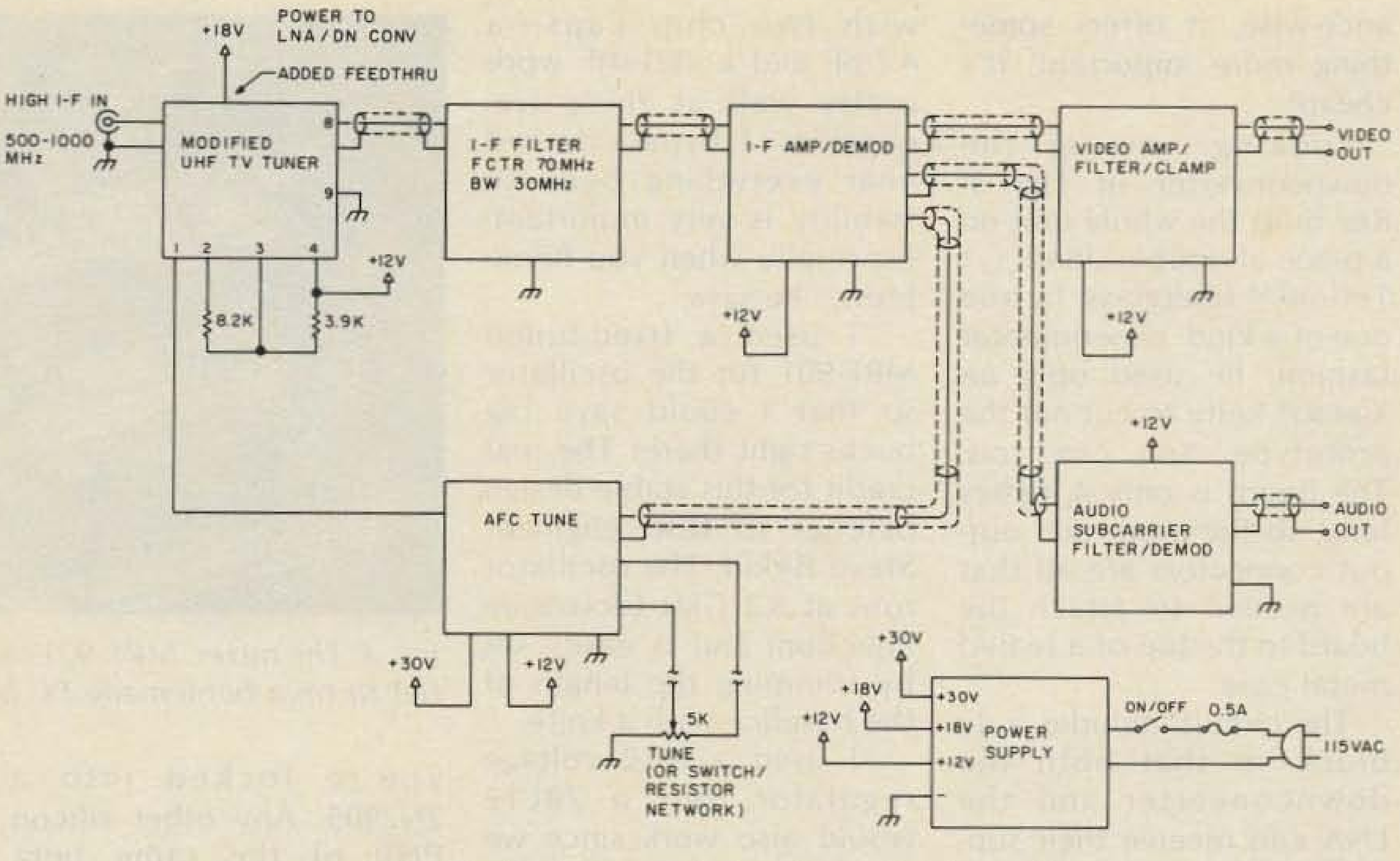


Fig. 1(a). Block diagram of the Cheap Trick receiver.

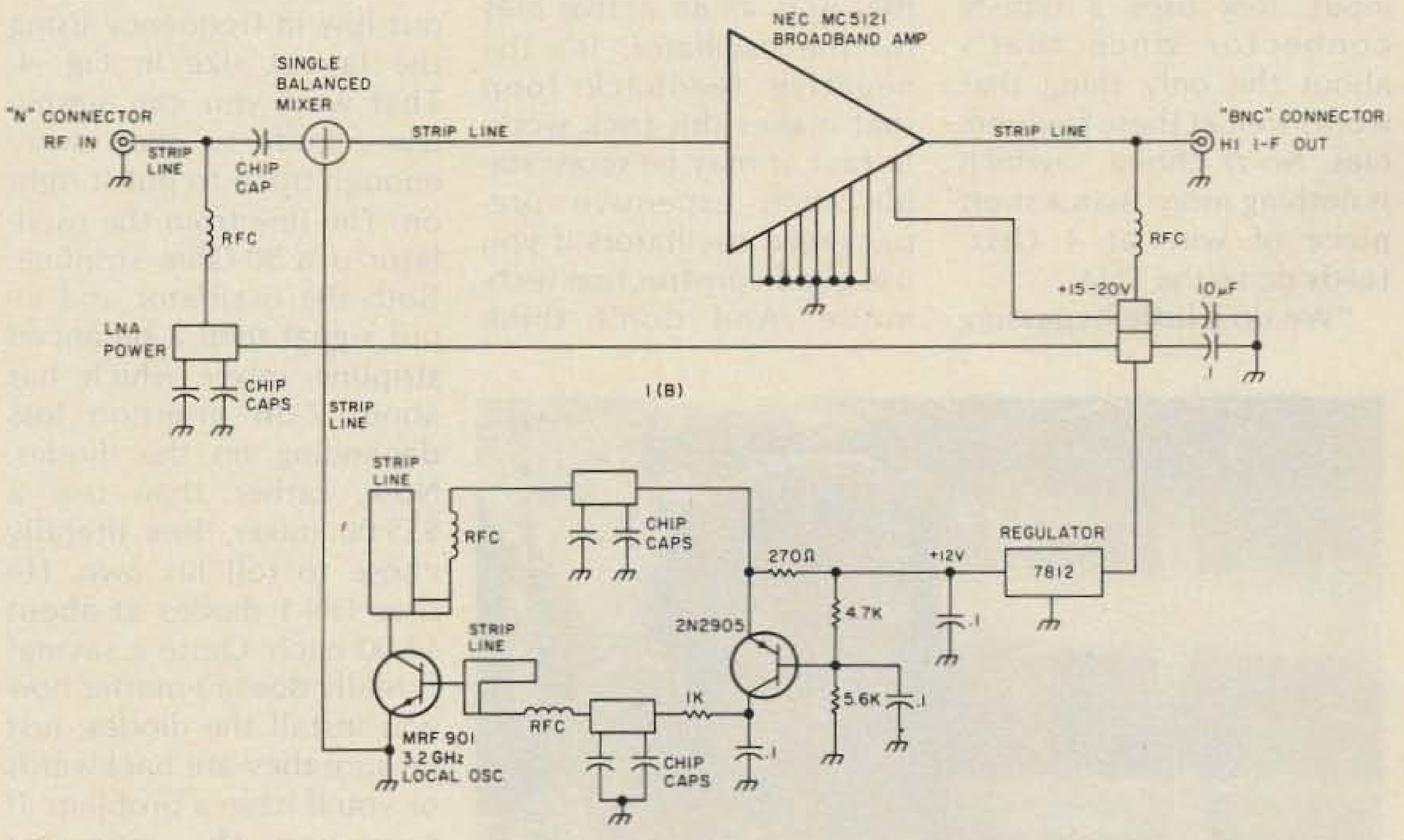


Fig. 1(b). First stage of the receiver downconverter, including balanced mixer and local oscillator.

Power Supply and Downconverter

This month, we'll delve into the power supply and clever downconverter design and save the baseband circuits for next month. It should be remembered that this project is labor-intensive. If you just want to watch satellite television, then you really should buy a receiver rather than fiddle with the "Cheap Trick." Some of the techniques used here will surely challenge your experimenting abilities.

According to Rex, "The power supply is not quite typical . . . but close. I use a 26-volt, 1-Ampere transformer that is center-tapped. This is a common transformer. Radio Shack has them. [Rex needed 30 volts for tuning and took the easy way with an LM317 adjustable voltage regulator—see Fig. 2.] I found that bypassing the LM317 got rid of a lot of noise, especially since we are dealing with the tuning voltage where noise could easily FM your tuner! It's clean as a whistle."

The really clever technique used here is to raise the centertap to get about half the voltage (18 volts) to feed the LNA-downconverter combination. A 7812 regulates it down to 12 volts to feed the rest of the receiver. While Rex admits this is not an optimum design balance-wise, it offers something more important: It's cheap!

Looking now at the downconverter in Fig. 3, Rex built the whole unit on a piece of double-sided 1/32" Teflon™ fiberglass. In true one-of-a-kind experimenter fashion, he used only an X-acto® knife to cut out the prototype. You can, too. The board is only 4 inches long, so the input and output connectors are all that are needed to attach the board to the top of a sealed metal case.

The circuit includes a dc block so that both the downconverter and the LNA can receive their supply voltage through the signal coax. Beginning at the input, Rex uses a type-N connector since that's about the only thing that works well at these frequencies. An rf choke . . . which is nothing more than a short piece of wire at 4 GHz, feeds dc to the LNA.

"We do a little bypassing with two chip caps—a 4.7-pF and a .001-mF work pretty well at these frequencies. I bypass darned near everything because stability is very important. Especially when you home brew," he says.

"I used a fixed-tuned MRF-901 for the oscillator so that I could save big bucks right there! The real credit for this stable design belongs to BBC engineer Steve Birkill. The oscillator runs at 3.2 GHz (downside injection) and is easily set by trimming the length of the baseline with a knife.

"I used a 7812 voltage regulator, but a 78L12 would also work since we need only about 15 mA. The 2N2905 is a PNP transistor that acts as an active bias for the oscillator. It's the negative feedback loop that makes this trick work. In fact, it may be more stable than expensive prepackaged oscillators if you use good construction technique. And don't think you're locked into a 2N2905. Any other silicon PNP of the same beta should work just as well."

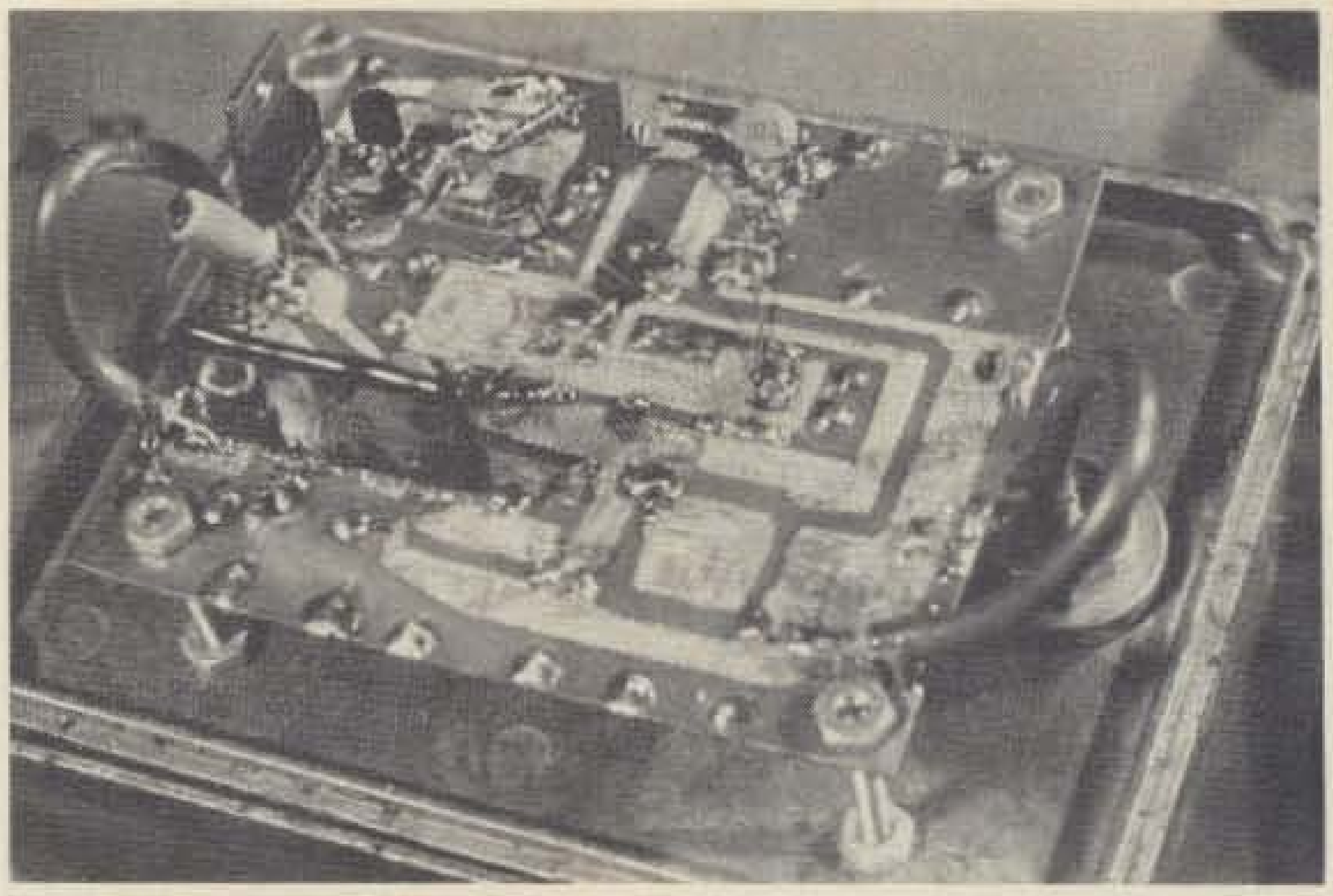
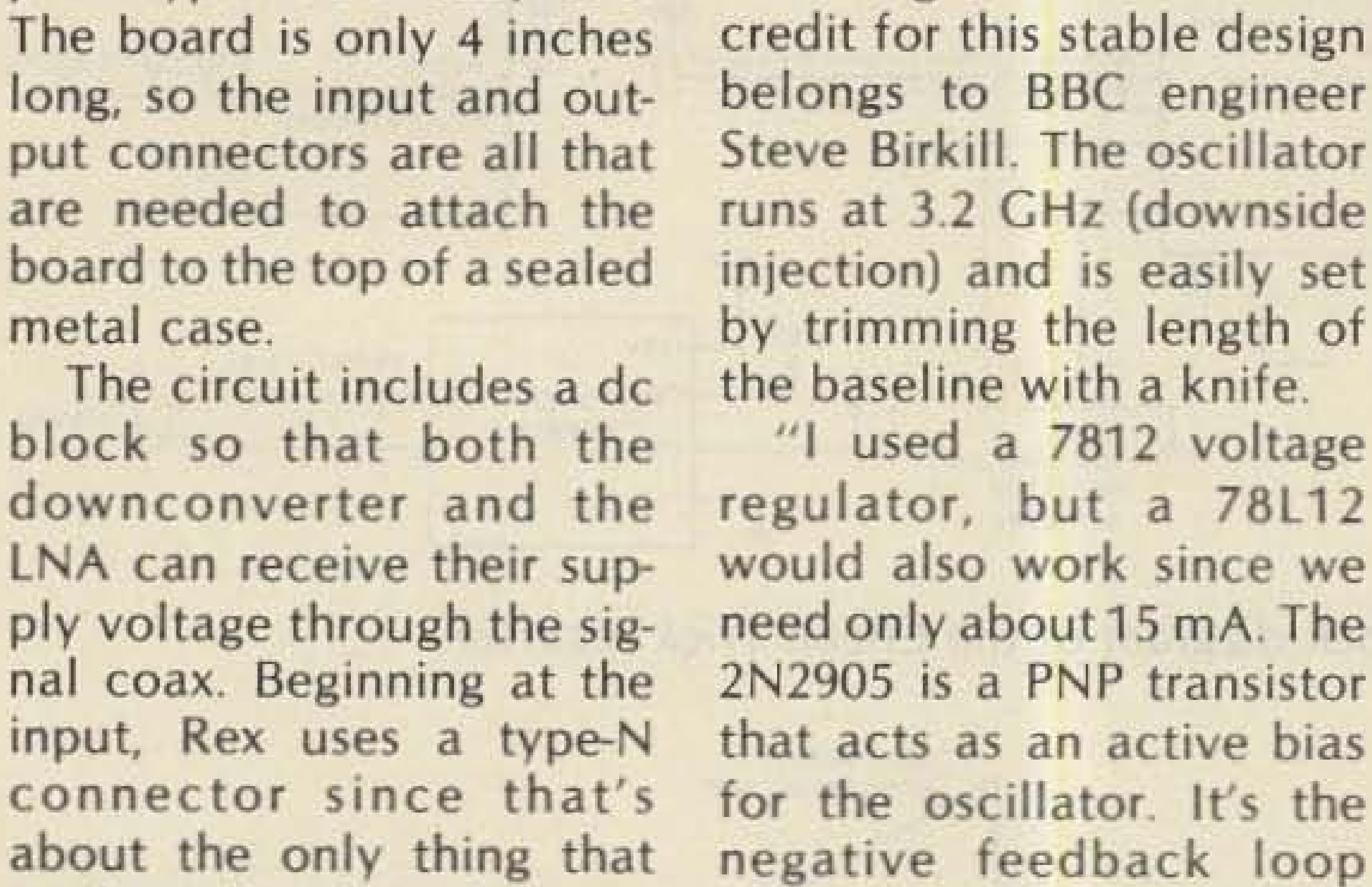


Fig. 3. The mixer, MRF-901 oscillator, and broadband amplifier fit on a homemade PC board.

The oscillator will come out low in frequency using the layout size in Fig. 4. That way, you can simply use a knife to chop away enough trace to put it right on. The line from the oscillator is a 50-Ohm stripline. Both the oscillator and input signal feed a balanced stripline mixer which has about 7-dB insertion loss depending on the diodes. Now, rather than use a $55.00 mixer, Rex literally chose to roll his own. He uses HN-1 diodes at about $2.00 each. Quite a saving! It really doesn't matter how you install the diodes; just be sure they are backwards or you'll have a problem. If you use the popular MBD-101 diodes, you may have to deal with slightly more noise out of the mixer. This may not be a problem if you use a large dish and a commercial LNA.

The NEC MC5121 broadband amp is the most expensive part of the whole receiver. It costs about $13.30 from Alaska Microwave, a *73* advertiser. Kick in another 25 cents and you can get the spec sheets, too. The MC5121 will give you about 20-dB gain, so the overall converter gain is about 14 dB not counting coax losses. Either a BNC or type-F connector will work on the output since the signal is now running somewhere between 500 and 1000 MHz. On a typical system, you can tolerate about 15-dB loss from the coax feeding the baseband unit. The +15 to +20 volts of power for the converter is tapped off the output coax with a 6-turn choke and some dc bypassing. There is no coupling capacitor on the MC5121 since it has its own internal caps.



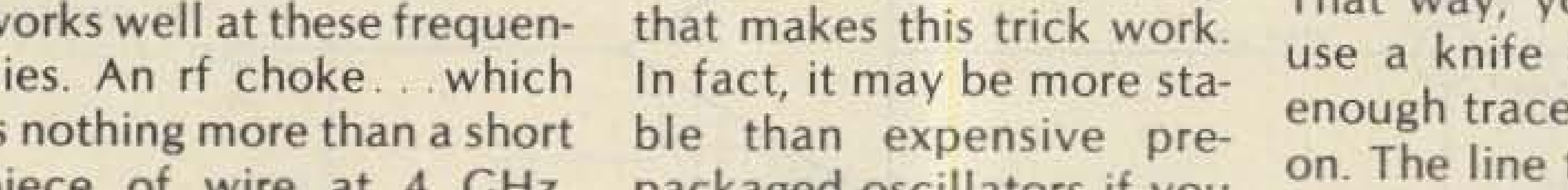


Fig. 2. The power supply furnishes +30, +18, and +12 volts dc.

Making It Work

Probably the hardest part of this project will be acquiring the parts. Yes, you *can* do it for less than $100. In fact, Rex built his for $75.00!

Dropping down in the scale of hardness, we come to troubleshooting. According to Rex: "A spectrum analyzer helps. Use a micro-

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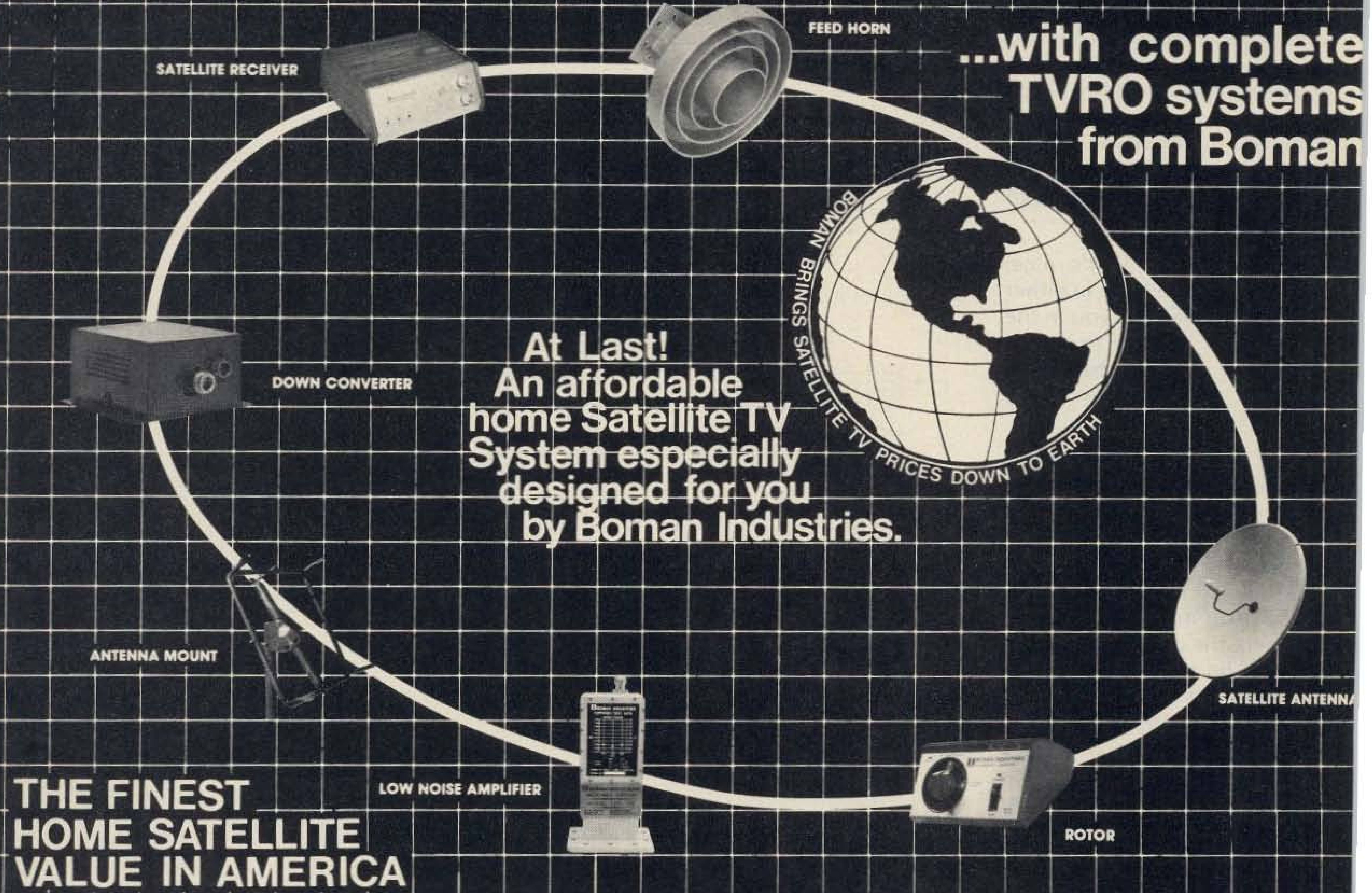

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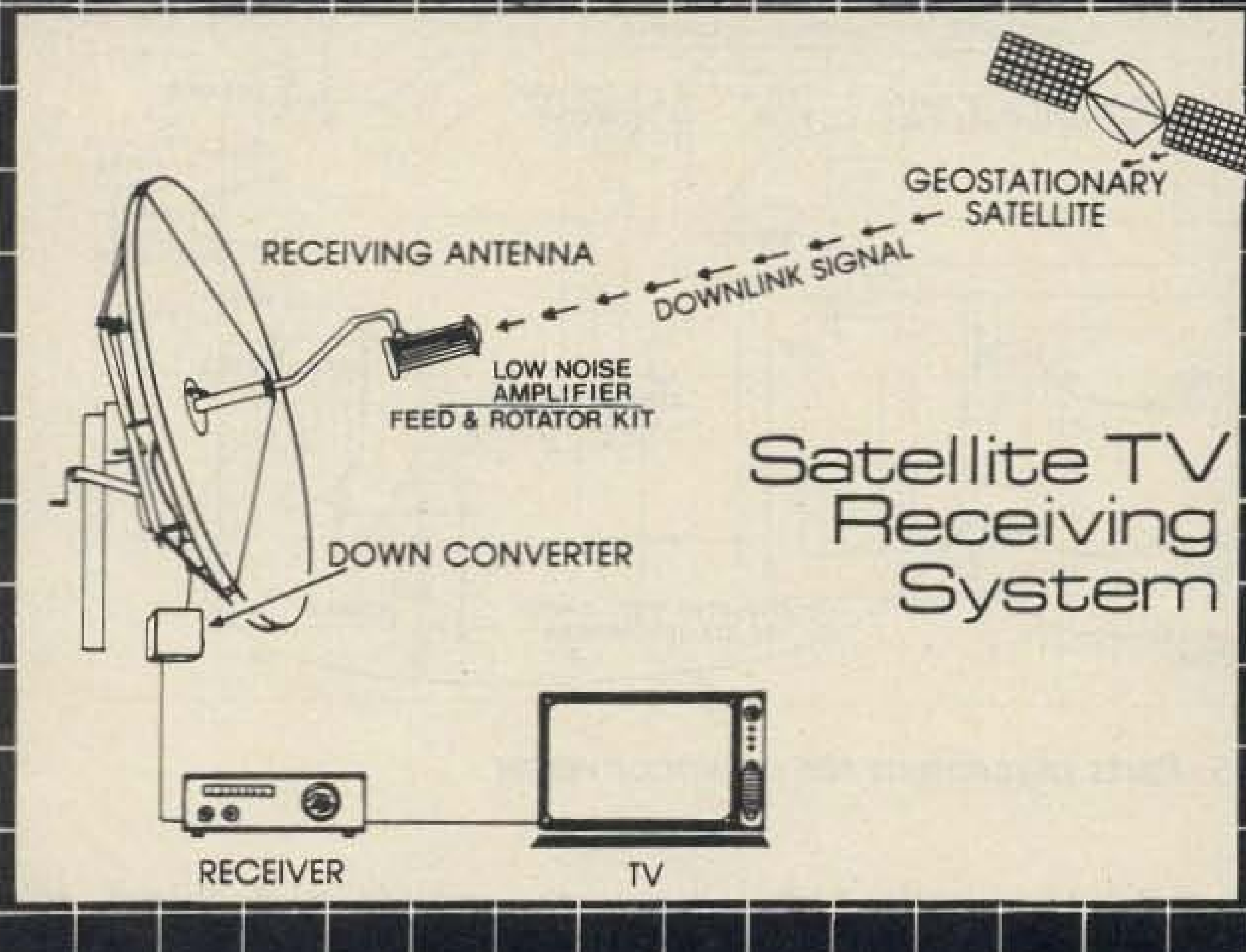

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wave frequency counter attached to the hybrid to tune the LO. Not everyone has one, so I suggest you simply apply power to the unit and tweak the oscillator until the bottom frequency corresponds to transponder one. You'll need a dish and an LNA that are working to do it.

"One thing that's nice: Being off 100 MHz in either direction will get you in the ball park enough to trim it up. Of course, having a friend with another TVRO always helps."

It is possible that the LO will not be stable or, worse, may not start at all. In that event, Rex suggests you move the shorting strip seen in Fig. 5. Do a tack-solder job. You may find a region where the oscillator is operating on many frequencies at once. It makes for rotten pictures, so move the shorting strip to cure the problem. Trial and error are the only ways to do the trimming without an analyzer.

New Life for UHF Tuners

Once the signal is converted to the 500-to-1000-MHz range, it is fed down the coax into the UHF tuner. Use top-notch RG-59 or better. No CB stuff. Rex used a Mitsumi UES-A55F which he bought at a swap meet for five bucks. See Fig. 7. Various mail-order houses carry this model for something like $25.00. If you do some scrounging for other parts used in this project, you still can build Cheap Trick for less than $100.

Now, most tuners have a narrow bandwidth. So you must modify yours to pass 30-MHz-wide FM. Not all tuners can be modified, so you should try to track down this particular model. On the other hand, if you've stayed with us this far, you can probably handle anything that comes your way!

As a rule, the i-f output stage is the culprit. See the "before" and "after" modification circuits in Figs. 8(a) and 8(b). According to Rex, "I replaced the final stage impedance-matching network with a broadband transformer wound on a ferrite bead. Amidon 101-43 beads work pretty well. I used them everywhere in the project."

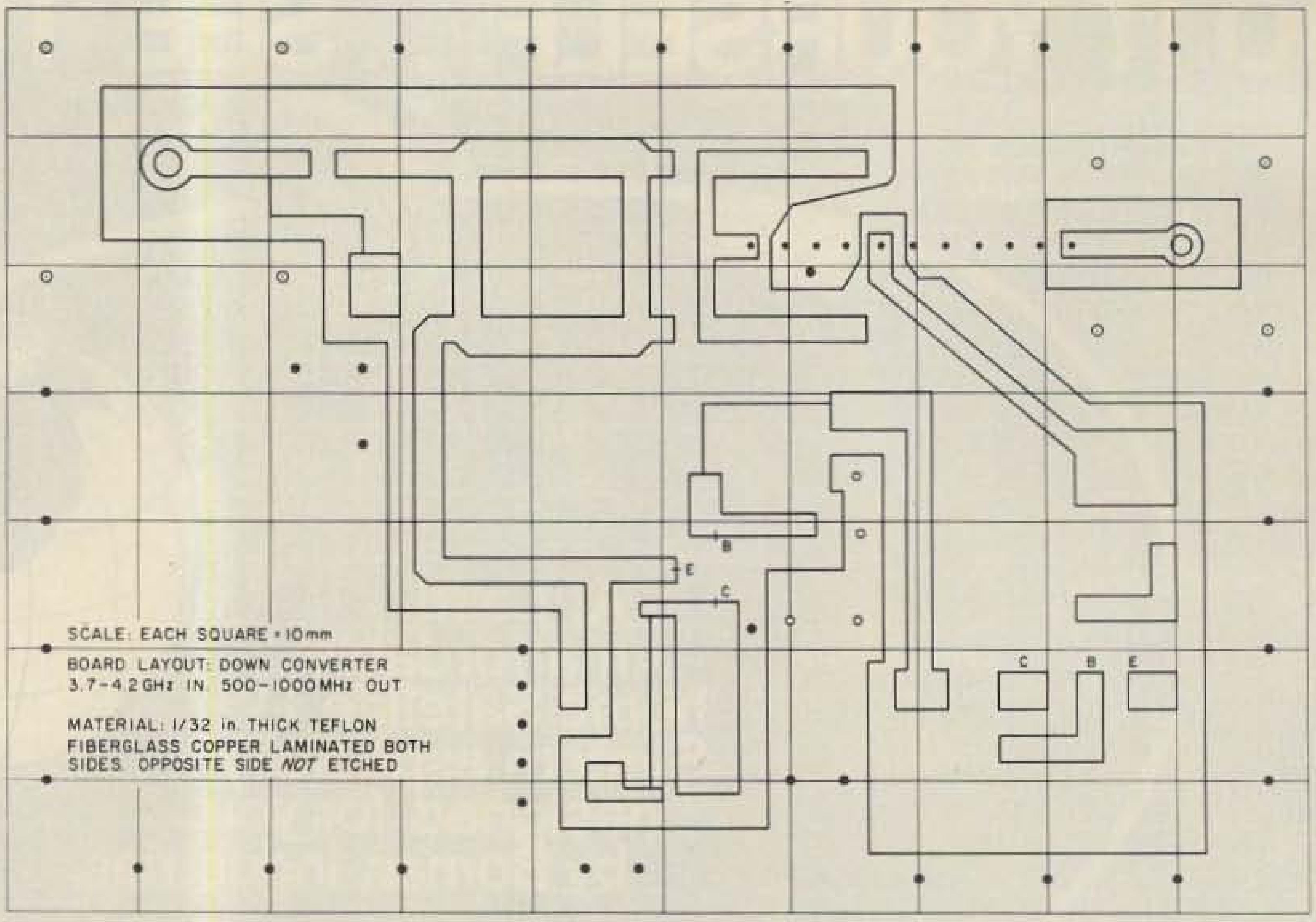

Fig. 4. Circuit board layout for downconverter.

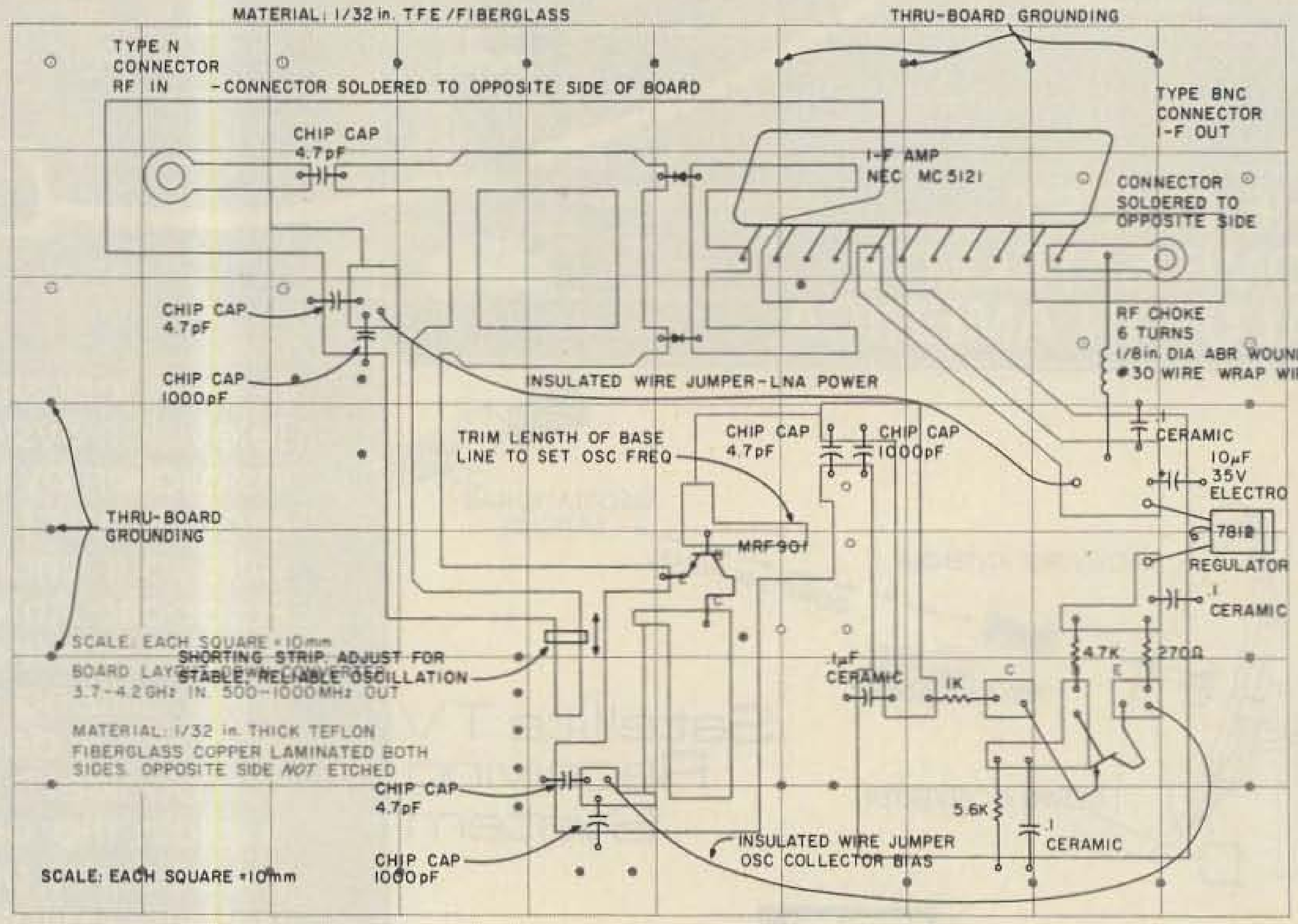

Fig. 5. Parts placement for downconverter.

The input stage should also be modified for a coax input. Some models of the Mitsumi already have a 75-Ohm input. "But if you were stuck with a 300-Ohm model," says Rex, "just look for the place on the board called L1 which was designed for a 75-Ohm link. You can couple to it with a little ceramic capacitor so you can use a 6-turn choke to provide a dc block to feed the coax power for the downconverter and LNA. You'll need to drill a hole in the tuner for this feed. I used a feedthrough cap so that I'd have a place to hook it.

"After these two mods, the bandwidth of the tuner should be about 45 MHz, and it will just cover the

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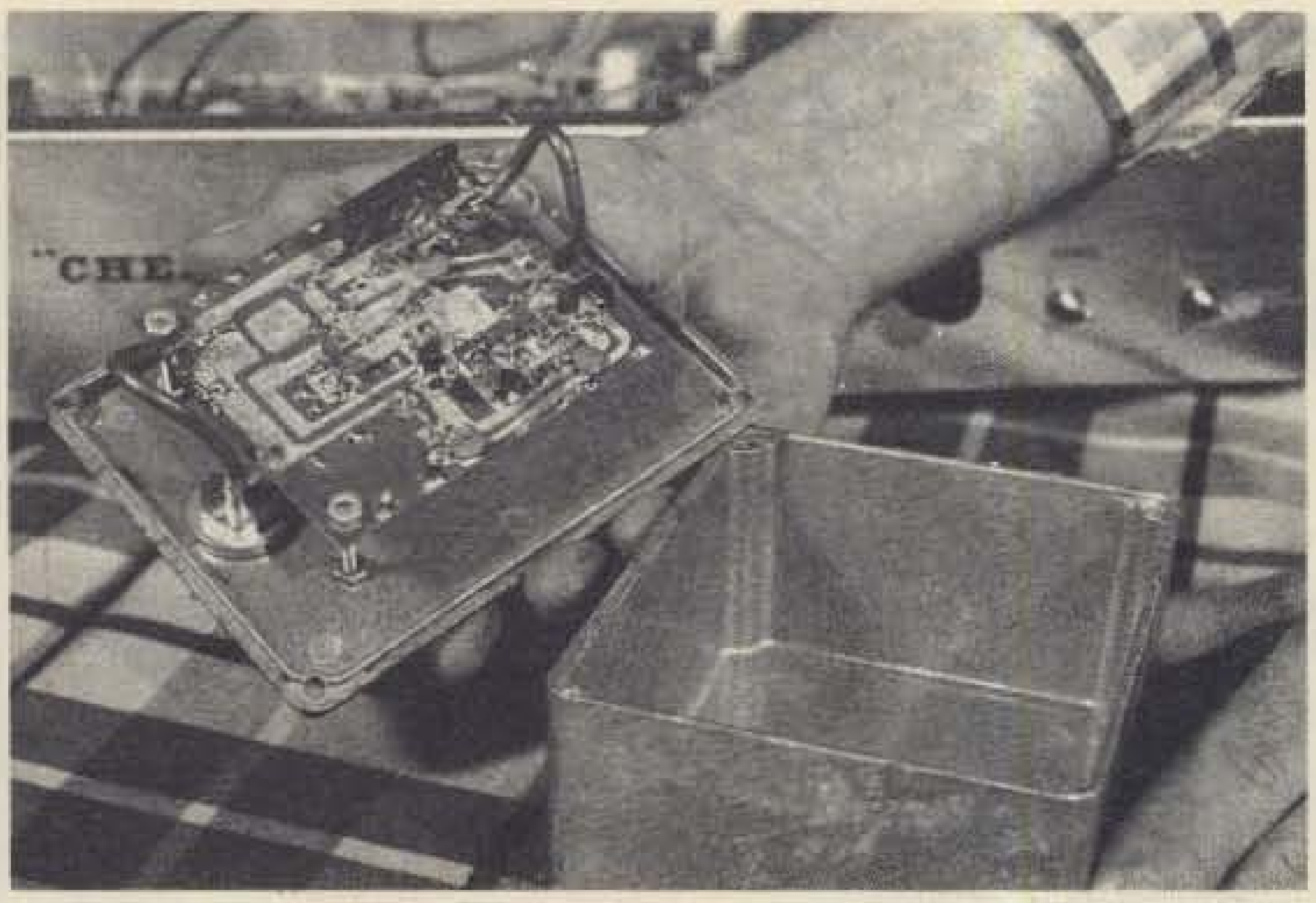

Fig. 6. The completed downconverter is housed in a watertight box. The PC board is held in place by the input and output connectors. A heavy dose of rubber cement will make a good seal.

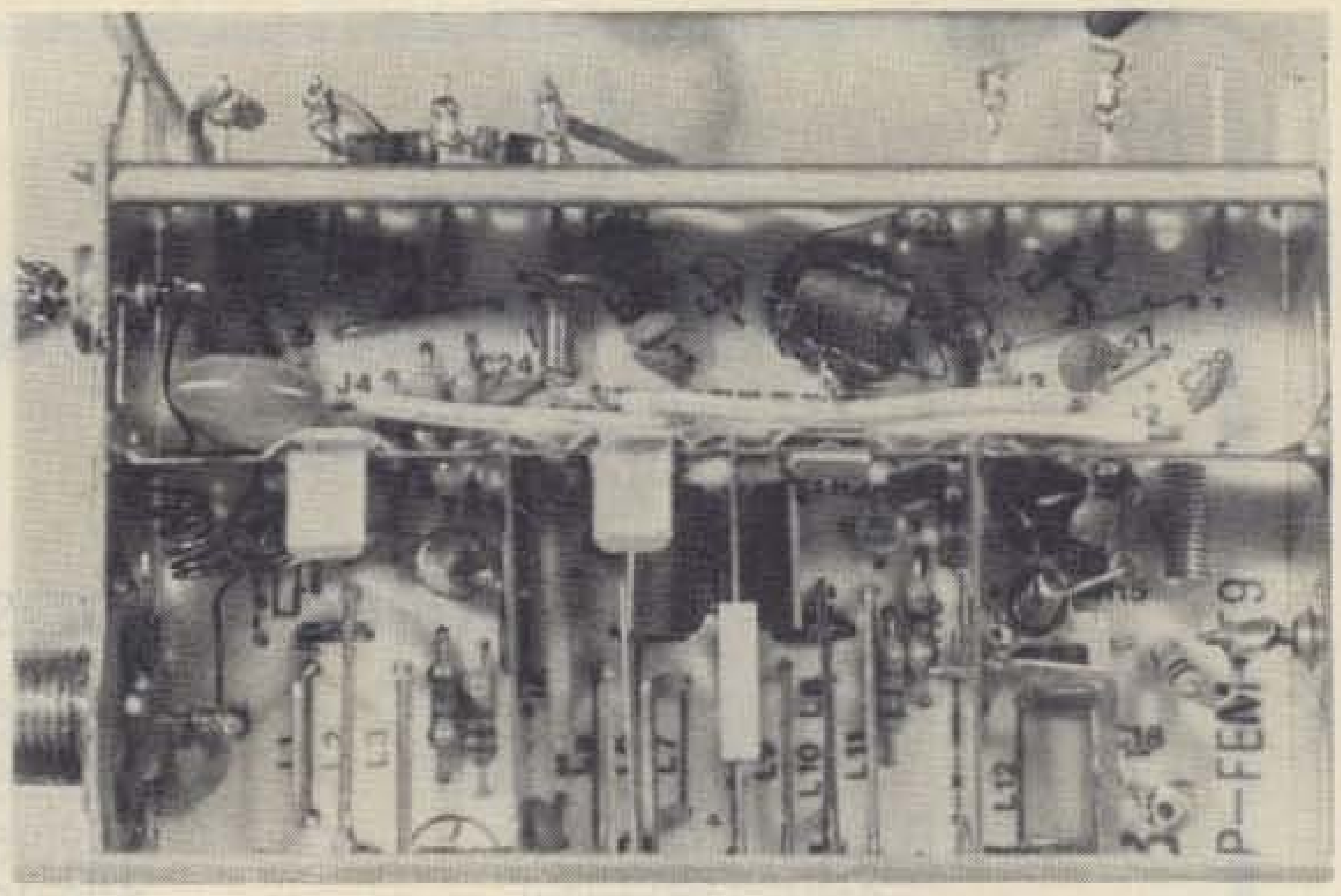

Fig. 7. A Mitsumi UES-A55F UHF tuner acts as the second converter with only two mods. The i-f output coil is replaced with a hand-wound toroid. Also, the input matching network is easily converted for 75-Ohm input. Mount the tuner inside the receiver chassis.

tuning range of all the input signals (500 MHz) with a little to spare. Here is where you must tweak the LO in the downconverter so that you get all transponders over the range of the UHF tuner. It's harder to say it than do it, despite the fact the tuning diodes don't give you much more than the needed 500-MHz range."

Rex suggests, "If you just drop one transponder, then diddle the tuner coils. But if you drop two transponders, you'll need to trot out to the LO/downconverter at the dish. You may have a fellow ham with a frequency counter in this range which should make the whole process very simple."

The tuner agc bias should be about 8 volts. The resistors seen in Fig. 1 form a suitable voltage divider. Eight volts is maximum gain.

Next Month: Part Two

After the tuner comes baseband processing, which I'll cover next month. Rex uses some clever ideas to make this last part of the project look easy. In the meantime, start hunting for parts. ■

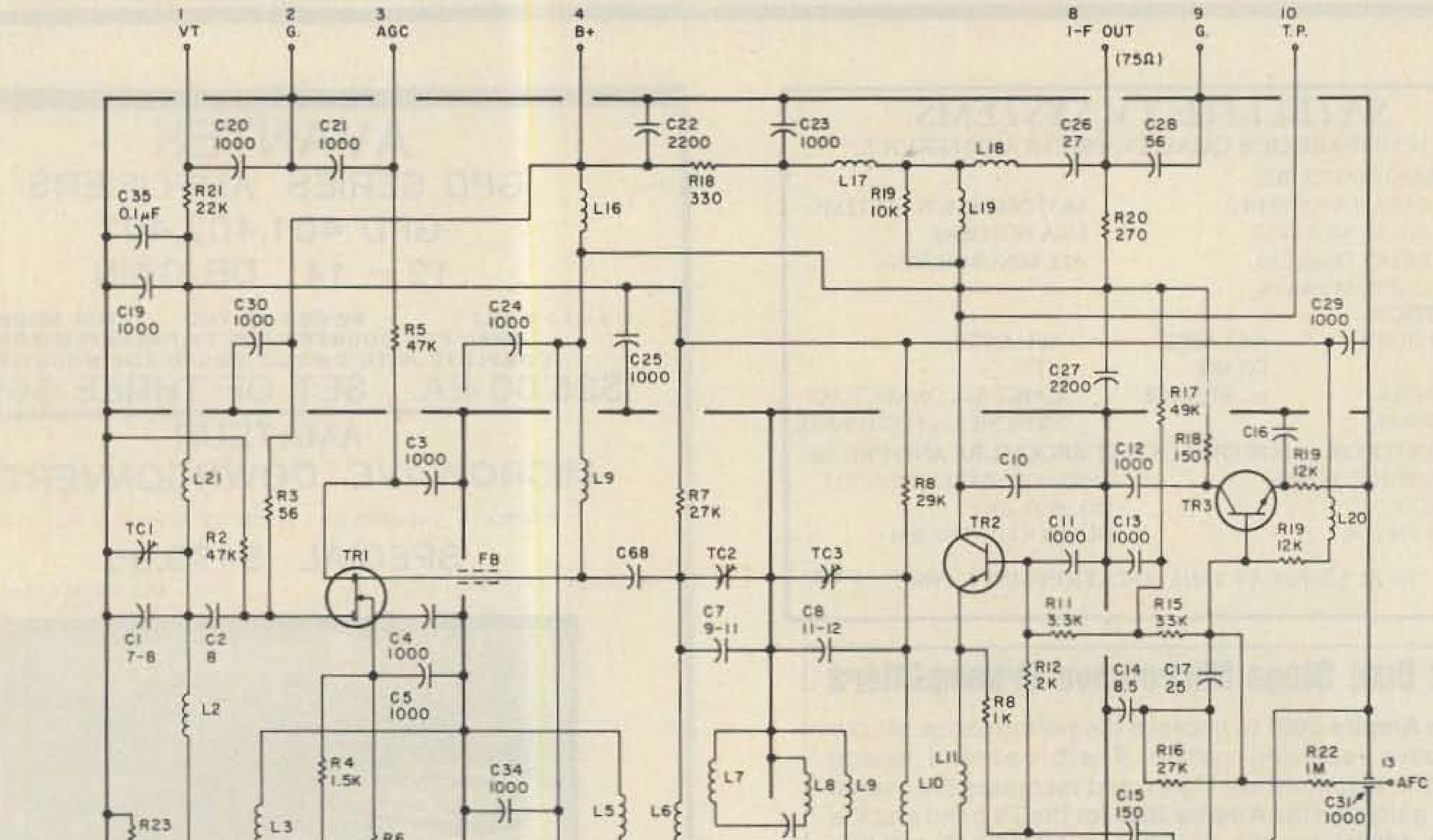

Fig. 8(a). Mitsumi VES-A55F tuner prior to modification. (1) Receiving channels—14-83 ch. (470-890 MHz). (2) P.I.F.—45.75 MHz; S.I.F.—41.25 MHz. (3) Supply voltage: BT—12 V; AFC—6.8 V; AGC—0.8 V; VT—0.5-28 V. (4) TR1—3SK53; TR2—2SC1070; TR3—2SC1730; DT1-DT4—1SV59. All capacitance values in pF; all resistance values in Ohms.

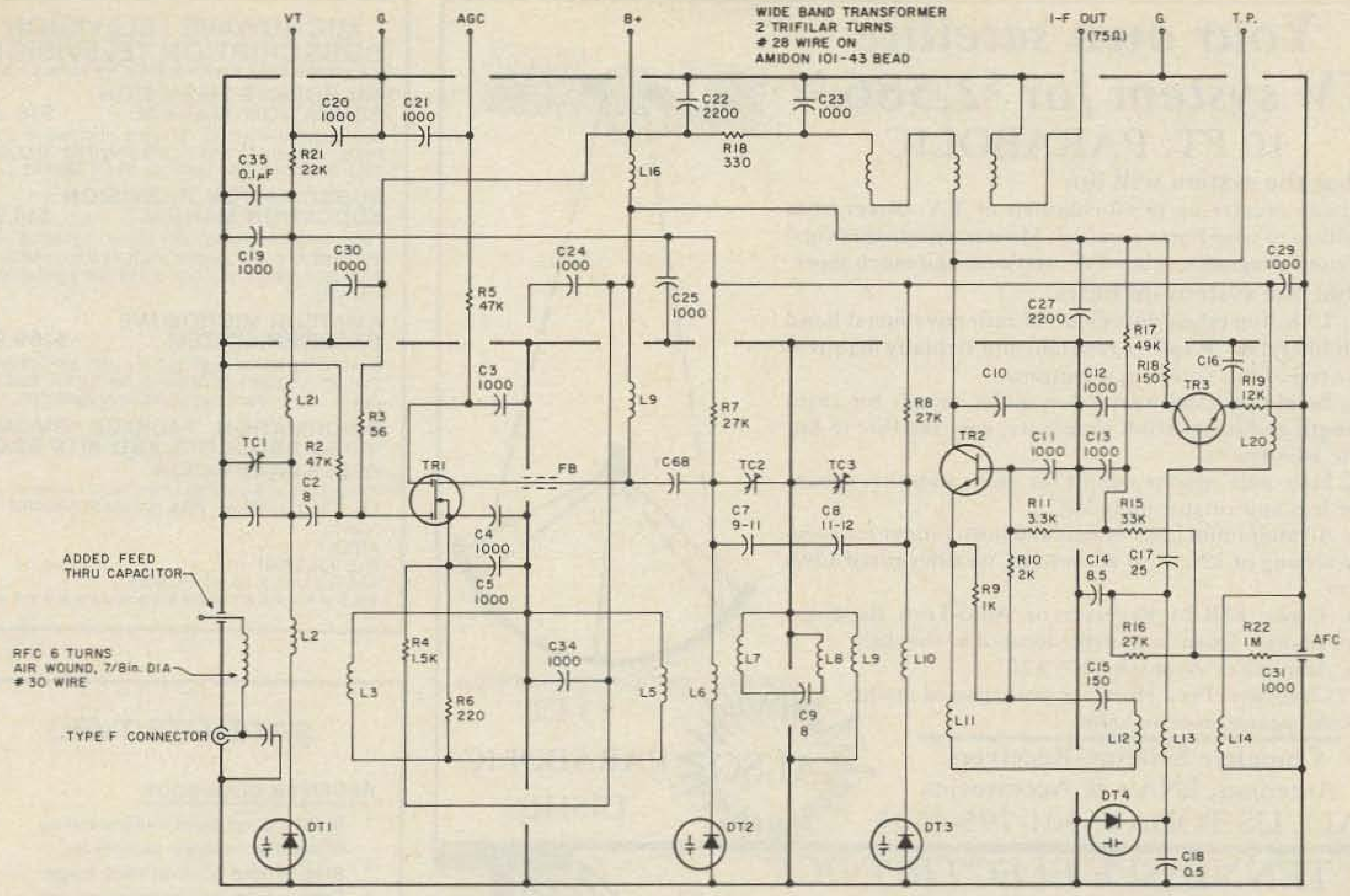

Fig. 8(b). Tuner after modification.

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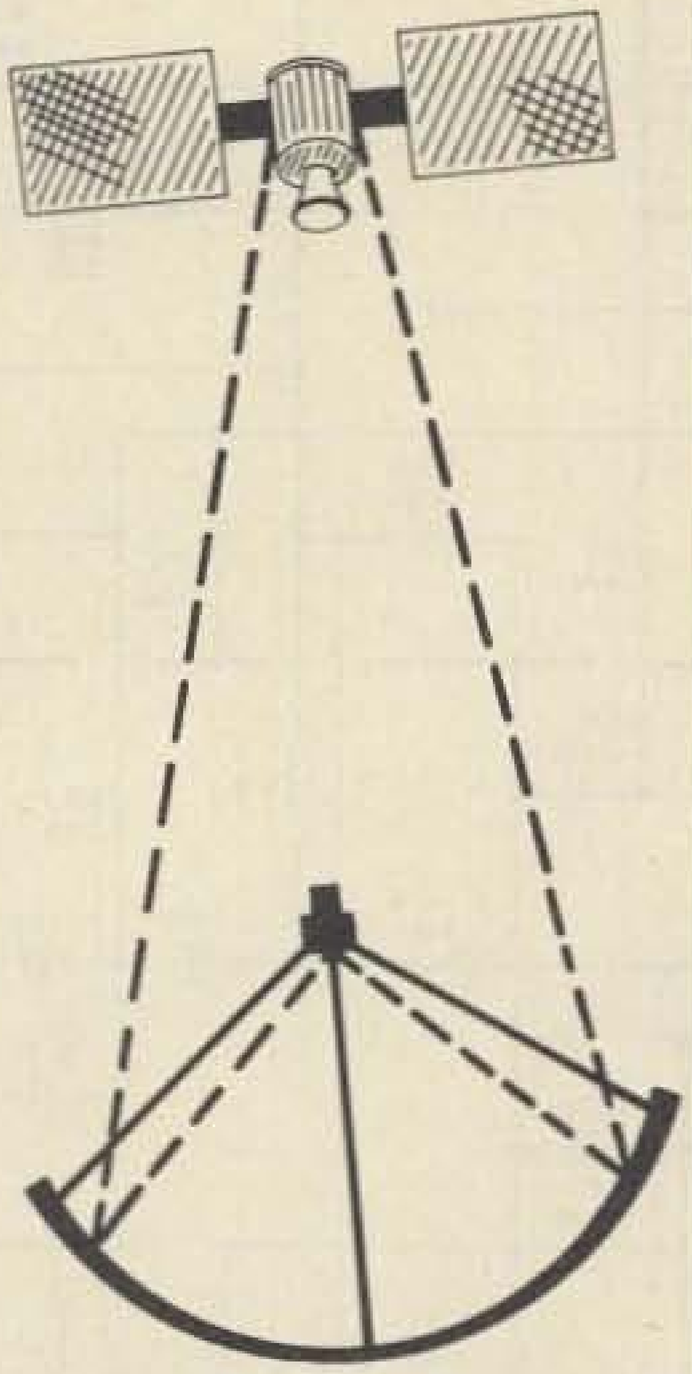

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VUM: Volume Units Meter

— makes measuring decibels easy

Have you ever wondered if the audio filter in your CW receiver is really as sharp as it is supposed to be? What's the frequency response of your stereo amplifier? How much insertion loss do you get when you stick that audio filter into that line? What's the trouble in that malfunctioning audio amplifier?

If you're a good troubleshooter, you can answer most of those questions with a scope, an audio oscillator, a VOM, and a calculator, but you can't do it either quickly or easily.

But a handy little device has been sitting on my bench for years which provides the answers quickly and accurately. It gets almost as much use as the VOM and a lot more use than the grid-dipper, and it costs very little to build.

Let's call it, affectionately, the V-U-M, for lack of a fancier term. Some electronics manufacturers make similar instruments which they call a "gain meter," and they have a very fancy price.

Basically, the VUM is an audio amplifier which has a calibrated step attenuator on the input and an audio voltmeter calibrated in decibels on the output. The meter itself is commonly seen on audio equipment of all kinds, such as good-quality tape decks, audio consoles, and such, and it goes by the name of "VU meter."

That's because it was originally devised for the broadcast industry to monitor "volume units" of complex voice and music waveforms so that audio input to an AM transmitter could be held within reasonable limits by the audio engineer "riding gain" on the program. In that sort of situation, one "volume unit" only approximates one decibel. But when sine waves are used, as they are in virtually all applications of the VUM, one VU exactly equals one dB.

These meters often can be picked up on the amateur market or at hamfests for a buck or two. They're available from most parts houses for anywhere from $6 to as much as $125, depending on how big they are and how fancy they get. Mine was rescued from a lightning-damaged Heath phone patch.

When using the VUM to solve bench or design problems, it is important to understand something about that interesting little animal, the decibel. It is a unit of measurement of power, voltage, or current, but you can't stick a VUM probe into an amplifier and say, "Ah-ha! It reads one dB!" That's like spotting a hitchhiker on the road and exclaiming, "Ah-ha! He's gone about halfway!"

Halfway from where to where?

A decibel is a measure of comparison. It is a ratio. It is used to state the difference between one level of energy and another.

It is also a rather com-

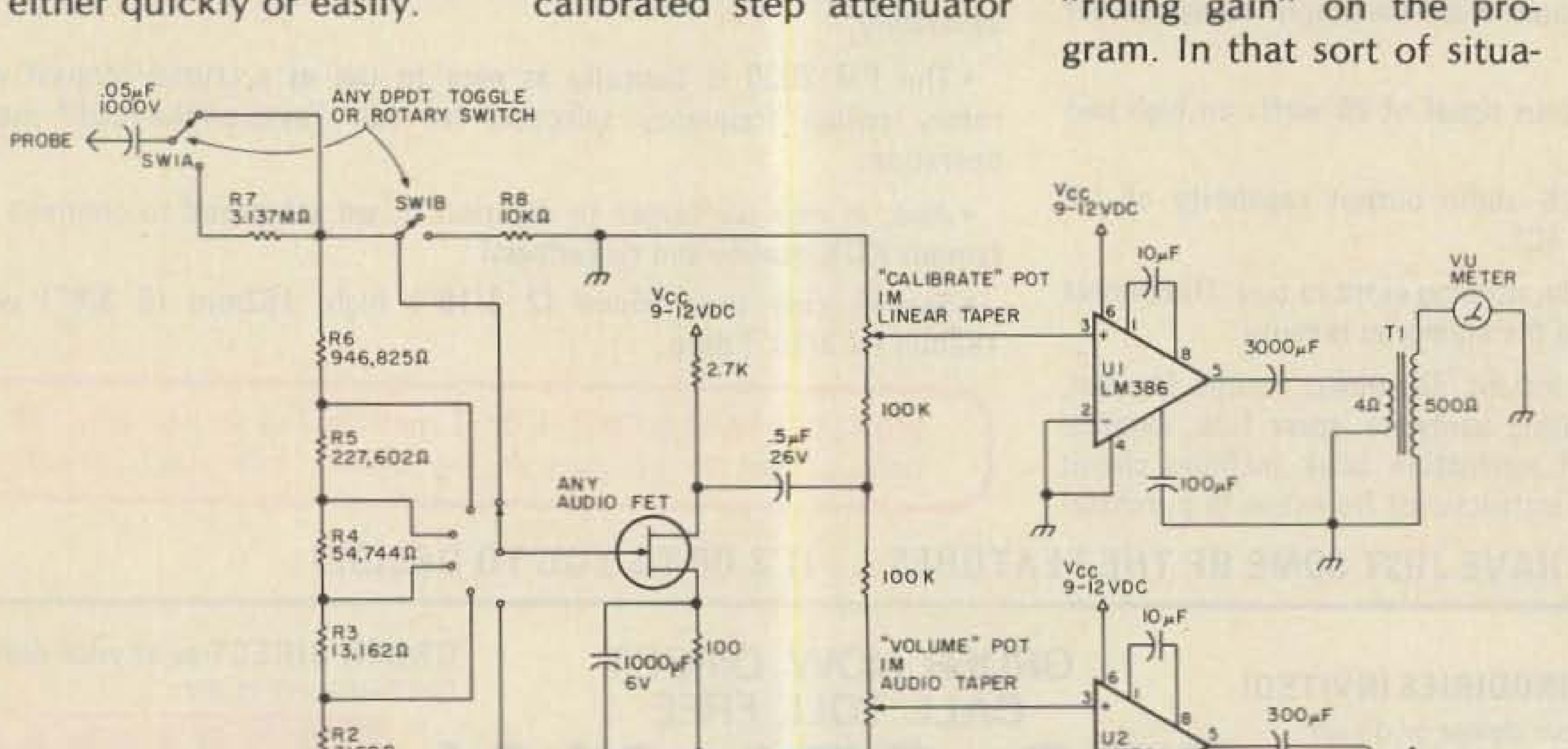

Fig. 1. The VUM (volume units meter), or calibrated audio dB meter.

plex little animal. It is not linear; it is exponential in nature. If you increase your transmitter output from 10 Watts to 20 Watts, the difference is 3 dB. If you increase it again, from 20 Watts to 40, the difference is again 3 dB. Ten Watts to 40 Watts is 6 dB, or two 3-dB steps.

If you increase line *voltage* from 120 volts to 240 volts, however, the increase is 6 dB. The basic formula for determining the dB difference between two *voltages* or between two currents is: dB = 20 log V2/V1.

Now, let's have another look at the VUM, this time in a little more detail. It is a convenient package of several different units:

- A voltage divider resistor string in which each tap on the divider provides 10 dB less signal than the one above it.
- An audio amplifier whose input is taken from the taps on the voltage divider and which drives the VU meter.
- A separate audio amplifier to let you hear what you're measuring.

Additionally, you will need a variable-frequency audio oscillator with adjustable output level. This easily can be built into the VUM as an integral part of the same package if you don't already have such an oscillator. It can be a fairly simple oscillator, covering the range from, say, 50 Hz to 20 kHz, built with ICs. But there are plenty of construction articles about these units and I won't get into that project here.

Essentially, the audio oscillator provides a tone of measurable strength and approximately-known frequency and the VUM measures what happens to that tone as it passes through amplifiers, filters, attenuators, and other exotic devices used by hams and audiophiles.

In my VUM (Fig. 1), the audio amplifiers are LM386 IC chips (available from Radio Shack for about one dollar each), which put out a potent little 400 mW and have a very wide frequency response, from well below the audible range, well into the superaudible. Other amplifier chips such as the LM2277, LM1877, or LM377 also can be used. They provide two 2-Watt amplifiers in the same chip.

One 386 drives the loudspeaker for aural monitoring. The other drives the meter. An even better meter driver might be constructed from an op amp, such as a 741 or TL081, which could drive the meter directly without help from a transformer.

The calibrated voltage attenuator is simply a resistive divider across the input. A standard shielded probe with a ground clip is used for pickup. A blocking capacitor keeps dc from being applied to the divider, and hence to the FET preamplifier gate.

The entire voltage divider, with its switches, lead wires, and input capacitor, should be shielded from stray pickup. Without shielding, it is subject to hum, rf, and other stray pickup which shows on the meter and is audible in the monitor. The input impedance is approximately one megohm. Many of the pickup problems can be solved by shunting the whole string with a one-meg (or lower value) resistor, thereby lowering the input impedance without changing the 10-dB interval between attenuator taps. (If this is done, it is necessary to recalculate the value of R7 to give 50 dB attenuation with the new divider resistance.) You might provide a switch to do this, so that you can retain the one-meg input impedance for use when you're working with very high impedance sources.

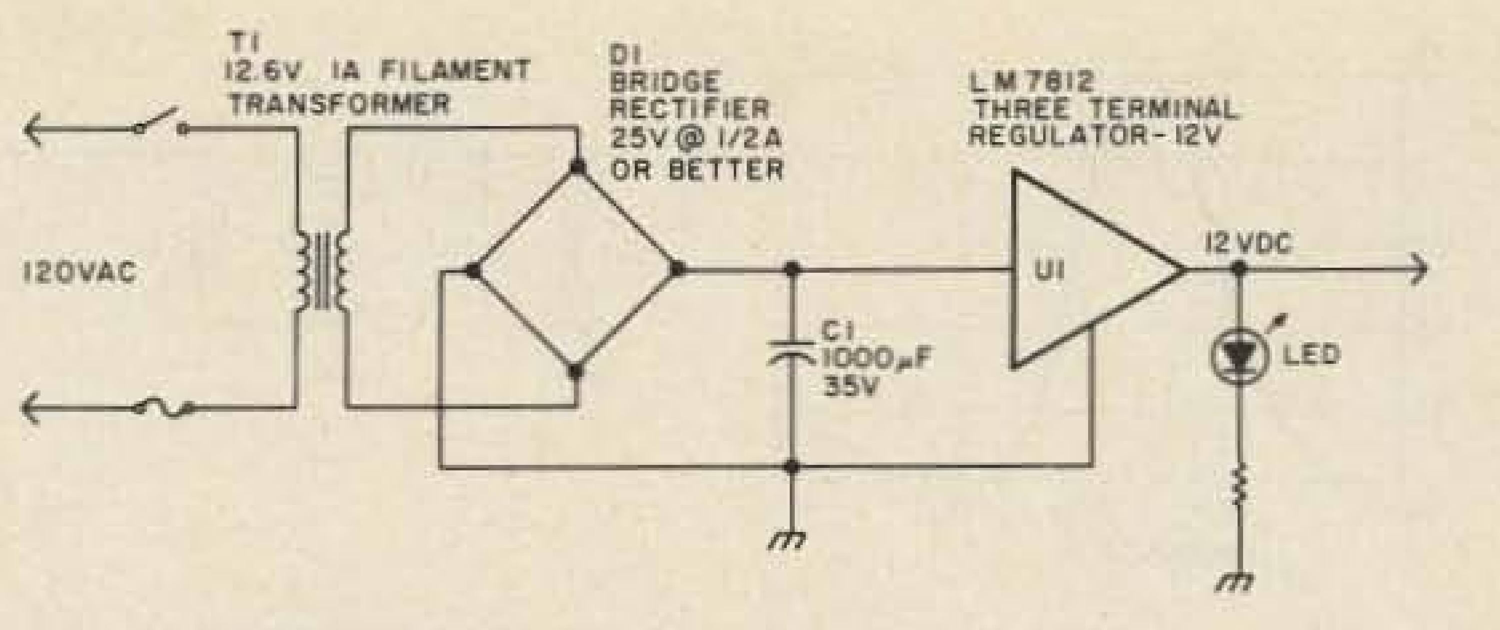

Fig. 2. Power supply for the VUM.

Resistance values are chosen such that each switch position gives 10 dB less signal than the one above it, for a total of 50 dB attenuation below the input signal. When the "high level" switch is flipped, an additional, fixed 50-dB attenuator is thrown into the circuit and the switch then reads in 10-dB steps from 50 to 100 dB below the input—and that's a *lot* of attenuation!

How do you determine the resistance values? That caused me a lot of floundering around with my trusty TI-55 calculator and a ream of paper smeared with several grams of graphite scribblings, but it finally came clear. As I said, the secret is that a dB is a *ratio* between two values, and you have to start with one known value and go from there.

You arbitrarily can assume a total value for the divider of one megohm, and calculate each step as a portion of that, or you can arbitrarily assume some value for R1 and calculate each step from there. I chose the latter because it enabled me to use a 10-dB ratio in all calculations, thus greatly simplifying the calculator work.

Now, let's go back to the basic formula stated earlier and solve it for 10 dB: 10 dB = 20 log V2/V1. Therefore, antilog V2/V1 = 10/20 = 0.5. The antilog of 0.5, obtainable from the calculator or a log table, is 3.1622777. So: V2/V1 = 3.16 and V2 = 3.16 V1.

In any purely resistive network, voltage divides in exact direct ratio to the resistance, so we can substitute R1 and R2 for V1 and V2 and restate the formula R2 = 3.16 R1.

Now, let's assume a value of 1000 Ohms for R1 (see Fig. 1). R2 is then 3.1622777 × 1000 = 3162 Ohms.

That gives us the values of two resistors in the string. Now let's get the value of R3. We want a value which will give us 10 dB less voltage across R1 + R2 than is applied across R1 + R2 + R3. So, R1 for this calculation is actually the sum of R1 and R2, or 4162 Ohms. Therefore: R3 = 3.16 (R1 + R2) = 3.16 × 4162 = 13,146 Ohms.

To get the value of R4, use the same method, making "R1" equal the sum of R1 + R2 + R3. And so on, until you have the value of all six resistors in the string.

Now, it happens that 1000 Ohms is a standard resistance value. That's why I chose it. Three thousand Ohms, however, is not a standard value, and 3162 certainly is not! However, 2700 and 470 are standard values, and they add up to 3170 Ohms, which is only 0.2 percent off the calculated value! Certainly close enough for amateur work.

13,146 isn't standard, but 13k is, and it is only about 1.0 percent off. If you want to be *really* finicky, you could use 13k and 150-Ohms in series, but, unless you're using very expensive 1% tolerance resistors, the difference is academic. Five percent is certainly close enough and ten percent probably will do nicely.

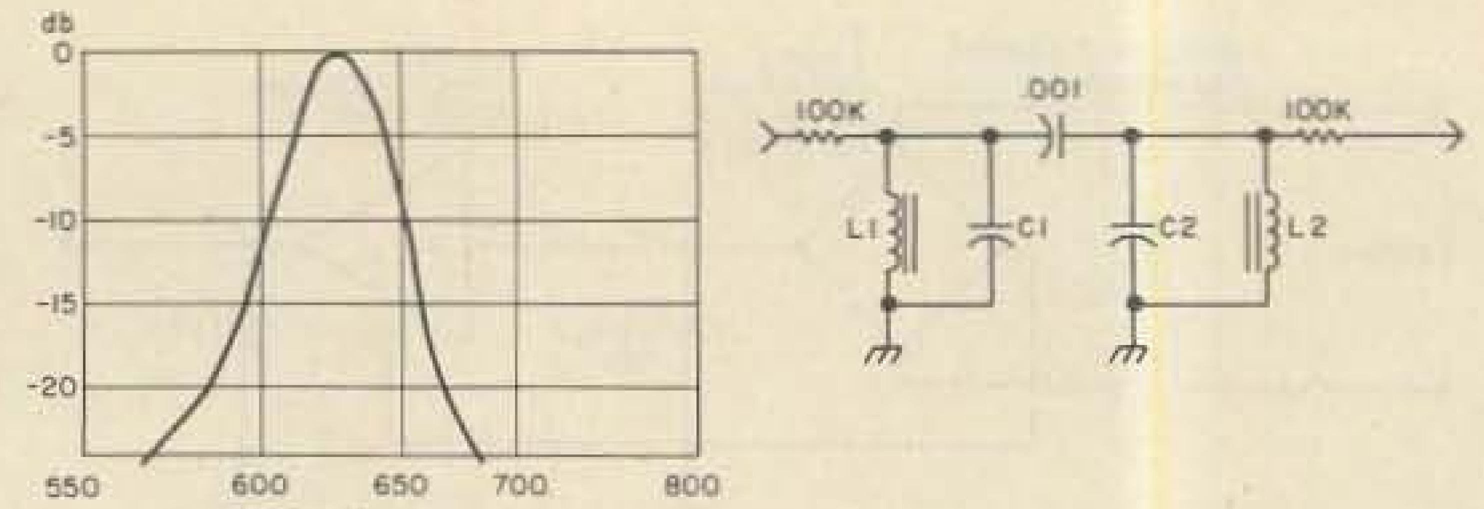

Fig. 3. Frequency response of two-toroid CW filter determined with the aid of the VUM. L1, L2—88-mH toroids; C1, C2—0.68 μF. Bandwidth: 25 Hz at −3 dB; 40 Hz at −5 dB; 55 Hz at −10 dB; 60 Hz at −15 dB.

Calculated values of the other resistors can be approximated in the same way, using standard values in series, parallel, or series-parallel. In most cases, quarter-Watt composition resistors will do fine. However, compostion tends to change value slowly over a period of years, especially when subjected to heat and/or high-voltage stresses. You could avoid this with metal film resistors, at much expense, but one-Watt or even two-Watt composition resistors will hold their values for many years before they change enough to affect the accuracy of your readings.

The resistors are easily mounted on a small piece of perfboard with wires running to the six-position rotary switch, but keep the leads fairly short, keep them away from output leads going to the speaker or meter, and keep them away from power-supply leads. If possible, enclose the whole resistor bank and switch in a shielded compartment, though this may not be necessary.

The FET amplifier is not needed to provide gain, though it provides about 10 dB. It is there to offer a very high impedance to the voltage divider. The input impedance of the LM386s, in parallel, is about 25k and if this impedance paralleled the attenuator, it would seriously affect the accuracy of the steps, especially at the small attenuation settings. Any inexpensive audio-type N-channel FET will work nicely. The FET drives the two pots which provide separate level controls for the amplifiers.

The meter amplifier is coupled to the 4-Ohm winding of a small audio transformer with a 500- or 600-Ohm secondary, such as those used to couple speakers to music distribution lines. The purpose of the transformer is to step up the low-voltage output of the amplifier to the higher voltage which the meter needs. The meter is designed to work across a nominal 600-Ohm load.

Except for lead dress and shielding of the input circuits, nothing is critical about construction. The audio amps, including the FET circuit, can be built on a single universal circuit board such as the "experimenter printed circuit board" sold by Radio Shack (catalog number 276-170) or any other "universal" board with 0.1-inch perforation centers. It can be built on perfboard without foil using wire-wrap or point-to-point wiring.

A regulated power supply (Fig. 2) using a three-terminal 12-volt IC chip is used because the regulator provides a high degree of hum filtration. Voltages are not critical at all, but don't exceed 15 volts—the 386s cannot take more than that. Nine-volt batteries should work fine.

After checking for wiring errors, plug in the ICs and check for output. You should find none until you provide an input signal. If hum appears on the meter and/or in the speaker, especially at the 0-dB attenuation setting, short out the probe terminal and see if it disappears. If it does, your problem is hum pickup in the attenuator board.

Occasionally IC amplifiers will oscillate. This would show up as squeals, hisses, crackles, and distortion in the speaker and as a reading on the meter, even with the probe input shorted or switched to high attenuation. This usually can be cured with an RC filter (0.05 μF and 10 Ohms in series) from the IC output to ground. Sometimes a 0.005-μF capacitor across the input terminals at the IC will be necessary. The FET can be eliminated as a suspect oscillator by grounding its gate or by removing its drain voltage.

After checking out and debugging, hook a source to the input of the VUM. The best source is an audio oscillator, but for this test, any steady tone will do.

You should hear it in the speaker and should be able to adjust its loudness with the "volume" pot.

The tone also should register on the meter. If it pegs the meter, rotate the attenuator switch until the meter drops back on scale. If little or no meter reading occurs, set the "calibrate" (Cal) pot at about half rotation or a little more, and then, if necessary, rotate the attenuator switch toward the 0-dB position.

Checking Calibration

Adjust the output level of the oscillator until you can set the attenuator at 0 dB and get the meter down to 0 VU (about two-thirds scale) with the Cal pot. Now flip the attenuator to −10. The meter should drop to −10. Reset Cal and, if necessary, the oscillator output, to get 0 VU again, and switch the attenuator to −20. The meter should again drop to −10.

Check all six steps in the attenuator in this way. You may find it necessary to adjust a resistor value here or there to get exact 10-dB steps. (Remember that R6 controls the first step from 0 dB to −10 dB. R5 controls the next step and so on.)

The full range of the Cal pot will give you about 25 or 30 dB of adjustment.

Using the VUM

Now you're ready to put the VUM to practical use. You have an audio filter for use in CW reception. How sharp is it? Put it on the bench and arrange to drive its input with the audio oscillator instead of the receiver. Be sure that the input and output of the filter see the same impedances they see when it is in the receiver, then put the VUM across the output of the filter. Let's assume that the filter was designed to peak at 700 Hz.

Adjust the frequency of the oscillator until it hits the filter peak, giving maximum reading on the VUM. Select an attenuation on the switch which will let you set the meter on 0 VU with the Cal pot.

Note that your oscillator frequency is 690 Hz when the filter output is peaked—pretty close, if you designed it for 700 Hz. Now, keeping the output level of the oscillator the same, switch the frequency to 700 Hz. You'll note a slight drop in the VUM reading. Note that at 690 Hz, the VUM read 0 VU and at 700 it read, say, −0.5 dB.

Change frequency again, to 710 Hz, and note that the meter reading drops to −1 dB (or VU). Keep going up frequency one step at a time until your meter readings drop below −20 dB. Then go down frequency from 690 Hz a step at a time, noting the meter and frequency readings each time.

When you finish, plot your results on a piece of semi-log graph paper, using the logarithmic scale for frequency and the linear scale for your dB readings. The results will be similar to those in Fig. 3, which represents an actual two-toroid CW filter I've used for years. The response curve was plotted with the aid of the VUM.

In a similar manner, you can determine the frequency response of a stereo amplifier, beginning in the middle of the audio range, say at 1000 Hz, to establish a 0 VU reference point. You will note that the meter readings begin to drop off as the frequency reaches some low value, perhaps below 100 Hz, depending on the quality of the amplifier. A similar drop-off occurs at the high end of the audio range, say, above 15 kHz.

The frequency response curve of the VUM itself is shown in Fig. 4 and this must be taken into account when testing another amplifier. The low frequency drop-off is caused, most likely, by the core losses in the small output transformer used to couple the amplifier to the meter. Up to a certain point, increasing the value of the output coupling capacitor will extend the low frequency response. You should use at least a 3000-μF coupling capacitor.

An op amp, such as an LM741 or TL081 driving the meter directly and omitting the output transformer, probably would improve the extreme low end response of the VUM. Since I have seldom, if ever, been called on to make accurate measurements at these frequencies, I have not explored that improvement. The high frequency response is virtually flat at least to 40 kHz.

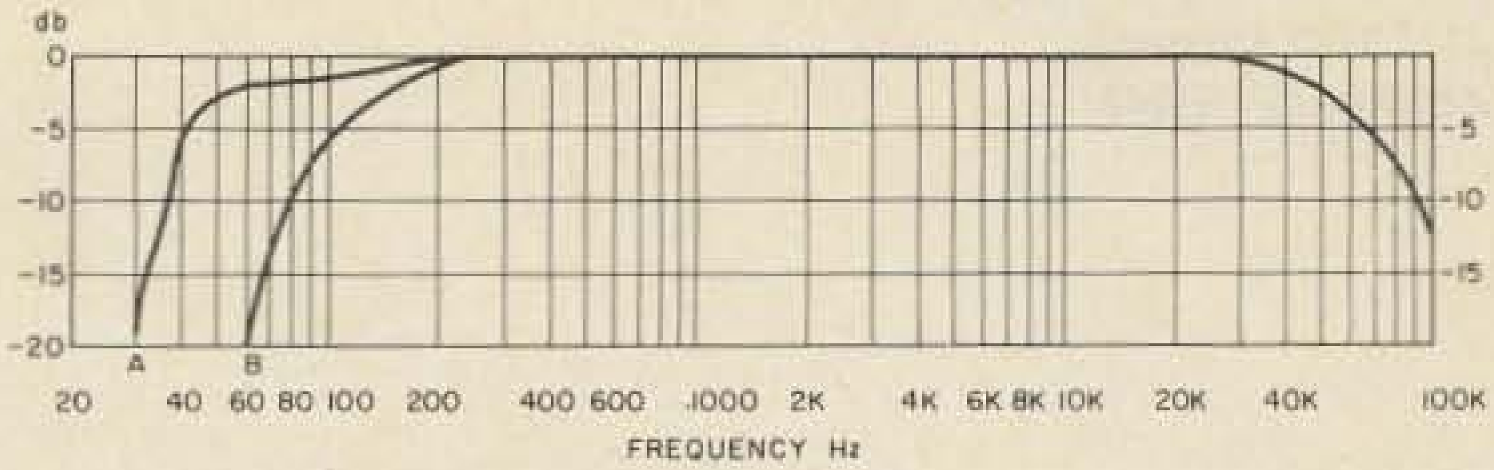

Fig. 4. Frequency response of the VUM. ±1 dB, 100 Hz to 40 kHz; ±3 dB, 40 Hz to 65 kHz. A—response with 200-μF output coupling capacitor to meter. B—1200 μF.

Now, suppose you have a solid-state audio amp which gives only low, distorted output. Apply a tone, such as 1000 Hz, to the input, at a level which the amplifier is designed to handle. Apply the probe of the VUM to the input, adjust the attenuator, and set Cal for 0 dB on the meter.

Now move the probe to the output of the first stage in the amp and note that you must switch in two more steps of attenuation—20 dB—and the meter then reads +2. (Don't touch Cal.)

The readings translate to mean that the first stage is providing 22 dB of amplification—a very healthy performance.

Reset Cal to give 0 on the meter and move the probe to the output of the second amplifier stage. This time, it isn't necessary to switch in any more attenuation. The meter reads −5 dB. That "amplifier" stage is offering a 5-dB loss! It is obviously sick and needs TLC.

The uses of the VUM are numerous and you probably can think of other ways to use it to compare the levels of any two audio signals. Often, that tells the whole story. ■

Gene Dewey WB6AFN/9
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Kenosha WI 53142

Analog Isn't Dead

— don't be LED astray by the digital revolution

Sometimes it seems that everything is going digital. At first it was a novelty to have a digital clock—you know, the kind with the metal plates that would flip down a new number every minute. With the emergence of the cheap LED seven-segment device, the movement to digitalize everything accelerated. First it was digital watches and clocks, then calculators; now it's used on thermometers, bathroom scales, radio dials, gas pumps, and almost everything on some luxury cars. Even a farmer friend of mine brags that the speedometer and tachometer on his new tractor is digital. Digital is becoming synonymous with modern, while analog is considered outdated. Is the analog device a twentieth-century dinosaur doomed to extinction in this era of rapidly advancing technology? The answer is a definite "no!" Old Charlie Darwin would agree that as long as a species is successful within its niche, it will survive. As it has evolved because of technology, the digital species has displaced the analog species from certain niches in which the analog species was only marginally fit, yet digitals are unable to compete with analogs in other areas.

Analog and digital devices each have distinct advantages and disadvantages. By understanding the merits of each system, the designer/user can intelligently select the better device. As a rule, a merit of one system is a shortcoming in the other system.

Precision

The digital device wins hands-down in the precision department. Precision is limited only by the number of digits you can afford or can read without confusion. But don't get confused between precision and accuracy. Accuracy is the measure of how close you are to the real value, while precision is the measure of your confidence in the measured value. If your new Rockcruncher 2000 all-digital transceiver says that you're transmitting on 21,447.605 kHz (a very precise measurement), but you are actually transmitting on 21,452 kHz (a very accurate measurement), then you are still likely to get a pink slip from the FCC. Moral: An ounce of accuracy is worth a pound of precision. However, if you have a high degree of accuracy but low precision, you won't be able to know just how accurate you are. You just won't collect as many pink slips.

Quick quiz: Which digital frequency meter is better (greater accuracy and precision) for measuring a signal at 420.0000000 MHz: a 6-digit meter with 1 ppm accuracy or a 10-digit meter with 4 ppm accuracy? Answer: Of course you knew all along that it was the 6-place meter, because:

6-place counter:

$1/1{,}000{,}000 \times 420.0000000 + 420.0000000 = 420.000$ (remember, only 6 digits).

10-place counter:

$4/1{,}000{,}000 \times 420.0000000 + 420.0000000 = 420.0016800$.

Wow! The 10-place counter is really impressive with all those numbers. It's too bad that the accuracy extends only to five significant figures. The 6-place counter is not as flashy, but it provides accuracy and precision to six significant figures.

The slide rule was displaced by the digital calculator simply because the slide rule was unable to compete with the superior accuracy and precision of the digital calculator.

Rate Measurement

Imagine that you have decided to update your old Rockcruncher 1000 (1967 model with analog frequency dial and old-fashioned D'Arsonval swinging-needle meter movement). Being short of funds, you select a $19.95 3½-digit LED meter kit to replace the old analog movement. After three weekends, one trip to the hospital emergency room, and the kind assistance from a friend who just happens to have an MSEE degree, you get the thing installed. To celebrate the occasion, you turn on the rig to 40 meters for a little QSO to brag about how you dragged your old Rockcruncher 1000 kicking and screaming out of the 1960s and into the 1980s.

As you tune in the first station, you get the first hint that all is not well with your new, state-of-the-art, digital meter. It is impressive to see all those LEDs flashing, but it would be better if they were readable instead of blurred. Well, that's the price of progress.

Then you start to tune up the rig. The old peak-and-dip ritual is suddenly a wild and crazy experience. Unless you tune very slowly, the meter displays a string of eights. Not only that, but finding the peaks and dips is almost impossible. Unfortunately, the final tubes hate non-resonance so much that by the time you are almost tuned up, they collapse in a molten puddle.

Exaggerated? Well, maybe, but the point is that digital displays are not suitable for measuring rapidly changing values. The digital display blurs, while the analog display provides a usable rate-of-change display by observation of the angular velocity (sweep speed) of the indicator's pointer. An example would be to compare the analog and digital display of an aircraft's altitude. During an aircraft's descent, the analog altimeter's pointer "unwinds" at a velocity proportional to the slope of the descent. The display remains readable at all times. The digital display will blur in the units position during the slightest descent, and as descent rate increases, the tens, hundreds, and eventually thousands positions will blur. While the analog altimeter provides continuous rate information over a wide range (slow "unwinding" through fast "unwinding"), the digital altimeter displays the descent rate in a limited number of discrete steps. For example: units blurred—slight descent; tens blurred—moderate descent; hundreds blurred—steep descent; thousands blurred—dive; ten-thousands blurred—don't even think about it.

Why do race cars still use old-fashioned analog tachometers instead of the spiffy new digital tachometers that Warshawsky and Co. sells? It comes down to economics. An over-revved engine with pieces littering the track simply cannot win a race. If a digital tach blurs on acceleration, the driver will be more likely to overrev the engine (an expensive mistake). The subject of race car instruments leads into the next criterion for selection of the appropriate analog or digital device.

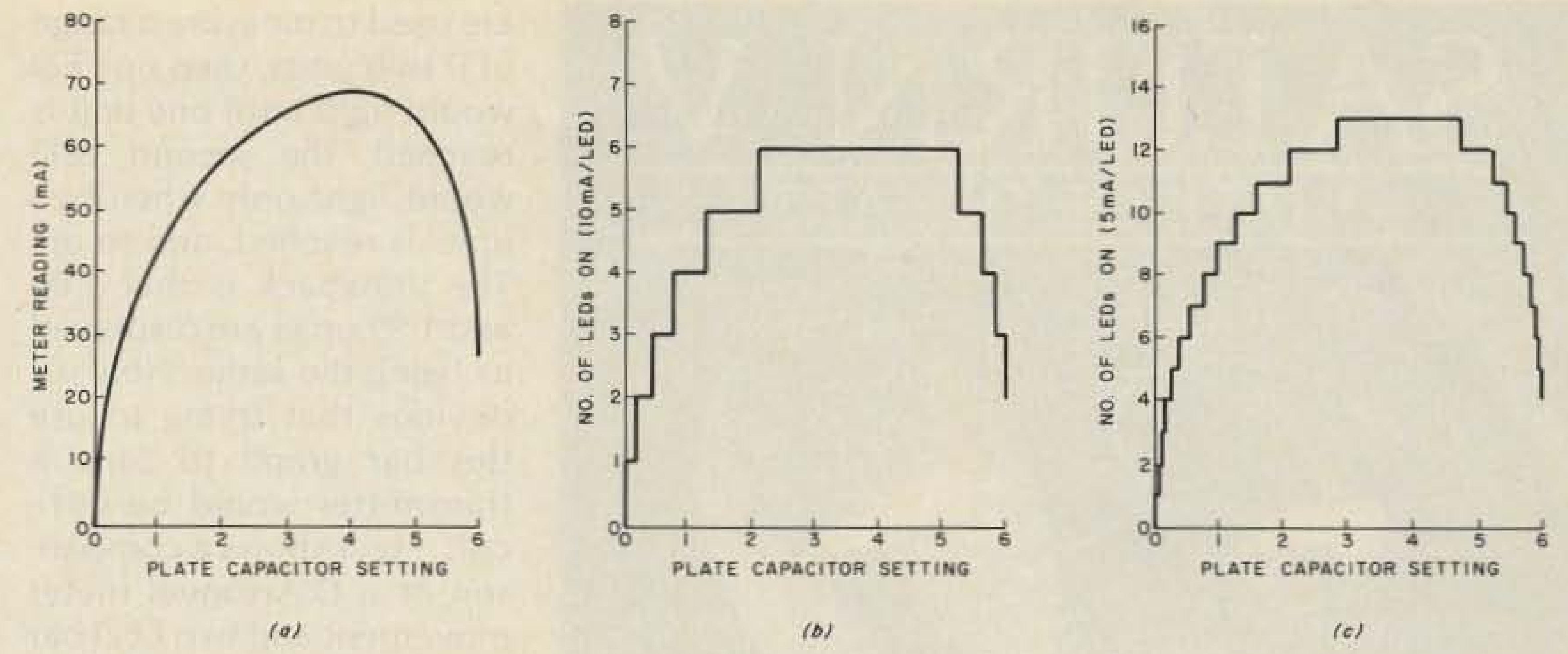

Fig. 1.

When I first saw the instrument panel on a race car, I noticed that the instruments were installed askew, with some turned clockwise and others turned counterclockwise. Later I was informed that it wasn't sloppy installation, but an intentional arrangement. The driver doesn't have time to read the numbers on each gauge, so the gauges are aligned so the pointer is at 12 o'clock at the ideal (or maximum) setting. A deviation is then readily noticeable. An analog device will show where you are with respect to the range of position. An analog defines its limits (empty-full, low-high, 0-1 mA, 0-120 mph) and the device's pointer simultaneously indicates its relative position on the range of values.

Comparing the ability of analog and digital devices to measure position can be demonstrated by the story about the hot-air balloonists who became lost while drifting over the countryside. One of the balloonists sighted a farmer in a field and began releasing gas from the balloon. As the balloon passed over the farmer, the balloonists yelled, "Where are we?" The farmer replied, "'Bout a hunnerd foot up in a hot-air balloon." The information transferred was absolutely correct, yet absolutely useless since there was neither a horizontal point of reference nor a distance and direction from the point of reference. Frequently a value alone can be meaningless unless accompanied by boundary limits. When using digital devices, you often must be aware of limits which are not displayed. Since analog devices display the entire range, hazardous or undesirable regions may be flagged by using a colored band as a warning marker. This flagging is generally not available for digital displays; however, red/green bidirectional LEDs in a 7-segment configuration could be used in circuitry that would allow a color change as an undesirable region is entered.

Another kind of position utilization in analog displays is incremental measurement. A good example is the wristwatch worn by a nurse. It is never digital and always has a second hand. The reason is that nurses take frequent readings of patients' vital signs—pulse and respiration. To save time (a survival skill in nursing), the pulse and respiration are each measured for 15 seconds. The procedure is to find the pulse, start counting the pulse as the second hand passes any 5-second increment, continue counting until the second hand has traversed 90° from the starting point, and finally multiply this 15-second count by 4. The starting and stopping points are of no consequence, but rather the 90° sweep of the second hand which measures a 15-second increment. A similar incremental measurement is used in transmitter tuning. The actual plate current reading is of little value until tuning is completed. The important things are the relative peaks and dips as the circuit is brought to resonance.

Continuous vs. Stepped Readings

There is a little gadget on the market called the LED bar-graph display which looks like an analog device, yet is still digital. It has the advantage of position display and may be used marginally for rate measurement. Its weakness is the one distinct advantage usually found in digital devices—precision. Precision is limited by the discrete number of steps (LEDs) on the bar display. If 8 LEDs are used to measure a range of 0 to 8 units, then no LED would light until one unit is reached, the second LED would light only when two units is reached, and so on. The drawback is that 1.00 and 1.99 units are displayed as being the same. Now it's obvious that trying to use this bar graph to tune a transmitter would be difficult. Fig. 1 shows a comparison of a D'Arsonval meter movement and two LED bar graphs. Fig. 1(a) shows the actual plate current (as displayed on the D'Arsonval meter). Fig. 1(b) shows an 8-LED bar graph, and Fig. 1(c) shows a 16-LED bar graph. The "peak" on the 8-LED bar covers over half of the capacitor tuning range, and the 16-LED bar-graph "peak" covers over a third of the capacitor tuning range. Neither bar graph has the sensitivity for tuning that the analog display has.

Conclusions

Use a digital device where precision is needed, but remember that high precision cannot improve accuracy. Digital devices are especially suited as frequency indicators on transceivers and frequency counters. However, if the frequency counter you are thinking about buying has 9 digits and 10 ppm accuracy, then you are wasting money on the last 4 digits. Six digits and 1 ppm accuracy is just right. Don't use an LED bar graph if precision is essential.

If position-orientation, -tracking, or -setting are important, stay with an analog device. And finally, rate measurement belongs to analog devices.

As an equipment designer/user, select the better device to meet your own needs—even if it means being old-fashioned. ■

Reader Service for facing page ✓45→

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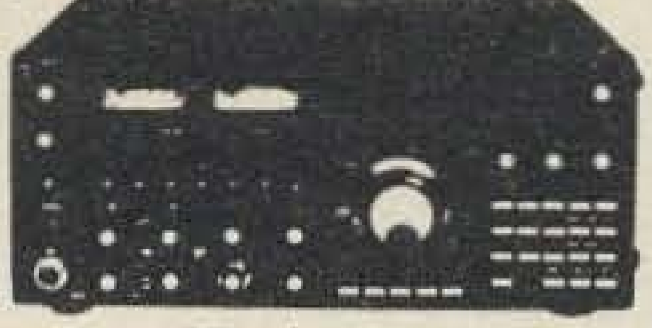

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The Ratings continue - 2 meter mobile month: Kenwood TR9130, excellent sensitivity, easy operation, light output; ICOM IC290A, good performance, cheaper pricing; Yaesu FT480R, great reliability, medium pricing.

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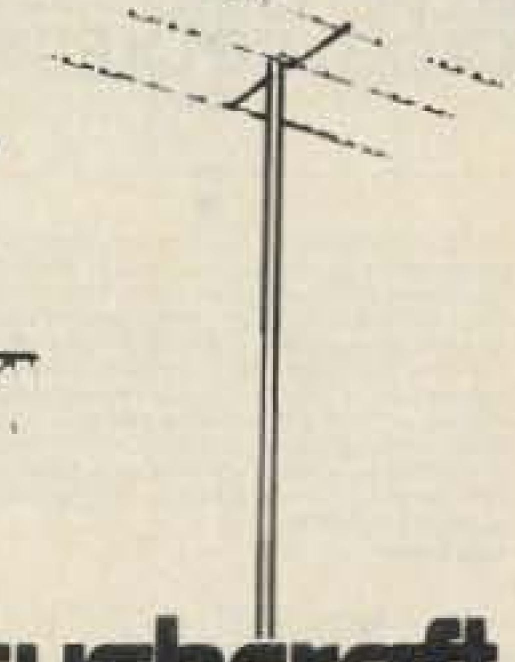

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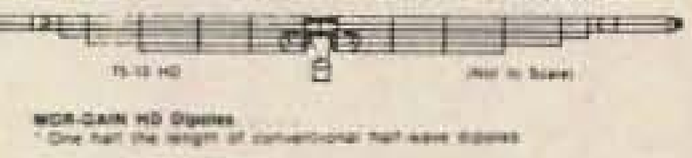

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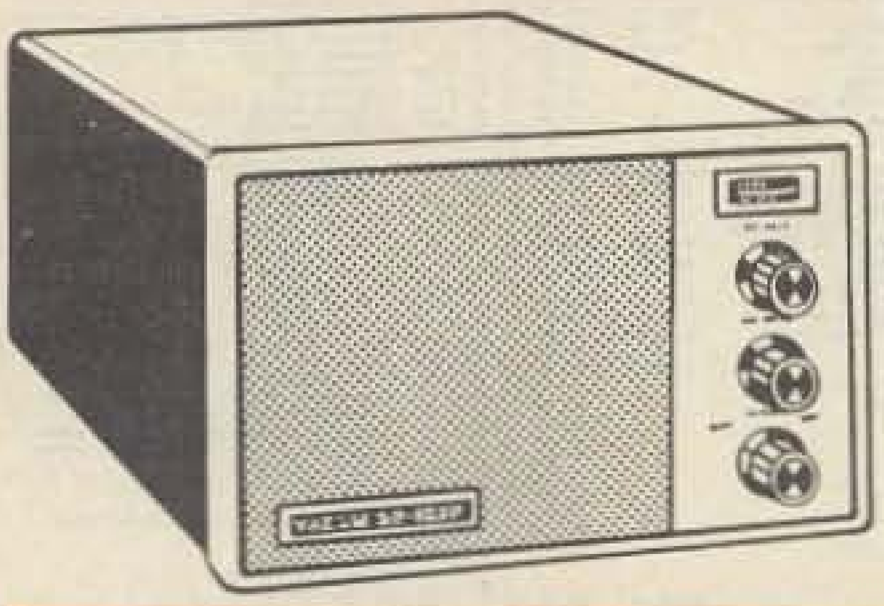

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Line Voltage at a Glance

—at last, a useful gadget

L. B. Cebik W4RNL
5105 Holston Hills Road
Knoxville TN 37914

A line voltage monitor can help you protect your equipment investment from problems that fuses and circuit breakers cannot cure. However, most monitors start with relatively expensive meters. To expand their scales for the 90-to-140-volt range may require additional circuitry. There must be an easier way.

The little monitor described here is inexpensive, easy to build, and provides LED indication of the line voltage in five-volt increments, which is as close as most of us need. Its accuracy is good because you can calibrate it against factory- or lab-calibrated instruments. Finally, the entire works are small enough to fit inside another piece of gear, or you can use a separate small case. Apart from the case, $10-12 should buy you new parts, although I suspect most junk boxes have everything exept the IC and the LEDs.

Monitoring the line voltage to the shack has always been fairly important. In recent years, the increasing incidence of brownouts and other line variations has made monitoring even more important. Occasionally voltages will rise or fall to levels which may endanger some equipment, especially motorized equipment. Less catastrophically, a line voltage monitor can help you trace unusual glitches, such as excessive power consumption, to the voltage entering the equipment. At the end of the article, we will look at some applications of the simple monitor described here.

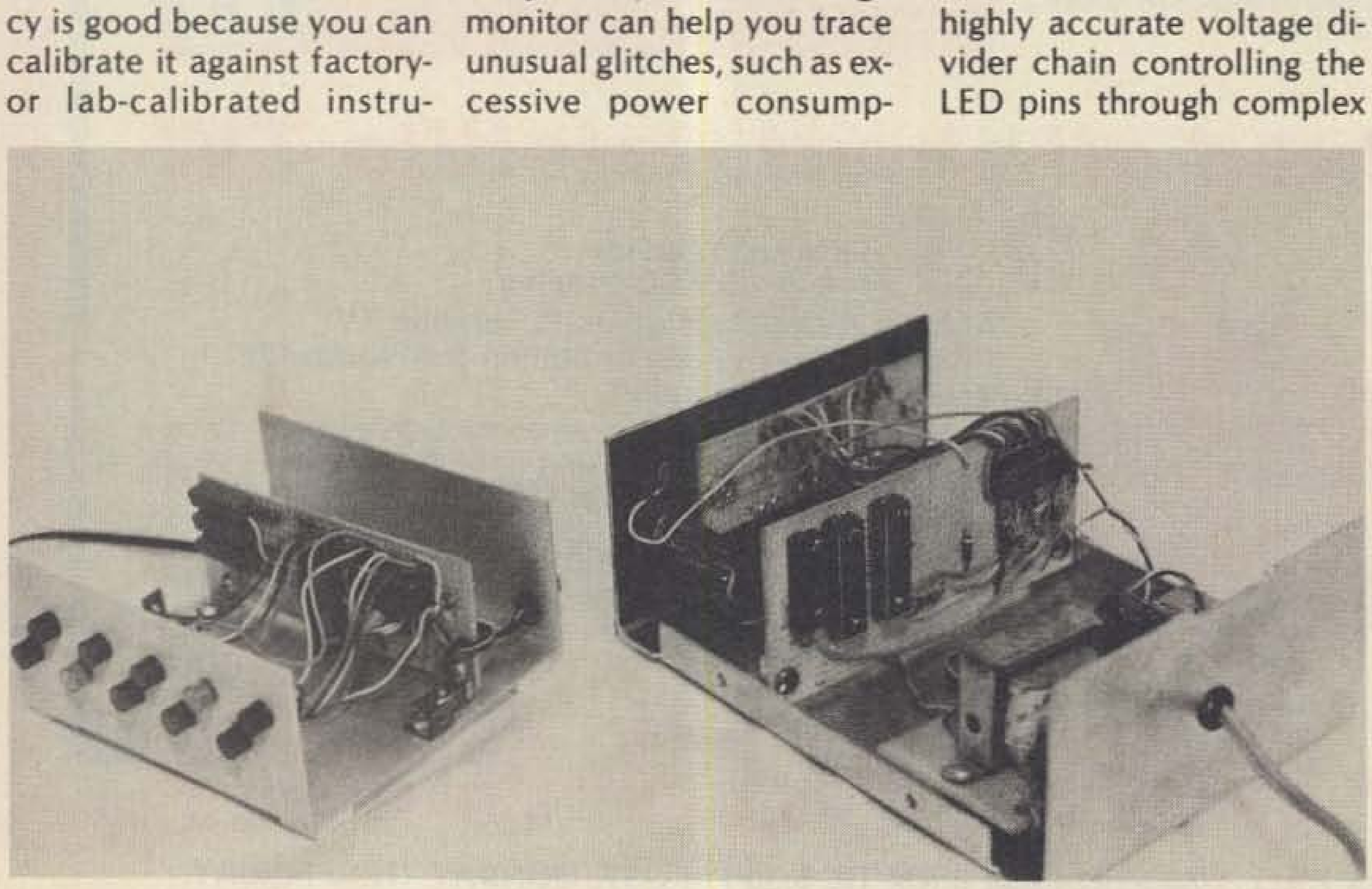
The Circuit: An LM3914

The LM3914 dot/bar display driver is a versatile 18-pin IC available from many sources, including Radio Shack. Pins 1 and 18 through 10 provide terminations for LEDs, which can be set up to come on one at a time or to come on progressively, depending upon how pin 9 is connected. Pins 2 through 8 provide the supply, control, and signal inputs. Fig. 1 shows the basic layout of the chip.

The 3914 consists of a highly accurate voltage divider chain controlling the LED pins through complex internal circuitry. By setting the high and low limits of the divider, we can achieve a smooth linear progression of lights as the voltage moves up and down at the input terminal, pin 5. Most applications of the 3914 are geared to low voltages, such as audio voltage meters, battery checkers, and the like. However, with a little care, we also can have the 3914 track higher voltages.

To make the 3914 function as a line voltage monitor, we simply need a low dc voltage which varies with the rms value of the ac voltage at our wall plugs. A 9- to 12-volt dc power supply with a relatively constant load will do just this, if the supply is loaded neither too lightly nor heavily. Additional drops across a resistor will also track the ac. In the circuit shown in Fig. 2, tracking by these means has proven as accurate as the expanded-scale ac meters against which the unit was checked.

The circuit in Fig. 2 is an adaptation of the 3914 configuration used by Weinstein and Gartman in their auto battery checker.[1] The resistor divider networks connected to pins 4, 6, and 8 set the lower and upper limits of the readout, while the resistor connected to pin 7 controls the brightness of the LEDs. Pin 5 samples the incoming voltage across another resistor



Interior view of these monitors shows two layout possibilities using perfboard construction.

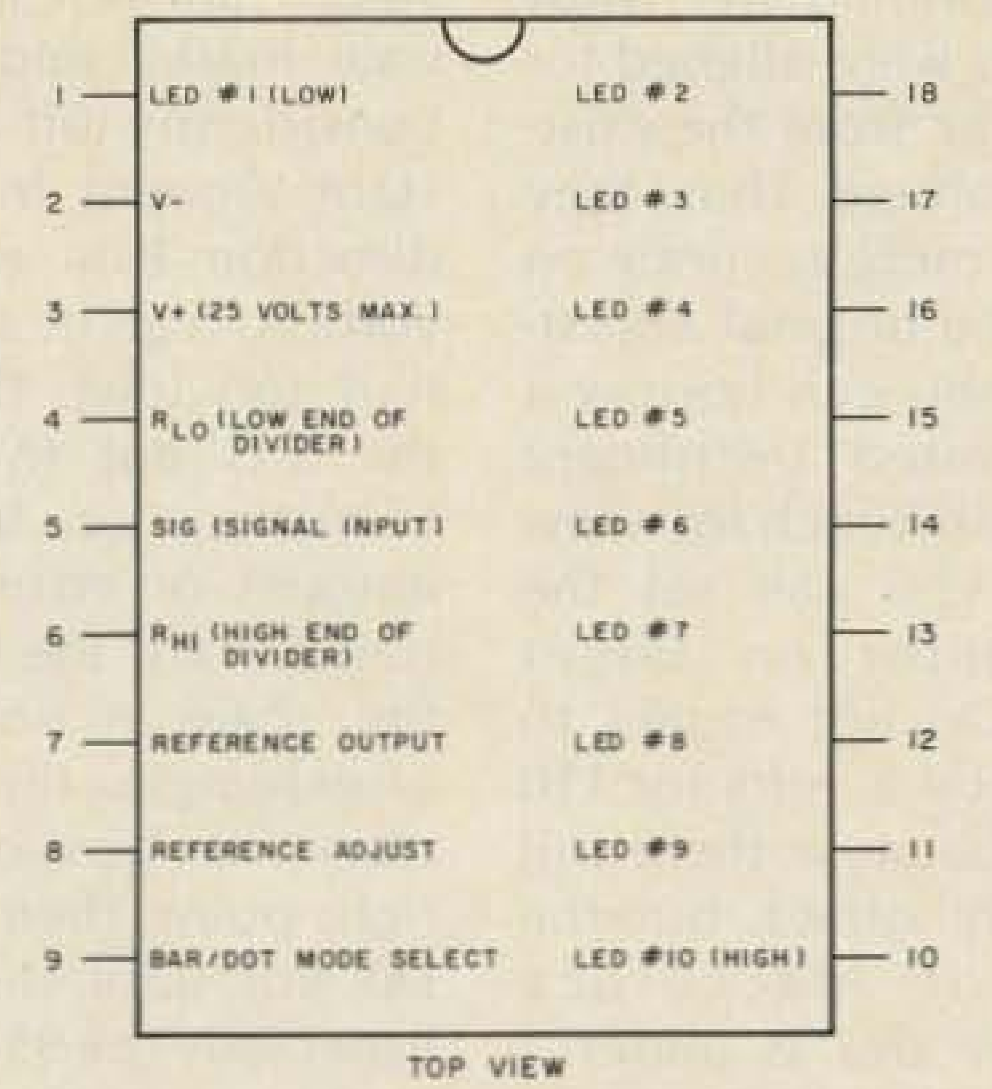


Fig. 1. Pinout of the LM3914 dot/bar display driver.

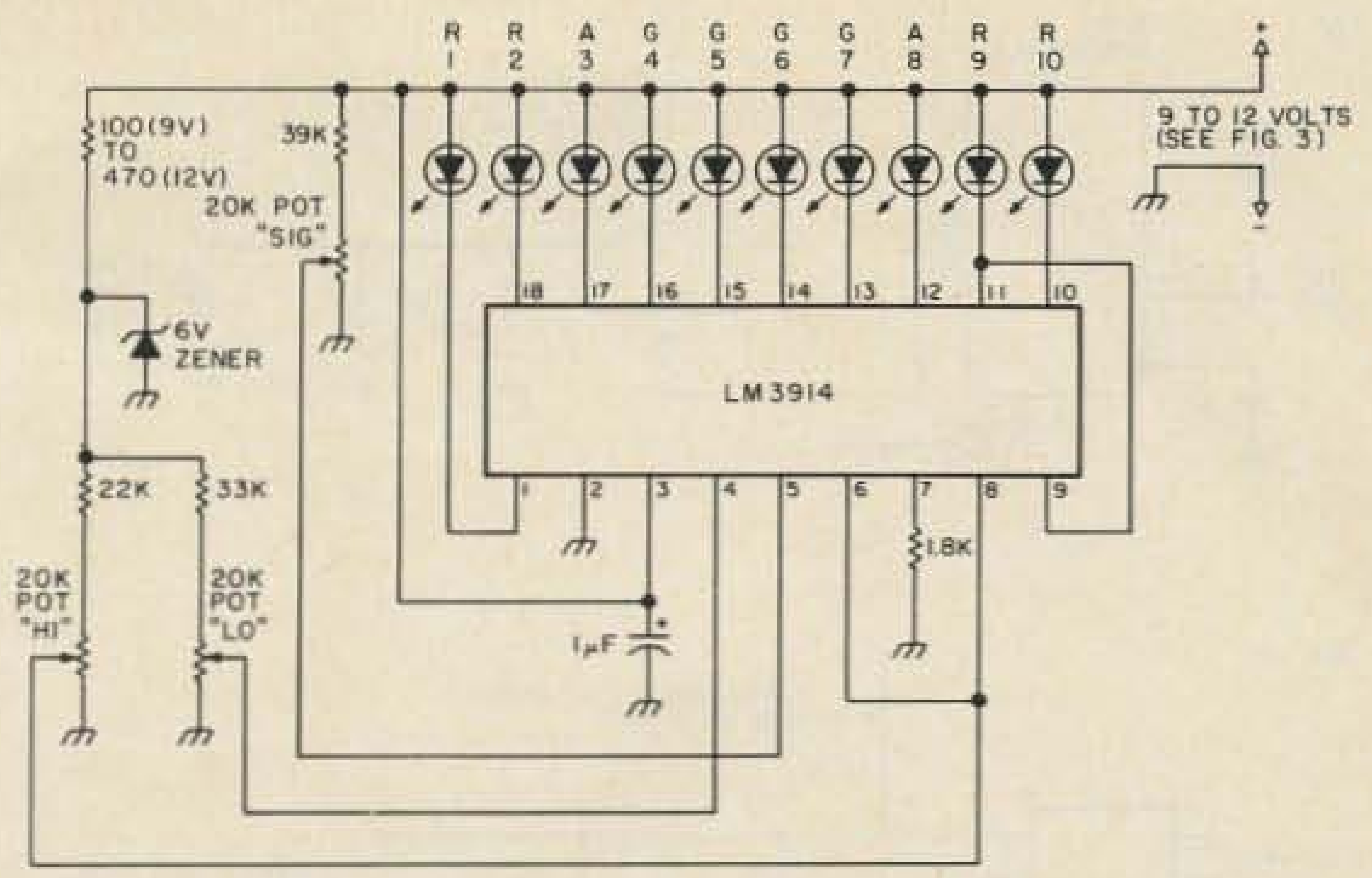


Fig. 2. The metering and LED sections of the line voltage monitor. LEDs: R = red, A = amber, G = green.

divider. Jumpering pins 9 and 11 allows the LEDs to light one at a time.

Each LED lights for a five-volt increment from 90 to 140 volts. The one exception is the last LED, at the upper limit, which remains lit when the voltage exceeds 140. The 50-volt range was chosen for several reasons. First, 50 divides neatly by 10. Second, the middle four increments cover the range from 105 to 125 volts, the recommended range for the operation of most electronic equipment. Hence, the readout has a nice symmetry. This fact also allowed me to use different colored LEDs: green for the safe range, red at the dangerous extremes, and amber in between.

The zener in the line feeding the limit-setting resistors is needed to hold the voltage constant to the limit pins. The exact value is not critical, as long as a range of 1 to 3 volts is available from the potentiometers. The pots are 10-turn miniature trimmers for ease of calibration. (Remember that what is called a 10-turn mini pot may have from 8 to 15 turns depending upon the model and manufacturer.) The input trimmer is the same sort of miniature potentiometer, set to give around 2 volts for an ac rms line voltage of 110.

The LEDs can be any type of the many available across the counter or through mail sources. The object is to create an easy-to-read display, remembering that pin 1 is the lowest, pin 18 is next, and pin 10 the highest value. The 1.8k resistor controls the brightness of the LEDs, and the value shown provides an easy-to-read level without being too obtrusive.

The remainder of the circuit is shown in Fig. 3 and consists of two different power sources for the meter. The original prototype was built with power supply components on hand, while a second version uses a 10-volt ac adapter, with the parts molded into the plug. Anything from 9 to 12 volts will work, so that the ac adapter for a dead transistor radio, tape recorder, etc., can be pressed into service with good results. The meter requires little current, so the current capability of the power supply is not a problem. However, whether you opt for a home-brew supply or an adapter, additional filtration and a load resistor (the 1k resistor in the schematic) are needed to provide a minimum load on the supply.

Construction and Components

The meter itself, as shown in Fig. 2, will fit on a 2" × 3½" piece of perfboard, assuming the LEDs are panel-mounted elsewhere. A socket for the IC simplifies wiring. Since only a few of the IC pins have more than one connection, wiring is so easy that no printed-circuit techniques have been used, although an enterprising builder might wish to create a board for himself.

Again, with the exception of the LEDs, there are so few external components that layout is no problem. The only caution is to mount the trimmer pots so that they are accessible for calibration. Since they are of the same value, it will pay to label them as HI, LO, and SIG. There is nothing more exasperating than to have the unit in the final tweaking stages of calibration, only to move the screwdriver adjustment of the wrong pot and have to start over.

Different types of LEDs and panel arrangements can be used with equal success. Rectangular bar-graph LEDs from Radio Shack have been used in one model. They are mounted on a piece of perfboard, with leads running to terminal pins on the board. A smaller unit uses jumbo LEDs in plastic mounting lenses. The zigzag line of ten LEDs across the face of the unit makes identification of the five-volt increment very easy, and once panel markings are added, readout is even simpler.

Fig. 4 shows a sketch of the front panel with the colors of LEDs identified. The arrangement from red through amber to green and back again is not only symmetrical, but also reflects the levels of potential trouble from line voltages that wander too far from the norm. In purchasing LEDs, especially green jumbos, be sure to buy more than you need and match them for brightness. The reds and ambers seem to be most consistent, but surplus greens appear to vary quite a bit.

The importance of using LEDs of approximately the same brightness stems from the fact that as the voltage nears a transition from one increment to another, two LEDs may be lit simultaneously. If the LEDs are well-matched, the relative brightness of the two will tell you which side of the dividing line the voltage is on at a given moment. Mismatched LEDs can misinform you. This trouble was not encountered with bar-graph LEDs. The degree of overlapping of LEDs seems to vary from IC to IC, but in no case has it proven to be such a problem as to produce false impressions of the line voltage.

If you use a home-brew power source, you can

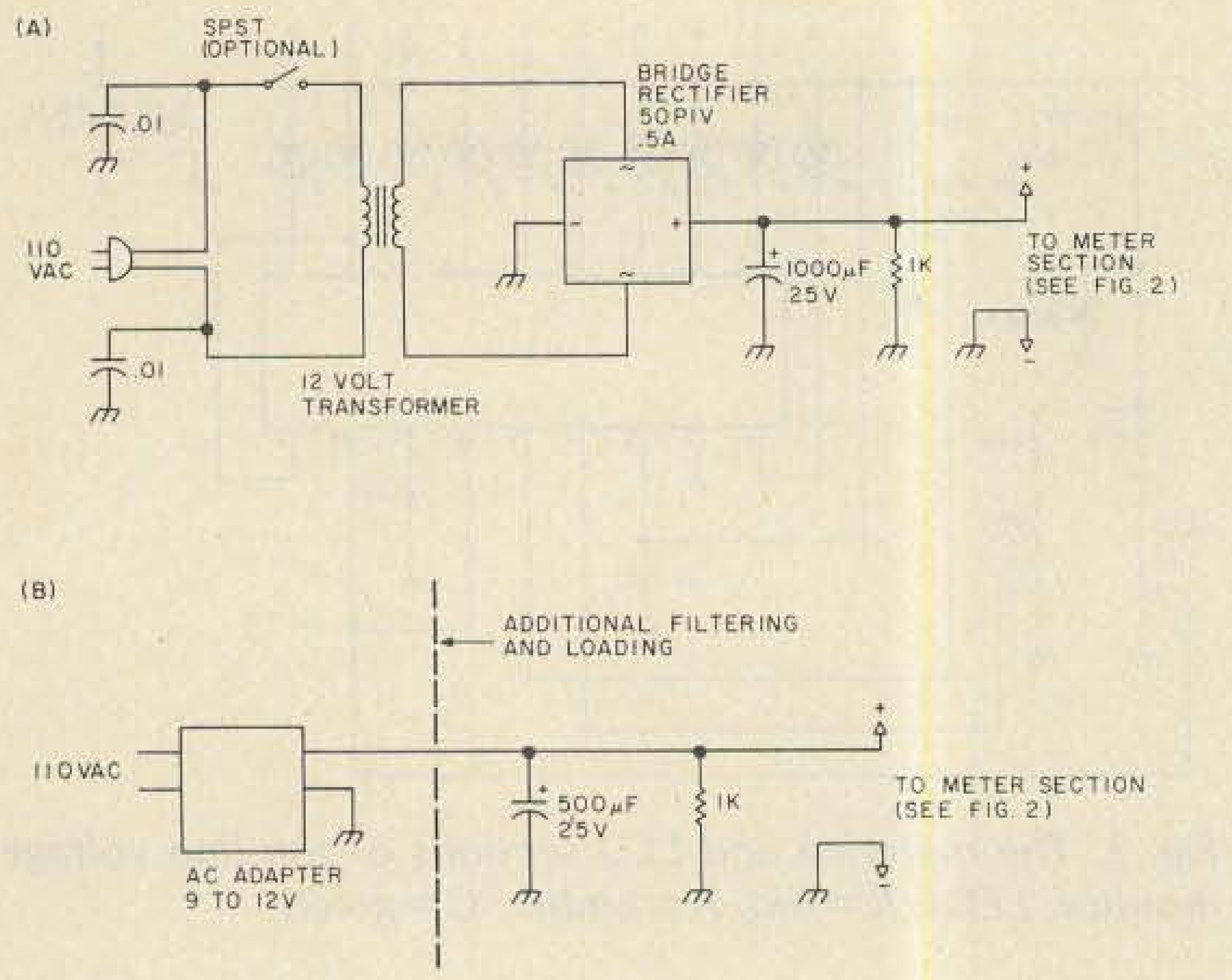


Fig. 3. Power and signal source for the line voltage monitor. (a) Home-brew power source. (b) Ac adapter module power source.

build it on a separate board or use one board for the supply and meter sections. With an ac adapter, the additional components can go on the meter board with the IC and pots. The only precaution with the power source is to use it for no other purpose. The varying load created by a secondary use will alter the voltage to the signal input , destroying the utility of the meter.

The entire assembly is compact and will fit cases as small as 2″ × 2″ × 4″ (with an ac adapter supply). The components also can be mounted within another piece of equipment as long as there is room somewhere for the LED display. If your shack has a master ac control panel, a small corner will be enough for the LED array.

Calibrating the Meter

Many of us have grown accustomed to using fixed components or having equipment factory-calibrated. In the process, we may lose sight of the fact that building an adjustable circuit can lead to a far more accurate instrument. Hence, potentiometers have been used rather than fixed voltage dividers.

The line voltage monitor described here can be calibrated at two levels of accuracy: close and right on. Close calibration requires only a fairly accurate VTVM and a little arithmetic. To get the meter right on requires a factory-calibrated meter (for ac and dc voltages) and a simple test circuit. The close calibration technique is also a good preliminary step for later, more precise calibration.

Let's begin with a little math. Suppose we let a signal input voltage of 2 volts dc to pin 5 of the LM3914 equal 110 volts ac. The voltage division factor is 55. (We could, of course, use other ratios, within limits.) This factor will apply throughout the meter range. Dividing 90 volts ac by 55 gives us a value of 1.64 volts dc as the lower limit control. Measure the voltage at pin 4 and set the LO pot for this voltage. Similarly, 140 volts ac divided by 55 gives 2.55 volts dc as the value we want at pin 6; adjust the HI pot for this value. The HI and LO pots may interact a bit for this degree of accuracy, so tweak both several times to set the final values. Now adjust the SIG pot until the correct LED lights for the actual value of ac voltage.

Use caution here. Most kit VTVMs were aligned for 110 volts ac from the existing line voltage. Thus, they will be no more accurate on ac than the original adjustment. If you can borrow a well-calibrated instrument or visit a lab bench for a few minutes, you can set the line monitor on target quickly. Do not expect to read exactly 2 volts for 110 volts ac, because there will be a slight offset, but the degree of inaccuracy caused by this is under 1 percent. With a little tweaking back and forth of the signal input pot, you will be able to set the voltage very accurately by watching for the overlap effect on the LEDs.

The monitor is very usable calibrated this way, but if you wish to be more accurate, try the circuit in Fig. 5. This circuit lets you vary the ac voltage to the monitor across the full range of the instrument. Use care, because the voltage can be lethal, and there is a tendency to grow a bit careless after handling the low voltages we use on ICs. The 5k pot should be 4 Watts or more and well insulated from your hands.

As the drawing shows, we will monitor the line voltage as we calibrate the meter. If we wish, we also can monitor the voltage to the control and signal pins, but this is not strictly necessary. If we have performed an initial calibration as described above with some care, we should be close enough to make the precision calibration easy.

First, recheck that the correct LED lights with a voltage in the 110-to-120 range. Now we will run the ac voltage up and down, checking the voltage at which the LEDs change from one to the next. (For these tests we will ignore the absolute limits, since the transitions are more accurate.) If the voltage transitions are not at the five-volt marks and they are consistently off by a constant amount in the same direction (for example, a volt too high or a volt and a half too low), then adjust the SIG pot to bring the transitions on line. If the amount of error at transition toward the low end of the scale is not constant after bringing the SIG pot as close as possible to the right point, then adjust the LO pot until the changes, especially the 95-volt transition, are correct. Do the same for the upper end of the range.

Remember that the two pots may interact just a bit, so recheck each end of the line. Be sure to make all adjustments slowly, and verify that you are moving in the correct direction before making a sizable change. Large hasty changes can throw everything off. But if everything does go askew, you can set it back in the ball park with a repeat of the first alignment procedure.

Now recheck the alignment, and you should be right on. At most, you may have to adjust the SIG pot a hair more. Although the resistor divider circuits show combinations of fixed and variable resistors, they could be replaced by 50k pots. However, there would be a loss of fine calibration control, so the cost of the three fixed resistors is well justified.

After using the monitor for several weeks, recheck the calibration. Components do change value during their lives, but most of the change (if not catastrophic) is either very early or very late in their lifetimes. Hence, after "burning in" the monitor for a few weeks, a check of the calibration should produce a stable monitor that needs to be tested only during your regular station maintenance checks.

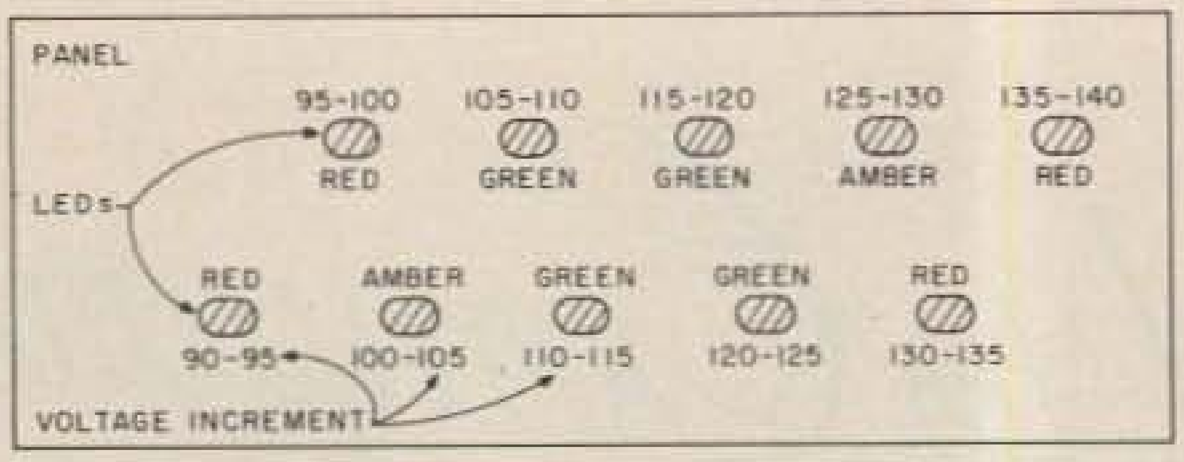


Fig. 4. One of many possible panel layouts for the LEDs.

What the Monitor May Tell You

The line voltage monitor described here is designed to be accurate, but not to yield precise voltage measurements. Within close limits, it will indicate the five-volt range of the current ac line voltage feeding your equipment. For many purposes, these readings will be sufficient. Closer readout of the voltage requires either a meter or a redesign of the present circuit. By adjusting the upper and lower limits, a smaller voltage range can be spread across the same ten LEDs. For example, within the general parameters of the two-step calibration procedure described earlier, setting the LO-HI range between 2.09 and 2.27 volts would permit you to read the ten volts between 115 and 125. If such precision is desired, a second set of resistor dividers might be switched in and out of the circuit (in place of the 50-volt dividers) with a DPDT switch.

Since the primary function of a line voltage monitor in the shack is to warn of possibly dangerous conditions, such precision is rarely required. Most of the monitor's utility is provided by the wider limits. This is especially true in this day and age of brownouts, when power companies—with or without warning—may lower the line voltage to 100 volts or less. Likewise, in some regions with a heavy industrial daytime load, early evening voltages have been reported occasionally to reach 135 volts.

Most household equipment, including ham gear, falls into four main categories: motors, lighting, heating, and electronic devices. Variations in line voltage can affect all four types of equipment, some more radically than others. Motorized equipment such as furnace fans, refrigerators, air conditioners, vacuum cleaners, stove fans, and the like all operate less efficiently as the voltage is reduced. Some types of motors can be damaged if the voltage drops too low and the motor is loaded heavily. In general, if the voltage either drops below 105 or rises above 125, it is best to shut down motors which must work hard. This includes air conditioners, refrigerators, power tools, and similar equipment. Lighter duty motors, such as fans, may be run to wider voltage limits, but do not be surprised should one fail. If any part of the motor has a weak spot, radical voltage excursions are one way of discovering it. These cautions do not mean that every drop or rise in voltage will mean catastrophe; rather, they are suggestions for preventing a possibly sizable replacement cost.

Lighting devices are generally of two sorts: incandescent and fluorescent. Light bulbs will react to line voltage variations by producing more or less light and heat. The power drawn by the bulb will vary approximately as the square of the voltage changes, since the current will also rise and fall with the voltage. The relationship is not exact, since filaments change their resistance with heat. While reduced voltage is an annoyance due to the reduced light output of bulbs, excess voltage is a bulb killer. A 10% voltage rise means approximately a 20% power increase, with an accompanying increase in heat. Using the national average ac line voltage of 117 as a standard, as little as 129 volts will produce this effect. Fluorescent fixtures are less evident in their reaction to line voltage variations, but harder starting may not always mean a bad condenser. A quick check with the line voltage monitor is in order first.

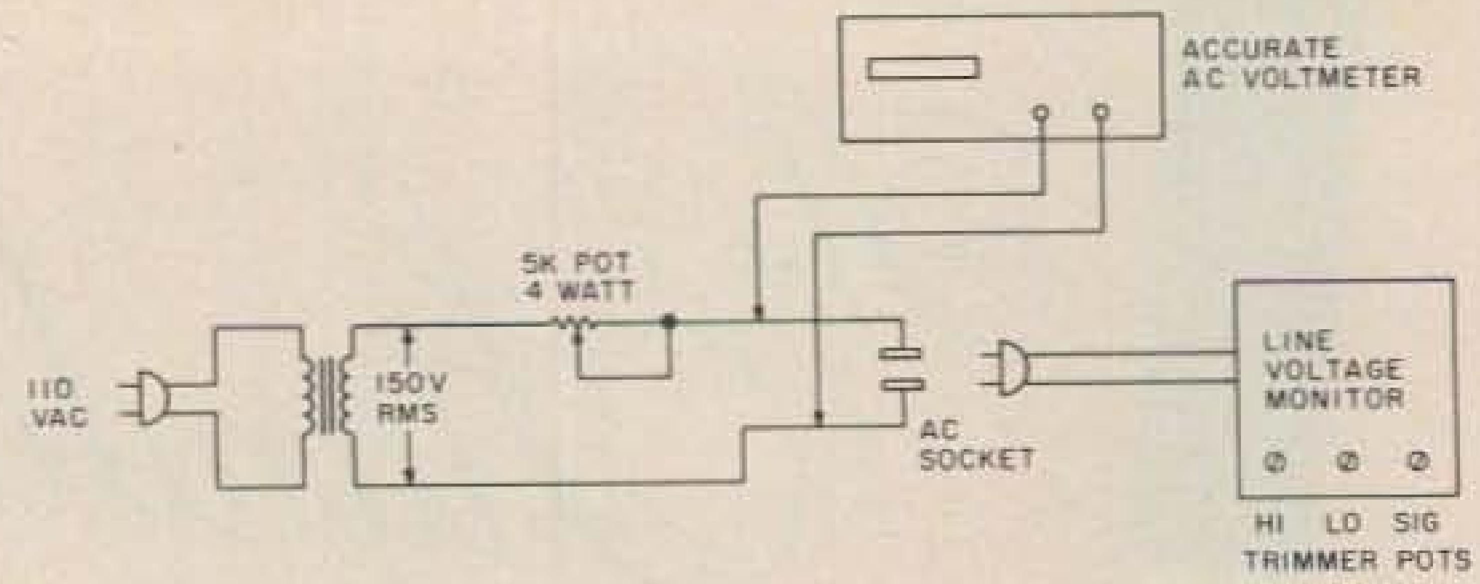


Fig. 5. Test setup for calibrating the line voltage monitor.

Electrical heating devices, such as stove and oven elements, are much like incandescent bulbs. Their heat output will vary as the line voltage varies, and so will the mechanical wear of the element. These are usually hardy devices, and often the adjacent wiring has a shorter lifetime than the element. Nonetheless, expect slower cooking during brownouts.

Electronic devices react to line voltage variations in many ways. Simple devices, such as tabletop radios and stereo equipment, usually show no effects from moderate drops or rises in line voltage. More complex equipment, such as television sets, may show some effects, especially with age. If accumulated dirt and other factors have lowered the high voltage to where it just holds the picture at full size, a brownout can show itself as picture shrinkage. Other effects are usually minor.

Critical equipment, such as computer terminals, should have heavy, very well regulated supplies, and the voltage feeding the regulator should not be marginal. If these conditions are met, then there are usually few problems. However, if the supply voltage to the regulator is marginal, a severe drop in line voltage may yield a temporarily unregulated supply, with consequent problems in TTL chips, memory, and other parts of the system.

Amateur transmitters and amplifiers will show the effects of line voltage variations in power output readings. In a transceiver or an average transmitter, plate voltage is usually not metered. Suppose your power output meter shows a 10% drop from the previous day's reading. One suspicion that naturally arises is that the final tubes might be going soft. However, a drop in line voltage can produce the same effect. A 10% drop in line voltage may reduce the plate voltage by 60 to 75 volts, depending upon transmitter design. Control positions also may change under these conditions, since the tube now exhibits a different plate resistance.

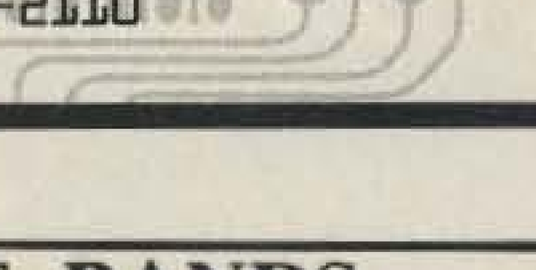
Rising line voltage also can yield misleading symptoms. Many of us have grown used to tuning up a transmitter to maximum power output, as read from an rf wattmeter or relative power indicator. A 10% rise in plate voltage may give us a temporary boost in power output, a condition which may make us proud for a moment of the equipment manufacturer's ingenuity. However, if the line voltage is in fact high, then the best bet is to reduce power slightly in exchange for longer tube life. The miniscule difference in power at a receiving station cannot be noticed, but the cost of replacement finals is almost always noticeable.

Amplifiers capable of the maximum legal power for amateurs must have a means of measuring both voltage and current so that we can hold them within limits. Since most amplifiers are capable of loading to greater than 1000 Watts dc or 2000 Watts PEP input, we cannot simply choose a standard level of plate current and assume that we are within the legal power limit. A 10% rise in line voltage can produce a corresponding rise in plate voltage. Reducing plate current is then the only way to hold the power within limits.

These sample potential problems and conditions make a strong case for monitoring line voltage. Some of us are lucky enough to live in areas which never—or hardly ever—have brownouts. High line voltages are even more rare. However, the small price of a monitor will be more than offset if we detect a condition early enough to save the cost of a service call or replacement parts. For this degree of safety and preventive medicine, we need an accurate monitor, although we do not always need to know the exact number of volts. The LED line monitor described here can fulfill the need, while providing an interesting weekend of building and calibrating. ■

Reference

"Guard Your Battery with *PM*'s Charge Checker," Weinstein and Gartman, *Popular Mechanics*, May, 1979, p. 94.



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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.*

FLAGSTAFF AZ
JUL 30-AUG 1

The Amateur Radio Council of Arizona will hold its 32nd annual hamfest from July 30 through August 1, 1982, at the Fort Tuthill Fairgrounds, just a few miles south of I-40, Flagstaff AZ. There will be thousands of dollars in prizes, improved XYL activities, a swapfest, a transmitter hunt, speakers, forums, awards, exhibits, and entertainment on Friday and Saturday nights. Overnight camping facilities will be available. Talk-in on 147.870/146.270. For further information, contact Wm. Oliver Grieve W7WGW, 4301 N. 31st Avenue, Phoenix AZ 85017, or call (602)-246-0200.

KINGSFORD MI
JUL 31-AUG 1

The Mich-A-Con ARC will hold the 34th annual UP Hamfest on Saturday, July 31, and Sunday, August 1, 1982, at the Dickinson County Armory on M-95, Kingsford MI. Tickets are $2.50 at the door (no advance sales) and registration will begin at 9:00 am on both days. There will be prizes, family activities, and a Saturday night banquet. Advance banquet reservations are needed since seating is limited. Plenty of free parking will be available. Talk-in on 146.25/.85 and .3922. For further information, write UPHAMFEST-82, 105 East Breitung Avenue, Kingsford MI 49801.

ANGOLA IN
AUG 1

The Steuben County Radio Amateurs will hold the 24th annual FM Picnic and Hamfest on Sunday, August 1, 1982, at Crooked Lake, Angola IN. Admission is $2.50. There will be prizes, picnic-style BBQ chicken, inside tables for exhibitors and vendors, and overnight camping. (A fee will be charged by county park.) Talk-in on 146.52 and 147.81/.21.

PITTSBURGH PA
AUG 1

The 45th annual South Hills Brass Pounders and Modulators Hamfest will be held on August 1, 1982, from 10:00 am to 4:00 pm, at South Campus, Community College of Allegheny County, Pittsburgh PA. Admission is $2.00 or 3 for $5.00. There will be computer, OSCAR, and ATV demonstrations, as well as a flea market. Talk-in on 146.13/.73 and 146.52. For further information, contact Andrew L. Pato WA3PBD, 1433 Schauffler Drive, West Homestead PA 15120.

BELVIDERE IL
AUG 1

The Big Thunder ARC will hold its annual hamfest on Sunday, August 1, 1982, at the Boone County Fairgrounds, Route 76, Belvidere IL. Admission is $2.00 in advance and $2.50 at the gate. A fee will be charged for 8-foot tables and there will be indoor space available in the exhibit building, as well as outdoor space in swappers' row. Sellers will be able to set up Saturday evening or at 7:00 am on Sunday. Features will include door prizes, a main prize, food, and refreshments. Camping will be available on Saturday evening (there will be a charge for electricity). Talk-in on 146.52 and 147.975/147.375. For further information or tickets, send an SASE to Jim Grimsby, 418 Beacon Drive, Belvidere IL 61008.

LEVELLAND TX
AUG 1

The Hockley County Amateur Radio Club and the Northwest Texas Emergency Net will hold their 17th annual picnic and swapfest on Sunday, August 1, 1982, beginning at 8:00 am at the city park in Levelland TX. This event is for the entire family. Bring your own picnic basket for lunch at 12:30. A two-meter FM transceiver is the grand prize. A $3.00 registration is requested but not required. There will be swapping all day, with tables provided. Talk-in on .28/.88.

GLEN MI
AUG 1

The Black River Amateur Radio Club will hold the 29th annual Southwestern Michigan VHF Picnic on Sunday, August 1, 1982, at the West Side County Park near Glen MI. (Take exit 30 from I-196 and follow the signs.) There will be swimming, a playground, a small flea market, and door prizes. There is no food available at the park, so bring your own picnic basket. Registration is $1.00. For additional information, contact Ed Alderman KI8Z, RR #2, Box 44, Lawrence MI 49064.

POMONA CA
AUG 7

The Tri-County Amateur Radio Association will hold its annual hamfest/picnic on Saturday, August 7, 1982, from 7:00 am to 1:00 pm, at the Los Angeles County Fairgrounds, Pomona CA. All buyers, sellers, and computer buffs are welcome. There will be prizes, exhibits, and refreshments. Talk-in on 146.025/.625. For more information, write to TCARA Hamfest Chairman W6ELZ, PO Box 142, Pomona CA 91769.

JACKSONVILLE FL
AUG 7-8

The Greater Jacksonville Hamfest Association will hold the annual Jacksonville Hamfest and Northern Florida ARRL Convention on August 7-8, 1982, at the Orange Park Kennel Club, located near the intersection of I-295 and US 17 just south of Jacksonville. Advance registration is $3.50 and is available from Robert J. Cutting W2KGI, 1249 Cape Charles Avenue, Atlantic Beach FL 32233. Registration at the door is $4.00. The FCC will administer amateur and commercial radio operator exams on Friday, August 6th, at the hamfest site. Those wishing to take the exams should apply to the Atlanta FCC office as soon as possible. Swap tables are $12.00 per table for both days (no one-day tables) and table reservations, as well as advance registrations, are available from Andy Burton NX4G, 5101 Younis Road, Jacksonville FL 32218. A full slate of programs is scheduled, along with meetings of statewide and regional nets and organizations, plus competitions including a rabbit hunt and pileup contest. The headquarters hotel is the Best Western First National Inn just across from the hamfest. Special rates may be obtained by writing to Jim Canfield KD4CG, 996 Dostie Circle, Orange Park FL 32073. Talk-in on 146.16/.76 and 146.07/.67.

MONTGOMERYVILLE PA
AUG 8

The Mid-Atlantic Amateur Radio Club announces its annual J. B. M. Hamfest to be held on Sunday, August 8, 1982, from 9:00 am to 4:00 pm, rain or shine. Tailgate setup begins at 8:00 am. Located at the Route 309 Drive-In Theater, 1/4 mile north of Route 63, Montgomeryville, PA (6 miles north of the Fort Washington interchange of the Pennsylvania Turnpike). Admission: $2.50, with $1.00 additional for each tailgate space. Non-licensed XYLs and children admitted free. Ample parking, refreshments, raffles, door prizes, and more. Talk-in on WB3JOE/R (147.66/.06) or 146.52 simplex. For further information, write the club, PO Box 352, Villanova PA 19085.

SAUK RAPIDS MN
AUG 8

The St. Cloud Radio Club will hold its annual hamfest on Sunday, August 8, 1982, from 8:30 am to 4:00 pm, at the Sauk Rapids Municipal Park, Sauk Rapids MN. Talk-in on 146.34/.94. For more information, contact Mike Lynch, 2115-1st Street, St. Cloud MN 56301, or call (612)-251-2297.

SONOMA CA
AUG 8

The Valley of the Moon Amateur Radio Club will hold its third annual ham breakfast and swap meet on Sunday, August 8, 1982, from 9:00 am to 4:00 pm, at the Sonoma Community Center, 276 East Napa Street, Sonoma CA. Breakfast is $3.50 each for adults and $1.75 each for children under 12. Waitresses will serve breakfast to people manning swap tables. Hot dogs will be served for lunch. Swap spaces are $5.00 each and tables can be set up beginning at 8:00 am. (Since there are only 30 tables available, plan to bring your own.) Admission, including a raffle ticket, is $1.00 and tykes, YLs, and XYLs will be admitted free. Featured will be computer displays and demonstrations, an operating 10-meter FM station, a Sonoma Valley Quilters' table, an amateur television display, an open auction at 2:00 pm, and a raffle at 3:30 pm. Talk-in on 147.47 simplex and 146.13/.73. For further information, call Darrel WD6BOR at (707)-938-8086; for swap space reservations, write VOMARC, 358 Patten Street, Sonoma CA 95476, enclosing payment of $5.00.

HOUSTON TX
AUG 13-15

The Texas VHF Society 1982 Summer Meeting will be held on August 13-15, 1982, at the Nassau Bay Resort Motor Inn, Johnson Spacecraft Center, Houston TX. Preregistration is $5.00 for all three days and includes one free ticket for a pre-registration drawing. Each additional prize ticket is $1.00. Registration at the door is $6.00 and does not include a prize ticket. There will be special tours of NASA, exhibits, a flea market, a ham astronaut speaker, space shuttle communications, and VHF and ARRL seminars. Prizes include an all-mode VHF transceiver. Talk-in on 146.04/.64 and 147.75/.15. For pre-registration information, write Texas VHF-FM Society, Summer Session, c/o PO Box 73, Texas City TX 77590.

TACOMA WA
AUG 14-15

The Radio Club of Tacoma will hold Hamfair 82 on August 14-15, 1982, at the Pacific Lutheran University campus, Tacoma WA. Registration is $5.00 and dinner is $7.50. Activities will include technical seminars, a flea market, commercial booths, an ARRL meeting, a repeater forum, a VHF tweak and tune clinic, prizes, raffles, and a loggers' breakfast. Talk-in on 147.88/.28. For more information, contact Grace Teitzel AD7S, 701 So. 120th, Tacoma WA 98444, or phone (206)-564-8347.

WILMINGTON DE
AUG 15

The seventh annual New Delmarva Hamfest will be held on Sunday, August 15, 1982, from 8:00 am to 4:00 pm at Gloryland Park, Bear DE (5 miles south of Wilmington). Admission is $2.25 in advance, $2.75 at the gate. Tailgating is $3.50. Limited tables will be available under the pavilion, but bring your own to be sure. Food and drinks will be available. First prize is an Atari® Home Video Game System. Talk-in on .52 and .13/.53. For more information and a map, send an SASE to Stephen Momot K3HBP, 14 Balsam Road, Wilmington DE 19804. For advance tickets, make checks payable to Delmarva Hamfest, Inc.

AMES IA
AUG 15

The Iowa 75 Meter Net will hold a picnic and swapfest on Sunday, August 15, 1982, at River Valley Park, Ames IA. A potluck meal will be held at 12:00 noon, with a program and prizes to follow. Talk-in on .16/.76. For further information, contact Lovelle J. Pederson WB0JFF, Hudson IA 50643.

LAFAYETTE IN
AUG 15

The Tippecanoe Amateur Radio Association will hold its 11th annual hamfest on Sunday, August 15, 1982, beginning at 7:00 am, at the Tippecanoe County Fairgrounds, Teal Road and 128th Street, Lafayette IN. Tickets are $3.00. Features will include a large flea market, dealers, fun, refreshments, and prizes. Talk-in on .13/.73 or .52. For advance tickets or additional information, write Lafayette Hamfest, Route 1, Box 63, West Point IN 47992.

TIOGA COUNTY PA
AUG 21

The Tioga County PA ARC 6th Annual Amateur Radio Hamfest will be held on Saturday, August 21, 1982, from 0800 to 1600 at a new location at Island Park, just off US Rte. 15, Blossburg PA. There will be a flea market, food, free camping, an auction, an H/T door prize, etc. Talk-in on .19/.79 and .52. For more information or advance tickets, write Tioga Co. ARC, PO Box 56, Mansfield PA 16933, or contact Paul Sando KC2AZ, 606 Reynolds Street, Elmira NY 14904 on .19/.79 or .96/.36.

DUNKIRK NY
AUG 21

The Northern Chautauqua Amateur Radio Club will hold the 4th annual Lake Erie International Hamfest on Saturday, August 21, 1982, at the Chautauqua County Fairgrounds, Dunkirk NY. There will plenty of outdoor and indoor flea-market space. Prizes will include an Icom IC-2A. Talk-in on 146.25/.85 and 146.07/.67. For more informa-

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tion, contact Ron Warren WA2LPB, PO Box 455, Dunkirk NY 14048.

OAKLAND NJ
AUG 21

The Ramapo Mountain Amateur Radio Club (WA2SNA) will hold its 6th annual flea market on August 21, 1982, at the Oakland American Legion Hall, 65 Oak Street, Oakland NJ, only 20 miles from the GW Bridge. Admission is $1.00; non-ham family members will be admitted free. Indoor tables are $6.50 and tailgating is $3.00. There will be a quality open kitchen, and door prizes, including an Icom IC-2AT, will be given away. Talk-in on 147.49/146.49 and .52. For additional information, contact Walt Zierenberg WD2AAI, 344 Union Avenue, Bloomingdale NJ 07403, or phone (201)-838-7565.

HUNTSVILLE AL
AUG 21-22

The Huntsville Hamfest will be held on Saturday and Sunday, August 21-22, 1982, at the Von Braun Civic Center in Huntsville AL. There is no admission charge. There will be prizes, exhibits, forums, an air-conditioned indoor flea market, and non-ham activities. Tours of the Alabama Space and Rocket Center are available for the family. A limited number of camping sites with hookups are available at the VBCC on a first-come, first-served basis. Flea-market tables are available for $4.00 a day. Talk-in on 3.965 and .34/.94. For more information, write Huntsville Hamfest, PO Box 4563, Huntsville AL 35802.

MARYSVILLE OH
AUG 21-22

The Union County Amateur Radio Club will hold the Marysville Hamfest on Saturday afternoon and all day Sunday, August 21-22, 1982, at the fairground in Marysville (near Columbus) OH. Admission is $2.00 in advance or $3.00 at the gate. Flea market space is $1.00. Food, beverages, and free overnight camping, movies, and popcorn will be available. Featured on Saturday night will be a free square dance (with a live band) followed by a big country breakfast available all night. Door prizes, ladies' programs, and ARRL, FCC, and MARS meetings will be featured on Sunday. Talk-in on 146.52 and 147.99/.39. For additional information, write UCARC, 13613 US 36, Marysville OH 43040, or call (513)-644-0468.

WENTZVILLE MO
AUG 22

The St. Charles Amateur Radio Club, Inc., will hold Hamfest 82 on August 22, 1982, at the Wentzville Community Center, Wentzville MO. Tickets in advance are $1.00 each or 4 for $3.00; at the door, they are $1.50 each or 4 for $5.00. Admission is $1.00 per car. There will be prizes, contests, a flea market, food, and air conditioned exhibitions buildings. For tickets, motel and camping information, prize lists, dealer reservations, etc., write SCARC Hamfest 82, c/o Mike McCrann WD0GSY, 25 Elm Street, St. Peters MO 63376.

ST. CHARLES IL
AUG 22

The Fox River Radio League will host the Illinois State ARRL Convention in conjunction with its annual hamfest, both to be held on August 22, 1982, from 8:00 am to 4:00 pm, at the Kane County Fairgrounds, St. Charles IL. Tickets are $2.00 in advance and $3.00 at the gate. For advance tickets, send an SASE to J. Dubeck KA9HQY, 1312

Bluebell Lane, Batavia IL 60510. There will be commercial exhibits, a flea market, contests, demonstrations, forums, prizes, and hot food. Talk-in on 146.94. Exhibitors, dealers, and vendors should contact G. R. Isely WD9GIG, 736 Fellows Street, St. Charles IL 60174.

ARGOS IN
AUG 29

The 7th annual Marshall County ARC Hamfest will be held on Sunday, August 29, 1982, from 8:00 am to 2:00 pm, at the Marshall County 4H Fairgrounds, Argos IN. Eight-foot tables are available for $3.00 and dealers will be able to set up at 6:00 am. Features will include commercial exhibits, a flea market, refreshments, and hourly drawings. Grand prize is $200. Talk-in on .07/.67, 146.52, and 222.9/224.5. For additional information or reservations, write MCARC, Box 151, Plymouth IN 46563.

FLINT MI
AUG 29

The Genesee County Radio Club, the Bay Area Amateur Radio Club, the Lapeer County Amateur Radio and Repeater Club, the Saginaw Valley Amateur Radio Association, and the Shiawassee Amateur Radio Association will hold the sixth annual Five County Swap-n-Shop on Sunday, August 29, 1982, from 8:00 am to 3:00 pm, at Bentley High School, 1150 Belsay Road, Flint MI. Tickets in advance are $2.00 per person; at the door, $3.00. Children under 12 will be admitted free. There will be a food concession, free parking, and prizes, including a first prize of a Ten-Tec 580 Delta and 280 power supply or $500 cash. Talk-in on 146.52 and 147.87/.27. For table reservations, contact Perry Baker WA8THK, 9055 Grand Blanc Road, Gaines MI 48436, or phone (313)-635-7287.

LEBANON TN
AUG 29

The Short Mountain Repeater Club will hold the Lebanon Hamfest on Sunday, August 29, 1982, at Cedars of Lebanon State Park, US Highway 231, Lebanon TN. There will be outside facilities only and exhibitors should bring their own tables. Food and drink will be available. Talk-in on 146.31/146.91. For further information, contact Mary Alice Fanning KA4GSB, 4936 Danby Drive, Nashville TN 37211.

SEWELL NJ
AUG 29

The Gloucester County Amateur Radio Club will hold its fourth annual GCARC Ham/Compfest on Sunday August 29, 1982, from 8:00 am to 3:00 pm at the Gloucester County College, Tanyard Road, Sewell NJ. Tickets are $2.00 in advance and $2.50 at the door. The tailgaters' and dealers' charge is $6.00 and includes one free admission. Doors will open at 7:00 am for setup. There will be speakers, seminars, contests, FCC exams, and prizes, including a Radio Shack TRS-80 computer and a Yaesu FT-208R. Talk-in on 146.52 and 147.78/.18. For more information, contact GCARC Hamfest Committee, PO Box 370, Pitman NJ 08017, or phone (609)-456-0500 or (609)-338-4841 (days) or (609)-629-2064 (evenings).

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

✓See List of Advertisers on page 114

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

NORTH HAVEN CT
NOV 7

The Southcentral Connecticut Amateur Radio Association's (SCARA's) third annual electronics flea market will be held on Sunday, November 7, 1982, indoors at the North Haven Recreation Center on Linsley Street in North Haven CT. Regular admission is $1.25; children under 12 with an adult will be admitted free. Sellers' spaces are $6.00. The best spaces will be assigned first. A limited number of free tables will be provided to the first reservations received. When those tables are gone, space will be available for selling from the floor or from your own table. Food will be available. Sellers may set up at 8:00 am, and walk-ins will be admitted from 9:00 until 3:00. For reservations, send check or money order payable to "SCARA" to Ed Goldberg WA1ZZO, 433 Ellsworth Avenue, New Haven CT 06511. Include an SASE for confirmation.

HAM HELP

I need information on an Abbott TR-4 and an Abbott TR-4B. I would also like information on Navy type CRI-43044, a unit of Model TBY-8 and Model TBY-7.

Craig Renier
7418 Lesada Dr.
Baltimore MD 21207

I need operating/maintenance manuals for the following equipment: Yaesu FT-707; Astro 150A; Hewlett-Packard Model 122AR oscilloscope; Anton Elect. Corp. TS-505 D/U VTVM; and Shallcross ZM-3/U capacitance analyzer.

I will buy originals or pay for copying.

H. Hutchison
N4GQE, HP1XHH, N4GQE/YSI
USMILGP, El Salvador
APO MI 34023

I am looking for an instruction or technical manual for an old BC 211M frequency meter as well as for a CW filter for a Galaxy GI 550A transceiver. I will pay.

Bob Currier KA5ETF
5529 Marblehead
Jackson MS 39211

I would appreciate any information on a frequency counter which could be used with the Collins 51S-1 and 51J-4 receivers. I am also looking for anyone who has modified a 51J-4 to receive FM or who may be able to supply a suitable modification.

Ciano Strachan C6ANI
PO Box N4106
Nassau NP
Bahamas

I am in need of a schematic or manual for an RCA Institute scope. Tubes are 1V2, 6BL8, 6D10, 6X4WA, (2) 12AU7s, and WX5078 P1. I will pay for the information.

J. W. Hopson W4AEM
959 Overhill Drive
Alexander City AL 35010

I need the QSL cards of those who are Church of Christ hams for the 1983 Church of Christ *Callbook* I am putting together.

Ray Hawk NW4L
1461 East Chester
Jackson TN 38301

I would like to purchase original manuals for the Hickok Model 1805A oscilloscope and Tektronix Model N preamp.

Eiichi Takarada
1423 Vassar Rd.
Rockford IL 61103

Would the fellow who sold me the Comco business-band handie-talkie at the Dayton Hamvention please contact me. I would like to buy the Model 43 Teletype machine that you had shown me. Please call collect after 6:00 pm: (614)-922-2652.

Daniel Durgin KA1AFJ/8
121 Lake St.
Uhrichsville OH 44683

I would like to hear from anyone who has a cure for the S-meter drift problem in the Tempo 1 transceiver.

Dick Roux N1AED
25 Greenfield Dr.
Merrimack NH 03054

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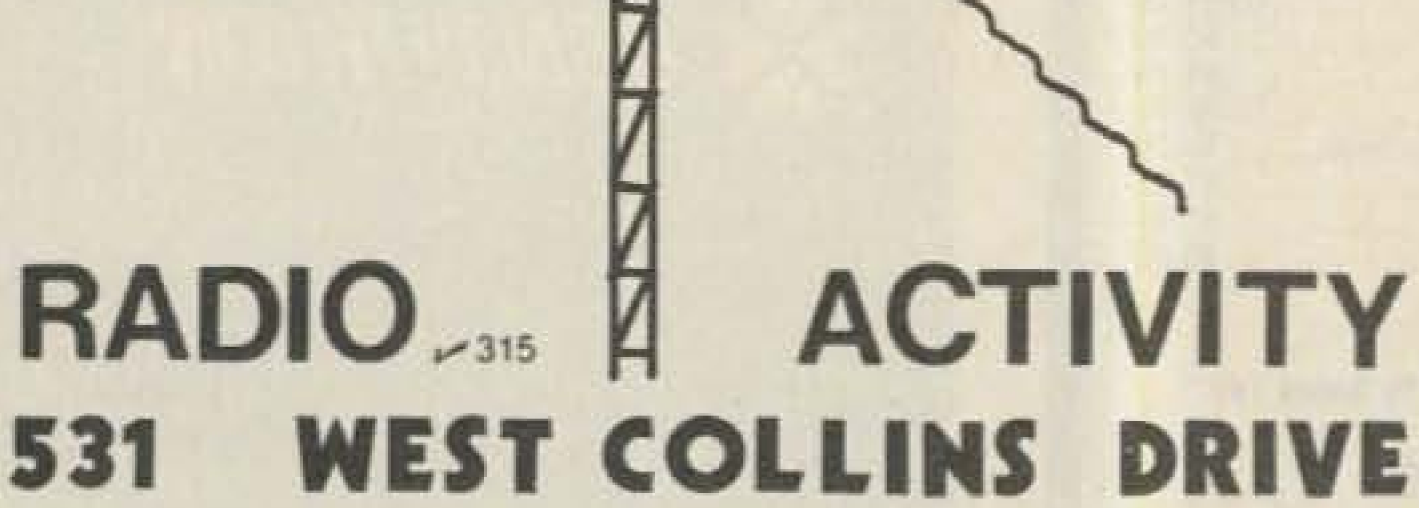

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Confessions of a Counter Evolutionary

—the best circuit yet?

Editor's Note: 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. Next month we'll bring you the conclusion of WA2FPT's discussion.

As many of you may have done already, I had vowed never again to be lured into reading another frequency counter article, one more of those ubiquitous "counter updates," or even another of the scores of ads splashed over the pages of ham magazines. I was certain that I had been told more than I ever wanted to know about counters.

Why have I yielded to temptation (lured by the possibility of publication) and become a part of this ever-increasing problem? I confess! The truth is, I was seduced by an LSI counter chip, the LS7030 from LSI Computer Systems, Inc. This little beauty measures a full 40 (pins, that is) and is an 8-decade, multiplexed up counter. It counts directly to 5 MHz, is CMOS and TTL-voltage compatible, and has BCD *and* 7-segment multiplexed display outputs. It also employs and enjoys leading-zero blanking and very low power consumption. A real gem!

Photo A. Push-button selection is used to control the 7030 Universal Counter.

Even with all this on a chip, what would cause anyone, much less an impatient convenience-seeker like me, to take the trouble to design a frequency counter when there are a host of appetizing kits well within the one "centi-buck" range? I'll answer this in terms of the WA2FPT 7030 Universal Counter's features:

- 10-MHz oven-controlled crystal oscillator
- Full 8-digit resolution with no least-significant-digit bobble (no ± 1 count uncertainty)
- Four selectable timebase gate times: .01, .1, 1, and 10 seconds
- Hi-Z dc to 5-MHz preamp input
- Lo-Z 5-500-MHz preamp prescaler input
- Kilohertz, megahertz readout with automatic decimal point placement
- Period measurement with 20-period average, with direct readout in μsec to 99,999,999 (equivalent to .01 Hz)
- Events mode (totalizing) with manual front-panel controls and remote rear-panel control inputs
- Separate power regulators for the master oscillator, front ends, displays, and counter
- 10-MHz TTL test output and 6 additional buffered CMOS oscillator timebase signal outputs from 10 Hz to 1 MHz
- 25-pin E1A RS-232C type monitor jack for future remote-data acquisition and control
- Push-button front-panel operation with LED indicators—no rotary switches
- 90% wire-wrapped noncritical construction

If these features are interesting, then read on to see how to build this deluxe counter for truly a fraction of the cost of a commercial equivalent.

Before we get tangled up in our wire-wrapping, here's a short review for those who don't live and breathe digital counters. If you are one of those fortunate few who do, then skip this short primer.

Elementary Counting

The simplest form of a counter is one that only totalizes incoming events. Fig. 2 shows three basic functional parts. The input conditioner transforms a physical event into electrical signals that are used to increment the second part. The decade counter counts from 0 to 9 and provides a carry-out to the next digit counter. The third vital element is the indicator. It decodes and converts the outputs of the decade counter to a visual presentation hopefully useful to some observer.

Fig. 3(a) shows a simple frequency counter. To count frequency, a "window" or "gate" must open and close for a specified time interval to give counts per second, or even "furlongs per fortnight." Any number of something counted in a unit of time is an expression of frequency. Simple enough.

Two extra items are needed, however, to make a frequency counter useful: a reset and a holding or loading device. The reset is needed to ensure that the counter begins counting from zero at the beginning of the gate time. The loading device retains the value of the last count and then updates the display with that value after the counting window has shut. This "new improved" simple frequency counter is shown in Fig. 3(b).

Period counters measure the time between events. Often period measurement is used to accurately calculate very low frequencies. This becomes necessary as the value of the frequency approaches the frequency of the counting gate. To appreciate the added resolution available for such low-frequency measurement, suppose you wanted to measure the ac line frequency. It's 60 Hz, right? Well, if you want to measure it to four significant digits, you would need a gate time of at least 100 seconds (to give a 60.00-Hz display)—a long time to wait. A simple period counter could enable us to obtain the required resolution by using our "unknown" line frequency (suitably conditioned for our digital circuitry) as the gate for a much higher *known* frequency, say 10 kHz (often readily available in timebase oscillator divider chains).

Suppose these 10-kHz pulses are then counted and displayed as before. Fig. 4 shows how the 60-Hz signal gives a count of 1668. This value is .01668 seconds, the period of the line frequency. As frequency = 1/period, and vice-versa, our 4-place readout is readily converted to frequency by using a calculator to divide 1 by 0.01668. Answer: 59.95 Hz. All we did to get this handy period counter was to interchange the "unknown" signal and the gate time. There is no waiting 100 seconds, either, as the display could normally be updated about 60 times per second.

Now that you're all enlightened, let's be counter productive and get back to the real counter.

Master Oscillator

The evolution and progression of the WA2FPT Universal Counter will be covered in pieces by looking in some detail at each of the Fig. 1 blocks.

The beating heart of any counter, the master oscillator, will be described first. The one shown in Fig. 5 is based on a 10-MHz AT high accuracy series-mode quartz crystal matched to its 85° oven. Both the crystal and oven were purchased from International Crystal Manufacturing Co., 10 North Lee, Oklahoma City OK 73102. The bucks spent here or on a similar affair will be well worth it to provide stability and accuracy for your counting machine.

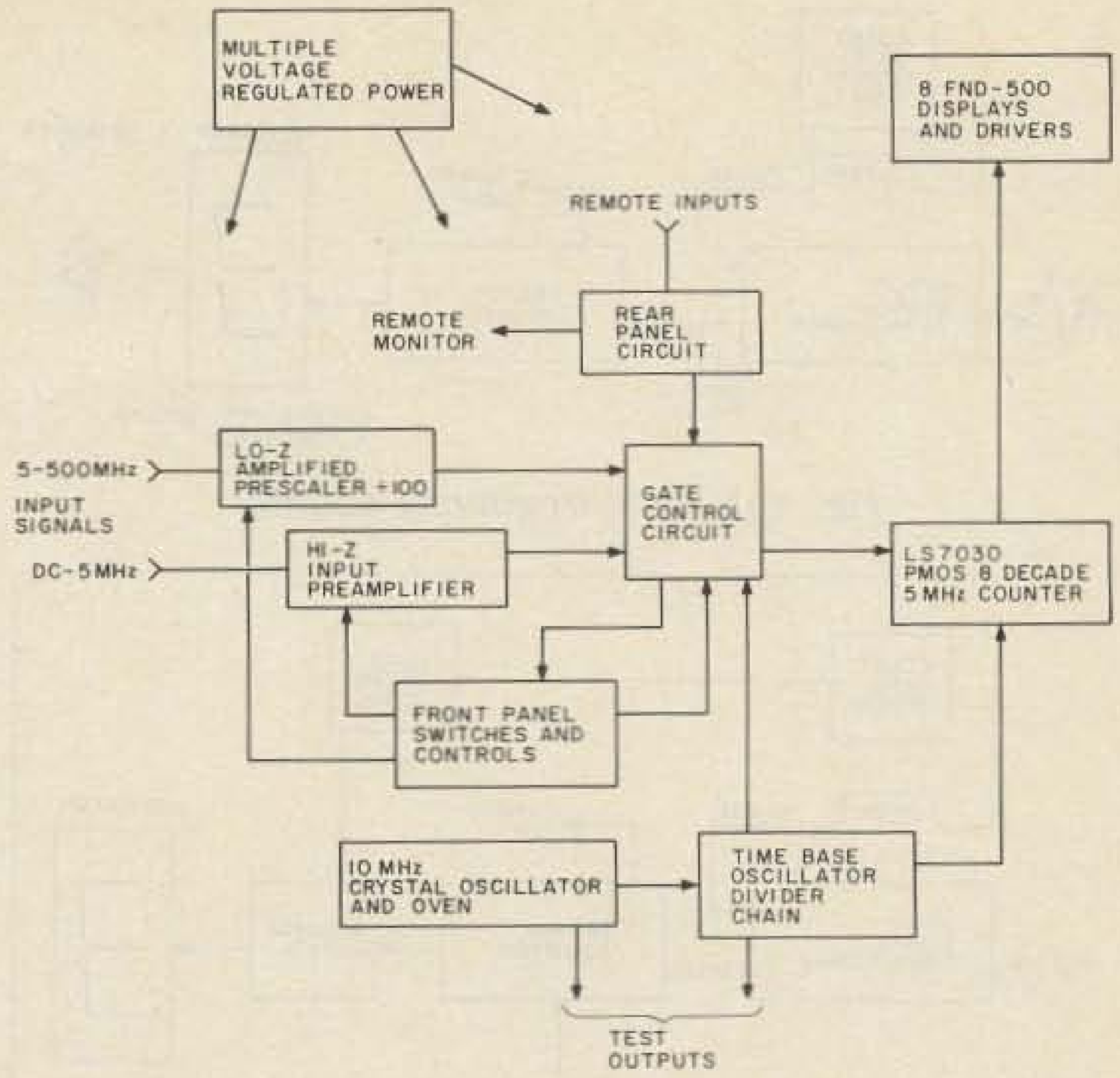

Fig. 1. Block diagram.

The oscillator itself is a 5400 TTL quad 2-input gate. A 7400 could be used, but the "Milspec" 5400 in its ceramic package was also chosen for stability (and because I had one!). The voltage regulation for the oscillator is provided by a dedicated 723 wired to give a 5-6-volt, 150-mA output. The oscillator, along with a 74LS90 decade divider, draws about 130 mA, which provides a desirably constant load. The variable capacitor serves as a coarse frequency trimmer. Except for the frequency and the 723 portion, this circuit is the same as the one WA1FUE described in his excellent counter article in the December, 1976, issue of *73 Magazine*.

I had hoped originally to build the 5400 into the oven, but soon found there wasn't enough room. Because there is a double oven, there is room for a trimmer cap as well as the crystal inside. The oven plugs into an octal socket mounted on a small aluminum minibox containing the 5400, the 723, and the rest of the oscillator components.

An extremely simple printed circuit board layout is shown in Fig. 6(a). This full-size board is copper-clad epoxy glass with 0.1" centered holes (Vector 169P44C1 or equivalent).

Keeping the trimmer capacitor in the oven solves a significant source of oscillator variance due to trimmer cap temperature drift. As the oven heats up to 85° C, the trimmer heats up, and, as the oven stabilizes, so does the trimmer. As you might imagine, a decent mica or ceramic trimmer (25-75 pF or so) is required here. The oven cover may have to be left off, depend-

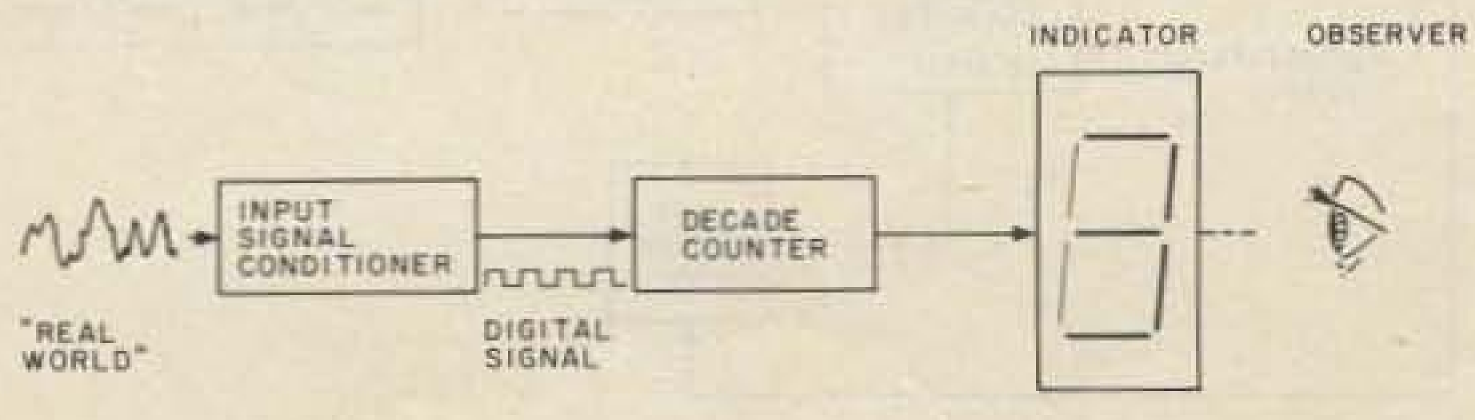

Fig. 2. Simple events counter.

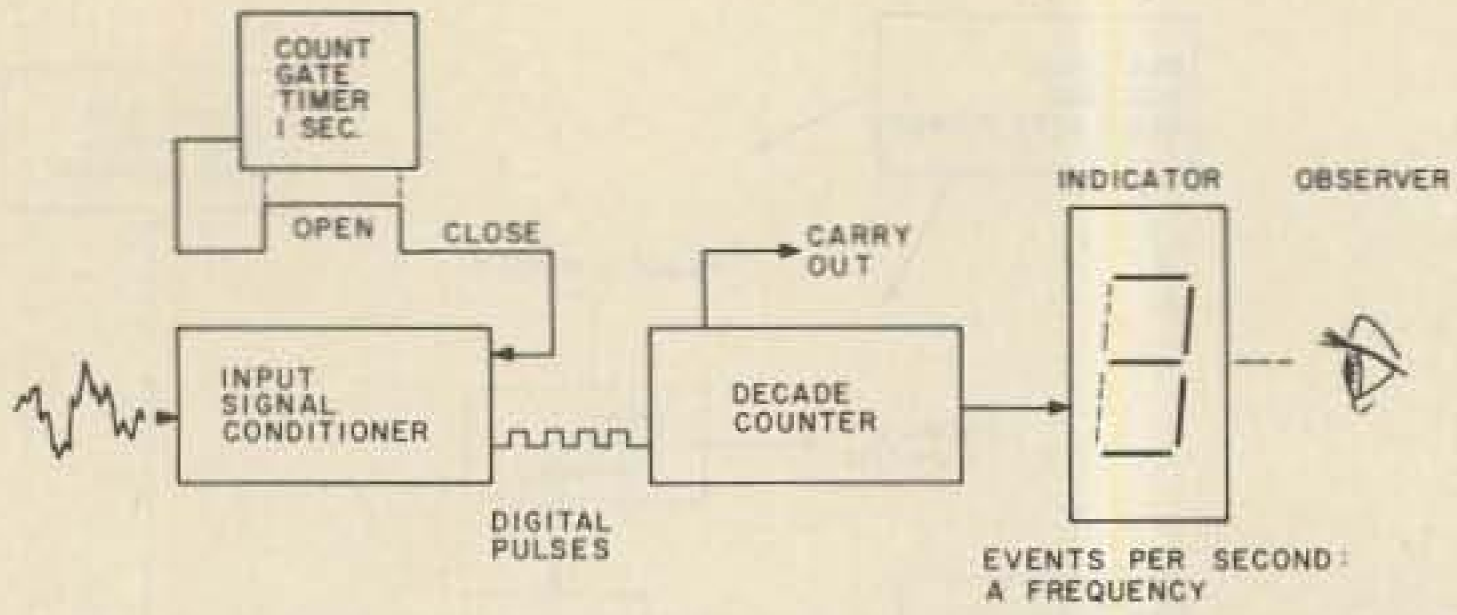

Fig. 3(a). Basic frequency counter.

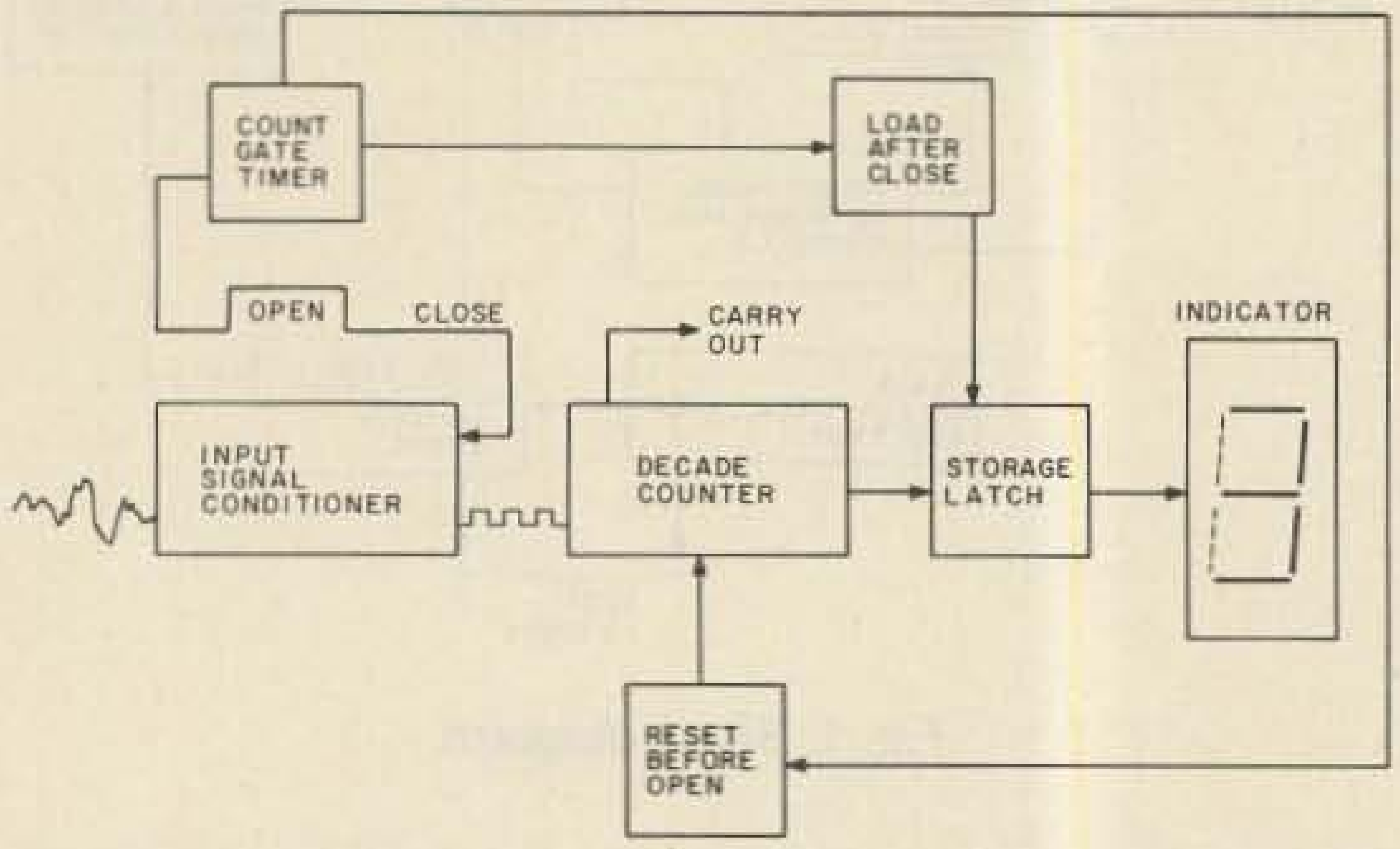

Fig. 3(b). Improved simple frequency counter.

ing on the size and/or accessibility of the capacitor's adjustment screw.

In addition to the trimmer capacitor, there is a fine frequency adjustment. The 723 has a ten-turn 500-Ohm pot to give controlled millivolt level changes in the 5-6-volt range of the 723 output. This allows minute tweaking of the output frequency. A screwdriver access hole for the trimmer pot screw was planned and cut in the minibox housing and through the counter chassis. Binding posts were provided on top of the minibox near the plug-in crystal oven for monitoring the output of the 723. This, with a rear-panel BNC 10-MHz test jack, allows convenient access to long-term oscillator drift and aging data versus voltage, if there should be a need for such logging. The 74LS90 is wired to produce a symmetrical 1-MHz square wave, and miniature coax, RG-174 or its equal, routes this signal to pin 22 of a 44-pin edge connector on the main counter board.

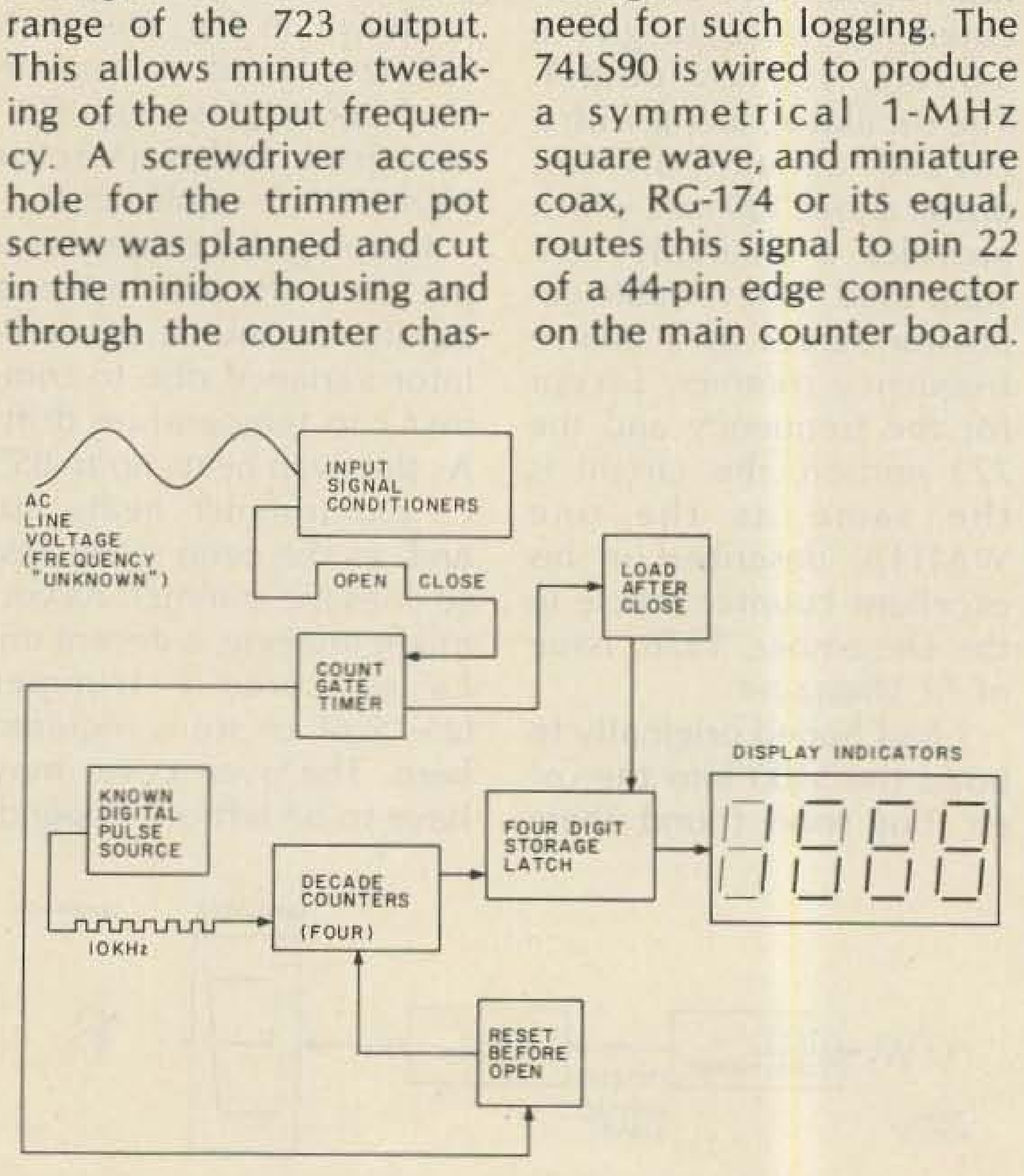

Fig. 4. Period counter example.

Timebase Oscillator Dividers

The timebase oscillator dividers (TBOD) are mounted on wire-wrapped sockets on the main board of the counter—a 4.5" × 6" Vector 3662. The wiring for the TBOD is shown in Fig. 7. ICs 3, 8, 9, and 10 are 74C90s, while ICs 2, 5, and 6 are 4029 types.

The 74C90 devices are wired as decade dividers, with the output of the ÷5 portion, pin 11, fed into the input of the ÷2 section at pin 14. The 4029 is a dual-mode (decade or binary) up-down (user-selectable) counter in a 16-pin package. In this application it is wired as a decade up counter. There is no reason why 74C90s could not be used exclusively as they are cheaper to buy and use cheaper sockets. I used both chips because I had a few of each on hand.

The TBOD, as is customary in electronic counters, provides a number of important signals that are distributed throughout the machine. The signal frequency and its destination, together with a brief description, comprise the list of pulses picked off the IC chain (see Table 1). As long as the master oscillator runs, these signals are present.

Display

The eight seven-segment common-cathode displays in this counter are FND 500 .5" right-hand decimal-point devices. They can be purchased for under a dollar apiece from many sources and are entirely adequate.

The displays are multiplexed, which is a fancy way of saying that one digit is lit at a time. Our persistence of vision will see all eight digits lit, however, if the scanning rate is fast enough. This technique greatly reduces power supply drain and just happens to be built into the 7030 chip. The 7030 implements this feature with an onboard digit-scanning generator that strobes the digits sequentially from left to right (digits 8 to 1) when a pulsing signal is input to pin 39. There is also a built-in digit-scanner oscillator requiring only an external capacitor between pins 39 and 40. Since the TBOD has a plentiful supply of signals, a 1-kHz signal was used for scanning, and it works well. A scan reset is needed, according to the 7030 data sheet, to avoid display damage and for leading-zero blanking. I used a 20-Hz signal, allowing 50 display scans before a reset blanks the display.

The result is a nice bright display with an almost imperceptible flicker. Faster scanning rates are possible, and faster resets will produce no visible flicker whatsoever, but the brightness will suffer. This is because the digit strobe duty cycle is only about 12%. The scanning-oscillator signal is divided into eight such sequential strobes.

These strobes, as MOS outputs, are not sufficient to drive display diodes directly. Instead, the strobes are sent to 75492 hex MOS-to-LED drivers, which have six drivers per package, each capable of sinking 250 mA.

The seven-segment information is similarly amplified by 75491s, which are quad MOS-to-LED segment drivers. The seven segments, labeled a–g, plus the decimal point, fully use two 75491 chips.

In a multiplexed display system, the seven-segment outputs are "daisy-chained" to all digits. That is, all the "a" segments for all the digits are wired together, and the "b" segments are wired to each other, and so on.

As the seven-segment information is sent to all those diodes, only the diodes in the digit that receives a strobe will light up.

A simplified pseudo-schematic could help illustrate this in Fig. 8. Assume that the three digits 8, 7, and 6 all have ones to be displayed. The active segment outputs from the 75491 are the "b" and "c" segments that will give a one when each digit is strobed. To forward bias the LEDs, the high pulse to the 75492 is inverted to a low, which will provide the proper bias solely for digit 8. The next strobe will activate digit 7 (turning off 8), and the next, digit 6 (turning off 7). All seven-segment information is synchronized by the digit strobes, and we see the result arranged as numbers 0–9. When the scan reset occurs, the scan oscillator restarts at position 8, the most significant digit.

One of the many economies resulting from display multiplexing is the elimination of the usual current-limiting resistors. They are not needed here because the scanning rate is sufficient to keep the average current through the LEDs at an acceptable level. A "direct drive" 8-digit display with decimal points could require 8 latches, 8 decoder drivers, and 64 current-limiting resistors. The overall brightness of the display may be varied by changing the supply voltage to the 75491 and 75492 devices and the scan rate.

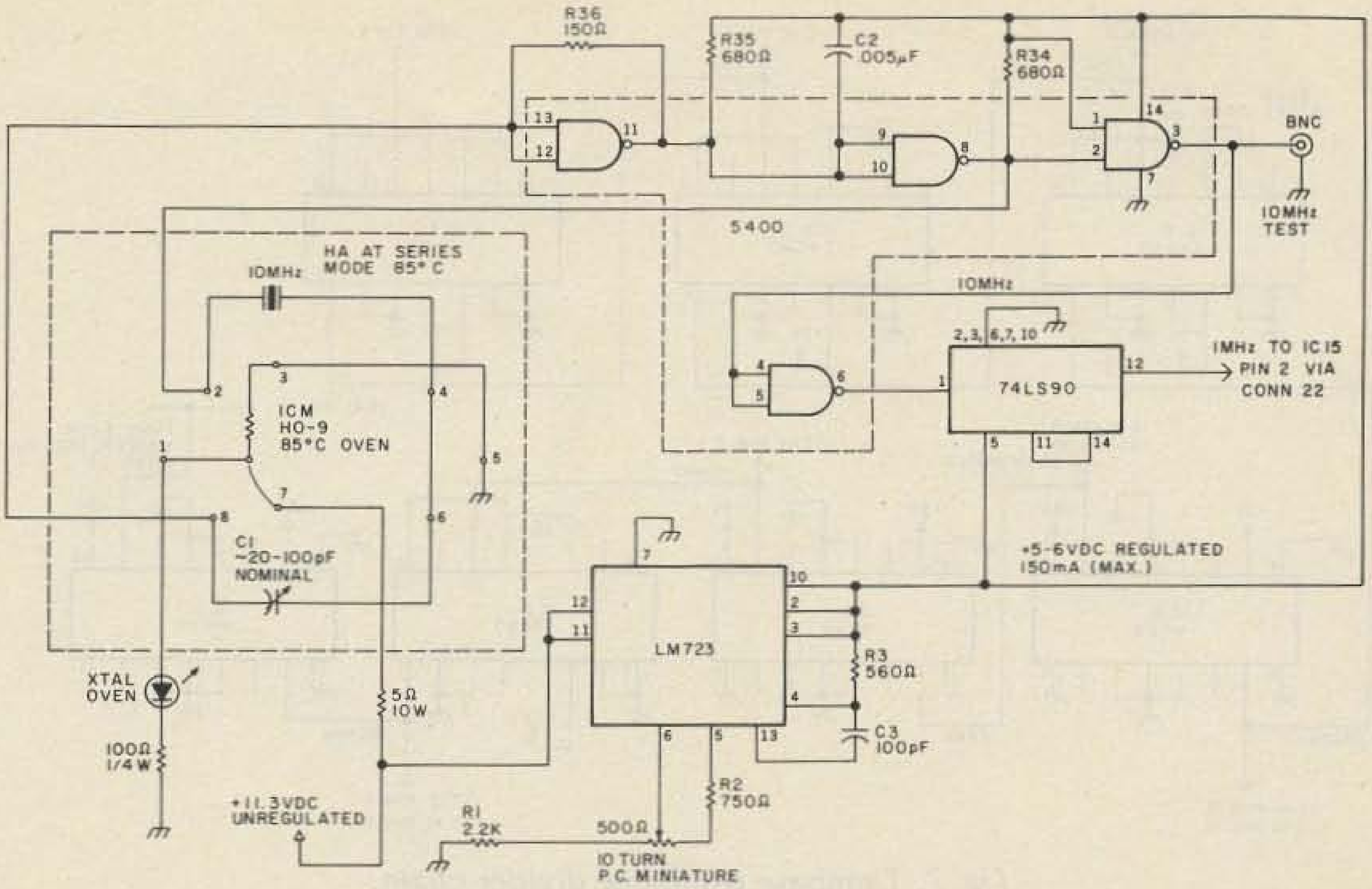

Fig. 5. Master oscillator.

The FND 500s are not as efficient as they are inexpensive, and the overall brightness was enhanced by using an 8-volt regulator, an LM340T-8, solely for the panel LEDs and the eight seven-segment display drivers.

If you decide to use different displays in your version, you will probably want to experiment a little with different voltages and scanning rates to optimize the display presentation to your liking. Fig. 9 shows the complete 8-digit wiring used in this counter.

The 7030 has a lamp-test input (pin 38) that, when brought high (+5 volts), will light all segments of all eight digits, showing all 8s. I couldn't resist putting a "lamp-test" push-button on the front panel for that purpose. The circuit used, though, does provide a useful function, because a counter overflow condition is also incorporated.

The 7030 has its three most significant decade overflow outputs for digits 8, 7, and 6 brought out to pins 14, 15, and 16, respectively, of IC1. Because this machine is an 8-digit counter, it made sense to use the eighth decade overflow output from pin 14 to set the overflow input latch at pin 13 of the 7030. An internal flip-flop holds the overflow indication until a counter reset (not a scan reset) occurs. As the overflow output becomes active, it sets the 4013 IC31 in the lamp-test circuit, causing a

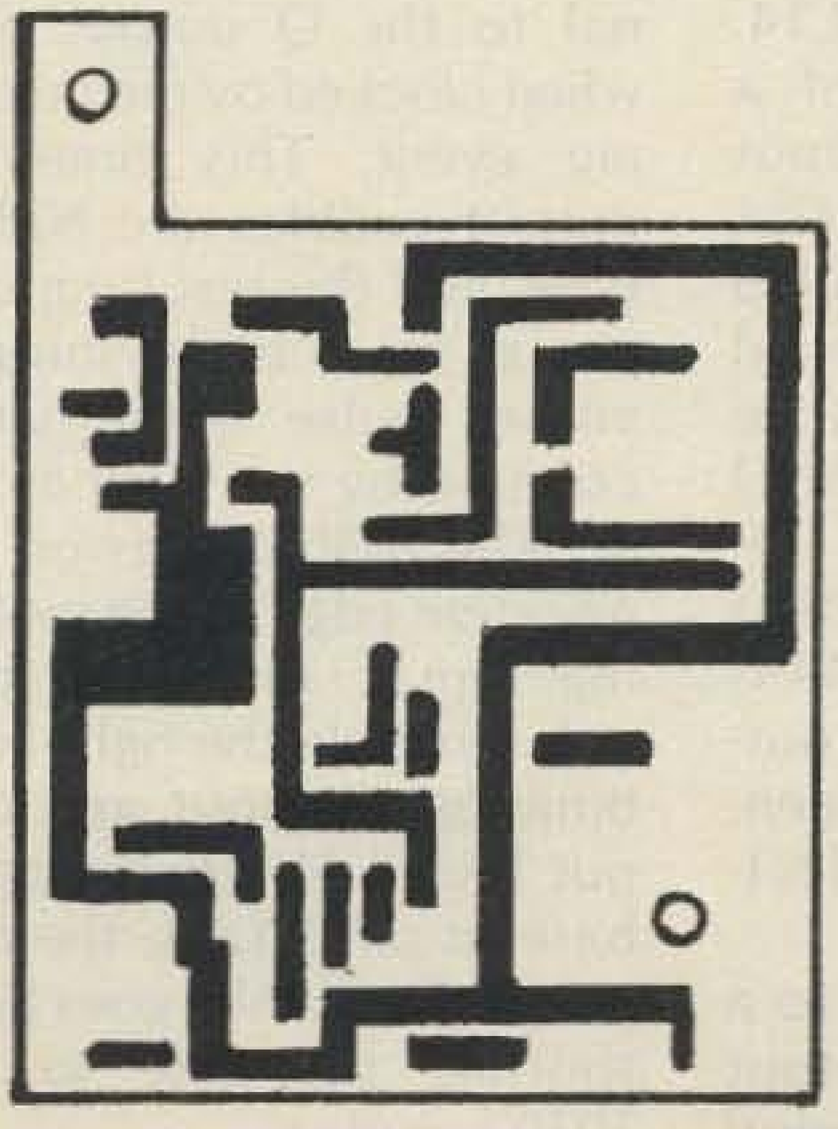

Fig. 6(a). Master oscillator PC layout.

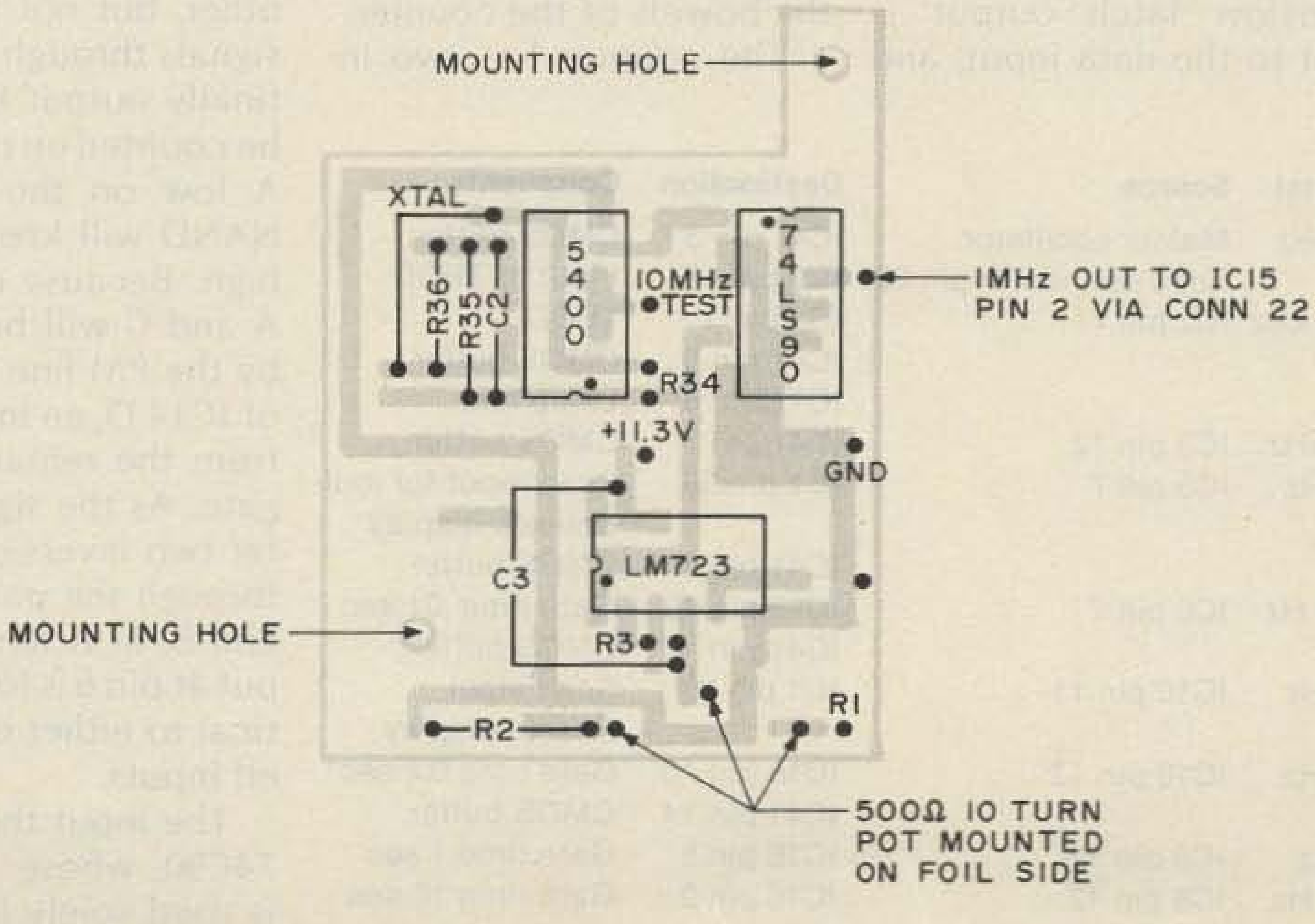

Fig. 6(b). Parts placement for master oscillator board.

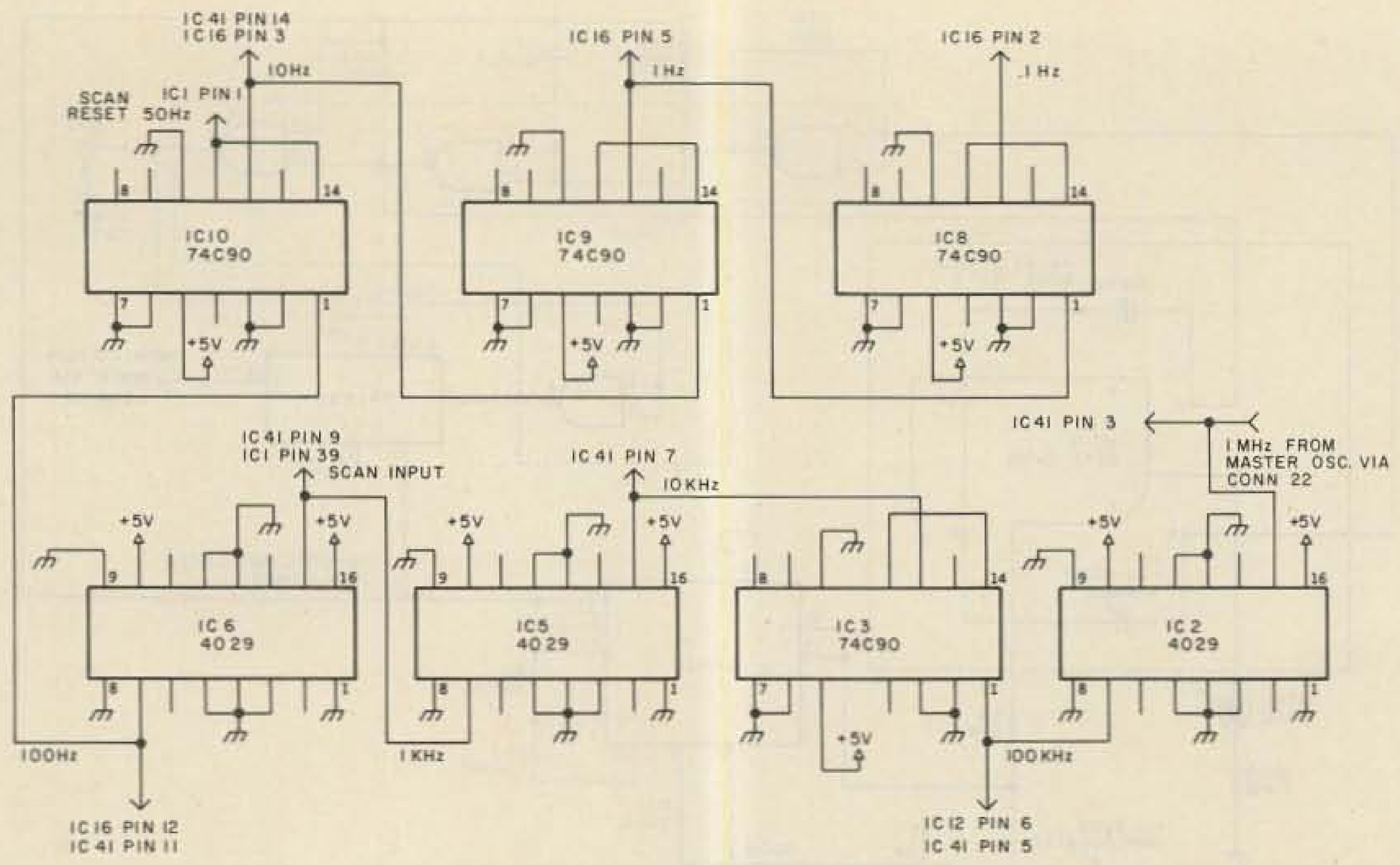

Fig. 7. Timebase oscillator divider chain.

display of all 8s. They will remain lit until the counter is reset. Should the overflow input be left unused, the counter display will "wrap around" to zero after 99,999,999 and begin counting again from zero. This probably wouldn't occur in frequency counting, but could be an important consideration in events totalizing.

The manual lamp-test push-button (as shown in Fig. 10) is connected to activate the lamp-test flip-flop (IC31) via the direct set input. An unused 74C00 gate is used as an inverter. The overflow latch output is sent to the data input, and when clocked by a convenient source (1 kHz here), it also activates the lamp test, separately from the previously-described manual operation.

This arrangement is only one of several possibilities, but it uses leftover gates and flip-flops. Other unused gates don't appear in the schematic, but have their inputs grounded. The CMOS doesn't like loose ends.

Counter Tactics

Now that the timebase and display have been described, let's journey into the bowels of the counter.

The counter has two inputs, in contrast to the simple demonstration example. These two inputs are shown with the gate controls in Fig. 11(a). The two input sources are conditioned to provide CMOS-compatible square waves that swing from almost ground to the supply voltage of +5 volts.

The PM line controls which of the two input signals is allowed through the remaining two input NAND gates of IC14. These comprise a 2-to-1 data selector; that is, the condition (GND or +5) of the PM line always enables one or the other, but not both, of the signals through the gates to finally output the signal to be counted on pin 6 of IC14. A low on the input of a NAND will keep its output high. Because of this, IC14 A and C will be controlled by the PM line with the aid of IC14 D, an inverter made from the remaining NAND gate. As the signal will suffer two inversions, whether through the path of IC14 C and B, or A and B, the output at pin 6 is logically identical to either of the selected inputs.

The input then goes to a 74C90, whose ÷10 output is used solely in the period mode, and then into a 74C157. The 74C157 is a device containing four 2-to-1 multiplexers that operate logically the same as the one formed by IC14. The 74C157 uses a single select line (pin 1) to route one of the two inputs for passage at a time. The two inputs A and B are shown for each of the four 2-to-1 multiplexers native to a 74C157. A high (or 1) level (~5 volts) on the select input chooses the B input for transmission, while a low (or 0) level (~GND) lets the A input pass.

Fig. 11(b) shows the gate synchronizer lifted out of the rest of the schematic for clarity. The input to the counter will *not* be the incoming frequency when the P (for Period) line is at a 1 level. For events totalizing and for frequency mode, the signal pulses are sent to a NAND gate (pin 4) and to the clock input (pin 3) of IC13, a 74C74 D-type flip-flop. The purpose of the other half of IC13 will be explained shortly.

Notice how the output of IC13, pin 5, is combined with the clock signal in the NAND gate accompanying pins 4, 5, and 6. This is the circuit that synchronizes the timebase with the input to eliminate the least-significant-digit jitter. The flip-flop "remembers" the timebase input at the pin 2 data input and transfers the rise or fall of the timebase signal to the Q output *only when clocked by the incoming event*. This timebase output enables the NAND gate, and the resulting output at pin 6 is the integer-valued pulse train that is counted by the 7030 at pin 32. The 7030 counts on the negative edge of the incoming signal, so NAND provides exactly the right combination of input and output levels. When the timebase at pin 5 falls, the output of the NAND goes high, shutting the gate to the 7030 counter.

This is an example of the

Signal	Source	Destination	Comments
1 MHz	Master oscillator	IC41 pin 3	CMOS buffer
	Edge connector pin 22	IC2 pin 15	Input to TBOD
100 kHz	IC2 pin 7	IC3 pin 1	TBOD
		IC41 pin 5	CMOS buffer
		IC12 pin 6	Lamp test
10 kHz	IC3 pin 12	IC41 pin 7	CMOS buffer
1 kHz	IC5 pin 7	IC1 pin 39	Scan input for multiplexed display
		IC41 pin 9	CMOS buffer
100 Hz	IC6 pin 7	IC16 pin 12	Gate time .01 sec
		IC41 pin 11	CMOS buffer
20 Hz	IC10 pin 11	IC1 pin 38	Scan reset Resets display
10 Hz	IC10 pin 12	IC16 pin 13	Gate time 0.1 sec
		IC41 pin 14	CMOS buffer
1 Hz	IC9 pin 12	IC16 pin 5	Gate time 1 sec
0.1 Hz	IC8 pin 12	IC16 pin 2	Gate time 10 sec

Table 1.

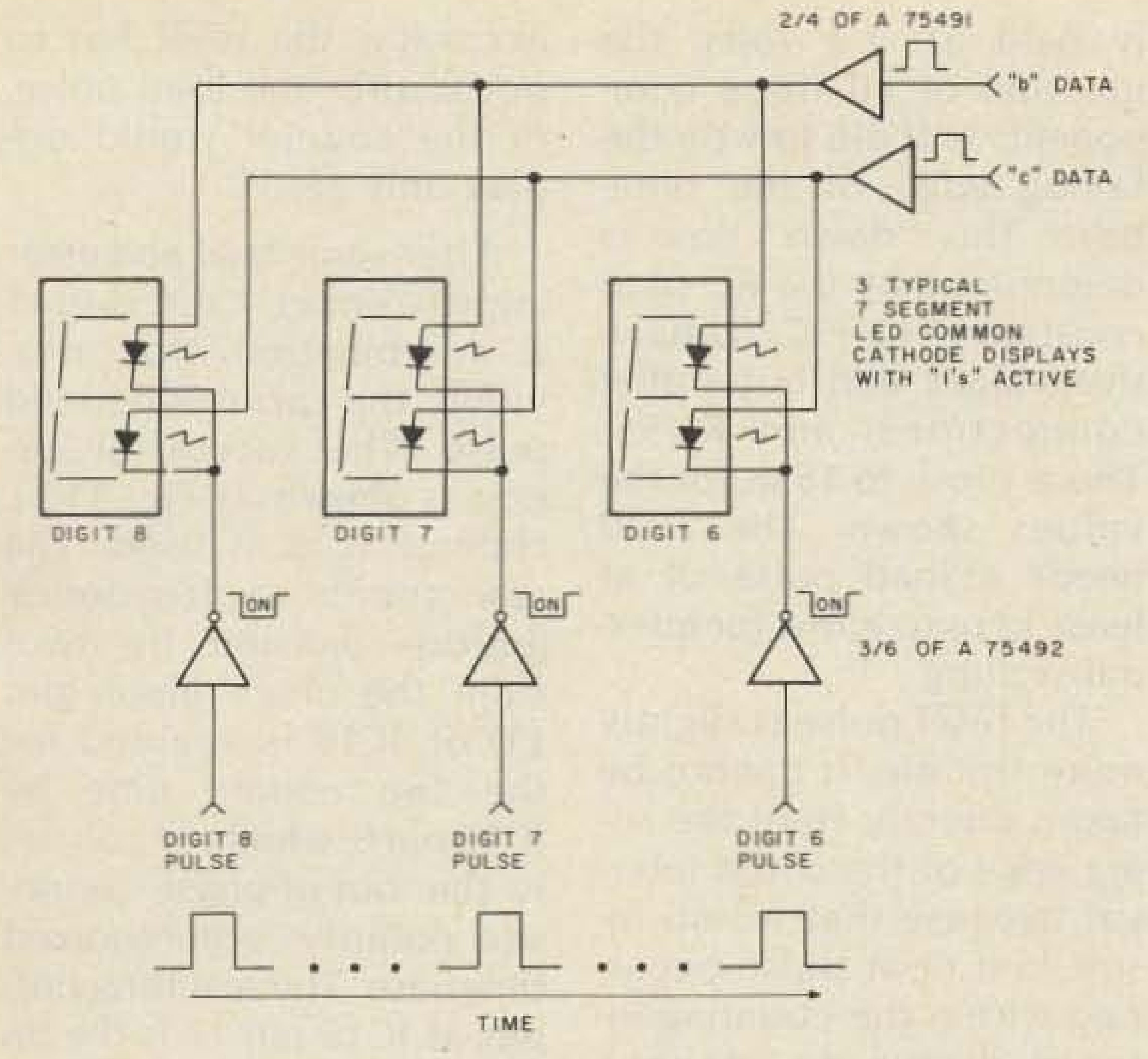

Fig. 8. Simplified multiplexed display example.

incoming pulses both starting and stopping the actual timebase at IC13 pin 2, which is shifted by the interval between event pulses. As long as this period of time between arriving pulses is longer than the difference between the propagation delay of the 74C74, the circuit will synchronize beautifully, allowing only whole numbers of pulses to be counted. This limitation is never realized because of the 5-MHz maximum count frequency into the 7030.

Page 208 in Don Lancaster's *TTL Cookbook* sparked my imagination and curiosity about eliminating the usual last-digit jitter found in most digital counting instruments. This ±1 digit ambiguity is an error source that is inversely proportional to the measurement frequency. To keep the following example simple, let's assume a 1-second timebase. For a 10-Hz frequency, the ±1 count results in a ±10% error per sample. At 100 kHz, the error decreases to ±.01%. If anyone wants an easily-forgotten formula, try this: % error = ± 100/(H × g), where H = frequency in Hz and "g" is the gate time in seconds. Notice that this particular source of measurement imprecision is in addition to timebase instability, noise, jitter in triggering, and all the other digital counter gremlins.

Now you can appreciate the slight cost of the couple of extra ICs to eliminate this error, especially for lower-frequency measurements. This important feature is overlooked by virtually all manufacturers of digital instrumentation in the hobbyist's realm.

If you are wondering about the other half of IC13, it is used to produce the proper duration of the timebase. Feeding pin 8 back to pin 12 gives a toggle action, dividing the incoming timebase by two. This gives a symmetrical signal high for the originally selected time, and then low for the same time. This "open gate" signal exits from pin 9 and then goes to the pin 2 data input of the previously-explained gate synchronizer.

A green LED on the front panel indicates gate interval. It is taken from IC13 pin 5, enabled by the AND gate in IC18 and driven from IC39, a 75492. A 220-Ohm resistor limits the current. An interesting side benefit is that uneven triggering of the gate synchronizer will show up as irregular flashing of the gate LED. This is a "poor man's" trigger-threshold indicator, since the incoming events must be continually starting the timebase and turning on the gate LED for reliable counting.

Remember the reset and update/load functions needed to make our ultrasimple counter accurate and convenient? Here's how they are generated in this counter.

The timebase representation from Fig. 3(a) will serve as a point of reference. Ideally, the load/update signal for the display should occur immediately after OPEN, at the beginning of

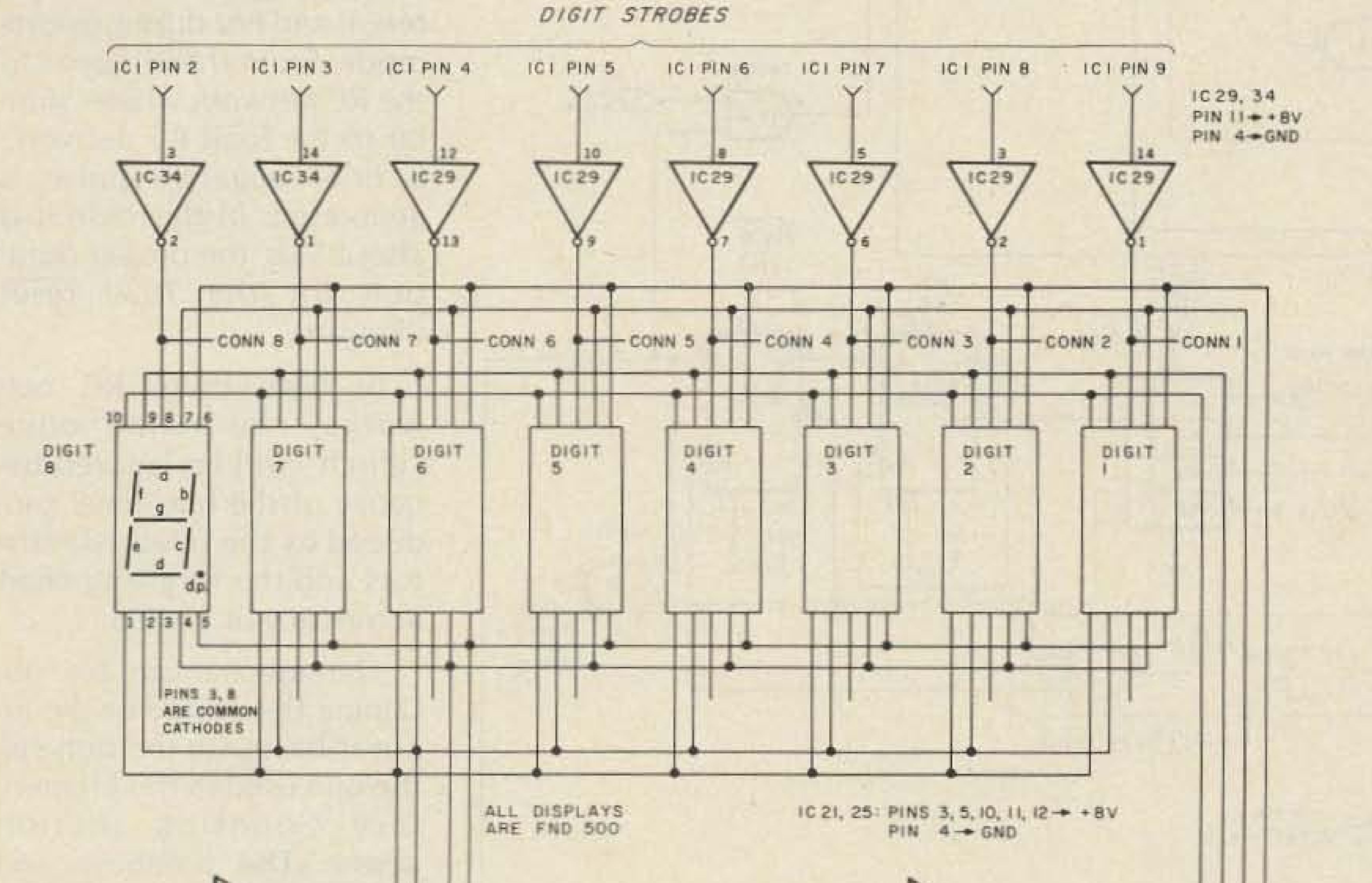

Fig. 9. Eight-digit multiplexed display.

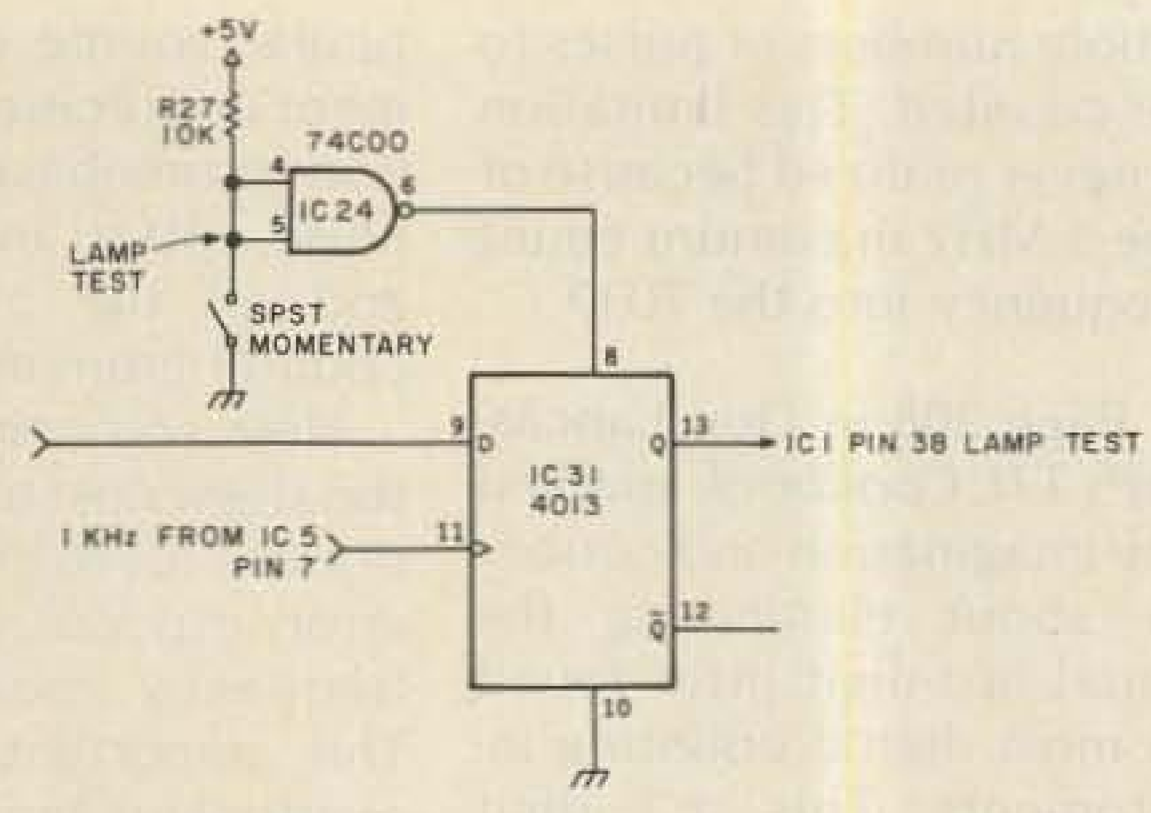

Fig. 10. Overflow lamp-test circuit.

CLOSE. The reset pulse should occur just prior to the start of the OPEN time, at the end of CLOSE time. We have to ensure that the 7030 is undisturbed for the entire prescribed interval, or the display will not be valid.

The load/update pulse is derived economically from the falling edge of the timebase Q_2 output of IC13 at pin 5. This signal is capacitively coupled through the parallel combination of C6 and C7 to the resistor network of R6 and R7. Normally held at +4 volts, the junction of all these components will dip low on the falling edge of the timebase. This "down" time is determined by the RC time constant of $C_6 + C_7$ (capacitive values add in parallel connections) and R_6/R_7. This is close to 15 µs for the values shown. The 7030 needs a load pulse of at least 12 µs to allow for internal settling.

The $\overline{\text{reset}}$ pulse is slightly more trouble. It cannot be taken directly from the rising edge of the count interval because that would result in a reset pulse occurring within the counting interval, destroying any hope of an accurate count. Not wanting to infringe on that accuracy, the $\overline{\text{reset}}$ has to occur *after* the load pulse, or the counter would display only zeros!

After some trial and error (mostly error), I discovered a combination that provides the properly-timed pulse. The successful circuit is shown in Fig. 11(b). Half of IC15 is used. The raw timebase frequency (before division by two) from the clock input (pin 11) of IC13 is enabled for the "no count" time by IC13 pin 6, which, of course, is the out-of-phase (opposite polarity) synchronized timebase. The resulting output at IC15 pin 11 is the inverse of what is needed, so it is inverted by the next NAND at pin 8. Events mode disables the $\overline{\text{reset}}$ by forcing a high output with a low at pin 9. The output at pin 8 is the needed high-to-low transition that occurs only during the no-count interval and not during events mode. From there it goes to the RC network where, similar to the $\overline{\text{load}}$ RC network, a brief negative pulse is generated. In this case it is about 5 µs, the proper duration for the 7030 $\overline{\text{reset}}$ circuitry.

In both these RC networks, the rising edge "glitch" will be ignored because of the bias level produced by the selected resistors and the forgiving characteristics of CMOS.

The mechanism for obtaining the period of the input is basically the same as the one used in the Elementary Counting section above. The timebase and the input signal are swapped with portions of a 74C157 doing the traffic direction. The input signals are first sent through IC7, a 74C90, for division by ten, and then through half of IC13 for an additional division by two. This gives a signal, now divided by twenty, that will become the "timebase" in period measurement. The P (for Period) se-

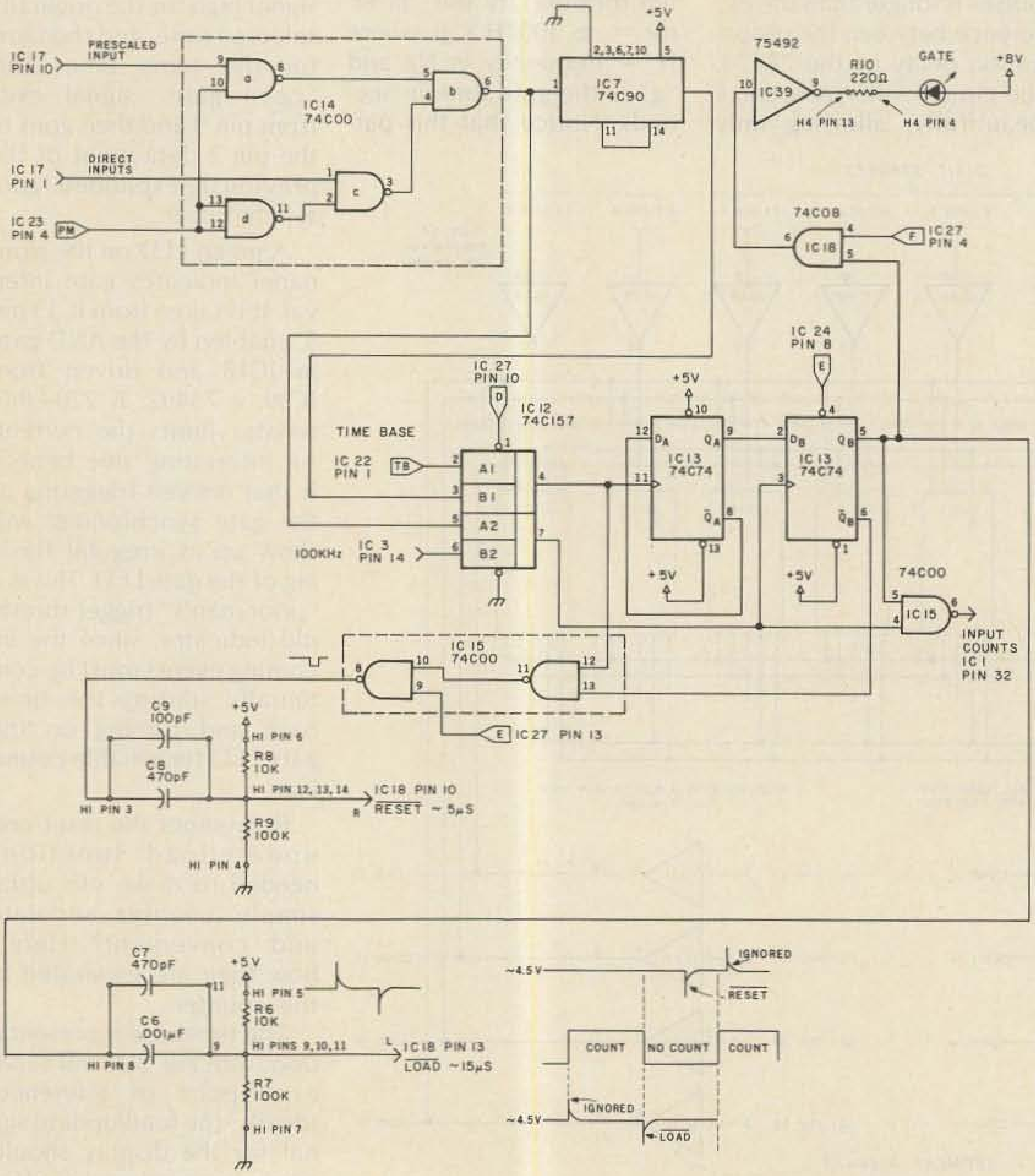

Fig. 11(a). Gate controls.

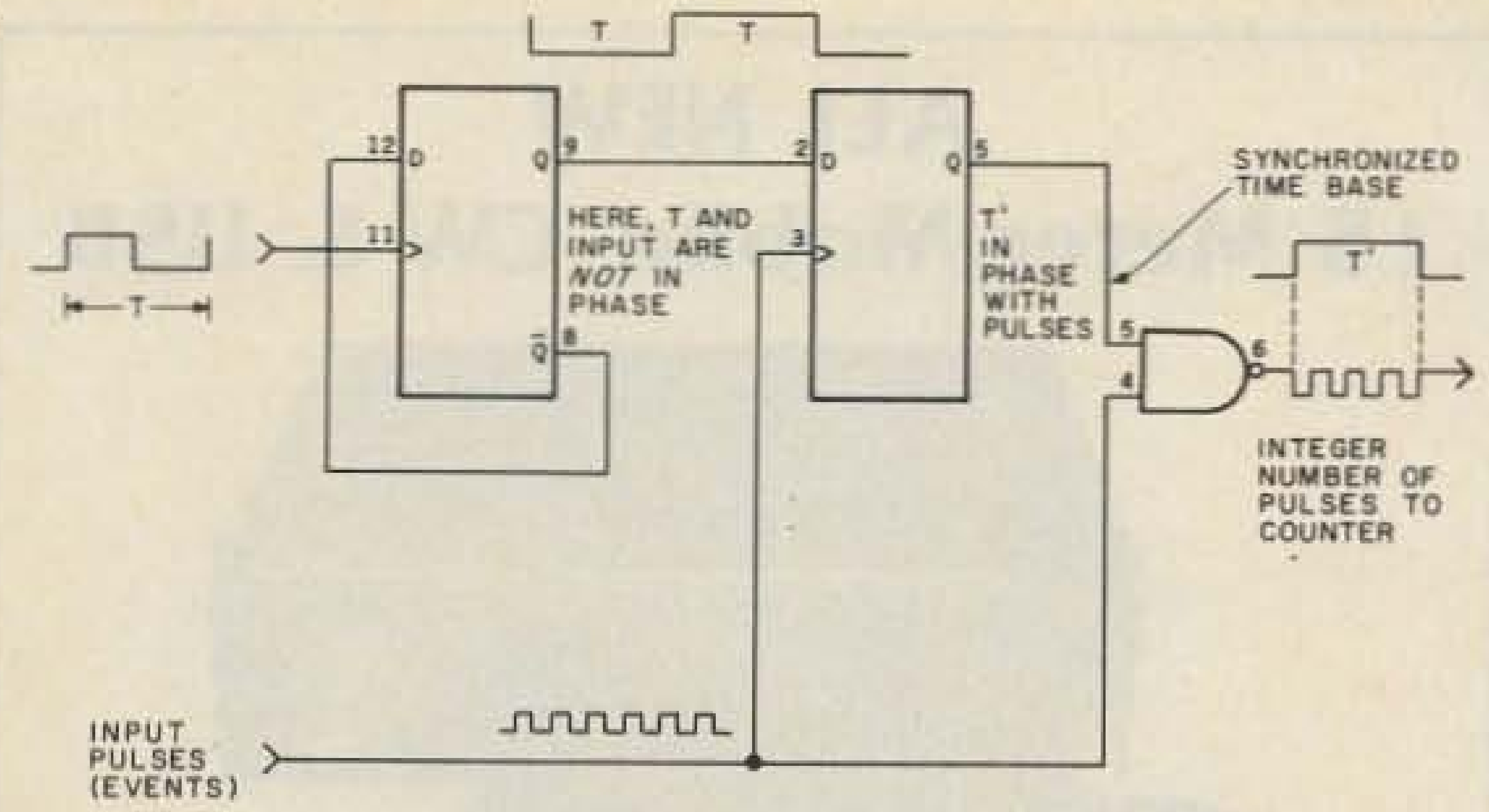

Fig. 11(b). Gate synchronizer.

lect line properly routes the B inputs of IC12 to accomplish this. When P is low, however, the A signals are digitally massaged to provide the normal frequency display.

Now that our period function has a timebase, the counter needs a source of pulses to count. A 50-kHz signal is picked off the TBOD chain. This frequency, when gated by a signal divided by twenty, gives a readout in microseconds. The $\overline{\text{load}}$ and $\overline{\text{resets}}$ remain the same as before.

The reason for prescaling the "unknown" low frequency is to reduce effects of noise on the input signal. Because low-frequency signals for which the period mode is used often are slow-rising leisurely functions of time, noise on the signal can cause false, premature, or late triggering of the counter. The random nature of noise can be put to use in the prescaling, or averaging, of the input signal. The uncertainty in triggering is reduced by the corresponding scale factor. This counter uses a factor of 20 for period averaging as a reasonable compromise between extreme precision and convenient utility.

The price to be paid for the averaging improvement is a correspondingly longer interval before the calculated period display is updated. For instance, if the period of a 20-Hz signal was directly measured, the updates would arrive every .05 seconds. Prescaling by 20 would divide the noise error by 20, but the display would be updated only every second (20 times .05 = 1 second). If your requirements dictate greater period averaging factors, more 74C90 dividers could readily be inserted into the period-measurement circuitry, with another pulse source chosen to give a display of the resulting period in µsec.

The events-mode operation of the counter only requires the withholding of the timebase and the subsequent resets of the counter. By having manual as well as automatic controls over resets and display updates in the counter, elapsed time/event functions are defined.

You're still here? Great! Next month I will cover the rest of the Universal Counter. We'll look at the front-panel design which features push-buttons rather than rotary-style switches. The counter's front end, decimal point, and power supply circuitry are waiting, too. Rounding out the story will be a discussion of construction techniques. Just why did I wire-wrap my counter? Read next month's article and find out. ■

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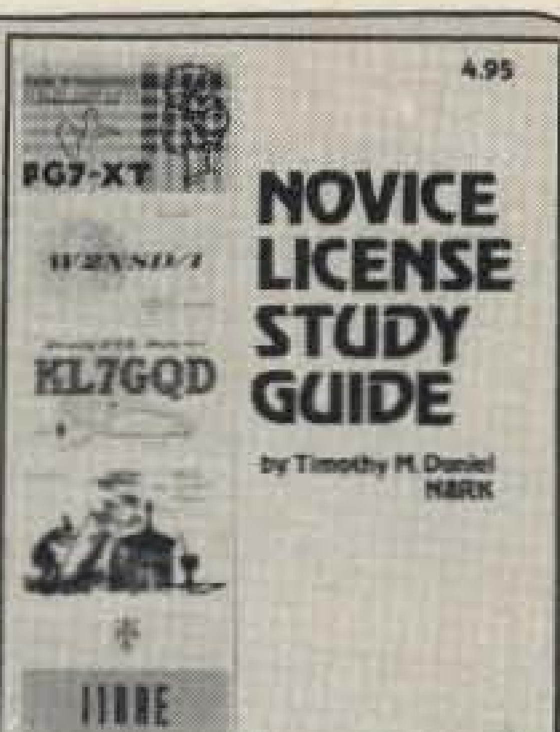

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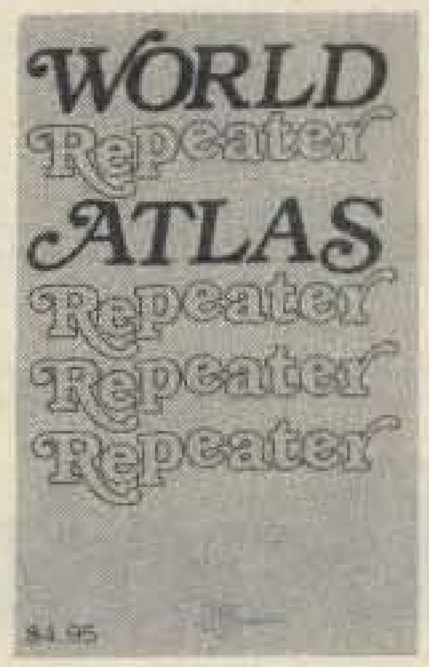

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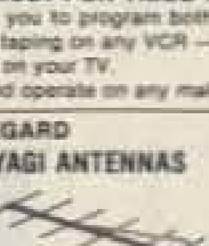

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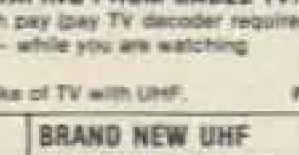

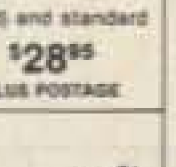

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TOP QUALITY NO SECONDS

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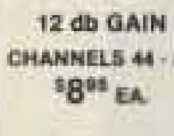

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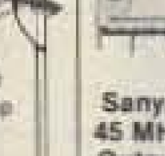

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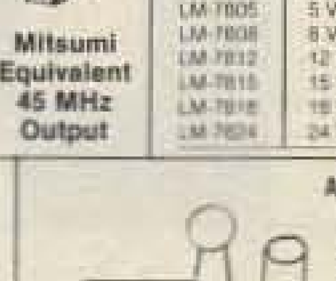

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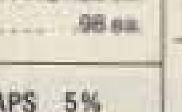

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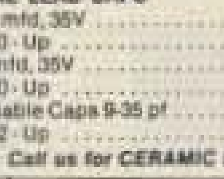

TUSA MAX-3

Low Loss 3.5-4 db, Low VSWR
Waterproof Housing **\$2.49 ea.**

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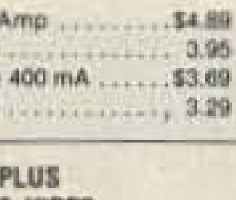
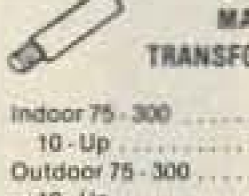


Hook up sheet included
\$6.49 ea.

CABLE CONNECTOR



F-59 Male connector for RG-59/U cable. Complete with ferrule. Mates with female "F" connectors.

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HAM RADIO'S GOLDEN YEARS

When were ham radio's golden years? It probably all depends on when you first entered the hobby. My golden years were the 1960s: Benton Harbor lunch boxes, Allied catalogues, New York's radio row and the introduction of transistors. For others, the 60s may have meant incentive licensing, a declining ham population, and the first CBers hitting our bands. For me, however, those years will always be the sweetest.

This month's column is all about ham radio's golden years. I hope you'll find a question or two about your era.

ELEMENT 1—CROSSWORD PUZZLE
(Illustration 1)

Across

1) Old top ticket
7) Iran prefix
9) A traditional ham
12) A Zepp, for instance
14) Big time for traffic
16) Not ac (abbr.)
17) First tube
21) VHF rice container
23) Slang for 17 across
26) Iceland prefix
27) Amateur practice

Down

1) Commission before the FCC (2 words)
2) Plate current (abbr.)
3) No danger
4) Morse greeting (abbr.)
5) A satellite signal path
6) Bug maker
8) Old modulation (abbr.)
10) Signal way
11) Operates
13) Spark discharge
15) Ireland prefix
16) Morse slash
18) Contest double-copy
19) Finland prefix
20) Japan prefix
22) New electronics type (abbr.)
24) Transceiver
25) Morse double dash

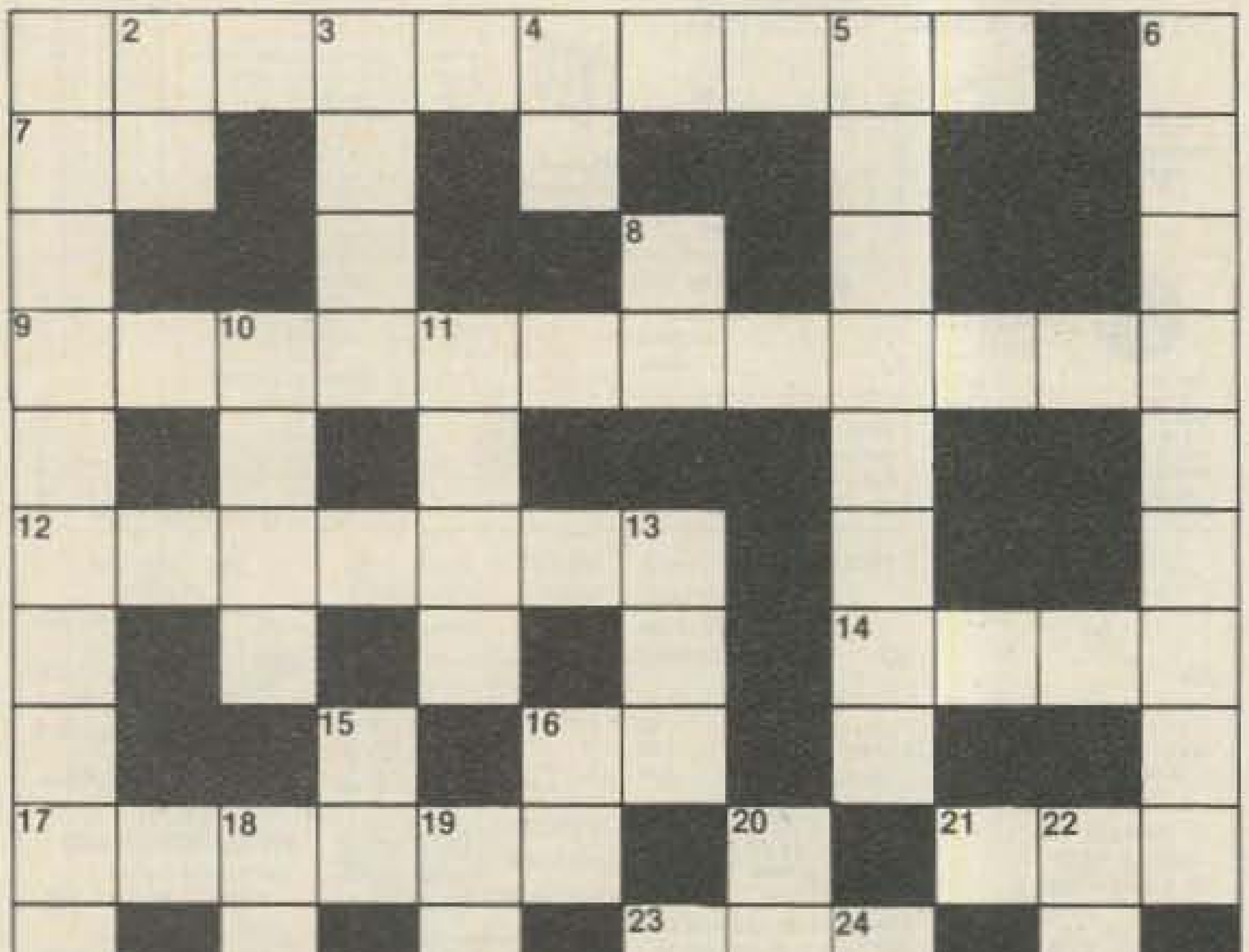


Illustration 1.

ELEMENT 2—MULTIPLE CHOICE

1) In 1958, Lee De Forest was asked by a reporter what would have been his reaction if transistors had suddenly been developed during the early years of the century. What did De Forest reply?
1. "I would have fainted."
2. "I would have invented the printed circuit board."
3. "I might never have invented the audion."
4. "Weren't they?"

2) What news did thousands of amateurs hear over their wireless sets on the night of November 8, 1916?
1. News of the formation of the ARRL
2. The first election night broadcast
3. News of the sinking of the *Titanic*
4. Word of the first transatlantic QSO

3) Remember those Fort Orange Radio ads that appeared in *QST* in the 1950s? In the ad, what was flying out the end of Uncle Dave's cigar?
1. Lightning bolts
2. Smoke
3. Radios
4. Money

4) Which year saw the introduction of the Hallicrafters SX-71?
1. 1920
2. 1934
3. 1950
4. 1958

5) In the introduction, I mentioned New York's "radio row." What stands on this site today?
1. The new Madison Square Garden
2. The Metropolitan Opera House
3. Shea Stadium
4. The World Trade Center

ELEMENT 3—TRUE-FALSE

	True	False
1) Howard Hughes was a ham.	______	______
2) The man who played Andy, on radio's "Amos 'n' Andy," was a ham.	______	______
3) The Conditional class license was phased out beginning in 1976.	______	______
4) In 1951, the US government forbade the ARRL to send its publications to the Soviet Union.	______	______
5) In its advertisements for the KWS-1, Collins claimed that SSB signals were "distortion free."	______	______
6) The 1947 WARC was held in New Jersey.	______	______
7) Novices have never had phone privileges.	______	______
8) The Heath Company got its start with "build-them-yourself" airplane kits.	______	______
9) NBVM was a popular operating mode in the 1930s.	______	______
10) A "Model 15" was a type of SSTV gear.	______	______

ELEMENT 4—SCRAMBLED WORDS

Unscramble these names of 1950s ham equipment manufacturers.

SNOHJNO	LINLCOS	IONTANLA	LAMCE
NORAS	SNEOGT	HTAIKHTI	

THE ANSWERS

Element 1:
See Illustration 1A.

Element 2:
1—3 That Lee. What a wit.
2—2 The only problem was, the broadcast proclaimed Charles

Evans Hughes—instead of Woodrow Wilson—as the winner. Oh, well—guess they had to wait for the invention of the computer.

3—1 Forming the phrase "calling CQ." Love them rf cigars.

4—3 A staple for many Novices in the 1960s.

5—4 And I still feel bitter.

Element 3:

1—True. Yes, indeed. His call was 5CY.

2—False. Freeman Gosden, "Amos," was the ham.

3—True. To the dismay of cheats everywhere.

4—True. Wouldn't want the Russkies to get any of the League's precious secrets, would you?

5—True. No consumer advocates back then.

6—True. Atlantic City, to be precise.

7—False. They must have had the privileges back in the 1960s, or a lot of my friends were breaking the law.

8—True. Troubleshooting section: Plane flies backwards. Check motor polarity.

9—False. Baldwin's folly.

10—False. Better check "RTTY Loop."

Element 4:

JOHNSON, SONAR, COLLINS, GONSET, NATIONAL, HEATHKIT, ELMAC.

F	I	R	S	T	G	R	A	D	E		V
E	P		A		A			O			I
D			F			A		W			B
E	X	P	E	R	I	M	E	N	T	E	R
R		A		U				L			O
A	N	T	E	N	N	A		I			P
L		H		S		R		N	O	E	L
R			E		D	C		K			E
A	U	D	I	O	N		J		B	O	X
D		U		H		J	A	R		P	
I		P			B			I		T	F
O	P	E	R	A	T	I	N	G		O	

Illustration 1A.

SCORING

Element 1:

Twenty-five points for the completed puzzle, or one-half point for each question correctly answered.

Element 2:

Five points for each correct answer.

Element 3:

Two and one-half points for each correct answer.

Element 4:

Three and one-half points for each correct answer.

How's your memory?

1-20 points—Erased
21-40 points—Faulty
41-60 points—16K
61-80 points—Sharp
81-100+ points—Golden Oldies!

FUN! MAILBOX

I feel I must point out an error in the True-False section of the May column. The Hazel episode that dealt with TVI showed a pretty good example of misunderstanding and jumping to conclusions. Mr. Baxter thought his TVI was caused by the ham—because his son was visiting the neighbor ham at the same time. Mr. Baxter also injured his back playing golf and was using a heating pad while he was trying to watch TV. At the end of the program an engineer from the electric company tracked down the TVI with an RDF unit. The heating pad had a bad thermostat and this was the cause.

Daniel L. Quigg WD4IRK
Lexington KY

You're absolutely correct. I'd like to say that I slipped in that question just to keep my readers on their toes, but I didn't. I goofed. For penance, I had myself strapped into a chair and forced to watch that episode 50 times on my VCR. As Hazel would say, "What a doozey!"—J. E.

READER'S CORNER

Well, I finally got around to checking the responses to February's Reader's Corner. The Magic Square's solution, not surprisingly, is "73." The following readers correctly guessed the answer: Frank Waldhaus WB1CSE, Dick Milewski N2ABA, Edward Baker N3CLP, Jim Higgens KB3PU, Bernie Lavezza N4FOC, Jim Morris WA6KGB, David Fox KA8CXQ, John Hufschmid KI9J, Dave Karr KA9FUR, Wayne Schuler AI9Q, I. Zender W9IQK, and Jerry Moore W0HMA.

Late arrival: Found one solution to January's DX puzzle—J. Edgar McDermott AH2K.

LETTERS

VIVA "QLF, OM"

I've been receiving *73* for 3 months now. So far, so good. I'm surprised to see someone agrees with my philosophies so extensively. Keep up the good work.

As far as getting more youngsters into ham radio goes, I think the key is reaching out more on their level: demonstrations in science classes and public places; offering classes in ham radio for beginners (WA3WKA and I have had several successful "graduates"); and finally just showing ourselves in a good light all the way around. And, of course, once the spark takes, it must be kindled with good examples from the old-timers. One of the reasons for some of the bad operating practices today is that the old-timers can't or won't put their feet down and correct a beginner's mistakes. (Is letting him develop into a lid doing him a favor? Viva QLF!)

Larry Gotts WA3UKC
Pleasant Mount PA

P.S. I'd sure like to catch you on the air, or for an eyeball sometime, Wayne. We'd have a lot to rag chew about!

Larry, you're right about getting teenagers interested. If they don't see amateur radio working, how can they get interested in it? Look for me around the low end of 20m phone. That's where I hang out when I get on.—Wayne.

RIGHT ON, WAYNE!

I have always wanted to drop you a line; renewal time seems to be a good time to do so. I have been following your articles, magazines, and other achievements since I was first licensed in 1959. You have not always been in the forefront of popularity, but you have usually been "right," and I have enjoyed all of it. I am a member of the ARRL and therefore feel that I am entitled to say whatever I wish. All organizations I have ever been associated with have benefited from criticism, and the ARRL should be no exception. I sometimes tire of those who at-tack you or *73 Magazine* because you choose to change.

Change is usually for the better. I joined the ranks of amateurs in the middle of the furor over AM vs. SSB, a change for the better. The same happened on 6 and 2 meters, where I worked AM. Now we have a nice proliferation of repeaters. I remember the huge rock-mounted transmitters and now you could hold the modern equivalent in one hand. Drive on, Wayne! There are many loyal supporters in your "silent majority." You do grace the bands with your presence, and it is a pleasure to work you.

Mike Davis K4WYC
Durham NC

By golly, Mike, it has been a long time. Yep, I generated a lot of unfans when I pushed for sideband. More when I pushed for solid state in the 60s. Then a whole new bunch hated me when I pushed for FM and repeaters on VHF. I don't seem to be able to shut up and leave things alone. Oh, I grumble and beef when the FCC does something silly or bad for us... ditto when the ARRL does it... or Bash. But you know, there are a lot of hams... a whole lot... who agree about the FCC, agree about Bash... and then get furious when I mention the ARRL. No, you can't be honest about them or try to put 'em into perspective. It's like religion and politics, a matter of emotion and to hell with facts. Guess I'll never learn to keep my mouth shut or my typewriter turned off. Thanks for sticking with me for so long, Mike.—Wayne.

IDIOTS?

After years of being interested in ham radio from afar, last year I got with it and got my license. I find the technology fascinating, but it wasn't long until I became disenchanted with the content of the QSOs on the air. Banal ramblings which go on and on and on yet say nothing... excruciatingly redundant callsign exchanges with every transmission... and, of course, the very prevalent "CB syndrome," which manifests its presence with seemingly uncontrollable overmodulation and heavy breathing in the mike. Idiots. I thought that there was intelligent life on the ham bands. There are exceptions, of course, but it seems like hardly anyone wants to discuss anything of any consequence. Has it always been like this?

Keith Orosz N6FQE
Seal Beach CA

Intelligent life on the ham bands? Surely you are jesting! No, as a matter of fact, though it is hidden from casual detection, it is there. But I have some bad news for you... it will rarely show its head. The fact is that before you will discover intelligence, you have to exhibit it. I realize that this is a painful fact to face. Keith, I've been hamming for a long time now and I manage to find interesting people to talk with. Often. Oh, I agree that there are some hams who are almost without redeeming qualities. There are some who are so afraid of talking that the best you can get is an antenna discussion, which is not one of my favorite topics. Keith... if you look hard and work out ways of getting through the layer of insulation, you'll find absolutely fascinating people who will enjoy talking with you. There are a thousand things I enjoy talking about. I give hints about some of them in my editorials. I'm alive with information, ideas, interesting experiences... and yet hundreds... perhaps thousands... of hams have contacted me without ever giving either of us a chance to enjoy the contact. Thousands have contacted me and had a contact to remember. It's all in you, Keith, not us.—Wayne.

MORE ABOUT CHARLIE

Upon returning from a meeting of the Montserrat Amateur Radio Society last night, I opened your magazine (which had been given to me that day) and I found your article "Messages from Station Charlie."

During the war, I was a member of the Women's Transport Service, F.A.N.Y., and I was stationed both at the camp shown in the photograph and also at another nearby station. I was a W.T. operator. I was able to recognize the faces in the picture, but unfortunately I was unable to put names to the faces.

It may interest you to know that the Special Forces Association Signals Section is still very much a group, having a newsletter published every four months and meetings twice yearly. Several of the members are still operating.

I will be writing to the Association to tell them all about the article. I thank you for helping me to contact the people mentioned in the article.

Ursula M. Sadler
Montserrat, West Indies

FIRST-CLASS TAPES

I passed my amateur Extra exam last week in Atlanta and would like to extend my thanks for your first-class code practice tapes. My only complaint is that the text proved to be so much easier than the random groups on the tape that I could have gone a couple of weeks earlier! Hi.

Alan P. Biddle WA4SCA
Huntsville AL

Sure, Alan, you could have gone earlier... but I wanted you to be so good at the code that you would not freeze up when faced with the test. By making you able to copy far faster than needed, you probably found yourself feeling confident when the code test started... and able to go right on through it with no problem. Remember that with the old-style code test, you had to copy only one minute solid of that test, but with the new one if you don't get the whole test solid, you can get tripped up by one of the questions. No, you want to have that code sound slow when you sit down to copy it and that's what my tape does for you.—Wayne.

CRANKY CURMUDGEONS?

As a new ham, here are a few observations on this wonderful world of amateur radio. But first: I am retired, having been a professional pilot and a businessman for, well, a long time.

I received my Novice license in November, 1981, my Technician this past February, and plan the General soon. Ham radio was a natural selection since my fascination with electronic things began with watching the old Collins airborne transceivers whir and grind to produce some new frequency that would let you talk to where you were going. That was especially nice if you had been flying over water for about 8 hours. But enough of that or shortly I'll be talking Ford Tri-motors.

So, what is this piercing clarity I propose to offer about amateur radio? First, that I like it very much. The logic of the licensing program (learn and work code as a Novice; upgrade for additional privileges) seems too delicious to have been government-produced. And the things you hear about meeting great people on the air are really true.

But I am dumbfounded at the customer relations to be found in a radio store. Passing the FCC tests is a minor part of becoming a ham. The big thing to learn is how to get along with the omniscient, crotchety people who sell the radios.

Perhaps I can never achieve the stature of these Ancient Icons, but, boy, I really tire of the idiot treatment. And if I am not received as an imbecile, I am labeled an intruder wantonly invading the A.I.'s busy-work-destroying thoughts of dreadful complexity.

I really feel that a person using the simplest sales technique (be cheerful, knowledgeable, helpful) could walk off with the business.

These observations don't emanate from just one store. They include everybody. Wayne, you have sagely said that amateur radio needs new blood. I think the first new blood to hit the sales end of hamming will blow the curmudgeon contingent right out of the water. I would not weep.

But I love the rest of it. I really do. I guess that's really why I wrote this letter.

R. J. Richardson KA6RJJ
Burbank CA

Hey, is R. J. right about this? I have been so well received in the ham stores I've visited that I am not a good judge of what the newcomer faces. How about some letters from readers which might help ham dealers understand what is going on... and how to fix it?—Wayne.

RAG-CHEW AWARDS

After having read and appreciated your editorials for several years, two ideas come to mind for your or anyone's consideration.

First off, why doesn't someone establish an award for DX rag chewing? I can't do it myself. Say the minimum qualifications to be a half-hour QSO on phone or SSTV or fifteen minutes on CW or RTTY with one ham from each of 100 countries. Additional endorsements could be for conversing with a second ham in each of the same 100 countries or for each of the 100 QSOs to be in the DX ham's native tongue. The certificate awarded should be suitable for the effort involved; 25-50 hours as a minimum amount of time requires brass plaques on walnut or similar cetificates.

Second, I strongly suspect that there is a huge demand for radios with an amateur appearance, especially in the 2-meter FM field. By amateur appearance, I mean big, bulky, ugly boat anchors with a myriad of gauges, knobs, levers, handles, and hasps rather than miraculous, neat little units which could fit in a shirt pocket. I find nothing wrong with the neat units on the market, but somehow I think that non-hams expect us to show up with boat anchors. Recently, at an emergency communications center, after just seeing the neat little boxes, a person in control referred to the hams in attendance as a group of CBers. Major bloodshed was averted only by heroic efforts.

So maybe I'll buy a big, ugly, military surplus chassis and stuff it with a 2-meter rig, power supply, thermos for coffee, and a cooler for the beer. I'll hang some gauges on it and be prepared for the next emergency.

Chris Creasy III WB3AAM
Catawissa PA

Chris, I used to have an award for long-winded folk like me. It was the Real Rag Chewers Club (RRCC) and one had to talk with a station for at least six hours to get the award. Several hundred were awarded.—Wayne.

BANGING CODE

First off—keep gunning! Amateur radio needs awakening if it's to continue as a living, growing service.

I agree with you about the relaxed technical standards needed for a given license. I am not a ham—I have an A.A.S. in electronics and am taking a General class study class that the Kalamazoo amateur club offers. I was totally surprised at how little I had to know about electronics to pass a test! The code should be an added privilege (frequencies w/ license grade)—not a requirement for a license. Most newer hams are more interested in interfacing a computer to their rigs, ATV, microwaves, etc., than banging code. I'm having trouble learning the code and may have to settle for a Technician's license, which would be OK since my main interest is with the possibilities available to me at VHF and above.

Once again, Wayne, keep rattling the cage, and let's both hope the Amateur Radio Service lasts long enough for the old blood to pass on and the newer aspirations of innovation come into control to "pressure" the FCC into awakening.

John E. Allgaier, Jr.
Kalamazoo MI

YES TO CODE

I think you are wrong about a code-free test for a ham ticket.

I am 75 years old and I passed the code test 3 years ago with no problem. The main reason you want to get more hams on the air is to sell more of your magazines and books.

The biggest reason why more people don't go ham, is the cost.

Instead of all the adds for TV satellite material, print more plans for low-cost transmitters and receivers for beginners.

I have had a lot of young people talk to me about ham radio and when you tell them what it costs to start, they lose interest.

I have contacted most of the European countries with only 30 Watts output.

I am sure some of the companies could put out low-priced sets for people who can't afford $700 to $2,000.

Yes, most of the people who take the Bash Test pass. But 2 days after the test, they couldn't answer one simple question on theory.

What we need is a way to get young people interested.

I am willing to give free code lessons and simple theory to anyone in my area.

If other hams would do this, I am sure it would work. Keep the CW.

R. Spencer KA1CEV
Franklin MA

So the whole thing is a con to sell magazines, eh? You sure are a nasty one, Spencer. And with HTs costing a couple hundred dollars, I'm not as convinced as you about money being any serious problem. Indeed, it has been my experience that kids seem to have little trouble getting the money they need for drugs and cars, so perhaps ham gear would not be that difficult if they were interested. My high school informants are adamant when they say that it is the code which is turning the kids off. They want to know why they should learn the code to operate phone, RTTY, slow scan, and so on. I don't have a rational answer for them. And I note that the FCC seems to be going in the same direction, with a dropping of the code requirement for the Tech ticket a good bet. By the way, Spencer, a couple of companies did put out low-cost low-band rigs and no one would buy them.—Wayne.

CONTESTS

Robert Baker WB2GFE
15 Windsor Dr.
Atco NJ 08004

NEW JERSEY QSO PARTY

2000 GMT August 14 to
0700 GMT August 15
1300 GMT August 15 to
0200 GMT August 16

The Englewood ARA invites all amateurs worldwide to participate in the 23rd annual NJ QSO Party. Phone and CW are considered the same contest. A station may be contacted once on each band. Phone and CW are considered separate "bands," but CW contacts may not be made in phone band segments. NJ stations may work other NJ stations, and NJ stations are requested to identify themselves as "DE NJ".

EXCHANGE:

QSO number, RS(T), and ARRL section, country, or NJ county.

FREQUENCIES:

1810, 3535, 3900, 7035, 7135, 7235, 14035, 14280, 21100, 21355, 28100, and 28610. Suggest phone activity on the even hours; 15 meters on the odd hours (1500 to 2100 GMT); 160 meters at 0500 GMT.

SCORING:

Out-of-state stations multiply

CALENDAR

Aug 7-8	ARRL UHF Contest
Aug 14-15	European DX Contest—CW
Aug 14-16	New Jersey QSO Party
Aug 21-22	SARTG Worldwide RTTY Contest
Aug 21-22	*A5 Magazine* FSTV UHF Contest
Aug 28-29	Occupation Contest
Aug 28-29	Ohio QSO Party
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 18-20	Washington State 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	BCOA Jamboree-on-the-Air
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

GEARVAKf — BULLETIN—

NEWSLETTER CONTEST WINNER

For more than 22 years, the *GEARVAKf Bulletin* has inflicted its own peculiar brand of madness on the world of amateur radio newsletter publishing. It's time the *Bulletin* received recognition for its many journalistic achievements.

Founded sometime in the murky past by the very distinguished Dr. Felix R. Onehundredton, GEARVAKf is more properly known as the Greater Enon AmateuRadioVention And Kite fly (the "f" is silent). Depending solely on reader contributions, this august society produces one and sometimes two issues of its amusing *Bulletin* each year.

The *GEARVAKf Bulletin* strives to cover stories which are overlooked or ignored by traditional amateur journals. Two years ago, for instance, the *Bulletin* broke the exclusive story of the raging fire that nearly destroyed the 20-meter band. A follow-up article detailed FCC plans to install a sprinkler system to guard against future conflagrations.

Strong technical content is a hallmark of the *GEARVAKf Bulletin*. The newsletter has published pioneering articles on such diverse subjects as the Exploding Rat Amplifier and the early closing of the 10- and 15-meter bands due to FCC budget cuts. The exploits of researchers such as Dr. Phugoid G. Dutchroll keep GEARVAKf at the cutting edge of technology.

The *Bulletin* frequently publishes the results of GEARVAKf member polls, which are conducted by the GEARVAKf Public Opinion Subcommittee. Members were asked recently, "How do you feel about current issues?" Fully 84% voted "no," with 11% "yes" and 5% "undecided" about current issues. That says it all.

For wackiness above and beyond the call of duty, editor/ringleader K8DMZ and his cronies deserve heartiest applause. Congratulations to our newsletter of the month, the *GEARVAKf Bulletin*.—WB8BTH.

RESULTS

3RD ANNUAL 160-METER SSB CONTEST*
(Claimed Scores Over 100,000)

SINGLE OPERATORS:

Callsign	QTH	Claimed Score
W9RE	IN	371,580
W8LRL	WV	350,700
WB3GCG	MD	322,660
WB8JBM	OH	315,315
W1CF/1	MA	236,280
WD8CRY	MI	234,240
WBØCMM	CO	230,895
KJ9D	IN	184,670
KC8P	MI	169,800
N5IJ	TX	169,650
N8ATR	OH	164,640
K9QLL	IL	160,950
WØCM	KS	147,600
K9RJ	IL	142,500
KB8HW	MI	138,320
N5CG	OK	135,810
W3BGN	PA	135,730
W9DUB	WI	135,660
KC4OV	TN	130,140
K1MNS	NH	120,725
K1LPS	VT	119,610
W4TMR	NC	117,720
KA7BTQ	ID	111,805
KØSTI	SD	109,080
W4VKK	GA	106,020
W2FJ	NJ	104,430
N7DF	UT	103,880
N4IN	FL	101,100

MULTI-OPERATOR:

Callsign	QTH	Claimed Score
W8NGO	MI	273,900
W4CN	KY	238,950
AK2E	NY	224,750
K9ZUH	IN	213,280
K9YUG	IL	152,400
K9ZX	IL	130,560

Full details and final scores will be featured in a future issue of 73. Well over 1,000 stations competed—the best year EVER!

sponsored by *73 Magazine

the number of complete contacts with NJ stations by the number of NJ counties worked (21 maximum). NJ stations count 1 point per W/K/VE/VO QSO and 3 points per DX QSO. Multiply total QSO points by the number of ARRL sections (including NNJ and SNJ; maximum: 74). KP4, KH6, KL7, etc., count as 3-point DX contacts and as section multipliers.

AWARDS:

Certificates will be awarded to the first-place station in each NJ county, ARRL section, and country. In addition, a second-place certificate will be awarded when 4 or more logs are received. Novice and Technician certificates will also be awarded.

ENTRIES:

Logs must show date/time in GMT, band, and emission. Logs must be received not later than September 11th. The first contact for each claimed multiplier must be indicated and numbered and a check list of contacts and multipliers should be included. Multi-operator stations should be noted and calls of participating operators listed. Logs and comments should be sent to: Englewood Amateur Radio Assoc., Inc., Post Office Box 528, Englewood NJ 07631-0528.

A #10 size SASE should be included for results. Stations planning active participation in NJ are requested to advise the EARA by August 1st of their intentions so that they can plan for full coverage from all counties. Portable and mobile operation is encouraged.

EUROPEAN DX CONTEST—CW
Starts: 0000 GMT August 14
Ends: 2400 GMT August 15

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 not more than three periods at any time during the contest. Operating classes include: single-operator, all-band and multi-operator, single-transmitter. Multi-operator, single-transmitter stations are only allowed to change band 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 only be established between a non-European and a European station. Each station can be worked only once per band.

EXCHANGE:

Exchange the usual six-digit number consisting of RST 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, UA9/UAØ. The multiplier on 3.5 MHz may be multiplied by 4, on 4 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 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 is later sent back to a European station. It can only be sent from a non-European station to a European station. The general idea is 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 one-point credit can be claimed for each station reported.

A QTC contains the time, call, and QSO number of the station being reported, e.g., 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 that sent the QTCs.

AWARDS:

Certificates to the highest scorer in each classification in each country, reasonable score provided. Continental leaders will be honored with plaques. Certificates will also be given stations with at least half the score of the continental leader or with at least 250,000 points. The minimum requirements for a certificate or a trophy are 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 you use the log sheets of the DARC or equivalent. 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 September 15th to: DARC DX AWARDS, PO Box 1328, D-895 Kaufbeuren, West 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, 9H1.

A5 MAGAZINE FSTV UHF CONTEST

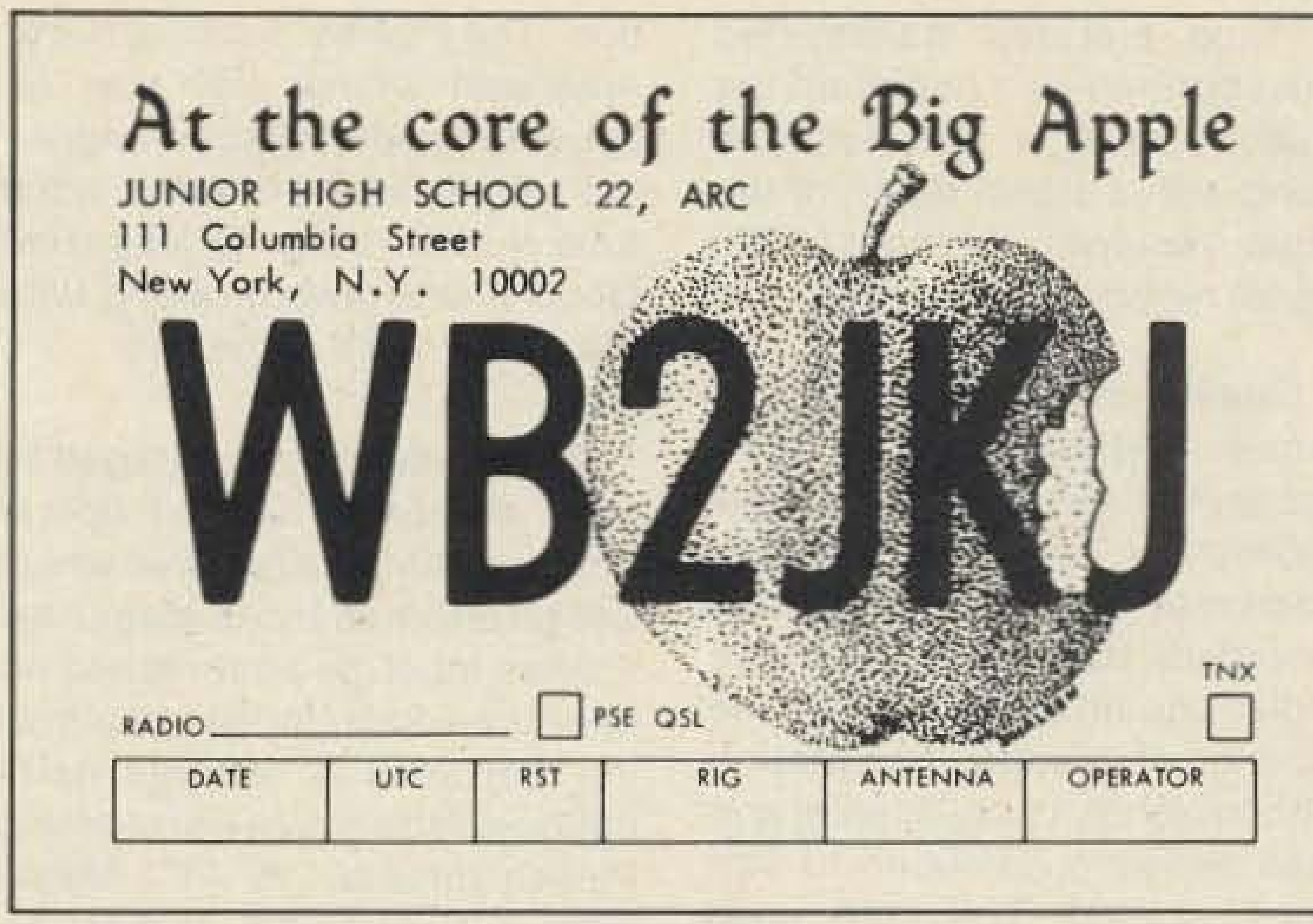
Starts: 1800 EDT August 20
Ends: 1800 EDT August 22

Over $750 worth of prizes will be awarded in the 1982 *A5 Magazine* North American FSTV UHF Contest. This 48-hour ATV contest is designed for the UHF specialized communications operator to work as many FSTV contacts as possible with rewarding bonus multipliers and additions for quality picture transmissions, DX distance accomplishments, and bands utilized. All ATV stations in the United States, Canada, and Mexico are eligible for entry. Even stations without transmit capability can participate utilizing a secondary frequency for voice confirmation of received video. Please note that dates and times are in Eastern Daylight Time (EDT).

Contacts must be made on authorized amateur bands and within power limitations as set forth by the governing agency. Transmission of TV signals in recognized SSB, EME, FM, or satellite portions of the UHF bands will not be recognized and becomes grounds for immediate disqualification of entry. No station may claim another station more than one time per band. Crossband contacts are encouraged and authorized.

Portable, mobile, and airmobile, etc., contacts are allowable as long as verification of location and simplex transmission is used. Contacts via repeaters or any type of relaying device are prohibited. This is not to discourage ATV repeater use, but merely to establish operator and station self-accomplishment. Secondary audio frequencies for signal coordination are recommended, such as 146.43 MHz FM, 7.290 MHz, and 3.990 MHz. Any locally-utilized secondary voice frequency may be used.

For a valid contact to occur, verification must be established by both the receiving and transmitting stations. This can be accomplished by video return, voice communications, hardcopy photography, or lettered QSL. Proof of contact to be included as logbook entry with required information or enclosed photographs to *A5*.



QSL OF THE MONTH: WB2JKJ

Joe Fairclough WB2JKJ had this to say:

I am a Junior High School English teacher and have been since 1968. I have been an amateur operator since 1962.

After several years of using the conventional methods of teaching English and finding they simply do not work on the 7th and 8th graders I'm dealing with, I decided it was time for a change. There had to be a better way. If a child is interested and *wants* to be in school, he will learn.

With the idea of creating interest and excitement, I took the standard English curriculum and revised it all around ham radio. Very basically and briefly, this is what I developed:

1. Teach the children Morse at the beginning of the term and get them to a point at which they can copy their spelling and vocabulary in CW.
2. Use the Novice handbook as the class textbook. Diagram its sentences, examine its parts of speech, etc.
3. Reading assignments from *73*, *QST*, *CQ*, and any other suitable publications.

Our program receives no funds from any government agency or even the school itself. We are totally self-supporting. All our equipment was purchased from the fund-raising efforts of the students and myself. Even down to the postage, it's all done by the kids. It's very difficult to survive this way, but it makes for a great spirit of everyone pulling together, and besides, hams are great people and without them, this wouldn't be possible.

So listen for us on 15. We'll be listening for you.

RESULTS

1982 SSTV CONTEST RESULTS

Activity during this year's SSTV contest was relatively mild, but there were indications of video enthusiasm and acceptance by amateurs on the bands. Slow-scanners were noted on several HF bands, many exchanging reports via color rather than black-and-white SSTV. Quite often, we also noticed contest activity giving way to general-interest SSTV views and idea exchanges. Great! If such interests are sparked and a general attitude of friendship developed, a worthwhile purpose is definitely served. DX signals poured into the US on both 10 and 20 meters during the contest's morning periods, and again during the last hours of each day's operation.

We've received requests for shifting the SSTV contest period from April to January or February (its close proximity to Dayton in April creates a "strain" on contesters). What's your opinion? Another item of interest concerns holding "crossband" SSTV activities between Advanced class and General class SSTVers during the first 15 minutes of each contest hour. Let's hear your opinions either via mail or via the Saturday SSTV net—and soon. Announcement deadlines for the next contest are nigh. Truthfully, we must show more contest participation, gang, or the contest will be doomed to failure. We know many of you operated, but where are those logs?

This year's SSTV contest winner was Mike Di Persio KC2Q, of Bradley Beach NJ. Congratulations, Mike, and enjoy your year's subscription to 73.

Thanks to all for the participation, and we look forward to your support next time. See you on the Saturday SSTV net (1800 UTC, 14,230 kHz).

Dave Ingram K4TWJ
Richard "Brooks" Kendall W1JKF

Video pictures transmitted must contain as a minimum the station callsign and location along with a signal report of the video received. Standard "P" signal reports will be used.

Quality multipliers, DX distance additions, and band usage multipliers will be used as shown later. Standard air or road maps may be used to determine recorded distances. A circle radius should be drawn from the location of the operating station with increments of 25 miles and dots showing locations of stations worked. The map used must be submitted to the *A5 Magazine* contest editor along with all log entry information.

Winners with the highest score in each US call area, Canadian province, or Mexican XE1, XE2, or XE3 areas will receive a free one-year subscription to *A5 Magazine*, a copy of the new ATV book *Everything You Always Wanted To Know About ATV But Were Afraid To Ask*, and a gold Specialized Communications Achievement Award certificate suitable for framing. All entries, regardless of placement, will receive a gold certificate showing participation. The highest-scoring North American winner will also receive a wooden plaque engraving with a large orthodon video tube similar to the *A5 Magazine* Good Image award, along with his photo in *A5 Magazine*.

All entries are encouraged to send photos of station operation and contacts received which will be returned by *A5 Magazine*. Entries must be postmarked no later than September 1st, allowing one week for lettered verifications. All logs will be returned. Please include *A5 ATV Magazine* subscription expiration date information with your entry.

SCORING:

The base points awarded are determined by the type and strength of signal received. Many times on long distance contacts or weak band conditions, only the sync bar level is seen, without a video picture. If indeed verification can be accomplished by both stations on a secondary frequency utilizing the "on-off" method with the receiving station stating the actual "on-off" reception test signals, then low-level points can be achieved. It is to the advantage of both stations to watch the bands or apply more power to obtain a better-quality contact with higher points. Continued quality upgrades, including color reception with sound, enhance higher point totals. In case of better conditions further along in the contest, previous claimed contacts may be erased and upgraded if desired.

FSTV UHF CONTEST SCORING

Base Point Table

Points	Contact Type
1	1-way, verified sync or audio tone bar display
2	2-way, verified sync or audio tone bar display
3	1-way, audio sound detected only (subcarrier or on-carrier)
6	2-way, audio sound detected only (subcarrier or on-carrier)
10	1-way, video picture (b&w) detected
15	1-way, video picture (b&w) detected with sound
20	2-way, video picture (b&w) detected
30	2-way, video picture (b&w) detected with sound
40	1-way, color picture detected
45	1-way, color picture and sound detected
80	2-way, color picture detected
85	2-way, color picture with sound

Picture Quality Multipliers
(Base point times P signal quality level)
Base times 1 = P-0 to P-1 picture
Not usable, lost in noise, limited use
Base times 2 = P-2 picture
Passable picture, high noise level
Base times 3 = P-3 picture
Fair picture, noticeable noise
Base times 4 = P-4 picture
Good picture, slight noise visible
Base times 5 = P-5 picture
Excellent, closed circuit, no noise visible

DX Distance Addition
(Base point times P-signal quality multiplier plus DX points)
Note: Distance figured in miles and rounded to nearest 25-mile marker. Plus 25 points for 25 miles, 50 points for 50 miles, 75 points for 75 miles, etc.

Band Used Multipliers
(Base times P-signal multiplier plus DX times band used)
1200 MHz = times 2
2300 MHz = times 3
Higher frequencies = times 4

OHIO QSO PARTY
Starts: 0000 GMT August 28
Ends: 2400 GMT August 29

Sponsored by the Cuyahoga Falls Amateur Radio Club, the contest is open to all radio amateurs worldwide.

EXCHANGE:

RS(T) and ARRL section, DXCC country, or Ohio county.

SCORING:

Score 2 points for each contact with an Ohio station. Contacts with a Falls member will be worth 10 points and contacts with W8VPV, the club station, will count 25 points. Outside Ohio, multiply your total QSO points by the number of Ohio counties worked on all bands. Ohio stations will score 5 points for out-of-state contacts plus the member and club station bonuses. Multiply your QSO point total by the sum of counties (max.: 88), ARRL sections (max.: 74), and DXCC countries on each band. Phone and CW are considered two bands.

AWARDS:

Plaques to the top station in Ohio and outside Ohio. Certificates to the top station in each ARRL section, Ohio county, and DXCC country. All awards will be made out to the station call on the entry.

ENTRIES:

Each log must show the date/time in GMT, band and mode, and the complete exchange. A copy of the official log sheet and reporting form are available from the club by sending an SASE. Dupe sheets must be completed for any stations with more than 200 contacts. Some form of summary sheet showing the scoring and usual signed declaration are also requested. Send a large SASE for a copy of the results. Deadline for logs is Sept. 29th. All entries and requests for forms/logs should be addressed to: The Cuyahoga Falls ARC, PO Box 6, Cuyahoga Falls OH 44222.

OCCUPATION CONTEST
Starts: 1800 GMT August 28
Ends: 2400 GMT August 29

The Radio Association of Erie PA is sponsoring their second annual contest. The contest is open to all amateur radio operators.

EXCHANGE:

RS(T); occupation; and state, province, or country. Please try to keep occupations in general fields such as engineer, technician, machinist, salesman, etc.

FREQUENCIES:

CW—50 kHz from the bottom of the ham bands. Phone—50 kHz from the top of the ham bands. Repeater contacts are not permitted.

SCORING:

Count 1 point per QSO, with multipliers determined by the number of similar occupations worked. One multiplier point is given for every 3 similar occupations. Final score is the product of the QSO points times the total multiplier.

AWARDS:

A plaque will be given to the top-scoring station. Certificates for the top stations in each state, province, and country.

ENTRIES:

The mailing deadline for logs is Oct. 1st. They are to be sent to: Chris Robson KB3A, 6950 Kreider Rd., Fairview PA 16415.

HAM HELP

I would like to know if the speaker-microphone SMC-24 is available for the Kenwood TR-2400 2-meter HT from a commercial distributor or an individual.

Stephen J. O'Malley N2CLE
35-54 169 Street
Flushing NY 11358

I am looking for any information on the Bendix Aviation Corp. Model 2V13E 450-MHz FM mobile radio—particularly the manual and schematic.

Michael Bilow N1BEE
Forty Plantations
Cranston RI 02920

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A3 3 Element Triband Beam	$167.00
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A744 7 & 10 MHz Add On for A4	$55.00
AV3 3 Band Vertical 10-20m	$41.00
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AV5 5 Band Vertical 10-80m	$88.00
R3 14.21.28 MHz Ringo	$204.00
32-19 Boomer 19 Element 2m	$75.00
214B Jr. Boomer 14 Element 2m	$61.00
A147-11 2m 11 Element Antenna	$34.00
A147-4 2M 4 Element Antenna	$23.00
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A144-10T 145 MHz 10 Element	$41.00
A432-20T 432 MHz 20 Element	$41.00
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SB25G Short Base for 25G	$16.50
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AS25G Accessory Shelf	$9.50
HB25AG 14" House Bracket	$14.50
BPC25G Cement Base Plate	$32.00
BAS25G Short top section w/acc. shelf	$36.00
M200 16 gauge, 10 ft. 2" O.D. Mast	$19.50
M200H 1/8" wall, 10 ft. 2" O.D. Mast	$36.00

Freight prepaid on Fold-over towers. Prices 10% higher west of Rocky Mts.

MINI-PRODUCTS

HQ-1 Mini-Quad 6/10/15/20m Antenna	$129.95
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RK-3 3rd Element Add-on for B-24. Improves 10-20m	$67.00
C-4 Mini-Vertical 6/10/15/20m	$59.00

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SF-2 5/8 Wave, 2 Meter Antenna		$9.00
HOT Hustloff Mt. with Swivel ball		$14.00
G6-144B 2M Colinear, fixed Station, 6db		$68.00
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TH7DX Thunderbird, 7 Element	$336.00
392S TH6DXX Conversion Kit to TH7DX	$135.00
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155BAS 5 Element 15m "Long-John"	$161.00
205BAS 5 Element 20m "Long-John"	$269.00
14AVQ/WBS 10-40m Vertical	$49.95
18AVT/WBS 10-80m Vertical	$87.50
V-2S Colinear Gain Vertical 138-174 MHz	$33.75
BN-86 Ferrite Balun, 10-80 meters	$13.00
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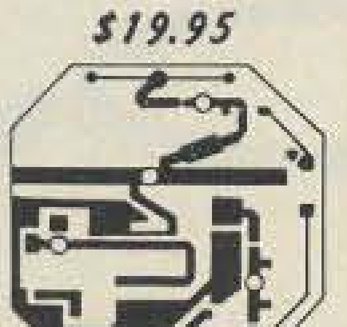
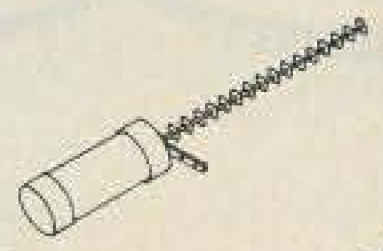




✓See List of Advertisers on page 114

NEW PRODUCTS

LINEAR AMPLIFIER

A 1200-Watt SSB, 1000-Watt CW linear amplifier covering 160, 80, 40, 30, 20, 17, and 15 meters is available from DenTron Radio Co.

The "Galion" amplifier features a rugged, reliable 3-500 grounded grid triode, full-function metering, and internal inout switching. A built-in dual power supply allows it to operate from either 120- or 240-V ac lines while reduced voltage tune ensures peak efficiency regardless of mode. The Galion amplifier includes a tuned input circuit for compatibility with either solid-state or tube-type exciters of any manufacturer.

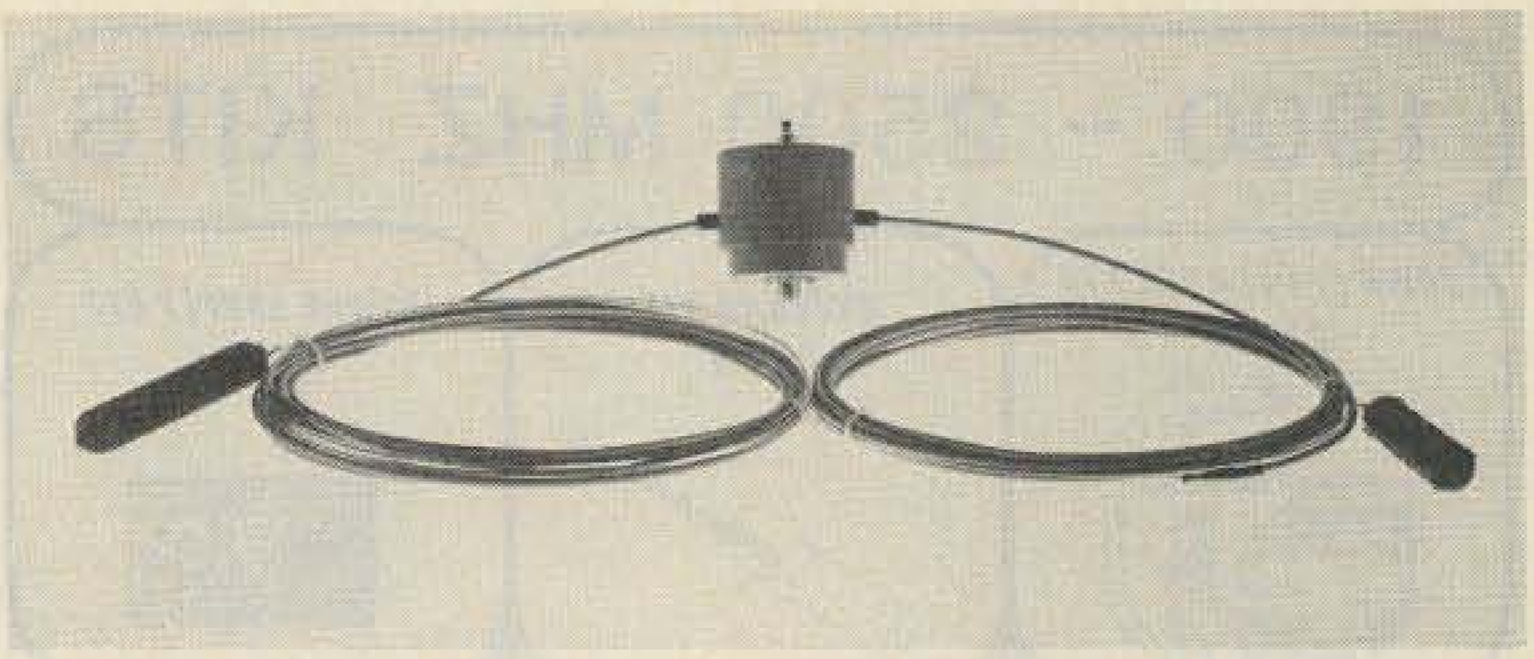
Improved reliability and performance are provided through an exclusive linearity test circuit, which instantly verifies proper tune-up and operation, and a two-speed blower to provide high volume cooling capacity.

A modification kit available for the Galion amplifier will extend frequency coverage to the 12- and 10-meter amateur bands and associated MARS frequencies. The Galion amplifier is priced at $695.

For more information on the Galion linear amplifier, contact *DenTron Radio Co., Inc., 1605 Commerce Drive, Stow OH 44224; (216)-688-4973.* Reader Service number 482.

The Galion linear amplifier from DenTron.

TERMINALL communications terminal from Macrotronics.



Compensating dipole antenna from Snyder.

COMPENSATING DIPOLE

Snyder Antenna Corporation now offers self-compensating dipoles that offer all the advantages of a conventional dipole plus increased efficiency. These full-band antennas have no resistors or capacitors and can be used with 50- or 70-Ohm feedlines. Available in 40-meter, 75/80-meter, and 160-meter models, prices start at $109.95. For more information, contact *Snyder Antenna Corporation, 250 East 17th St., Costa Mesa CA 92627; (714)-760-8882.* Reader Service number 485.

COMMUNICATIONS TERMINAL

Macrotronics, Inc., has introduced TERMINALL, an integrated hardware and software system which converts the Apple II or Apple II Plus into a state-of-the-art communications terminal.

TERMINALL includes all the necessary computer-interfacing, audio-demodulating, AFSK tone-generating and transmitter-keying hardware integrated in one cabinet. This reduces equipment interconnection to a minimum and allows the operator to be on the air receiving and transmitting Morse or RTTY or ASCII in minutes. Plug it into the receiver headphone jack and copy Morse code, Baudot, or ASCII. Plug it into the CW key jack and send Morse code. Attach a microphone connector and send Baudot or ASCII using audio tones (AFSK).

TERMINALL T2 requires an Apple II or Apple II Plus, 48K RAM, and disk drive. Software provided on disk in DOS 3.2 format (MUFFIN to 3.3). Latched and buffered cable plugs into any card slot (1 through 7).

TERMINALL comes complete with software on disk, assembled and tested hardware, and an extensive instruction manual. List price is $499. For complete information, contact *Macrotronics, Inc., 1125 N. Golden State Blvd., Turlock CA 95380; (209)-667-2888.* Reader Service number 484.

6-METER MULTIMODE

The IC-505 is a fully-synthesized multimode transceiver covering 50 to 54 MHz on FM (option), USB, LSB, and CW. Utilizing an internal battery pack (9 C-size batteries), the IC-505 puts out 3 Watts of rf power when run on its batteries, or 10 Watts when connected to an external 13.6-volt dc source; low power is 0.5 Watts.

IC-505 features include an LCD frequency display for low battery consumption, provision for internal memory backup, dual vfo's, 5 memories plus a call channel, memory scan, program scan, sideband squelch, LCD annunciators for vfo, scan,

IC-505 transceiver from Icom.

memory channel, call and split, and split frequency operation. The transceiver has a list price of $449.

For more information, contact *Icom America, Inc., 2112 116th Ave. NE, Bellevue WA 98004; (206)-454-8155.*

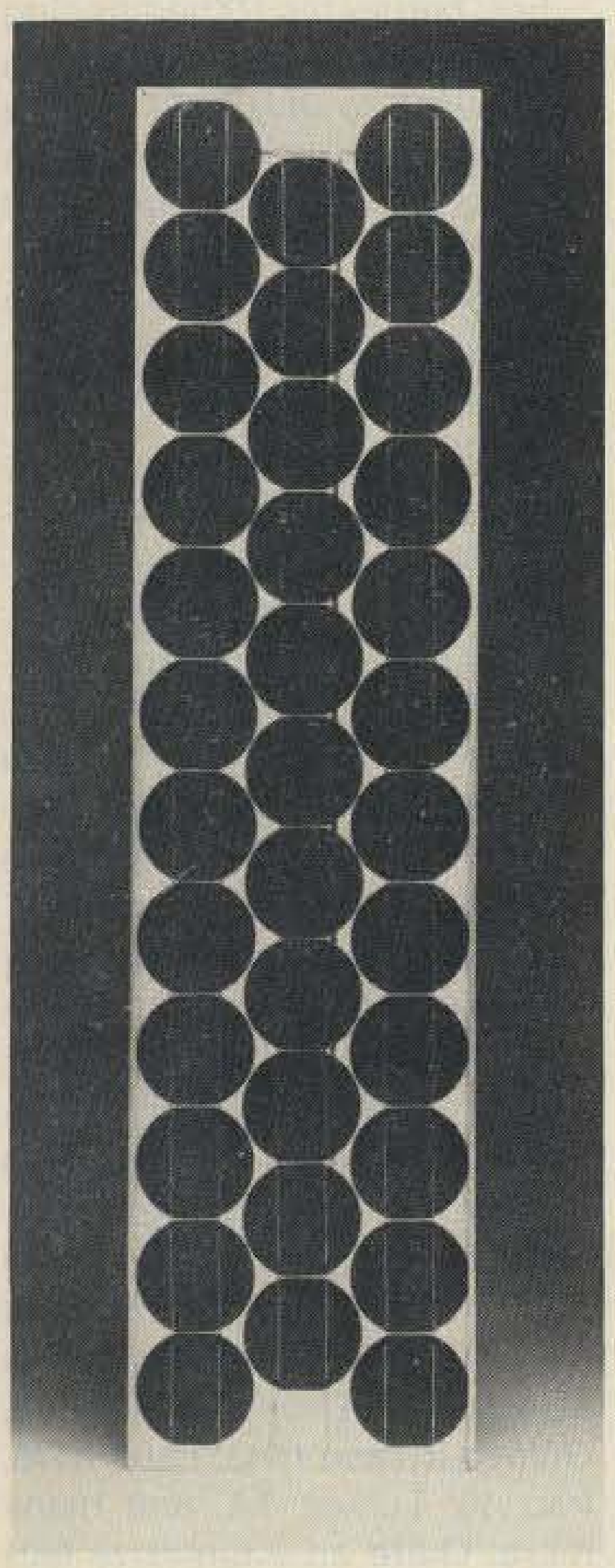
SOLAR MODULE

A photovoltaic module that produces 40 Watts of peak power using 35 solar cells is available from ARCO Solar, Inc.

The M51 module is designed for high voltage applications where efficiency and reliability are critical considerations. It maximizes Watt-hours per day while keeping balance of system costs down. It has been successfully tested beyond industry standards.

The new 1'×4' module is 10.75% efficient. Using single crystal silicon cells, it can even charge batteries at five to ten percent of noontime sun. Under such low light level conditions, ARCO Solar analyses show the M51 can deliver up to 25 percent more energy than a typical module of polycrystalline design.

Solar cells in the M51 are 100 percent electrically matched to ensure maximum power output. Each series-connected cell employs 44 contacts for enhanced reliability.

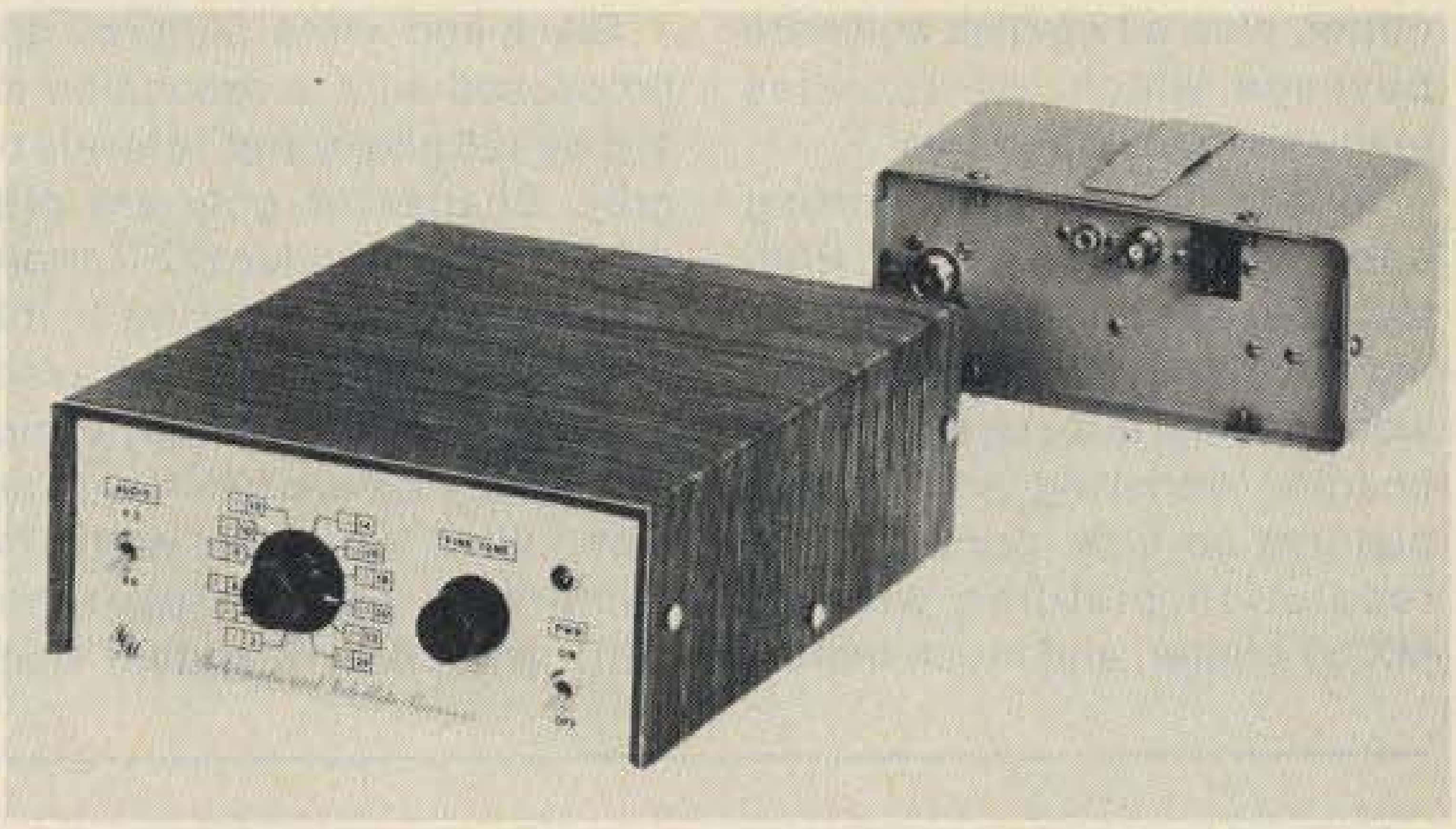


ARCO Solar's M51 module.

For more information, contact *ARCO Solar, Inc., 20554 Plummer Street, Chatsworth CA 91311; (213)-700-7458.* Reader Service number 481.

SATELLITE RECEIVER

The unique two-piece design of the International Crystal ICM TV-4400 satellite receiver permits mounting the downconverter at the LNA. Signal is fed to the baseband unit via RG-59 coax at 70 MHz. The dual-conversion receiver features step-switch tuning with variable fine-tuning control. A subcarrier output may be used with audio accessories. There are two standard audio outputs and a built-in dc block for LNA power. The ICM TV-4400 has a list price of $1295 and is available from *International Crystal Mfg. Co., Inc., 10 North Lee, Oklahoma City OK 73102.* Reader Service number 478.



TV-4400 satellite receiver from International Crystal.

INTERFERENCE TRAP

The Model 3966 is a microwave trap for preventing strong microwave carriers from reaching Earth station downconverters.

The trap can block out up to 6 microwave telephone carriers (offset 10 MHz from transponder frequencies). Connectors are type N and the trap passes dc power to the LNA.

The trap is custom-made to customer's specific microwave offenders. Price is $180.00 for a single carrier trap plus $90.00 per additional interfering carrier. Delivery is 10 days. For more information, contact Emily Bostick, *Microwave Filter Co., Inc., 6743 Kinne Street, East Syracuse NY 10357; 1-(800)-448-1666.* Reader Service number 483.

1:1 BALUN

Hustler, Inc., now offers a 1:1 ratio balun to complement their line of HF amateur antennas.

The balun, designated model "BLN," features a low-loss air-core design eliminating saturation at high power levels while maintaining a uniform power balance in the system.

BLN features include a 1-kW input rating and bandwidth of 7 to 35 MHz with under 2:1 vswr.

All stainless-steel hardware and flying leads are supplied for connection to the driven element of beams, quads, or dipoles and coax termination into an SO-239 connector. The BLN is priced at $21.95.

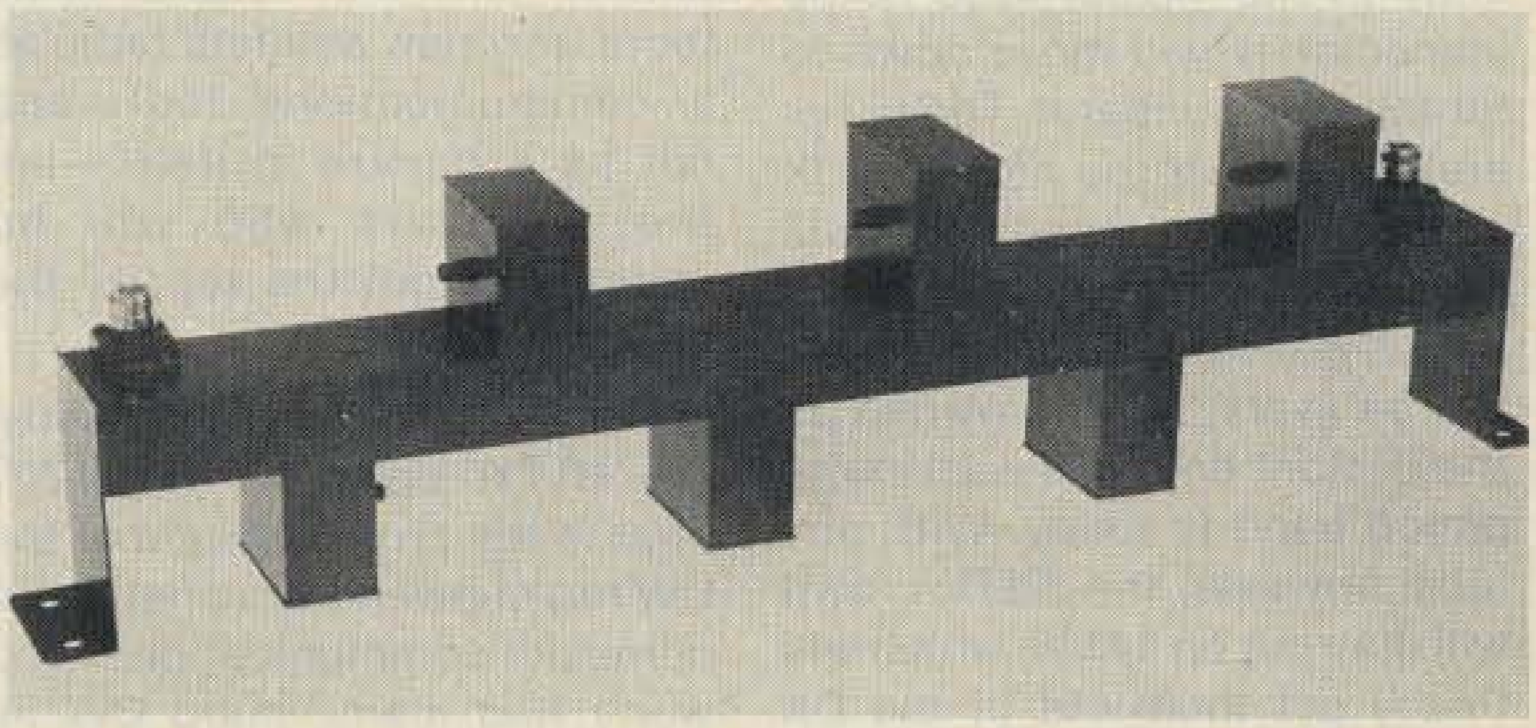
For additional information, contact *Hustler, Inc., Sales Department, 3275 North B Avenue, Kissimmee FL 32741.*

NOVICE COURSE

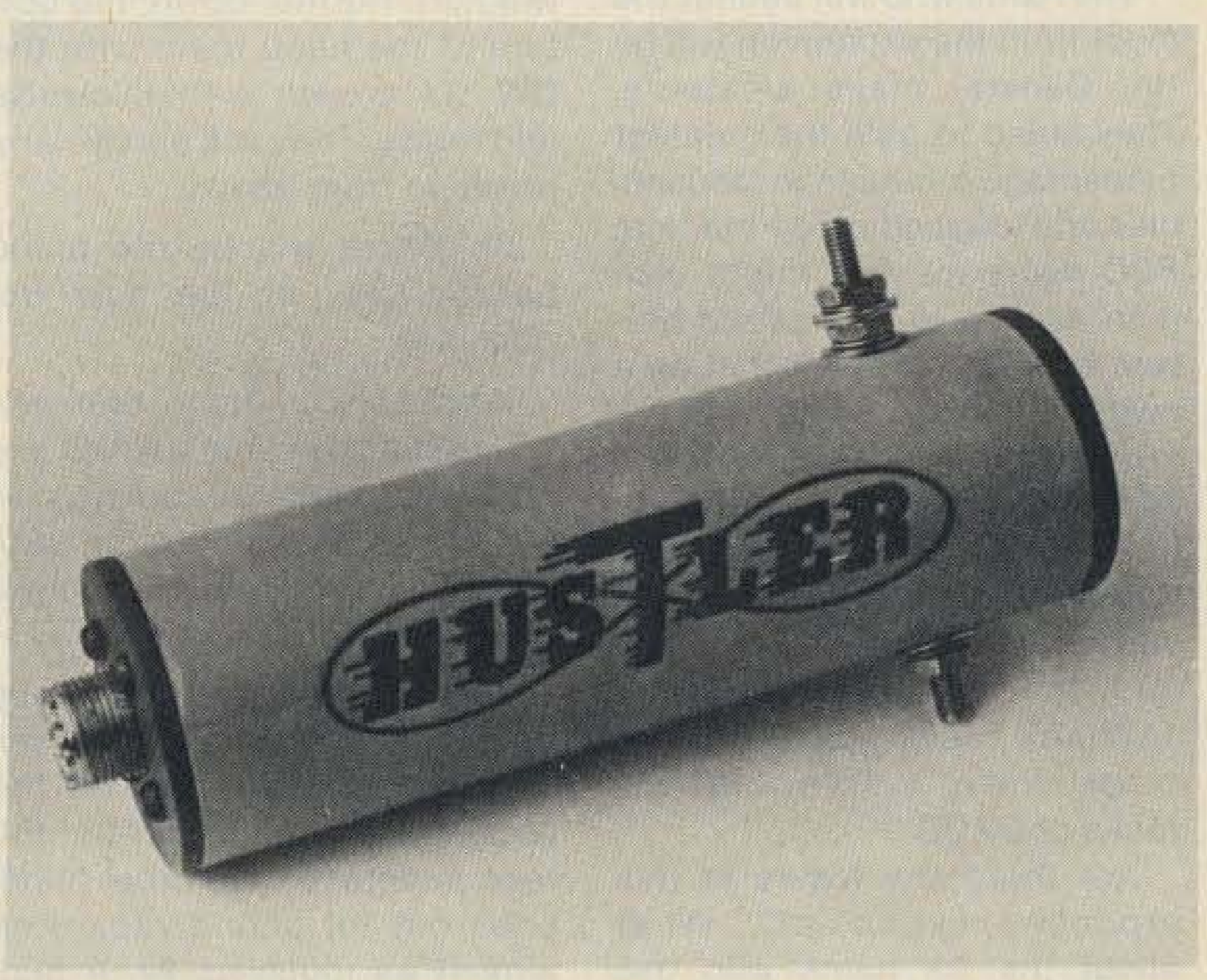
A complete Novice course is available from VHF Communications. The course features six hours of theory sent by Morse code. The copy is then given in voice so that the student may check his or her progress. The package includes a copy of the Ameco *Novice Guide.* The introductory price is $21.95. For more information, contact *VHF Communications, 915 North Main St., Jamestown NY 14701.* Reader Service number 479.

APPLE SSTV

The COMMSOFT PhotoCaster™ provides an easy way for hams who own Apple computers to get started on SSTV with a full-featured black-and-white and color system. PhotoCaster includes a circuit board to interface an APPLE to a TV camera and a receiver/trans-



Earth station interference trap from Microwave Filter Co.



1:1 BLN balun from Hustler.

mitter, plus a two-disk software package which incorporates many advanced features.

In addition to transmitting and receiving pictures, PhotoCaster has provisions for adding titles and graphics, creating video special effects, enhancing images, retrieving and storing pictures on disk, printing high-resolution pictures with an MX-80 printer, and much more.

Black-and-white pictures are processed with a resolution of 128 by 128 pixels and 16 levels of gray. Shades of gray are presented on a standard CRT monitor by using dot dithering. In the color mode, 8 colors are available with 16 saturation levels. Color pictures are taken with an unmodified black-and-white TV camera using a three-frame RGB sequence. Standard RGB transmission formats are available in addition to a unique Apple-to-Apple single frame color mode which takes 8 instead of the usual 24 (or more) seconds to transmit a color picture.

PhotoCaster requires an Apple II or Apple II Plus computer with 48K of RAM and one disk drive. The price of PhotoCaster is $499.95 for the basic system which includes an assembled and tested circuit board and software. A complete system consisting of a Panasonic WV1400 camera, board, and software is available for $749.95.

For more information, contact *COMMSOFT, Inc., 665 Maybell Avenue, Palo Alto CA 94306; (415)-493-2184.* Reader Service number 480.

DX

Chod Harris VP2ML
Box 4881
Santa Rosa CA 95402

FCC SAYS MORE 20-METER SSB FREQUENCIES

Expand the 20-meter phone subband? The FCC is considering just this action. Add good sunspots and you have DXer heaven! But what will FCC Docket 82-83 *really* do for DX?

The DXers, nets, and DX presently in the 14200-14250 range immediately will move down to fill the new subband. These operators want to be near the DX portion of the band and will move accordingly. In weeks—if not days—the new frequencies will be every bit as crowded as the bottom end of the 20-meter phone band is today. With any luck, however, the SSTV crowd will stay put on 14230, which will finally get them out of the DX area!

The hams who will benefit the most from the expansion will be the General class amateurs. They stand to gain the greatest percentage increase in frequencies and (depending on the final FCC decision) they might also gain access to that prized bottom 50 kHz! Wouldn't that be a switch! They would go from the status of a poor relation in the 20-meter DX world to head-to-head battles with top DXer W6AM. More likely, the FCC will settle for contiguous subbands and the Generals will gain 14225-75. The 66% increase will propel many a DXer into the ranks of DXCC.

Are there any losers in this proposed expansion? What about the DX hams who use 14150-14200 now? The top half of that range contains many of the DXers, DX nets, and long-haul communications. These hams will share with those stateside or move down, depending on interference to their operation. Below this DX layer lurk the personal, non-DX QSOs: long-standing skeds, families and friends, non-English QSOs. They will be the real losers. The RTTY just below 14100 acts as a floor to phone operators; voice communication below 14100 is almost unknown. Those amateurs who view amateur radio as a communications tool—and not as a pursuit in itself—are the amateurs who will be squeezed from the top as the DXers descend.

Will these hams jump below the RTTY, down to 14050-80? That is the present home of the CW rag-chewer, traffic nets, and domestic communications. You won't find many sharp CW filters here and SSB interference will hurt. Further down, the bottom of the band roars with the CW DX crowd, with kilowatts and filters. They will survive any pressure from above.

So DXers will be the prime beneficiaries of the new frequencies.

What about the other HF bands? In the same docket, the FCC wants amateur opinion on expanding other phone subbands, 80-10 meters. How might these changes affect DX?

Ten meters doesn't need any more phone frequencies; we seldom fill what we have at the peak of the sunspot cycle. Fifteen meters, on the other hand, cries out for phone expansion almost as much as 20. A hundred additional kHz, relocating the Novices to 21050-21150, would attract a lot of the 20-meter operators except at the bottom of the sunspots.

Any 40-meter expansion would force the Novices to move down to 7050-7100, still head-to-head with the VEs, but at least away from the shortwave broadcast stations. This move might be a welcome change! But there is no DX outside the western hemisphere above 7100, so phone expansion would be meaningless to the DXer. Now, if they could only get the foreign broadcast stations to go someplace else (I can think of a certain, overly-warm location), 40 meters could be a great band. But phone expansion? No, thank you.

An additional 25 kHz on 75 meters wouldn't revolutionize DX on the band, but it might go a long way in that direction. 75-meter DX is the exclusive province of the Extra. If other license classes get privileges below 3800, a whole new world of 75-meter DX might open up.

But don't rush onto the proposed 20-meter frequencies just yet. The FCC moves slower than New Hampshire molasses in January, and it will be a while before we can begin moving down. To help our DX totals meanwhile, we might keep an ear out for Erik SMØAGD, from somewhere in the South Pacific.

ERIK SJOLUND SMØAGD: DXPEDITIONER EXTRAORDINAIRE

Erik Sjolund left this spring for an extended DXpedition through the South Pacific, as one of the four-man crew of the 50′ yacht *Marathon AQ.* Erik was lured from "retirement" from DXpeditioning by the fact that the skipper of the ship is a descendant of Leif Ericson. The support of the Sundsvall DX group and the Northern California DX Foundation help make the trip possible. The trip's itinerary reads like an atlas of the area (and a ham's dream-come-true): North Cook Islands ZK1, Tokelau ZM7, Central Kiribati T31, American Phoenix KH1, East Kiribati T3, Tuvalu T2, and more. The 1983 itinerary is even more ambitious and includes Spratly 1S! The last group to operate from Spratly had to dodge bullets (more about Spratly in a future column).

What kind of amateur would head off on a scheduled two-year voyage, which includes actively disputed territories, just to hand out radio contacts to the deserving few? Erik Sjolund SMØAGD is a very special amateur and a special person who has operated from more than his share of rare and difficult locations.

Erik began his DXpeditioning career about 11 years ago, when he traveled to Rhodes SVØ for a vacation. Although he had been an active amateur for about 20 years prior, this was the first time Erik operated from outside his native Sweden. The DXpedition bug bit, and bit hard.

Erik traveled extensively through his job with the European Space Agency, and he carried a radio everywhere he went: Easter Island CEØA, the Falklands (or is it the Malvinas?) VP8, and others. Erik then began traveling for the Swedish government to various embassies all over the world.

The well-known neutrality of the Swedish government helped open many doors for Erik. Swedish embassies in such out-of-the-way places as Bangladesh or Botswana were perfect locations for radio operations, and Erik's diplomatic connections paved the way for licensing. Erik also operated from Lesotho 7P8, Guinea-Bissau CR3, Laos XW8, Iraq YI, Turkey TA, and many more. Quite an impressive list! Finally, Erik "retired" and returned to his home and wife, only to head off again this spring.

On his way to the South Pacific, Erik stopped by the International DX Convention in Visalia CA. While there he shared some of his experiences, including his recent trip to J5, Guinea-Bissau, with the hundreds of CA amateurs and guests.

THE SUNDSVALL DXPEDITION TO GUINEA-BISSAU J5AD

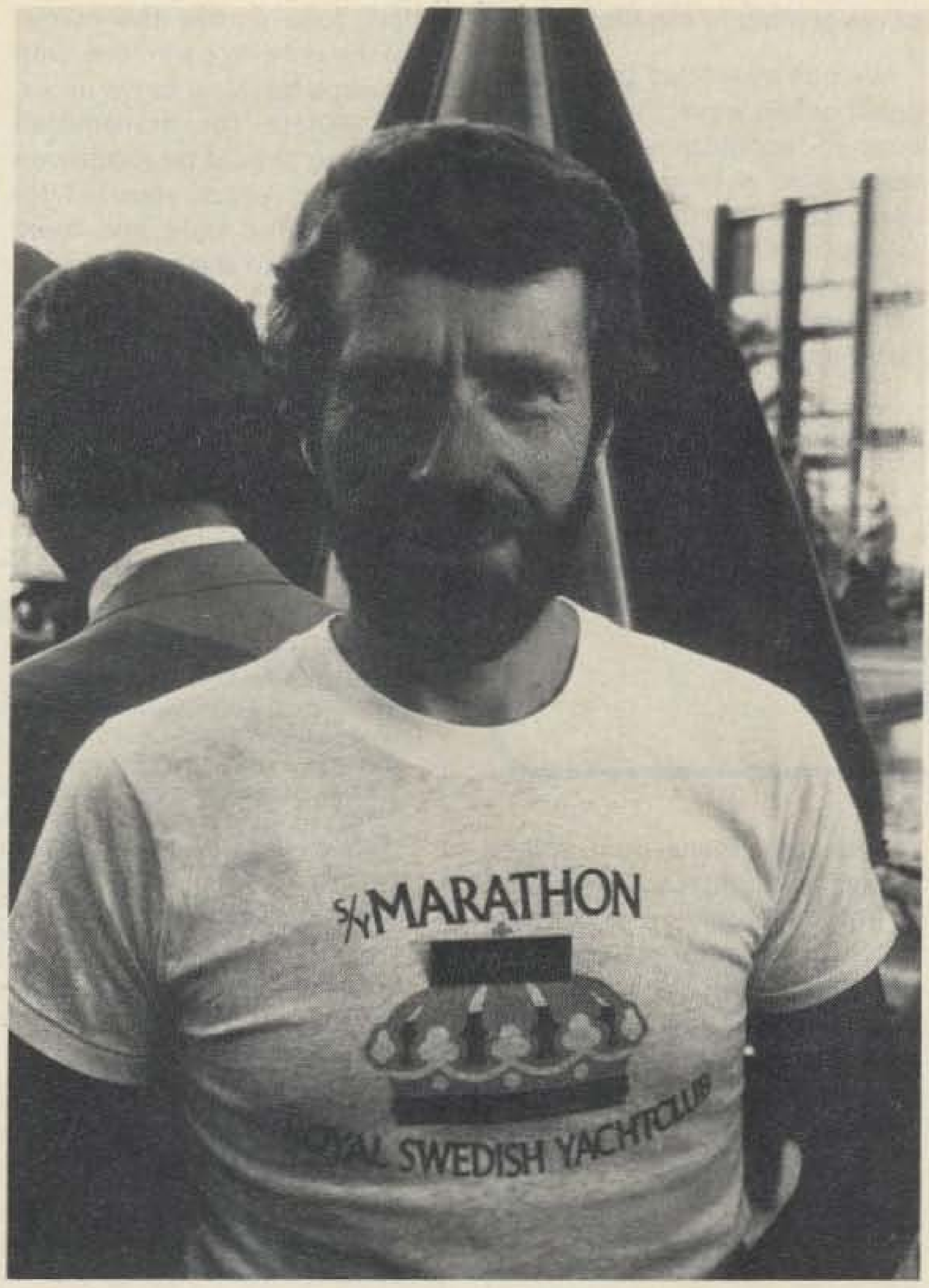
Erik had always wanted to reward his hard-working and dedicated QSL manager, Jorgen Svensson SM3CXS, with a fully-conducted DXpedition. His chance came in 1981, when Erik unexpectedly received permission to operate from Guinea-Bissau J5. Although greatly troubled by a bad knee, Erik immediately begain preparing for the trip: food, hotel, transportation, equipment, customs, antennas. A seasoned DXpeditioner, Erik completely constructed and fully tested each antenna before leaving Sweden.

The travel arrangements centered on Gambia C5, a popular tourist spot for Scandinavians on the west coast of Africa. Erik, Jorgen, and other members of the Sundsvall DX Group arranged to fly a small plane the 300 km from Gambia to the tiny capital of Bissau. To see the countryside, they would chance driving back—a decision which would almost prove their undoing!

Use of the small plane severely restricted the amount of weight the group could carry, and radio gear consumed most of that. Erik had purchased enough food for the entire two-week trip, but there simply was too much weight. So the group sat down to eat the two weeks worth of food before they left two days later!

Erik maneuvered the group's gear, including 2 Icom transceivers, 2 amps, and a couple of vertical antennas, through Gambia customs and rendezvoused with their pilot, C5ADX. A sandstorm in Guinea-Bissau delayed departure for a day, but the group finally arrived and was met by J5HTL, who helped secure licenses and provided other local assistance.

Their troubles were not over, however. Minutes after firing up the radios and getting on the air for the first time, bang! The room went dark. No power. Outside, the entire town of Bissau was dark. "Maybe we shouldn't have used the amplifier," Erik mumbled, looking out over the dark city of 110,000 people.



Erik Sjolund SM0AGD on his way to an extended DXpedition to the South Pacific.

The lack of power turned out to be a regular occurrence. Whenever the enormous football (we call it soccer) stadium turned on its lights, the entire city was blacked out. Fortunately (that's experience and foresight), Erik's radios could operate on car batteries, without the amplifiers. A portable generator powered the amplifier when the group was away from the hotel.

Despite the hardships of inconstant power and stomach problems from trying to eat two weeks' worth of food in two days, J5AD managed 20,400 QSOs in 9 days. Contacts were about evenly split between SSB and CW.

Now came the drive back to Gambia, 300 km north. "10 hours," the driver promised. That's about 20 mph on the tortuous dirt roads. The driver appeared with his battered "taxi," but the trunk was completely filled with a barrel of oil. The driver claimed he needed that much oil for the trip, and there wouldn't be any gas stations along the way. More likely, he was afraid someone would steal his precious barrel of oil if he left it behind for a day. He was probably right.

Erik finally convinced the driver to unload the oil and load their gear, and the car began to lurch toward Gambia. But Gambia is a small country completely surrounded by Senegal, and one must pass through Senegal on the way to Gambia. The trouble began at the Senegal border.

Dead tired from the trip and still bothered by his bad knee, Erik refused to pay the implied bribe for passage through Senegal. The border guards retaliated with a three-hour lunch, leaving the Sundsvall DX Group sweltering in the tropical sun. Finally, the two sides reached a compromise and Erik's party headed north. But now the border guard insisted on accompanying the travelers and claimed the front seat. It was a long ride to Banjul, Gambia.

Erik Sjolund and friends survived the trip, however, and pleased thousands of amateurs in the process. And now the modern-day Leif Ericson is off again, this time with transceiver in hand, and SM0AGD portable wherever is on the air again.

QSL Erik's operation via SM3CXS, as usual. Please include a separate envelope for each different callsign, since the cards will be handled in more than one location.

You can recognize Erik by his clean, crisp operating style and his courtesy. Erik also works an even balance between phone and CW. In honor of Erik, and to compensate for the remarks above about the expansion of the phone bands, let's look at a CW topic: zero-beating.

ZERO-BEATING FOR DX FUN AND PROFIT

Zero-beating is the process of aligning the transmitting frequency to that of another station. While important in SSB operation, zero-beating is crucial to successful CW DXing.

The best way to work a DX station in a CW pileup is to transmit on exactly the same frequency as the last successful station. This implies the ability to align the transmitting frequency to that of another station. How do you accomplish this?

The DXer can zero-beat separate receivers and transmitters by means of the spot switch: Tune in the desired frequency on the receiver, press the spot button, and adjust the vfo for an identical note in the receiver. The transmitter is now on the same frequency as the receiver.

But most of us have transceivers without separate external vfo's. No spot switch. Now what?

Again, tune in the desired frequency on the rig. Most transceivers employ an 800-Hz offset for CW. This means that when the dial is aligned on 14030, for example, the CW receiving beat oscillator in the rig (which generates the audible tone in the product detector) oscillates 800 Hz away from the frequency of the transmitting oscillator. If the audible tone is 800 Hz, the transmit and receive frequencies are identical.

But I prefer to copy CW at a lower frequency than 800 Hz. If I adjust my receiver to my preferred note of 650-700 Hz, my transmit frequency will move up 100-150 Hz above that of the other station. That station will shift up in frequency to match my transmitted frequency.

I then shift up still further when the DX station comes back, and we dance up the band. More likely, we will lose contact or never meet in the first place.

We can avoid this problem in either of two ways. First, we can learn to recognize and listen to the 800-Hz note which the rig manufacturers have selected. Or we can adjust the RIT or clarifier to compensate for our personal preferences. I prefer the latter approach.

Tune in a strong, steady carrier, such as WWV. In the CW position, tune across the carrier until the note drops in tone until it disappears. Now move up exactly 800 Hz. Your transmitted frequency should be exactly on the carrier. Adjust your RIT for your preferred note and mark the position of the pointer.

Now, to zero-beat the DX station, tune the rig for your favorite beat note and you will be very close to the correct frequency!

NOTES FROM HERE AND THERE

The French amateur radio society suggests watching for 3A2ARM, the official club station of Monaco, which is often on 14 and 21 MHz Saturdays, 0900-1100Z.

Heard Island plans move ahead, with the support of the Wireless Institute of Australia. An extended stay on Heard is scheduled for early '83.

REVIEW

THE HEIL EQ-200 MICROPHONE EQUALIZER

If you actively seek to improve your transmitter's audio, sooner or later you'll discover the concept of equalization (hereafter referred to as EQ). Simply put, EQ is the boosting or cutting of specific frequencies (or bands of frequencies) within the audio spectrum. In public address systems, EQ is used to flatten out the frequency response of the system, allowing maximum gain at all frequencies before feedback. In the recording studio, engineers apply EQ to sweeten sound and make it more pleasing to the ear.

Obviously, in amateur radio we needn't concern ourselves with either audio feedback or sweetening our sound. So why worry about equalization? Because many years ago researchers discovered that boosting certain bands of frequencies improved intelligibility. A slight boost, say, in the upper-mid-range area, makes our voices easier to understand. Because of this, microphone and transmitter manufacturers have been building such a boost into their equipment for years. More than anything else, this accounts for the subjective differences we detect between the qualities of various microphones and rigs. And it is precisely where we begin to run into some interesting compatibility problems. There is no agreement between manufacturers as to how much boost is necessary or at what frequency it should take place. Worse, some feel that the equalization should be done at the microphone, while others argue that it should be done at the rig. You can imagine the problems this presents! If both the microphone and the rig you buy have substantial boosts at the same frequencies, your audio is likely to sound "honky" and unpleasant. And if a manufacturer designed his rig with the characteristics of a particular microphone in mind, results will be unpredictable with another mike. The combination may lack highs, lows, or anything in between. Or it might have too much of something!

Which brings us to the Heil

EQUALIZING THE MOBILE SIGNAL

When a commercial sound contractor writes the specifications for a sound system to be installed in a large auditorium, he must know the room's resonant frequency. The dominance of this frequency can cause feedback, resulting in a less than optimal gain value for the sound system. By adding an active equalizer that notches out the room's dominant frequency, the likelihood of feedback is reduced, allowing more gain to be used.

The very same sound analysis procedure was applied to the internal cavity of four automobiles. The results were astonishing! From a Honda Civic to a GMC van, they exhibited a large rise in the 400- to 700-Hz range, the exact same place that mobile signals have a large peak in their audio.

If you think about it, you will probably realize that all mobile signals sound alike. It makes no difference what kind of microphone or transmitter is being used. These signals are characterized by low frequency rumble and vey little high-end audio response, and in most cases are very hard to copy when they are immersed in noise.

The fact is that the frequency of the car's internal cavity is reproduced through the mobile microphone and causes all of the signals to include a rumble. The hand-held microphones favored by most mobile operators only make matters worse; they have very little high-end response, with their −3-dB "hinge point" often lying as low as 1800 Hz.

Results from a typical on-the-air mobile setup are shown in Fig. 1. A Kenwood TS-120 transceiver with MC-30S microphone was installed in a GMC van. The signal was received on a Kenwood TS-820S and analyzed with a Heil AA-1 audio analyzer. Before equalization, a pronounced peak was found at 500 Hz, verifying the resonance check. By using a two-band equalizer between the microphone and rig, the resonant frequency of the passenger compartment was notched out, giving the audio a flat response. Next, boost was added to the high end, making up for the deficiency of the microphone. Receiving stations and the audio analyzer back in the lab all reported a 6- to 10-dB difference and there was a marked improvement in the intelligibility of the speech.

We found that articulation is the key factor in understanding a mobile signal. The all-important articulation is lost when the low frequencies predominate. In the worst case, these lows can overdrive the microphone preamplifier, leading to terrible distortion. The application of proper equalization to the audio section of an SSB transmitter will provide this necessary articulation without distortion.

Bob Heil K9EID
Marissa IL

The Heil EQ-200 microphone equalizer. (Photo by KA1LR/4)

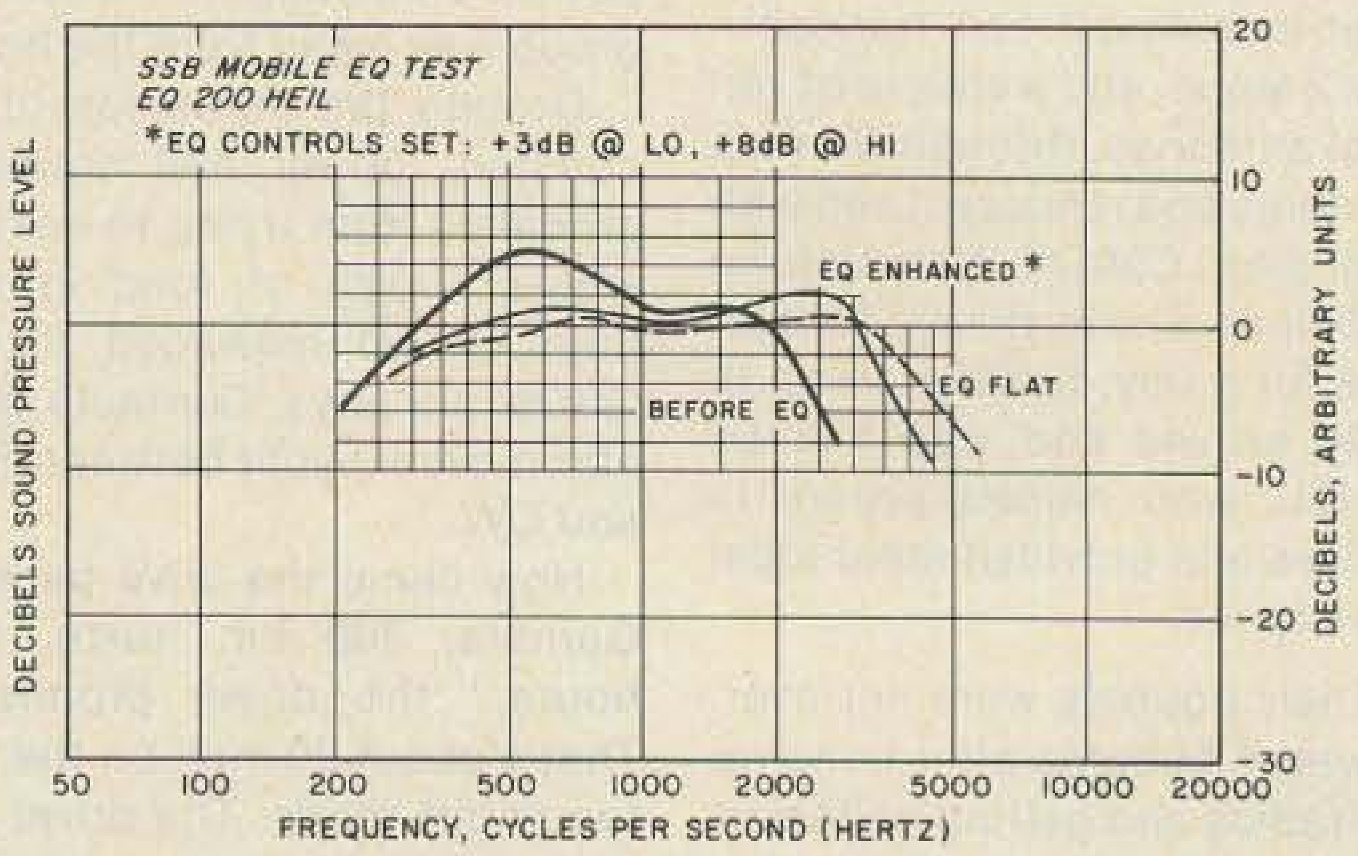


Fig. 1. SSB mobile EQ test results for the Heil EQ-200.

microphone equalizer. The idea is to connect the equalizer between microphone and rig. The LO and HI controls allow you to cut or boost the two bands of frequencies, correcting any deficiencies and hopefully improving intelligibility. A third control permits you to match the output level to what your rig wants to see. Does it work? Well, yes and no. If you just need to perk up your audio a little bit, dialing in a little LO or HI boost can improve things. But it's important to remember that changes you make will only be audible to someone listening to your signal. If you are dumb enough to adjust your rig on the basis of what someone you may or may not know is telling you over the air, you deserve what you get! You really need a means of listening to your own signal while you make adjustments. You're in good shape if you have one of the few transceivers with a monitor circuit. Turn it on, plop on a pair of headphones, and you'll get a pretty good idea of what you sound like to the rest of the world. If you have a second receiver, you are even better off.

One problem we noted in our installation is that the gain control had to be run at a fairly high level. The EQ-200 uses a pair of 741 op amps to do its work, and the noise performance of these devices is less than exciting—i.e., you hear some hiss. While this may or may not be noticeable in other installations, I recommend that Heil use a slightly better op amp in the future. After all, if someone is picky enough to want to EQ their mike line, they aren't going to want to add hiss to their signal!

The second problem I see is the placement of the controls on the front panel. Once you have gone to all the trouble to carefully set them, you don't want anybody messing them up. Internally mounted trimpots with three small access holes for a screwdriver would make the most sense to me.

Conclusions

Used correctly, the Heil EQ-200, which sells for $49.95, can improve the intelligibility of many microphone/transceiver combinations. Used incorrectly, it could make a good signal sound terrible. Please, if you don't have the knowledge or patience to adjust this or any other audio processing device correctly, don't buy it!

For more information, contact *Heil Sound, Marissa IL 62257*. Reader Service number 475.

Paul Grupp KA1LR
Casselberry FL

Editor's note: Heil Sound reports that a design change was made to the final amplifier stage of the EQ-200. By lowering the gain, they achieved a 20-dB reduction of the noise level leaving the unit. This should help in solving the problem, reviewer Grupp reports.

SILICON SYSTEMS DTMF DECODER

Anyone who has tried to tame a dual-tone frequency (DTMF) decoder using the ubiquitous 567 IC has probably thought that touchtone™ control probably isn't worth the hassle. The 567 decoder, although versatile, is far from ideal for decoding DTMF signals that have a variety of levels of distortion and volume. The 567 can give false outputs if input levels aren't carefully controlled, and frequency stability is only as good as the timing network. In short, getting a 567-based decoder working reliably at a remote repeater site is a lot like searching for an honest man—you're always disappointed in the end.

But take heart. Time and technology have passed the 567 by, and thanks to the development of switched-capacitor filters, we now have DTMF decoders in a single package which offer more features and better reliability than a handful of 567s. Silicon Systems, Inc., the people who first made commercial use of switched-capacitor technology, have a chip representative of this new breed in their SSI-201, a 22-pin IC which requires only four external components to operate as a complete DTMF decoder.

The SSI-201 uses 40 poles of switched-capacitor filtering to detect the presence of valid DTMF tones at the input. The filter center frequencies and bandwidths are controlled by a 3.58-MHz crystal (one of the outboard components), so frequency drift and temperature instability are a thing of the past. A valid tone can be detected in as little as 20 milliseconds and the audio input can be anything from 53 mV to 1.3 V. A 60-Hz notch filter on the chip reduces susceptibility to overload from hum.

Implementing the SSI-201 is very easy. Power required is 12 volts at about 30 mA. When valid tones are present at the input, the four output lines present either a hexadecimal (similar to BCD) or binary-coded 2-of-8 output, selectable by tying one pin high or low respectively. The outputs may be configured for either standard CMOS or tristate (high impedance) use. Another control pin allows detection of the full 16-digit set or the more standard 12-digit set. A strobe output is available to ease interface with clocked-logic systems.

A minor flaw with the SSI-201 is that the problem of temperature immunity has not been completely solved. The chip is specified to operate only down to 0° C (32° F), so you'll have to provide some sort of heat at your outdoor repeater site. The answer could be as simple as letting some current flow through a couple of resistors mounted near the chip.

This chip isn't cheap—$60 in single units (if you buy 10 or more, the price drops to $40.64). I buffered all its connections with the real world. I used a 741 op amp as an audio buffer, bypassed the power bus, used a series diode to protect against reverse polarity, and used a 4049 inverter package to buffer the digital outputs. All this may not be necessary, but I feel a lot safer knowing that there's an op amp between the phone line and my expensive chip.

When all things are considered, using a chip like the SSI-201 is well worth the additional cost. Now I *know* that my control system is reliable and that old Ernie with the weird voice won't bring up the autopatch every time he says, "Well, fine business, old man."

For more information, contact *Silicon Systems, Inc., 14351 Myford Road, Tustin CA 92680*. Reader Service number 477.

John Ackermann AG9V
Green Bay WI

ASTRON RS-7A POWER SUPPLY

The RS-7A is one of a series of 13.8-V-dc supplies with ratings ranging from 4 to 35 Amps. The 7A is good for 5 Amps continuous or 7 Amps at 50% duty cycle. I paid $64.95 for mine.

Ripple is spec'd at 5 mV peak-to-peak, full load and minimum line voltage. Load regulation is 50 mV. This is what would be expected from an industrial power supply, but it's much better than many of the supplies built for amateur service. A look at the schematic and the construction explains the performance. The regulator is a 723 IC, a somewhat elderly but altogether respectable chip. Regulator sensing is done at the output terminals, and the sense leads are twisted to minimize magnetic pickup from the transformer. The circuit includes not only foldback current limiting, but a crowbar circuit as well! Thus the unit resists damage very effectively, and if the regulator or the pass transistor should ever malfunction, the crowbar will blow the primary fuse and shut everything down in a millisecond or so. The pass transistor is mounted on a heat sink outside the back of the case, so ventilation is unnecessary. This keeps dirt out of the guts. That, in turn, means that the regulator is unlikely to become humidity-sensitive in its old age.

My unit has a varistor across the transformer primary, although the schematic doesn't show it. Nothing could be more convincing evidence of a thoroughly professional job of power-supply design. If the rig is expected to be available for operation in a disaster, it's extremely important to protect the circuitry against lightning damage. Several pieces of gear in my shack failed during a lightning storm a couple of years ago. After I put varistors across power and telephone line connections, there was no more trouble in subsequent storms. If there are any early-production units out there without varistors (or any other kind of station supply, for that matter), I recommend putting a GE V150LA20B across the primary.

The packaging is what's required, and no more. It's a simple modified steel minibox-style case, with the lid held on with sheet metal screws. Nothing is mounted on the cover; the unit is structurally complete when opened up for service. The line cord is solidly anchored.

The parts are good quality. The main capacitor looks to be either industrial grade or computer grade. I didn't recognize the part number, but it sure isn't any fugitive from a TV set. The transformer was obviously custom-designed for the job, a requirement when a linear-regulator supply has to operate efficiently over the 105-125-V range.

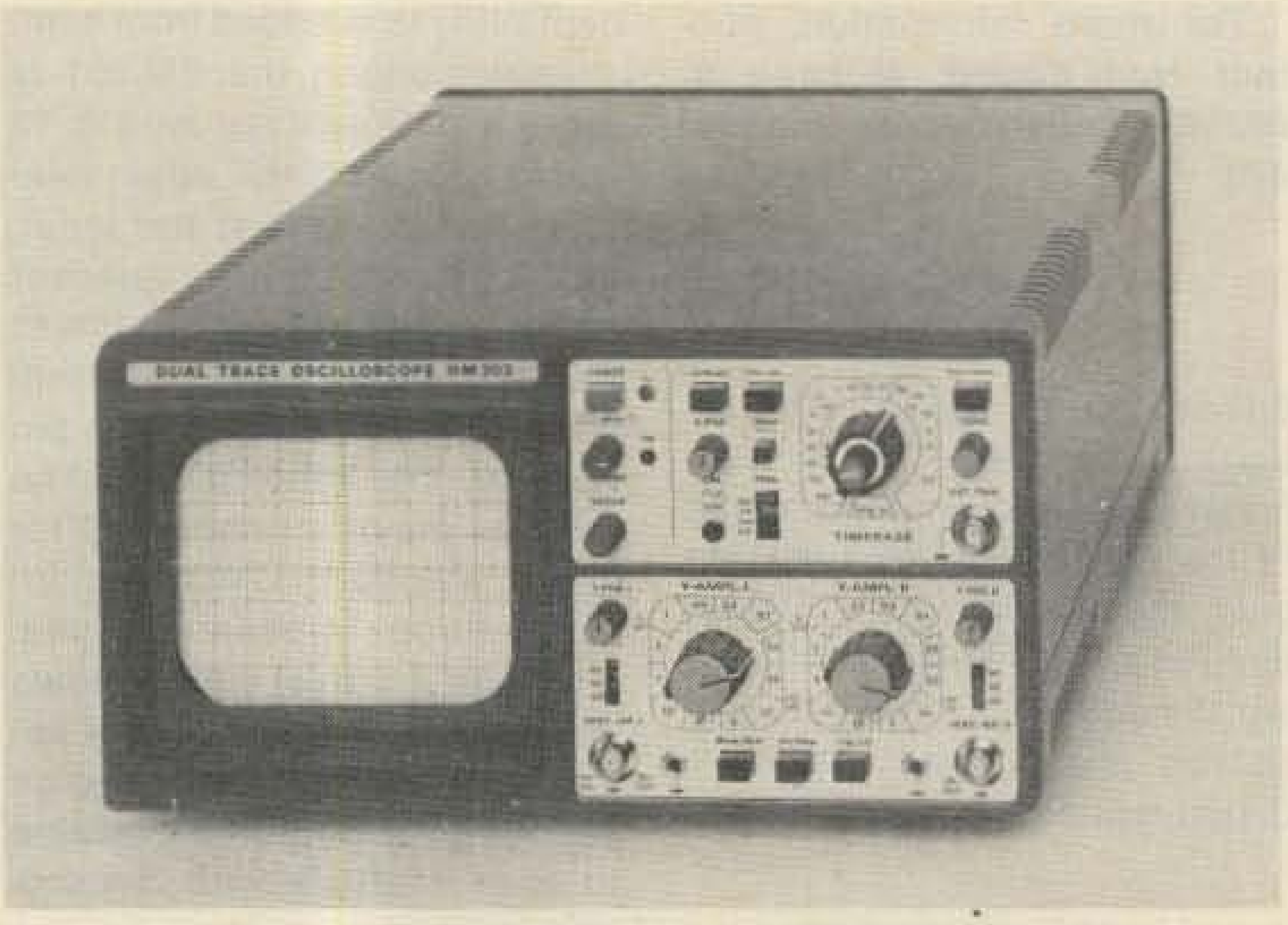
On-the-air tests . . . I hooked it up to my UV-3 and dialed up a couple of repeaters I could hit full quieting. The signal reports said there was no audible hum. Key-down operation for 30 seconds caused barely noticeable warming up of the heat sink. Not having access to a power supply test set these days, I didn't carry the testing beyond that. From looking at the size of the heat sink, I'd have some doubts about running at 5 Amps continuously at the maximum rated line voltage, but if that became necessary it would be no trick at all to put on a heat sink about four times as big.

To summarize: Whoever designed this thing has an understanding of what a ham station indoor power supply has to do and knows how to design power supplies. This is probably the most cost-effective supply possible, and it leaves nothing to be desired technically. It's the kind you turn on and just forget about.

For more information, contact *Astron Corporation, 2852 Walnut—Unit E, Tustin CA 92680*. Reader Service number 476.

John A. Carroll AB1Z
Bedford MA

HAMEG HM203 OSCILLOSCOPE



Hameg's HM203 dual-trace oscilloscope.

The Hameg HM203 oscilloscope is much like ham radio: both are international phenomena. The HM203, a newcomer to the US market, features a rugged yet precise feel that one would expect of a piece of gear designed and originally manufactured in West Germany. The outstanding performance/price ratio reminds you of similar gear from the Far East. And not to be neglected is the fact that the HM203 is manufactured and serviced right here in the United States.

Oscilloscopes can be incredibly useful test instruments. Unfortunately, many hams are only familiar with the expensive laboratory-grade units found at work and school or the inexpensive surplus or used models that sell for a song at any swapfest. Hameg has managed to come up with an excellent compromise. Now you can have a dual-trace scope that has a 20-MHz (−3-dB) or 30-MHz (−6-dB) bandwidth, 3% accuracy, and variable triggering for under $600.

Weighing just over 12 pounds and measuring approximately 6 inches high, 11 inches wide, and 15 inches deep, the HM203 is designed with field-service applications in mind. The unit's compact front panel also lends itself to fitting into a tightly-packed workbench. One half of the unit is devoted to the cathode ray tube, which measures 5 inches diagonally. The usable screen is an adequate 10 cm × 8 cm, and the dark red grid allows you to interpolate measurements to about 0.1 cm.

One feature common to all Hameg oscilloscopes is a subdivided control section. The upper half of the HM203 is devoted to the power switch, intensity, and focus control, plus all of the timebase or horizontal display functions.

The lower half consists of controls for the two Y or vertical channels. The back panel is void except for ac power connection (with removable line cord) and sockets for direct connection to the CRT's vertical and horizontal control plates.

Dual Trace Capability

Two identical vertical channels are available. Each has a 12-step frequency-compensated input attenuator giving scales from 5 mV/cm to 20 V/cm. The attenuator is followed by a diode-protected FET preamplifier that has a 40-MHz bandwidth. Conspicuous by its absence was any kind of continuously-variable vertical sensitivity control. The lack of this kind of control did not prove to be a serious problem, I just made do by adjusting the vertical position potentiometer.

The 1-megohm, 25-picofarad vertical inputs can be switched between ac, dc, and ground. For single-trace or "mono" applications, you can use either channel. For those jobs that require two signals to be displayed, just push in the mono-dual switch and you connect your second signal. Triggering can be done on either channel. (More on triggering later.)

The Alt/Chop switch is an important part of successful dual-trace operations. If the signals have a low frequency (less than 1 kHz), the display will tend to flicker if both traces are displayed independently. By choosing the Chop mode, the scope switches back and forth between the traces at a 120-kHz rate, displaying both signals on the same sweep and eliminating the flicker.

Timebase

According to Hameg, the HM203 uses a new type of triggering circuit. There is no need for any sort of stability adjustment, since most of the processing is done by a voltage comparator chip whose TTL output drives the sweep generator directly. The result is trouble-free triggering, even with fast-changing, high-frequency, or low-amplitude signals.

The sweep can be triggered by either vertical channel, the line, or an external source. A choice can be made between a positive or negative trigger edge and the trigger level is adjustable. A time axis can be displayed even when no signal is present—just place the 203 in the Auto trigger mode. Service technicians may be interested in the TV trigger mode which operates off the line or frame frequency.

A non-swept or X-Y mode is available by pressing the Hor Ext switch. The X signal is provided via the Y channel I input. The bandwidth of the X amplifier is approximately 2 MHz, with any phase difference between the two axes becoming apparent above 50 MHz.

Looking Inside

In addition to the controls and inputs already mentioned, the HM203 has front-panel access to the TR (trace rotation) control, which allows you to compensate for variations in the earth's magnetic field that cause a misalignment of the trace. The back panel includes access to the power supply fuse and the ability to change between 110-, 125-, 220-, and 240-volt power sources.

Taking the HM203 apart is simple. You just remove two screws and slide the case off the chassis. Once it's apart, you'll discover a straightforward yet impressive layout. The vast majority of the 203's components reside on two circuit boards. This includes most of the controls which are connected to the front panel via mechanical links. With service in mind, Hameg has used sockets for most of the ICs and FETs. The cathode ray tube is surrounded by Mumetal screening, reducing the likelihood of stray magnetic fields causing a problem.

Accessories and Documentation

The HM203 is ready to use the day it arrives. Each one comes with two X1/X10 probes. The Hameg penchant for quality is seen here—the probes include a compensation adjustment and feature interchangeable tips. Although the 203 is good to almost 30 MHz, the probes supplied top out at around 10 MHz. For measurements in the higher range, you can try some of the other Hameg probes. The line of accessories includes test cables, a 50-Ohm terminator, and a simple component testing jig (to be reviewed in a future issue of *73*).

The HM203 manual thoroughly documents correction operation of the instrument and even includes a brief discussion of errors that can affect your measurements. Plenty of service information is given, with emphasis on diagnosing and correcting the problem without using expensive test gear. A complete set of schematics is included and they are large enough to be pored over by the armchair circuit-design crowd.

Conclusions

Six weeks of using an HM203 at home and at work have reinforced my first opinions about this scope. It works as billed. The drawbacks such as the absence of a continuously-variable vertical attenuator are offset by extras like a built-in calibration signal. I found that the HM203 fulfilled my needs, which vary from designing simple digital-electronics circuits to troubleshooting a flaky SSB modulator to monitoring the stability of the power in the *73* darkroom. (In the darkroom application, the HM203 was left turned on for almost three days and exhibited no signs of instability or drift!)

I would be the first to admit that the HM203 does not equal the performance you get from many laboratory-grade instruments. But how often do you need 100-MHz bandwidth and features such as trace highlighting? The HM203 is adequate for many service jobs and should fill the needs of almost any hobbyist. With a special amateur price of $529, it beats just about everything, including units that you build from a kit.

The HM203 is available from *Rivendell Associates, RFD 5, Warner Hill, Derry NH 03038.* Reader Service number 487.

Tim Daniel N8RK
***73 Magazine* Staff**

MICRO CONTROL SPECIALTIES' VHF/UHF CONTINUOUS-DUTY POWER AMPLIFIER

Reliability is the name of the game when repeater hardware is concerned. The equipment must be of conservative design unless you enjoy unscheduled trips to the repeater site—trips which always seem to entail a 20-mile drive through the season's worst storm.

The power amplifier is a case in point. You can't simply graft an everyday, mobile-type amplifier onto a repeater system and expect it to provide trouble-free service. Such amplifiers are not designed for the long periods of continuous duty which are faced by most repeaters during some part of each day.

A better choice is an amplifier built from the ground up for repeater operation, such as the PA-75 power amplifier from Micro Control Specialties (MCS). This continuous-duty, 75-Watt amplifier is available in 144-, 220-, and 440-MHz versions. It provides full output with 10-15 Watts of drive. In the interest of reliability, each PA-75 is burned in for four (count 'em, four) days before being shipped.

Most VHF/UHF amplifier circuits are designed to operate from a 12-V dc power source. In contrast, the circuits in the PA-75 use 24 V dc, which is produced by a built-in 105-125-V ac supply. The 24-V design means that the amplifier runs more efficiently, and it allows the power supply to be made physically smaller. The amp *will* operate from an external 12-V dc source and automatically switches from the ac lines to the dc source in the event of an ac power failure. Output power is reduced to 50 Watts when the amp operates on 12 V dc. A pair of 2N5643 final transistors gives the PA-75 its punch. The amp features excellent output filtering, with harmonics suppressed at least 65 dB.

The enclosure of the PA-75 fits standard 19-inch equipment racks. The front panel is kept as simple as possible—just three fuse holders and a dc ammeter for measuring amplifier current. Cooling for the finals is provided by a large heat sink and a high-volume fan. The fan also cools the power supply.

In our 2-meter repeater installation, an amplifier was needed to improve the signal on the far side of a mountain ridge. Since we were already using the MCS Mark 3CR repeater with good success, it seemed only natural to give the matching PA-75 a tryout.

Installation could not have been easier. We simply placed the amp in-line after the exciter output and plugged it in. Voila! Our repeater was transformed from a 15-Watt into a 75-Watt machine.

The amateur net price for the PA-75 is $493 for the 2-meter version, $544 for 220 MHz and $595 for 440 MHz. A $50 discount is available if the amp is purchased at the same time as an MCS repeater.

In five months of operation, our PA-75 has been completely trouble-free. It has performed precisely as advertised and has enabled us to fill some annoying gaps in our coverage. The PA-75 is a rugged, reliable answer to the repeater amplifier question.

For more information, contact *Micro Control Specialties, 23 Elm Park, Groveland MA 01834.* Reader Service number 486.

Jeff DeTray WB8BTH
***73 Magazine* Staff**

AWARDS

Bill Gosney KE7C
Micro-80, Inc.
2665 North Busby Road
Oak Harbor WA 98277

WORKED TRUMBULL COUNTY AWARDS

The Warren (Ohio) Amateur Association, Inc., announces its Worked Trumbull County (WTC), Worked Trumbull County Mobile (WTC-M), and Worked Trumbull County YL (WTC-YL) awards. These programs are designed to promote increased amateur radio activity among and with Trumbull County Amateur Radio Operators. The awards are also award operating achievements.

Application: Send applications and all correspondence to Don Lovett K8BXT, Awards Chairman, WARA, PO Box 809, Warren OH. One dollar must accompany applications from W, K, and VE amateurs; all others should send three IRCs with application. Only Trumbull County applicants must submit actual QSL cards. All others should have certification letters from two other radio amateurs who signify that they have seen and checked the applicant's QSLs. Each application must also be accompanied by a list of the calls worked, with full log data for each contact.

Requirements:

- WTC—For each certificate or endorsement, Trumbull County applicants must have 20 contacts with other Trumbull County amateurs. Other W, K, and VE stations must contact 10 Trumbull County amateurs, while DX applicants must have five contacts.
- WTC-M—For each certificate or endorsement, Trumbull County applicants must have 20 contacts with other Trumbull County amateurs operating mobile in Trumbull County. Other W, K, and VE stations must contact 10 Trumbull County amateurs operating mobile in Trumbull County, while DX applicants must have five contacts.
- WTC-YL—For each certificate or endorsement, W, K, and VE stations must contact 10 Trumbull County YL or XYL amateurs, while DX applicants must have three contacts.

Award: A certificate will be issued on each approved application but in order to appear on the certificate, special endorsements must be filed with the initial filing, each containing at least 25 percent new contacts. Initial endorsements are free of charge but endorsements made on later dates will take the form of WTC certificates. Applications for these must contain proper filing fees. Endorsements may be "All One Mode," "All One Band," "All Mobile-to-Mobile," or "All Members of the Warren Amateur Radio Association, Inc."

Net contacts, contacts made through repeaters, and contacts made before January 1, 1959, cannot be counted.

WORLDWIDE AWARDS DIRECTORY, VOL. I

If you like to go after awards or win contests, this directory is a must! Volume I lists over 270 awards from all over the world, with names and addresses, costs, and descriptions. $9.95 brings Volume 1 to your doorstep. Volume 2 is in production now and will cost $5.95 for an additional 130 awards. Why not order Volumes 1 and 2 for a combined price of $12.75? The

Worldwide Awards Directory is for the amateur radio operator who is interested in showing his proficiency to others at radio communications throughout the world. You will never know how easy it is unless you know how to go about it. You probably already have enough QSLs in your files for some of the awards. $9.95 includes all postage and handling. COD extra. Quantity discounts available.

Also, if you know of some awards that you would like listed, please let Larry know and they will appear in the next volume. Write to: Larry Kebel KBØZP, 736-39th Street, West Des Moines IA 50265.

HONG KONG AWARDS

HARTS meets every Tuesday at 1700 local, excluding public holidays, at the China Fleet Club, Arsenal Street, Wanchai, Hong Kong Island.

Nine Dragons Award

One contact with a country in each of the following 9 zones: 18, 19, and 24 to 30. Contact for zone 24 must be a VS6. Stations within the 9 zones require 2 contacts in each zone, with 2 VS6 contacts. Contacts after Jan. 1, 1979, only, are valid. Fees are US $3, Aust. $3, £1.50p. postal order, or 24 IRCs.

Firecracker Award

Six contacts with different VS6 stations. Stations in zones 18, 19, and 24 to 28 require 10 contacts with different VS6 stations. Contacts after January 1, 1964, only, are valid. Fees are US $2, Aust. $2, £1 postal order, or 10 IRCs.

Usual Conditions

Certified log extracts only—no QSL cards are required. Payment to be made in cash; no bank drafts. Postal orders to be left blank. Claims to: Awards Manager, HARTS, GPO Box 541, Hong Kong.

HAROAA AWARDS AND CERTIFICATES

These awards are of high quality and will make a very nice addition to any radio room. The awards are available to all licensed amateurs and amateur stations. Please do not send QSL cards. A list showing full details of the contacts (log information) should be certified by one other amateur or radio club officer. Photocopies of your QSL cards or original log will also be permitted. At your request, special endorsements will be added, such as: CW, SSB, all YL, QRP, RTTY, SSTV, one band, etc. If you so desire, you may request separate awards for each special endorsement. Contacts may be made over any period of years. Contacts made through repeaters cannot be used. Satellites permitted. Please pass this award information along to another amateur or post it at your local club. All correspondence or applications should be sent to: HAROAA, PO Box 341, Hinckley OH 44233, Attn: Awards Manager Gary Zimmerman WB8RTR.

Application for each award must be accompanied by three US dollars to cover handling and award costs. Payment may be made by cash, personal check, money order, ten IRCs, or first-class-rate US postage stamps. DX applicants may send a money order made out in US funds, ten IRCs, or any of the above.

If at any time your award is lost, misplaced, or damaged in any way, send the date, award number, and pertinent information, and we will replace it free of charge. All awards include the special HAROAA gold seal.

Great Lakes Award

This requires one contact with each state bordering the Great Lakes: New York, Pennsylvania, Ohio, Michigan, Indiana, Illinois, Wisconsin and Minnesota.

Super Certificate Hunter Award

This HAROAA award is designed for the serious certificate hunter. To earn this award, you must have a minimum of ten amateur radio operating awards. Simply list the awards that have been issued to you. Special endorsements are 10, 25, 50, 75, 100 plus.

HAROAA DX Award

This is obtained by working DX stations. It is the number of stations worked that is important. Each DX station counts as one, even if several are from the same country or area. Special endorsements for this award are 10, 25, 50, 75, 100, 200 and 500 DX contacts.

HAROAA Insomnia Award

This award is earned by communicating with one other amateur radio station for a minimum of one hour between the hours of 1:00 and 5:00 am. A super conversation piece for your shack.

HAROAA Super Operator Award

This certificate is rendered for those providing a service on behalf of amateur radio, such as weather observation, public service, emergency work, helping a new ham, providing communications for a community function, etc. The requirements are for the applicant to briefly describe the event or service. The officials of HAROAA will determine whether it deserves this special recognition.

HAROAA Official Traffic Handler Award

This award is a self-issued achievement, allowing you to display the fact that you are indeed an official handler of radio traffic.

ISLAND DX AWARD

The IDX Award, sponsored by the Whidbey Island DX Club, is probably one of the most sought after awards in the DX community. This award is available to licensed amateurs and shortwave listeners worldwide.

The IDX Award is issued for

ISLAND DX COUNTRY LISTING

The IDX Awards Program uses DXCC countries which are bona fide "islands" as recognized by the National Geographic Society. The first criterion is that they must have been DXCC countries on or after October 1, 1977, as stated on the DXCC List of the ARRL. Any "qualifying" DXCC country omitted from this list by error or which has been recognized for DXCC after the release of this listing will be added the next time it goes to press. In the meantime, applicants may count these new countries in their tally.

A3	KH1, KB	VP2S
A9X	KH2, KG6	VP2V
BV	KH3, KJ	VP5
C2	KH4, KM	VP8 (Falkland)
C6	KH5, KP6 (King)	VP8, LU (Orkney)
CEØA	KH5, KP6 (Palmyra)	VP8, LU (Sandwich)
CEØX	KH6, AH6, WH6, NH6 (Haw)	VP8, LU (Shetland)
CEØZ	KH6, KH7 (Kure)	VP8, LU (Georgia)
CO, CM, KG4	KH8, KS6	VP9
CT2	KH9, KW	VQ9
CT3	KHØ, KH2, KG6 (Mari)	VR1 (See T3)
D4	KC6 (West)	VR4 (See H4)
D6	KC6 (East)	VR7
DU	KP (Desoth)	VS5, 9M6, 9M8
EA6	KP1, KC4 (Navassa)	VS6
EA8	KP2, KV	VS9 (See 8Q)
EI, GI	KP3, KS4, HKØ (Ran-Ser)	VS9K
FB8W	KP4, NP4 (Puerto Rico)	VU7 (Andaman)
FB8X	KX	VU7 (Lacca)
FB8Z	OHØ	XF4
FC	OJØ	XP (See OX)
FG (Guad)	OX, XP	YB, YC, YD
FG, FS	OY	YJ
FH8	P29	YVØ
FK	PJ (Neth Ant)	ZD7
FM	PJ (St Maarten)	ZD8
FO (Clipperton)	PYØ (Fern)	ZD9
FO (Tahiti)	PYØ (Peter-Paul)	ZF
FP	PYØ (Trini)	ZK1 (North)
FR (Glor.)	S7	ZK1 (South)
FR (Juan)	S9, CR5	ZK2
FR (Reunion)	SV (Crete)	ZL (New Zealand)
FR (Tromlin)	SV (Dodecan)	ZL (Auck-Camp)
FW	T3, VR1 (Central Kiri)	ZL (Chatham)
G, GM, GW (G. Brit)	T3, VR1 (East Kiribat)	ZL (Kerm)
GC, GU (Guern)	T3, VR1 (West Kiribat)	ZM7
GC, GJ (Jersey)	TF	ZS2 (Mari-Pr Ed)
GD	TI9	1S
GI, EI	UA1, UK1 (Franz Jos)	3B6, 3B7
H4, VR4	VE1 (Sable)	3B8
HC8	VE1 (St Paul)	3B9
HH, HI	VK (Lord Howe)	3CØ
HKØ (Bajo)	VK9 (Willis)	3D2
HKØ (Malp)	VK9 (Christmas)	3Y
HKØ (San An)	VK9 (Cocos)	4S
IS	VK9 (Mellish)	5B, ZC
J3, VP2G	VK9 (Norfolk)	5R
J6, VP2L	VKØ (Heard)	5W
J7, VP2D	VKØ (Macquarie)	6Y
JA-JR, KA	VP2A	8Q, VS9
JD, KA1 (Mina)	VP2D (See J7)	8P
JD, KA1 (Ogasa)	VP2E	9H
JD, 7J1 (Okino)	VP2G (See J3)	9M6, 9M8 (See VS5)
JW	VP2K	9V
JX	VP2L (See J6)	9Y
KG4 (See CO, CM)	VP2M	

2 × SSB, 2 × CW, 2 × RTTY, 2 × SSTV, and mixed mode, as well as mixed- and single-band accomplishments. To meet the minimum qualifications, applicants must work fifty (50) IDX islands for the basic award. Endorsements are given in increments of 50 islands, up to and including the maximum number of islands possible.

All DXCC countries which are bonafide "islands" are the only qualifying contacts. A special IDX listing appears within this column. To be valid, all contacts must have been made after October 1, 1977.

To apply, prepare a list of qualifying contacts in prefix order. Please number your contacts 1 through 50, etc. Include the call of the station worked, IDX island name, band, mode, date, and GMT.

Do not send QSL cards! Have your list verified by two amateurs or local radio club officials. Confirmation of each contact must be in the applicant's possession at the time it is being verified.

Send your list of contacts along with $4 in US funds only and a 4- × 9-inch business-size self-addressed stamped envelope to the following address (foreign stations may substitute for the fee by enclosing an SASE and 20 IRCs): Whidbey Island DX Club, Attn: IDX Award, 2665 North Busby Road, Oak Harbor WA 98277.

Rules governing this award program are reviewed annually in the month of September. Please enclose an SASE with any enquiries regarding this award program.

ELMIRA NY

Elmira area amateurs will operate W2ZJ from Chemung County's 1st Annual Good Neighbor Festival 1300Z, July 31 through 2100Z, Aug. 1. Frequencies: 30 kHz up from the lower edge of the General-class phone band on 20, 40, and 80 meters. Special certificate for large SASE to: ARS W2ZJ, General Delivery, Elmira NY 14904.

MT. DAVIS PA

The Somerset County ARC will operate AK3J for the second annual DXpedition from the highest point in Pennsylvania, Mt. Davis, from 1800 UTC August 7th to 1800 UTC August 8th. Frequencies will be the first 25 kHz in the General section for phone and the Novice section for CW. A beautiful certificate will be sent upon receipt of QSL card and $1.00. QSL to Box 468, Somerset PA 15501.

SMYTH COUNTY VA

The amateur radio operators of Smyth County VA, in celebration of the county's sesquicentennial, will be on the air Aug. 21, 1982 from 0000Z until 2100Z. Frequencies will be 15, 40, and 80 meters, up 10 kHz from the bottom of the general phone band and Novice CW band (as activity dictates). The call used will be W4KON. Please QSL with a large SASE for an attractive certificate and booklet about the county to: Ken Sturgill KC4IH, PO Box 526, Marion VA 24354.

SOUTH BASS ISLAND OH

The Huron County Amateur Radio Club will celebrate the 169th anniversary of the Battle of Lake Erie by operating from Perry's Victory and International Peace Memorial on South Bass Island in Lake Erie. The station, WA8HUR, will be on the air beginning at 1000Z August 21, 1982, til 0000Z August 22, 1982. Operating on SSB, the frequencies will be: 3910, 7250, 14280, 21360 and 28550 kHz. The CW station will be found at 40 kHz up from the bottom of each HF band. A Novice station will be found at 3720 kHz and at 7115 kHz. An FM station will be operated on 146.52 MHz. A special QSL card will be issued to all those making contact who send their QSL and an SASE to ARS KF8O.

FLUSH KS

The Kansas State University Amateur Radio CLub, WØQQQ, Manhattan, Kansas, and the Manhattan Area Amateur Radio Society announce the first annual DXpedition to Flush, Kansas, in Pottawatomie County. It will be held on August 29, 1982, for 24 hours of continuous operation beginning at 0000Z.

CW operators can work WØQQQ around 21.112 MHz or 7.112 MHz, and phone operators will find WØQQQ around 14.292 MHz or 3.892 MHz, depending on band conditions.

Successful participants will receive a handsome 8" × 10" certificate by sending an SASE to WØQQQ, Electrical Engineering Dept., Kansas State University, Manhattan KS 66506.

Flush is a quaint metropolis in the beautiful Flint Hills region of Kansas, 12 miles east of Manhattan, home of Kansas State University.

MT. PLEASANT IA

The Mount Pleasant Amateur Radio Club will be operating a station at the Midwest Old Threshers Reunion in Mount Pleasant, Iowa, September 2-6, 1982. Using club call WØMME, they will be operating in the General portion of 80, 40, and 20 meters.

Amateurs from the Mount Pleasant area will also be handling emergency communications on the grounds and will be providing talk-in on 147.99/.39 (WØMME/R) and 146.52 simplex for those attending.

Several hundred amateurs are among the 250,000 people annually that attend this display of memorabilia from America's past. Such things as steam engines, vintage cars, trolley cars, antique radios, and threshing by horse and steam power will be on display.

Hams attending are invited to visit the ham shack and sign the guest book. Admission for the five day event is $4.00. Camping is available on the grounds. For further information, contact Dave Schneider WDØENR, 507 Vine, Mount Pleasant IA 52641.

PIQUA OH

The Piqua Amateur Radio Club (W8SWS/8) of Piqua, Ohio, will operate from the Colonel John Johnston Farmstead, an historical Indian museum, on September 4-6 from 1400 to 0000 UTC.

Colonel Johnston, a federal Indian agent, built his Dutch colonial farmhouse in 1808; it's the only Indian agent house in Ohio. This is Piqua Heritage Festival Days, the first celebration of its kind in the state. Piqua is celebrating its 175th birthday.

A special picture QSL card and 8½" × 11" certificate will be sent to all stations who QSL with a large SASE to Larry Underwood W8UO, 811 N. Sunset Dr., Piqua OH 45356.

Frequencies for W8SWS/8 will be SSB 3.900, 7.250, 14.290, 146.460, and 7.115 (1800-2000 UTC).

PALMYRA

The M.O.T.H.E.R.S. (Marengo Over-The-Hill Electric Radio Society), an informal group of radio amateurs in the north-central Illinois area, have been planning a DXpedition for some time. So far, the destination and duration of the expedition had only been speculation. Last month, however, the destination, Palmyra, was announced. This came after confirmation of a landing permit and operating permission had been received from local authorities. The fact that this Palmyra is located in south-central Wisconsin hasn't dampened the spirits of WB9NKH, K9UA, KF9E, KC9DC, or WA9TAH, the expected operators.

The DXpedition will attempt the landing, initial setup, and possibly some limited operation on September 11, 1982, with a full-blown multi-transmitter operation expected on September 12, 1982, from approximately 0700 to 2100 CDT. The operating frequencies will be up 30 kHz from the bottom of the CW band edges and the General phone band edges.

Since Wisconsin and Illinois have fully reciprocal licensing agreements, the DXpedition will use the call WA9TAH, with QSLs available for an SASE.

CORRECTIONS

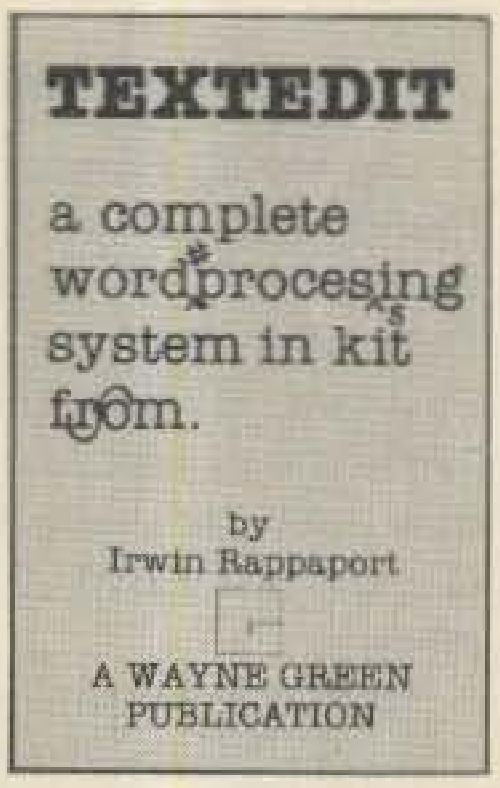
The crystal X1 used in the British VHF converter project (April, 1982) is correctly listed as 38.667 MHz in the text and Parts List. The value shown on the schematic is incorrect.

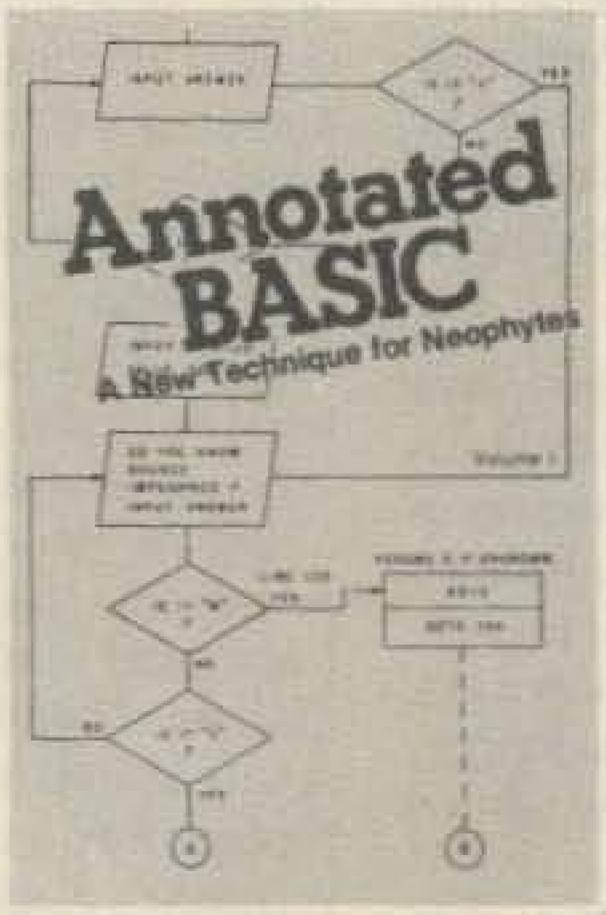
Minor engineering changes made since the design was published include substituting BF274s for the BFW92s used for Q3 and Q4. C6 has been changed from 22 pF to 47 pF.

Tim Daniel N8RK
***73 Magazine* Staff**

Wayne Green Books

NEW ARRIVALS





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by Irwin Rappaport

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—one-key phrase entering
—complete editorial functions
—and much more!

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SATELLITES

SOVIET SURPRISE!

On May 17, World Telecommunications Day, the Soviet Union placed yet another amateur radio satellite into orbit. However, the unusual manner of its launch and the technical details so far released make it clear that this is no ordinary amateur bird.

The satellite, called ISKRA-2 ("iskra" is Russian for "spark"), was put into orbit by two Soviet cosmonauts who simply pushed the spacecraft out an airlock aboard the Salyut 7 orbiting space station. Several sources, including Radio Budapest, have said that ISKRA-2 carries a 15-to-10-meter communications transponder, which would be the first use of the 21-MHz band for an amateur communications satellite. Telemetry beacons from the new bird have been copied on the high end of 10 meters at 29.576 and 29.875 MHz, using the callsign RK02. At press time, no transponder activity had been heard.

ISKRA-2 is in a rather low orbit, less than 225 miles high. This means that the satellite will have a rather limited lifetime, unless it carries some means by which to raise its orbit.

The launch, which was shown on Soviet television, is apparently only the second of its kind. In 1972, the Apollo 16 astronauts placed a small satellite into orbit around the moon.

PHASE IIIB

It now appears that the long-awaited launch of the Phase IIIB satellite will take place next January and not this summer, as had been hoped. The delay comes as a result of problems with the government and scientific satellites which are the primary payloads for the European Space Agency's Ariane rocket.

Phase IIIB is now scheduled to fly aboard the seventh flight of Ariane, but until the problems with the other satellites are solved, no launches can take place. Meanwhile, the amateur Phase IIIB bird is ready to go.

Thanks to *AMSAT Satellite Report.*

THAT BIG TABLE

Our monthly table of amateur satellite data this month takes on a new form, designed to pack a lot more information into only a little more space. Joining the usual data for OSCAR 8 are reference orbit predictions for four of the Soviet Radio Sputniks, RS-5 through RS-8. Each of these five satellites carries at least one operating communications transponder or robot (automatic QSO device).

This table provides reference orbit data for each day of the month on the cover of this magazine, plus the first half of the following month. For each day during this period, two items of information are given for each of the five satellites. The first number (UTC) is the time (Universal Coordinated Time—same as GMT for most purposes) of the satellite's first northbound equatorial crossing of the day. The second number (EQX) is the longitude (degrees west) at which that crossing occurs. The data in the table is based on the Project OSCAR, Inc., orbital predictions.

Using these two numbers, there are a variety of ways to determine when any of the satellites will be within range of your location. If you have a microcomputer or programmable calculator at your disposal, you can make use of one of several programs published in *73* and other amateur publications. The new AMSAT Software Exchange has a good selection of satellite tracking programs. The OSCARLOCATER package from the ARRL gets the job done in a simple but effective manner. A completely manual method for making rough estimates of satellite accessibility was presented in the October, 1981, issue of *73*, page 178.

Addresses: AMSAT Software Exchange, Box 338, Ashmore IL 61912. ARRL, 225 Main Street, Newington CT 06111.—Jeff DeTray WB8BTH.

Amateur Satellite Reference Orbits

		OSCAR 8		RS-5		RS-6		RS-7		RS-8		
Date		UTC	EQX	UTC	EQX	UTC	EQX	UTC	EQX	UTC	EQX	Date
Aug	1	0022	79	0021	159	0148	183	0153	183	0153	182	1
	2	0026	81	0016	159	0133	180	0144	182	0150	182	2
	3	0031	82	0010	159	0117	178	0134	181	0148	183	3
	4	0035	83	0005	159	0102	176	0124	181	0145	184	4
	5	0039	84	0000	159	0047	174	0115	180	0142	185	5
	6	0044	85	0154	190	0031	171	0105	179	0139	186	6
	7	0048	86	0148	190	0016	169	0056	178	0136	186	7
	8	0053	88	0143	190	0000	167	0046	177	0133	187	8
	9	0057	89	0138	190	0144	194	0036	176	0131	188	9
	10	0101	90	0132	190	0128	192	0027	175	0128	189	10
	11	0106	91	0127	190	0113	189	0017	174	0125	190	11
	12	0110	92	0122	191	0058	187	0007	174	0122	190	12
	13	0115	93	0116	191	0042	185	0157	203	0119	191	13
	14	0119	95	0111	191	0027	182	0147	202	0117	192	14
	15	0123	96	0106	191	0011	180	0138	201	0114	193	15
	16	0128	97	0100	191	0155	208	0128	200	0111	194	16
	17	0132	98	0055	192	0139	205	0118	199	0108	195	17
	18	0137	99	0050	192	0124	203	0109	198	0105	195	18
	19	0141	100	0044	192	0109	201	0059	197	0102	196	19
	20	0002	76	0039	192	0053	198	0049	196	0100	197	20
	21	0007	77	0034	192	0038	196	0040	195	0057	198	21
	22	0011	78	0028	193	0022	194	0030	195	0054	199	22
	23	0015	79	0023	193	0007	191	0021	194	0051	199	23
	24	0020	80	0018	193	0150	219	0011	193	0048	200	24
	25	0024	81	0012	193	0135	216	0001	192	0046	201	25
	26	0029	83	0007	193	0120	214	0151	221	0043	202	26
	27	0033	84	0002	194	0104	212	0141	220	0040	203	27
	28	0037	85	0156	224	0049	209	0132	219	0037	204	28
	29	0042	86	0150	224	0033	207	0122	218	0034	204	29
	30	0046	87	0145	224	0018	205	0112	217	0031	205	30
	31	0050	88	0140	224	0003	202	0103	217	0029	206	31
Sep	1	0055	90	0134	224	0146	230	0053	216	0026	207	1
	2	0059	91	0129	225	0131	228	0043	215	0023	208	2
	3	0104	92	0124	225	0115	225	0034	214	0020	208	3
	4	0108	93	0118	225	0100	223	0024	213	0017	209	4
	5	0112	94	0113	225	0044	221	0014	212	0015	210	5
	6	0117	95	0108	225	0029	218	0005	211	0012	211	6
	7	0121	97	0102	226	0014	216	0154	240	0009	212	7
	8	0126	98	0057	226	0157	243	0145	239	0006	213	8
	9	0130	99	0052	226	0141	241	0135	238	0003	213	9
	10	0134	100	0046	226	0126	239	0125	238	0000	214	10
	11	0139	101	0041	226	0111	236	0116	237	0157	245	11
	12	0000	77	0036	227	0055	234	0106	236	0155	246	12
	13	0004	78	0030	227	0040	232	0057	235	0152	247	13
	14	0009	79	0025	227	0025	229	0047	234	0149	248	14

W2NSD/1
NEVER SAY DIE
editorial by Wayne Green

from page 8

hibit had a nice restaurant with no wait at all, right in the middle of the lunch hour.

Sherry and I went to the restaurant in the Chinese exhibit for dinner. Tom Salvetti, of Ten-Tec, was with us and we went right in with no wait at all. The food was real Chinese. It was good, but not outstanding. Sherry prefers to use chopsticks when eating Asian food and this was a bit of a problem. The waiter, a Chinese lad from the Knoxville area, explained that they only had three sets of chopsticks for the whole restaurant! He managed to get one of the sets for her, but the rest of us had to eat with forks.

The food prices are a bit above what I'd normally expect, but not astronomical. China seems to be getting all she can out of the fair (they *need* dollars, so that's not a surprise), with their dinners running around $14 per person. That's as bad as a banquet price. Belgian waffles were $2.10 instead of perhaps $1.50. . . and so on. High, but not prohibitive. They have to get their $110 million back some way, don't they?

In all, I would suggest that if you are going to be anywhere near the Knoxville area, you should allow a couple of days to see the fair. Never mind all the put-downs. . . it's a good show and the people couldn't be more friendly.

ROCHESTER

The debacle of '81 still hung heavy over the 1982 running of the Rochester Hamfest. It's still a shadow of former years, but perhaps with the relaxation of harassment by the tax people, the exhibitors and then the crowds will be back.

This year there was but *one* major manufacturer exhibiting: Hy-Gain/Telex. A few dealers were there, hoping that the New York tax people would not bring in the police and threaten again to close down the whole show. The dealers seemed to feel that business was okay, considering the economy.

There is a plan to move the banquet to Friday night and keep the show to one day on Saturday. This would allow hams to arrive the night before, attend the banquet, and then spend the day at the show. After a full day of browsing around the flea market, most hams are too tired to wait for the banquet; they just drive home to rest. It may be better to run it Friday night. It's worth a try.

After all of the fuss from *CQ* about attending hamfests, guess who was not there? Heh, heh! But then *Ham Radio* was also conspicuously absent. They seem to have pulled in their horns almost completely and become invisible. *73*'s Jim Gray was there to keep 'em honest. . . answer questions and fly the flag.

Speaking of the magazines, guess who was at the ARRL booth? There were a lot of rotten remarks about Harry being dead and refusing to lie down. I think that sort of thing is in poor taste. As I've written, I think the least the board could have done for Harry is to make him a president emeritus like they did the previous president. And if they have any real case against him for malfeasance, I think they should bring it out in the open, not just make sly hints about it. Harry should be given the credit he deserves for building up the League, for promoting satellite communications, and for his enthusiasm for packet communications, RTTY, and so on. Let's not have another of those crummy deals like they pulled on Don Miller.

Other than that, Rochester was upbeat this year, looking better. But Harold Smith was almost invisible again this year. . . where *are* you, Harold? He's the one who almost singlehandedly organized and built up the hamfest over the years, turning it from a small independent effort into a genuine ARRL hamfest.

FCC NEWS

The FCC has extended the deadline for filing comments on Docket 82-83 to August 16. Reply comments are due September 16. Docket 82-83 proposes wider phone bands. For more information, see pages 143-145 of the May, 1982, issue of *73*.

The return time limit for Novice exams was extended to 60 days, effective May 6, 1982. This change will be of interest to volunteer examiners who previously had 30 days to return the test papers.

SADDLE STITCHING

In addition to the cover design change, we are also changing to what is called "saddle stitching" of the binding. The idea is to get back to the way we used to be when *73* was running a raft of small construction projects. We want to make the magazine easy to open up while you are working on a project. With the square binding, called "perfect binding," the magazine may look better, but it is a bitch to keep open on the workbench. I really hate it when the magazine flips closed while I'm wiring some chips together.

We're going to be concentrating on publishing as many relatively simple construction projects as we can scare up for you, so get your soldering iron out and start shopping for parts.

A NEW COVER. . . AGAIN?

Sure, why not? Every few years we get kind of fed up with everything being the same. We look around for ways to make *73* better. . . or worse, depending on your reactions to change.

The new cover solves some serious problems for us. First, it will stop the continuous flack we've been getting from *73* readers who liked the old contents type of covers. It *is* a lot easier to find things when the table of contents is right there on the cover, no question about that. And since virtually 100% of the *73* readers save their magazines religiously and use them for reference, this is a big plus.

Another problem was our desire to use color pictures brought back from DXpeditions on the cover. If you are not into photography, you may not know that 35mm color pictures can't be enlarged to the full cover size without getting fuzzy. Normally we would want to use a larger film format camera for cover shots. . . such as a 6 x 6 cm or a 6 x 7 cm such as the Hassleblad or Mamiya RB-67 cameras. These will enlarge and provide sharp cover pictures. Just look at some of the cover pictures on *QST* in recent months and you'll see what I mean. . . fuzzy.

By running the pictures in a smaller format on the cover, they will be nice and sharp. . . and look better. Also, we'll be able to run maybe two or three pictures instead of just one.

I realize that you probably are no more a fan of change than I am and will take a few months to get used to the new look. For all my insistence on change being important in amateur radio, I'm as much of a stick in the mud when it comes to change as you probably are. Let's try it and see how it plays.

HAM HELP

I need help on my code speed for the General ticket.

Howard Halperin WB7WDI
4122 West Flower St.
Phoenix AZ 85019

Wanted: Information on the Gonset Model 900A 2-meter Sidewinder. I would like to get in touch with anyone with parts for this unit or who can suggest where these parts can be found.

Peter Mitroff VE3DSW
8 Marsten Dr.
St. Catharines ONT L2N 3C7
Canada

I would like any information on the Globe Electronics HG 303, including manuals and schematics. I will purchase at a reasonable price or will make copies and send an extra set of copies back to you with the original.

Al Wilde W8JZZ
5580 E. Galbraith Rd.
Cincinnati OH 45236

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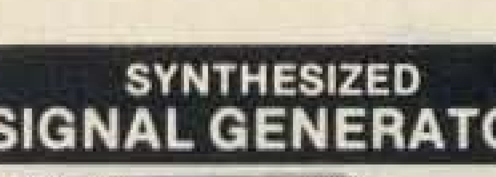

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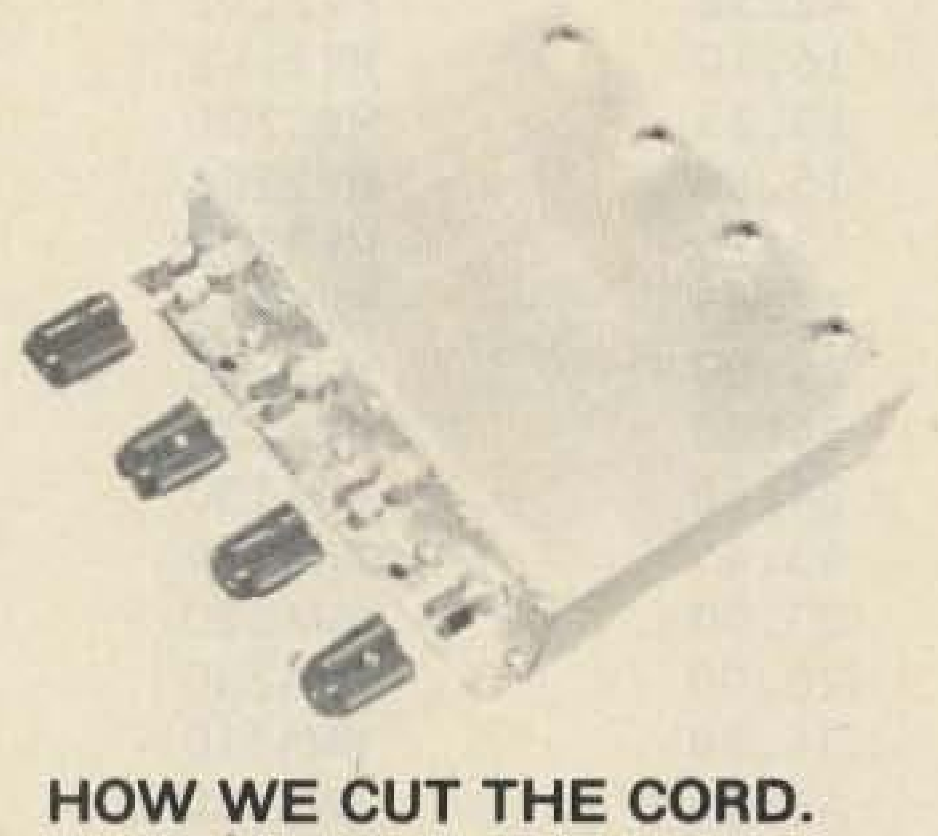

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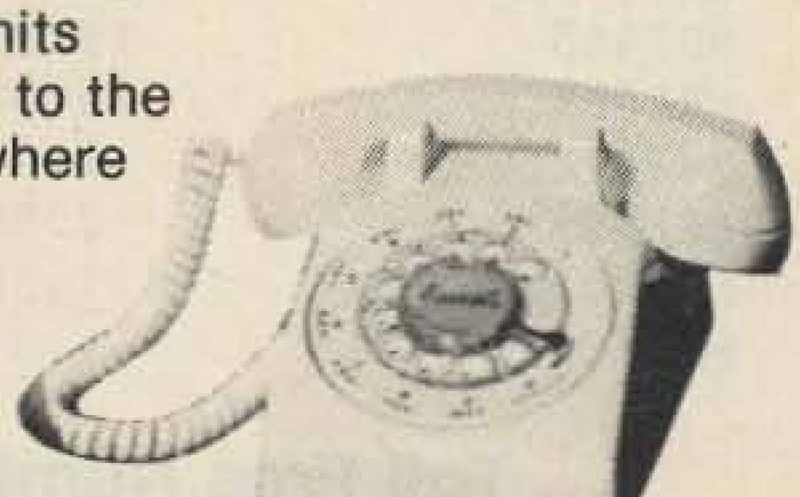

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2N5591	13.80	BFW92	1.50	5082-8323 H.P.	POR
2N5635	10.95	BFX89	1.00	35826E H.P.	POR
2N5637	15.50	BFY90	1.00	35831E H.P.	29.99
2N5641	9.20	BGY54	25.00	35853E H.P.	71.50
2N5642	10.95	BGY55	25.00	35854E H.P.	75.00
2N5643	15.50	BGY74	25.00	HPA0241 H.P.	75.60
2N5645	13.80	BGY75	25.00	HXTR3101 H.P.	7.00
2N5646	20.70	BL161	10.00	HXTR3102 H.P.	8.75
2N5691	18.00	BLX67	11.00	HXTR6101/2N6617 H.P.	55.00
2N5764	27.00	BLY568CF	25.00	HXTR6104 H.P.	68.00
2N5836	5.45	BLY87	13.00	HXTR6105 H.P.	31.00
2N5842	8.00	BLY88	14.00	HXTR6106 H.P.	33.00
2N5849	20.00	BLY89	15.00	QSCH1995 H.P.	POR
2N5913	3.25	BLY90	20.00	J02000 TRW	10.00
2N5922	10.00	BLY351	10.00	J02001 TRW	25.00
2N5923	25.00	C4005	20.00	J04045 TRW	25.00
2N5941	23.00	CA402 (TRW)	25.00	K3A	10.00
2N5942	40.00	CA405 (TRW)	25.00	MA450A	10.00
2N5944	9.20	CA612B (TRW)	25.00	MA41487	POR
2N5945	11.50	CA2100 (TRW)	25.00	MA41765	POR
2N5946	19.00	CA2113 (TRW)	25.00	MA43589	POR
2N6080	9.20	CA2200 (TRW)	25.00	MA43636	POR
2N6081	10.35	CA2213 (TRW)	25.00	MA47044	POR
2N6082	11.50	CA2418 (TRW)	25.00	MA47651	25.50

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"TRANSISTORS"

WATKINS JOHNSON WJ-M62 3.7 to 4.2GHz Communication Band Double Balanced Mixer $100.00

```
SSB Conversion Loss 4.9dB Typ. 6dB Max. fR 3.7 to 4.2GHz
                    5.5dB Typ. 6.5dB Max. fI DC to 1125MHz fL fR
                                          fI 880MHz fL fR
SSB Noise Fiqure                        fR 3.7 to 4.2GHz
                    4.9dB Typ. 6dB Max.   fI 30 to 1125MHz fL fR
                    5.5dB Typ. 6.5dB Max. fI 880MHz fL fR
Isolation
     fL at R        30dB Min. 40dB Typ.   fL 2.8 to 5.35GHz
     fL at I        25dB Min. 30dB Typ.   fL 4.5 to 5.35GHz
                    20dB Min. 30dB Typ.   fL 3.6 to 4.5GHz
                    15dB Min. 25dB Typ.   fL 2.8 to 3.6GHz
Conversion Compression   1dB Max.         fR Level +2dBm
Flatness                 .2dB Peak to Peak Over any 40MHz Segment of fR=3.7 to 4.2GHz
Third Order Input Intercept +11dBm        fR1=4GHz fR2=4.01GHz Both at -5dBm fL=4.5GHz
Group Time Delay    .5ns Typ. .75ns Max. fR3.7 to 4.2GHz fL 3480MHz          @ +13dBm
VSWR                L-Port    1.25:1 Typ.  2.0:1    fL 2.8 to 5.35GHz
                    R-Port    1.25:1 Typ.  2.0:1    fR 3.7 to 4.2GHz fL fR
                              1.4 :1 Typ.  2.0:1    fR 3.7 to 4.2GHz fL fR
                    I-Port    1.5 :1 Typ.  2.0:1    fI=100MHz
                              1.3 :1 Typ.  2.0:1    fI=500MHz
                              1.8 :1 Typ.  2.5:1    fI=1125MHz
```

SGS/ATES RF Transistors			Motorola RF Transistor	
Type.	BFQ85	BFW92	MRF901	2N6603
Collector Base V	20v	25v	25v	25v
Collector Emitter V	15v	15v	15v	15v
Emitter Base V	3v	2.5v	3v	3v
Collector Current	40ma	25ma	30ma	30ma
Power Dissipation	200mw	190mw	375mw	400mw
HFE	40min. 200max.	20min. 150max.	30min. 200max.	30min. 200max.
FT	4GHZ min. 5GHz max.	1.6GHz Typ.	4.5GHz typ.	2GHz min.
Noise Fiqure	1GHz 3dB Max.	500MHz 4dB Typ.	1GHz 2dB Typ.	2GHz 2.9dB Typ.
Price	$1.50	$1.50	$2.00	$10.00

National Semiconductor Variable Voltage Regulator Sale !!!!!!!!!

LM317K	LM350K	LM723G/L	LM7805/06/08/12/15/18/24
1.2 to 37vdc	1.2 to 33vdc	2 to 37vdc	5, 6, 8,12,15,18,24vdc
1.5Amps	3Amps	150ma.	1Amp
TO-3	TO-3	TO-100/TO-116	TO-220/TO-3
$4.50	$5.75	$1.00 $1.25	$1.17 $2.00

P & B Solid State Relays Type ECT1DB72

5VDC Turn On 120VAC Contact 7Amps
20Amps on 10"x10"x.062" Alum.Heatsink with
Silicon Grease $5.00

*May Be Other Brand Equivalent

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"SOCKETS AND CHIMNEYS"

EIMAC TUBE SOCKETS AND CHIMNEYS

SK110	Socket	$ POR	SK626	Chimney	$ 7.70
SK406	Chimney	35.00	SK630	Socket	45.00
SK416	Chimney	22.00	SK636B	Chimney	26.40
SK500	Socket	330.00	SK640	Socket	27.50
SK506	Chimney	47.00	SK646	Chimney	55.00
SK600	Socket	39.50	SK711A	Socket	192.50
SK602	Socket	56.00	SK740	Socket	66.00
SK606	Chimney	8.80	SK770	Socket	66.00
SK607	Socket	43.00	SK800A	Socket	150.00
SK610	Socket	44.00	SK806	Chimney	30.80
SK620	Socket	45.00	SK900	Socket	253.00
SK620A	Socket	50.50	SK906	Chimney	44.00

JOHNSON TUBE SOCKETS

124-115-2/SK620A	Socket	$ 30.00	124-113	Bypass Cap.	$ 10.00
124-116/SK630A	Socket	40.00	122-0275-001	Socket (For 4-250A, 4-400A, 3-400Z, 3-500Z)	10.00 2/$15.00

CHIP CAPACITORS

.8pf	10pf	100pf*	430pf
1pf	12pf	110pf	470pf
1.1pf	15pf	120pf	510pf
1.4pf	18pf	130pf	560pf
1.5pf	20pf	150pf	620pf
1.8pf	22pf	160pf	680pf
2.2pf	24pf	180pf	820pf
2.7pf	27pf	200pf	1000pf/.001uf*
3.3pf	33pf	220pf*	1800pf/.0018uf
3.6pf	39pf	240pf	2700pf/.0027uf
3.9pf	47pf	270pf	10,000pf/.01uf
4.7pf	51pf	300pf	12,000pf/.012uf
5.6pf	56pf	330pf	15,000pf/.015uf
6.8pf	68pf	360pf	18,000pf/.018uf
8.2pf	82pf	390pf	

PRICES: 1 to 10 - .99¢ 101 to 1000 .60¢ * IS A SPECIAL PRICE: 10 for $7.50
11 to 50 - .90¢ 1001 & UP .35¢ 100 for $65.00
51 to 100 - .80¢ 1000 for $350.00

WATKINS JOHNSON WJ-V907: Voltage Controlled Microwave Oscillator $110.00

Frequency range 3.6 to 4.2GHz, Power ouput, Min. 10dBm typical, 8dBm Guaranteed. Spurious output suppression Harmonic (nf_0), min. 20dB typical, In-Band Non-Harmonic, min. 60dB typical, Residual FM, pk to pk, Max. 5KHz, pushing factor, Max. 8KHz/V, Pulling figure (1.5:1 VSWR), Max. 60MHz, Tuning voltage range +1 to +15volts, Tuning current, Max. -0.1mA, modulation sensitivity range, Max. 120 to 30MHz/V, Input capacitance, Max. 100pf, Oscillator Bias +15 +-0.05 volts @ 55mA, Max.

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TUBES

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
2E26	$ 5.69	KT88	$ 20.00	6562/6974A	$ 50.00
2K28	100.00	DX362	50.00	6832	22.00
2X1000A	300.00	DX415	50.00	6883/8032A/8552	7.00
3B22	19.75	572B/T160L	49.00	6897	110.00
3B28/866A	7.50	592/3-200A3	144.00	6907A	75.00
3-500Z	102.00	807	7.50	6939	15.00
3-1000Z	400.00	811	10.00	7094	125.00
3CX1000A/8283	428.00	811A	15.00	7117	17.00
3CX1500A7/887	533.00	812A	35.00	7211	60.00
3X2500A3	200.00	813	50.00	7289/3CX100A5	34.00
3CX3000A7	490.00	829B	38.00	7360	11.00
4-65A/8165	45.00	832A	28.00	7377	67.00
4-125A/4D21	58.00	4624	310.00	7408	4.00
4-250A/5D22	75.00	4662	80.00	7650	250.00
4-400A/8432	90.00	4665	585.00	7695	8.00
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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TEKTRONIX OSCILLOSCOPES	PRICE
MODEL 453 Portable 50 MHz Dual Trace.	$1200.00
MODEL 453A Portable 60 MHz Dual Trace.	$1400.00
MODEL 454 Portable 150 MHz Dual Trace.	$1800.00
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
MODEL 7514 Storage Oscilloscope with a 7A15A and a 7A15AN-11 Amplifier and a 7B50 Time Base.	$3500.00
MODEL 577D1 Storage Curve Tracer with a 177 adapter.	$3233.00
MODEL 577D2 Curve Tracer with a 177 adapter.	$2796.00
Tektronix Lab Cart Model 3	$ 316.00
MODEL 547 50 MHz Bench Scope.	
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

HEWLETT PACKARD OSCILLOSCOPES	PRICE
MODEL 180A Main Frame.	$ 675.00
MODEL 180E Main Frame.	$ 750.00
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
1831A Direct Access 600 MHz.*	$ 200.00
1840A Time Base & Delay Generator.*	$ 450.00
1841A Time Base & Delay Generator.*	$ 675.00
*For 183A Only. !!!!!!!!	
TELEQUIPMENT MODEL D83 Oscilloscope Dual Trace Portable 50 MHz. With a V4 and S2A Plug-In.	$1200.00
DUMONT MODEL 1062 Oscilloscope Dual Trace 65 MHz portable.	$ 750.00
TEKTRONIX	
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.

SALES TAX: Arizona must add 5% sales tax, unless a signed Arizona resale tax card is currently on file with MHZ Electronics. All orders placed by persons outside of Arizona, but delivered to persons in Arizona are subject to the 5% sales tax.

SHORTAGE OR DAMAGE: All claims for shortages or damages must be made within 5 days after receipt of parcel. Claims must include our invoice number and the date of purchase. Customers which do not notify us within this time period will be held responsible for the entire order as we will consider the order complete.

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NO INFORMATION WILL BE GIVEN. 1-800-528-0180.

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	$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	$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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TERMS: DOMESTIC: Prepaid, C.O.D. or Credit Card
FOREIGN: Prepaid only, U.S. Funds—money order or cashier's check only.

C.O.D.: Acceptable by telephone or mail. Payment from customer will be by cash, money order or cashier's check. We are sorry but we cannot accept personal checks for C.O.D.'s.

CONFIRMING ORDERS: We would prefer that confirming orders not be sent after a telephone order has been placed. If company policy necessitates a confirming order, please mark "CONFIRMING" boldly on the order. If problems or duplicate shipments occur due to an order which is not properly marked, customers will be held responsible for any charges incurred, plus a 15% restock charge on returned parts.

CREDIT CARDS: WE ACCEPT MASTERCARD VISA AND AMERICAN EXPRESS.

DATA SHEETS: When we have data sheets in stock on devices we do supply them with the order.

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ramsey **the first name in Counters!**

9 DIGITS 600 MHz $129.95 WIRED

PRICES

CT-90 wired, 1 year warranty	$129.95
CT-90 Kit, 90 day parts warranty	109.95
AC-1 AC adapter	3.95
BP-1 Nicad pack + AC Adapter/Charger	12.95
OV-1, Micro-power Oven time base	49.95
External time base input	14.95

The CT-90 is the most versatile, feature packed counter available for less than $300.00! Advanced design features include; three selectable gate times, nine digits, gate indicator and a unique display hold function which holds the displayed count after the input signal is removed! Also, a 10mHz TCXO time base is used which enables easy zero beat calibration checks against WWV. Optionally; an internal nicad battery pack, external time base input and Micro-power high stability crystal oven time base are available. The CT-90, performance you can count on!

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 10 MV to 150 MHz Less than 50 MV to 500 MHz
Resolution:	0.1 Hz (10 MHz range) 1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	9 digits 0.4" LED
Time base:	Standard-10.000 mHz, 1.0 ppm 20-40°C. Optional Micro-power oven-0.1 ppm 20-40°C
Power:	8-15 VAC @ 250 ma

7 DIGITS 525 MHz $99.95 WIRED

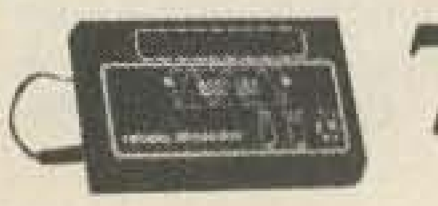
SPECIFICATIONS:

Range:	20 Hz to 525 MHz
Sensitivity:	Less than 50 MV to 150 MHz Less than 150 MV to 500 MHz
Resolution:	1.0 Hz (5 MHz range) 10.0 Hz (50 MHz range) 100.0 Hz (500 MHz range)
Display:	7 digits 0.4" LED
Time base:	1.0 ppm TCXO 20-40°C
Power:	12 VAC @ 250 ma

The CT-70 breaks the price barrier on lab quality frequency counters. Deluxe features such as; three frequency ranges - each with pre-amplification, dual selectable gate times, and gate activity indication make measurements a snap. The wide frequency range enables you to accurately measure signals from audio thru UHF with 1.0 ppm accuracy - that's .0001%! The CT-70 is the answer to all your measurement needs, in the field, lab or ham shack.

PRICES:

CT-70 wired, 1 year warranty	$99.95
CT-70 Kit, 90 day parts warranty	84.95
AC-1 AC adapter	3.95
BP-1 Nicad pack + AC adapter/charger	12.95



7 DIGITS 500 MHz $79.95 WIRED

PRICES:

MINI-100 wired, 1 year warranty	$79.95
AC-Z Ac adapter for MINI-100	3.95
BP-Z Nicad pack and AC adapter/charger	12.95

Here's a handy, general purpose counter that provides most counter functions at an unbelievable price. The MINI-100 doesn't have the full frequency range or input impedance qualities found in higher price units, but for basic RF signal measurements, it can't be beat! Accurate measurements can be made from 1 MHz all the way up to 500 MHz with excellent sensitivity throughout the range, and the two gate times let you select the resolution desired. Add the nicad pack option and the MINI-100 makes an ideal addition to your tool box for "in-the-field" frequency checks and repairs.

SPECIFICATIONS:

Range:	1 MHz to 500 MHz
Sensitivity:	Less than 25 MV
Resolution:	100 Hz (slow gate) 1.0 KHz (fast gate)
Display:	7 digits, 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	5 VDC @ 200 ma

8 DIGITS 600 MHz $159.95 WIRED

NEW READ RECEIVER FREQUENCY

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 25 mv to 150 MHz Less than 150 mv to 600 MHz
Resolution:	1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	8 digits 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	110 VAC or 12 VDC

The CT-50 is a versatile lab bench counter that will measure up to 600 MHz with 8 digit precision. And, one of its best features is the Receive Frequency Adapter, which turns the CT-50 into a digital readout for any receiver. The adapter is easily programmed for any receiver and a simple connection to the receiver's VFO is all that is required for use. Adding the receiver adapter in no way limits the operation of the CT-50, the adapter can be conveniently switched on or off. The CT-50, a counter that can work double-duty!

PRICES:

CT-50 wired, 1 year warranty	$159.95
CT-50 Kit, 90 day parts warranty	119.95
RA-1, receiver adapter kit	14.95
RA-1 wired and pre-programmed (send copy of receiver schematic)	29.95

DIGITAL MULTIMETER $99.95 WIRED

PRICES:

DM-700 wired, 1 year warranty	$99.95
DM-700 Kit, 90 day parts warranty	79.95
AC-1, AC adaptor	3.95
BP-3, Nicad pack +AC adapter/charger	19.95
MP-1, Probe kit	2.95

The DM-700 offers professional quality performance at a hobbyist price. Features include; 26 different ranges and 5 functions, all arranged in a convenient, easy to use format. Measurements are displayed on a large 3½ digit, ½ inch LED readout with automatic decimal placement, automatic polarity, overrange indication and overload protection up to 1250 volts on all ranges, making it virtually goof-proof! The DM-700 looks great, a handsome, jet black, rugged ABS case with convenient retractable tilt bail makes it an ideal addition to any shop.

SPECIFICATIONS:

DC/AC volts:	100uV to 1 KV, 5 ranges
DC/AC current:	0.1uA to 2.0 Amps, 5 ranges
Resistance:	0.1 ohms to 20 Megohms, 6 ranges
Input impedance:	10 Megohms, DC/AC volts
Accuracy:	0.1% basic DC volts
Power:	4 'C' cells

AUDIO SCALER

For high resolution audio measurements, multiplies UP in frequency.

- Great for PL tones
- Multiplies by 10 or 100
- 0.01 Hz resolution!

$29.95 Kit $39.95 Wired

ACCESSORIES

Telescopic whip antenna - BNC plug	$ 7.95
High impedance probe, light loading	15.95
Low pass probe, for audio measurements	15.95
Direct probe, general purpose usage	12.95
Tilt bail, for CT 70, 90, MINI-100	3.95
Color burst calibration unit, calibrates counter against color TV signal	14.95

COUNTER PREAMP

For measuring extremely weak signals from 10 to 1,000 MHz. Small size, powered by plug transformer-included.

- Flat 25 db gain
- BNC Connectors
- Great for sniffing RF with pick-up loop

$34.95 Kit $44.95 Wired

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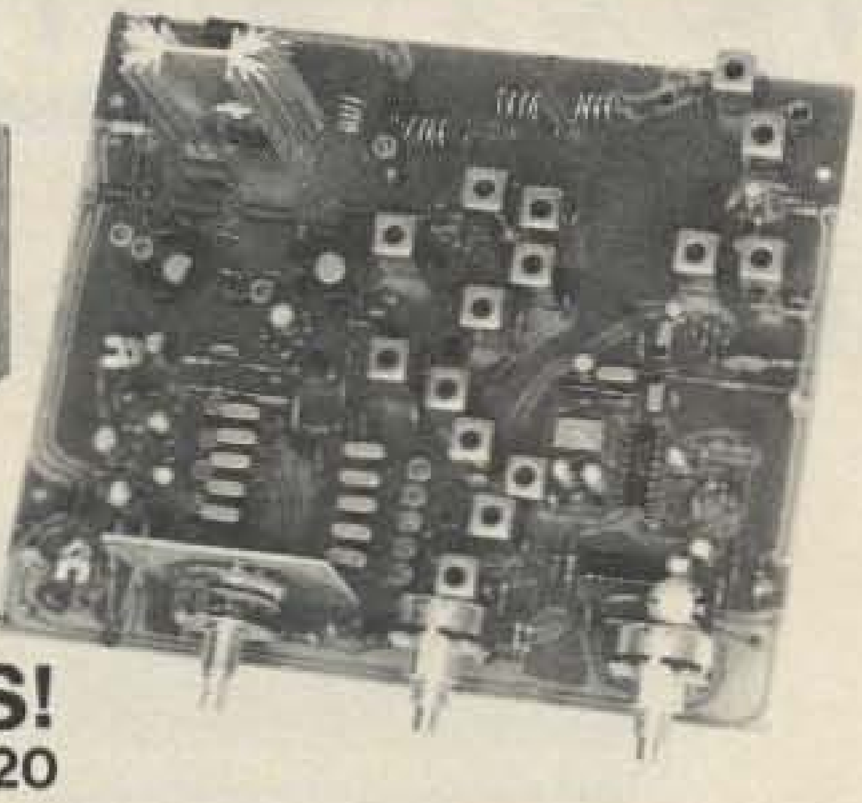
-NEW-



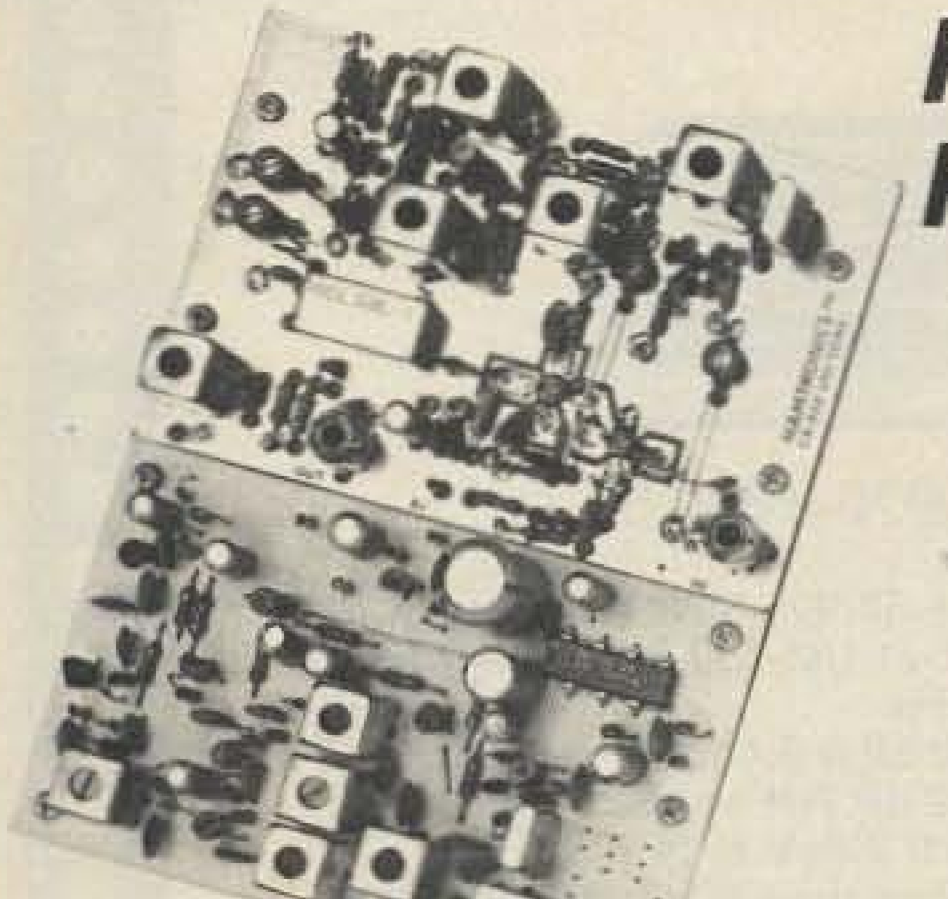
FM-5 PC Board Kit - **ONLY $159.95**
complete with controls, heatsink, etc.

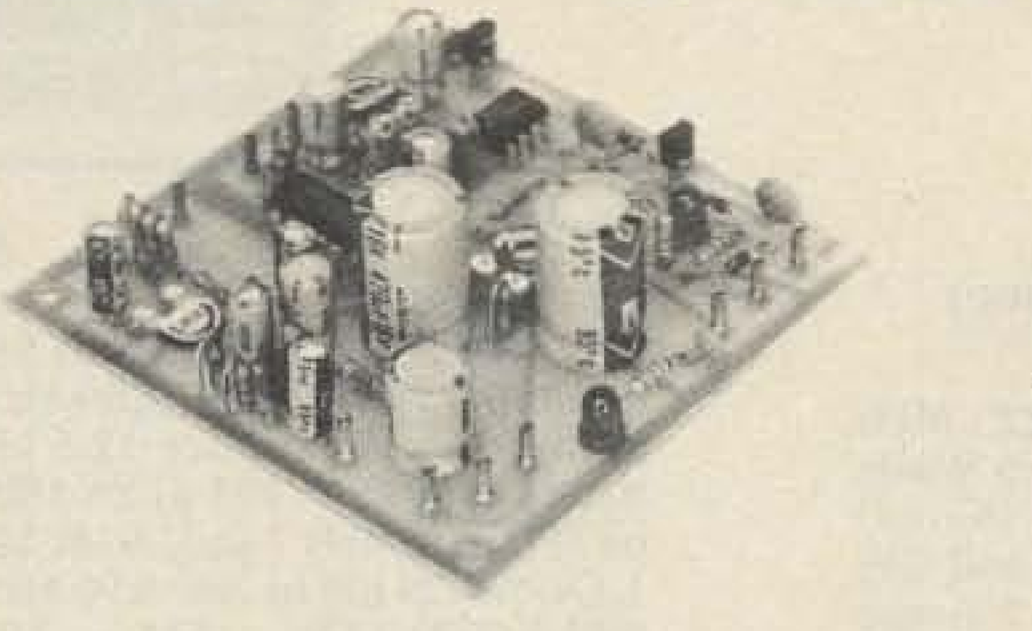
★ **SPECIAL OFFER** Free cabinet kit, complete with speaker, knobs, connectors, hardware. A $59.95 value, yours free with purchase of kit. Hurry! Offer limited. ★

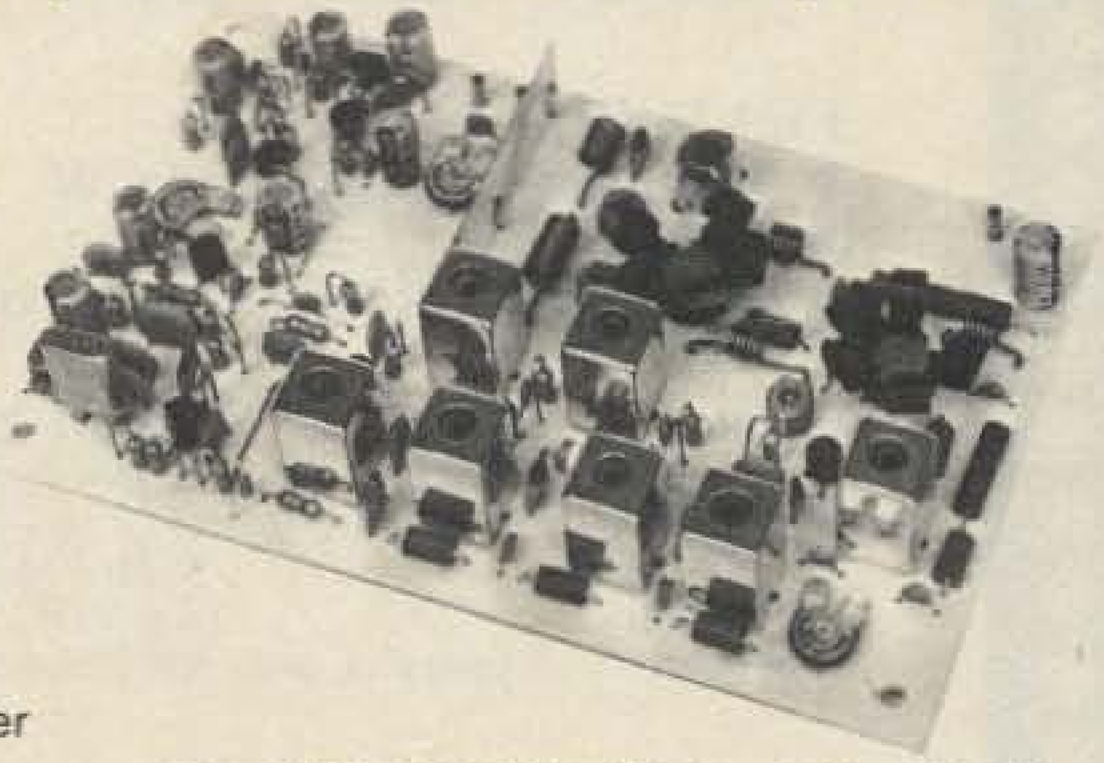
SAVE A BUNDLE ON VHF FM TRANSCEIVERS!

10 watts, 5 Channels, for 6M, 2M, or 220

HIGH QUALITY FM MODULES FOR REPEATERS, LINKS, TELEMETRY, ETC.







- **R76 VHF FM RECEIVER** for 10M, 6M, 2M, 220, or commercial bands. Fantastic selectivity options. Kits from $84.95 to $109.95
- **R450 UHF FM RECEIVER** for 380-520 MHz bands. Kits in selectivity options from $94.95
- **R110 VHF AM RECEIVER** Kit for vhf aircraft band or ham bands. Only $84.95.
- **COR KITS** With audio mixer and speaker amplifier. Only $29.95.
- **CWID KITS** 158 bits, field programmable, clean audio. Only $59.95.
- **A16 RF TIGHT BOX** Deep drawn alum. case with tight cover and no seams. 7 x 8 x 2 inches. Only $18.00.
- **SCANNER CONVERTERS** Copy 72-76, 135-144, 240-270, 400-420, or 806-894 MHz bands on any scanner. Wired/tested Only $79.95.
- **T51 VHF FM EXCITER** for 10M, 6M, 2M, 220 MHz or adjacent bands. 2 Watts continuous. Kits only $54.95.
- **T451 UHF FM EXCITER** 2 to 3 Watts on 450 ham band or adjacent. Kits only $64.95.
- **VHF & UHF LINEAR AMPLIFIERS.** Use on either FM or SSB. Power levels from 10 to 45 Watts to go with exciters & xmtg converters. Kits from $69.95.

VHF & UHF TRANSMITTING CONVERTERS

For SSB, CW, ATV, FM, etc. Available for 6M, 2M, 220, 440 with many IF input ranges. Converter board kit only at $79.95 (VHF) or $99.95 (UHF) or kits complete with PA and cabinet as shown.

VHF & UHF RECEIVING CONVERTERS

20 Models cover every practical rf and if range to listen to SSB, FM, ATV, etc. on 6M, 2M, 220, 440, and 110 aircraft band. Even convert weather down to 2M! Kits from $39.95 and wired units.

VHF & UHF RECEIVER PREAMPS. Low noise.

VHF Kits from 27 to 300 MHz. UHF Kits from 300 to 650 MHz. Broadband Kits: 20-650 MHz. Prices start at $14.95 (VHF) and $18.95 (UHF). All preamps and converters have noise figure 2dB or less.

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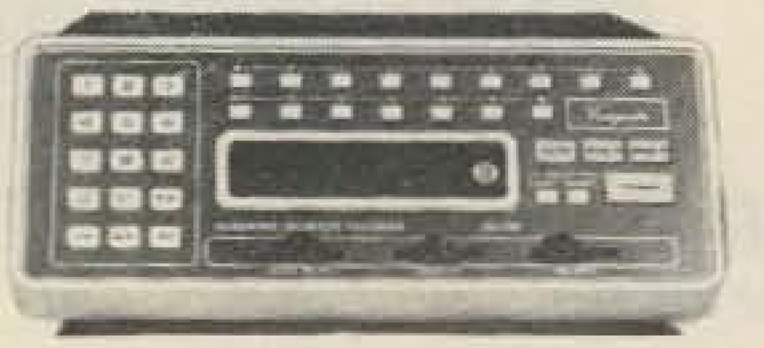
★ SPECIALS OF THE MONTH ★

☆ MIRAGE ☆ C22

2W IN — 20W OUT

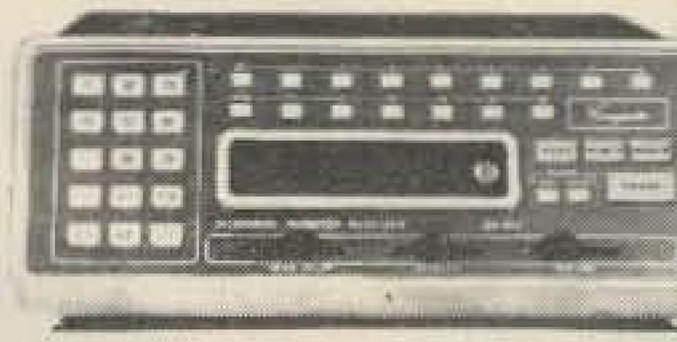
FEATURES:
- All-mode SSB, FM and CW
- Small Size
- Automatic antenna change over

Frequency Range .... 220 to 225 MHz
RF Power In .... 200 mw to 5 Watts
RF Power Out ..... 30 Watts (2 in — 20 out)
Modes .... SSB, FM and CW
DC Power .... 13.6 VDC 5 Amps
Warranty .. 5 years (1 year RF Power Trans.)



☆ J.I.L. SX-100 ☆

SPECIALLY PRICED AT ONLY $199.95



☆ J.I.L. SX-200 ☆

TYPE: FM & AM
FREQUENCY RANGE: a) 26-57.995 MHz Freq. Space 5kHz: b) 58-88 MHz Space 12.5 kHz: c) 108-180 MHz Space 5kHz: d) 380-514 MHz Space 12.5 kHz
SENSITIVITY: FM a) 26-180 MHz 0.4 uV S/N 12 dB b) 380-514 MHz 1.0uV S/N 12 dB AM a) 26-180 MHz 1.OuV S/N dB b) 380-514 MHz 2.0uV S/N 10 dB
SELECTIVITY: FM . . . More than 60 dB at +25 kHz
AM . . . More than 60 dB at +10 kHz

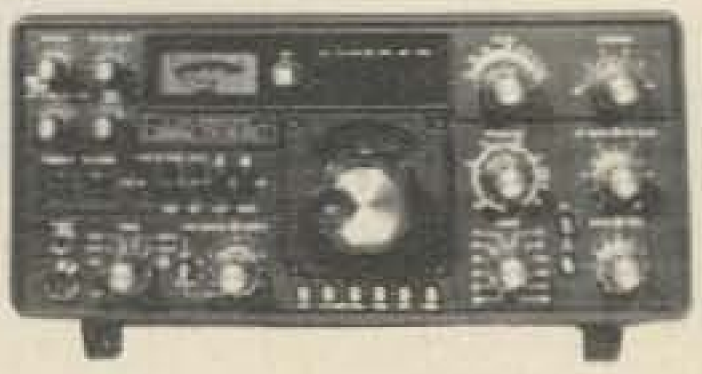
SUPER VALUE FOR ONLY $389.95

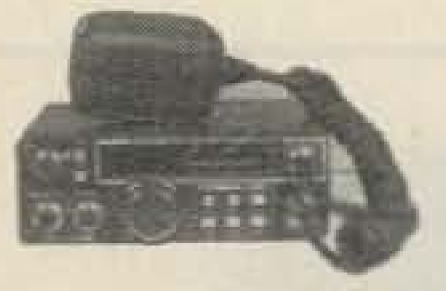
★ ANTENNA SPECIALS ★

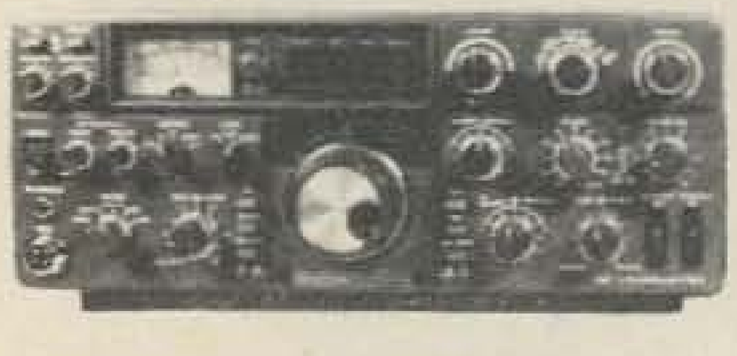
HUSTLER G7-144	$99.95	HUSTLER 4BTV	$79.95
HUSTLER G6-144B	69.95	HYGAIN TOWERS	CALL
HUSTLER 5BTV	99.95	CDE ROTORS	CALL

WE TRADE

CALL FOR QUOTE







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TERMS: Satisfaction guaranteed or money refunded. C.O.D. add $2.00. Minimum order $6.00. Orders under $10.00 add $1.50. Add 5% for postage, insurance, handling. Overseas add 15%. N.Y. residents add 7% tax.

MINI KITS - YOU HAVE SEEN THESE BEFORE NOW HERE ARE OLD FAVORITE AND NEW ONES TOO. GREAT FOR THAT AFTERNOON HOBBY.

FM MINI MIKE

A super high performance FM wireless mike kit! Transmits a stable signal up to 300 yards with exceptional audio quality by means of its built in electret mike. Kit includes case, mike, on-off switch, antenna, battery and super instructions. This is the finest unit available.

FM-3 Kit $14.95
FM-3 Wired and Tested 19.95

Color Organ

See music come alive! 3 different lights flicker with music. One light each for high, mid-range and lows. Each individually adjustable and drives up to 300 W. runs on 110 VAC.

Complete kit, ML-1
$8.95

Video Modulator Kit

Converts any TV to video monitor. Super stable, tunable over ch. 4-6. Runs on 5-15V, accepts std. video signal. Best unit on the market! Complete kit, VD-1 **$7.95**

Led Blinky Kit

A great attention getter which alternately flashes 2 jumbo LEDs. Use for name badges, buttons, warning panel lights, anything! Runs on 3 to 15 volts.

Complete kit, BL-1
$2.95

Super Sleuth

A super sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as general purpose amplifier. Full 2 W rms output, runs on 6 to 15 volts, uses 8-45 ohm speaker.

Complete kit, BN-9 **$5.95**

CPO-1

Runs on 3-12 Vdc 1 wall out, 1 KHZ good for CPO, Alarm, Audio Oscillator. Complete kit **$2.95**

CLOCK KITS

Your old favorites are here again. Over 7,000 Sold to Date. Be one of the gang and order yours today!

Try your hand at building the finest looking clock on the market. Its satin finish anodized aluminum case looks great anywhere, while six .4" LED digits provide a highly readable display. This is a complete kit, no extras needed, and it only takes 1-2 hours to assemble. Your choice of case colors: silver, gold, black (specify).

Clock kit, 12/24 hour, DC-5	**$24.95**
Clock with 10 min. ID timer, 12/24 hour, DC-10	**$29.95**
Alarm clock, 12 hour only, DC-8	**$29.95**
12V DC car clock, DC-7	**$29.95**

For wired and tested clocks add $10.00 to kit price.
SPECIFY 12 OR 24 HOUR FORMAT

FM Wireless Mike Kit

Transmits up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9V. Type FM-2 has added sensitive mike preamp stage.

FM-1 kit **$3.95** FM-2 kit **$4.95**

Whisper Light Kit

An interesting kit, small mike picks up sounds and converts them to light. The louder the sound, the brighter the light. Includes mike, controls up to 300 W, runs on 110 VAC.

Complete kit, WL-1
$6.95

Tone Decoder

A complete tone decoder on a single PC board. Features: 400-5000 Hz adjustable range via 20 turn pot, voltage regulation, 567 IC. Useful for touch-tone burst detection, FSK, etc. Can also be used as a stable tone encoder. Runs on 5 to 12 volts.

Complete kit, TD-1 **$5.95**

Car Clock

The UN-KIT, only 5 solder connections

Here's a super looking, rugged and accurate auto clock, which is a snap to build and install. Clock movement is completely assembled — you only solder 3 wires and 2 switches, takes about 15 minutes! Display is bright green with automatic brightness control photocell — assures you of a highly readable display, day or night. Comes in a satin finish anodized aluminum case which can be attached 5 different ways using 2 sided tape. Choice of silver, black or gold case (specify).

DC-3 kit, 12 hour format $22.95
DC-3 wired and tested $29.95

Universal Timer Kit

Provides the basic parts and PC board required to provide a source of precision timing and pulse generation. Uses 555 timer IC and includes a range of parts for most timing needs.

UT-5 Kit **$5.95**

Mad Blaster Kit

Produces LOUD ear shattering and attention getting siren like sound. Can supply up to 15 watts of obnoxious audio. Runs on 6-15 VDC

MB-1 Kit **$4.95**

Siren Kit

Produces upward and downward wail characteristic of a police siren. 5 W peak audio output, runs on 3-15 volts, uses 3-45 ohm speaker.

Complete kit, SM-3 **$2.95**

60 Hz Time Base

Runs on 5-15 VDC. Low current (2.5ma) 1 min/month accuracy TB-7 Kit $5.50
TB-7 Assy $9.95

Calendar Alarm Clock

The clock that's got it all. 6-.5" LEDs, 12/24 hour, snooze, 24 hour alarm, 4 year calendar, battery backup, and lots more. The super 7001 chip is used. Size: 5x4x2 inches. Complete kit, less case (not available)

DC-9 **$34.95**

Under Dash Car Clock

12/24 hour clock in a beautiful plastic case features 6 jumbo RED LEDS, high accuracy (.001%), easy 3 wire hookup, display blanks with ignition and super instructions. Optional dimmer automatically adjusts display to ambient light level.

DC-11 clock with mtg. bracket $27.95 kit
DM-1 dimmer adapter $2.50
Add $10.00 Assy. and Test

Video Terminal

A completely self-contained, stand alone video terminal card. Requires only an ASCII keyboard and TV set to become a complete terminal unit. Features are: single 5V supply, XTAL controlled sync and baud rates (to 9600), complete computer and keyboard control of cursor. Parity error control and display. Accepts and generates serial ASCII plus parallel keyboard input. The 6416 is 64 char. by 16 lines with scrolling, upper and lower case (optional) and has RS-232 and 20ma loop interfaces on board. Kits include sockets and complete documentation.

RE 6416 terminal card kit (add $60.00 for wired unit)	$189.95
Lower Case option	$13.95
Power Supply	$14.95
RF Modulator kit	$7.95

PARTS PARADE

IC SPECIALS

LINEAR

301	$.35
324	$1.50
380	$1.50
555	$.45
556	$1.00
565	$1.00
566	$1.00
567	$1.25
741	10/$2.00
1458	$.50
3900	$.50
3914	$2.95
8038	$2.95

TTL

74S00	$.40
7447	$.65
7475	$.50
7490	$.50
74196	$1.35

SPECIAL

11C90	$15.00
10116	$1.25
7208	$17.50
7207A	$5.50
7216D	$21.00
7107C	$12.50
5314	$2.95
5375AB/G	$2.95
7001	$6.50

CMOS

4011	.50
4013	.50
4046	$1.85
4049	.50
4059	$9.00
4511	$2.00
4518	$1.35
5639	$1.75

FERRITE BEADS

With info and specs 15/$1.00
6 Hole Balun Beads 5/$1.00

READOUTS

FND 359 .4" C.C.	$1.00
FND 507/510 .5" C.A.	1.00
MAN 72/HP7730 .33" C.A.	1.00
HP 7651 .43" C.A.	2.00

Sockets

8 Pin	10/$2.00
14 Pin	10/$2.00
16 Pin	10/$2.00
24 Pin	4/$2.00
28 Pin	4/$2.00
40 Pin	3/$2.00

TRANSISTORS

2N3904 NPN C-F	15/$1.00
2N3906 PNP C-F	15/$1.00
2N4403 PNP C-F	15/$1.00
2N4410 NPN C-F	15/$1.00
2N4916 FET C-F	4/$1.00
2N5401 PNP C-F	5/$1.00
2N6028 C-F	4/$1.00
2N3771 NPN Silicon	$1.50
2N5179 UHF NPN	3/$2.00
Power Tab NPN 40W	3/$1.00
Power Tab PNP 40W	3/$1.00
MPF 102/2N5484	$.50
NPN 3904 Type T-R	50/$2.50
PNP 3906 Type T-R	50/$2.50
2N3055	$.80
2N2646 UJT	3/$2.00

Diodes

5.1 V Zener	20/$1.00
1N914 Type	50/$1.00
1KV 2Amp	8/$1.00
100V 1Amp	15/$1.00

25 AMP
100V Bridge
$1.50 each

Mini-Bridge 50V
1 AMP
2 for $1.00

Resistor Ass't

Assortment of Popular values - ¼ watt. Cut lead for PC mounting, ½" center, ½" leads, bag of 300 or more. **$1.50**

Crystals

3.579545 MHZ	$1.50
10.00000 MHZ	$5.00
5.248800 MHZ	$5.00

Switches

Mini toggle SPDT **$1.00**
Red Pushbuttons N.O. **3/$1.00**

AC Adapters

Good for clocks, nicad chargers, all 110 VAC plug one end

8.5 vdc @ 20 mA	$1.00
16 vac @ 160mA	$2.50
12 vac @ 250mA	$3.00

Earphones

3" leads, 8 ohm, good for small tone speakers, alarm clocks, etc.
5 for $1.00

Mini 8 ohm Speaker

Approx. 2¼" diam. Round type for radios, mike etc.
3 for $2.00

Solid State Buzzers

small buzzer 450 Hz, 86 dB, sound output on 5-12 vdc at 10-30 mA, TTL compatible **$1.50**

Slug Tuned Coils

Small 3/16" Hex Slugs turned coil. 3 turns. 10 for $1.00

AC Outlet

Panel Mount with Leads
4/$1.00

CAPACITORS

TANTALUM Dipped Epoxy		ALUMINUM Electrolytic		DISK CERAMIC	
1.5 uF 25V	3/$1.00	1000 uF 16V Radial	$.50	.01 16V disk	20/$1.00
1.8 uF 25V	3/$1.00	500 uF 20V Axial	$.50	.1 16V	15/$1.00
.22 uF 25V	3/$1.00	150 uF 16V Axial	5/$1.00	.001 16V	20/$1.00
		10 uF 15V Radial	10/$1.00	100 pF	20/$1.00
				.047 16V	20/$1.00

DC-DC Converter

+5 vdc input prod. -9 vdc @ 30ma
+9 vdc produces -15 vdc @ 35ma **$1.25**

Ceramic IF Filters

Mini ceramic filters 7 kHz B.W. 455 kHz $1.50 ea.

25K 20 Turn Trim Pot **$1.00**
1K 20 Turn Trim Pot **$ .50**

Trimmer Caps

Sprague - 3-40 pf
Stable Polypropylene
.50 ea.

Crystal Microphone

Small 1" diameter ¼" thick crystal mike cartridge **$.75**

Mini RG-174 Coax
10 ft. for $1.00

Coax Connector

Chassis mount
BNC type **$1.00**

9 Volt Battery Clips

Nice quality clips **5 for $1.00**
⅝" Rubber Grommets **10 for $1.00**

Parts Bag

Asst. of chokes, disc caps, tant., resistors, transistors, diodes, MICA caps etc.
sm. bag (100 pc) **$1.00** lg. bag (300 pc) **$2.50**

Connectors

6 pin type gold contacts for mA-1003 car clock module price **.75 ea.**

Leds - your choice, please specify
Mini Red, Jumbo Red, High Intensity Red, Illuminator Red **8/$1**
Mini Yellow, Jumbo Yellow, Jumbo Green **6/$1**

Varactors

Motorola MV 2209 30 PF Nominal cap 20-80 PF - Tunable range - **.50 each or 3/$1.00**

Audio Prescaler

Make high resolution audio measurments, great for musical instrument tuning, PL tones, etc. Multiplies audio UP in frequency, selectable x10 or x100, gives .01 HZ resolution with 1 sec. gate time! High sensitivity of 25 mv, 1 meg input z and built-in filtering gives great performance. Runs on 9V battery, all CMOS.

PS-2 kit **$29.95**
PS-2 wired **$39.95**

600 MHz PRESCALER

Extend the range of your counter to 600 MHz. Works with all counters. Less than 150 mv sensitivity. specify - 10 or -100

Wired, tested, PS-1B **$59.95**
Kit, PS-1B **$44.95**

30 Watt 2 mtr PWR AMP

Simple Class C power amp features 8 times power gain. 1 W in for 8 out, 2 W in for 15 out, 4W in for 30 out. Max output of 35 W, incredible value, complete with all parts, less case and T-R relay.

PA-1, 30 W pwr amp kit **$22.95**
TR-1, RF sensed T-R relay kit **6.95**

MRF-238 transistor as used in PA-1 8-10db gain 150 mhz **$11.95**

RF actuated relay senses RF (1W) and closes DPDT relay.
For RF sensed T-R relay
TR-1 Kit **$6.95**

Power Supply Kit

Complete triple regulated power supply provides variable 6 to 18 volts at 200 ma and +5 at 1 Amp. Excellent load regulation, good filtering and small size. Less transformers, requires 6.3 V @ 1 A and 24 VCT.

Complete kit, PS-3LT **$6.95**

OP-AMP Special

BI-FET LF 13741 - Direct pin for pin 741 compatible, but 500,000 MEG input z, super low 50 pa input current, low power drain.

50 for only $9.00 **10 for $2.00**

Regulators

78MG	$1.25	7812	$1.00
79MG	$1.25	7815	$1.00
723	$.50	7905	$1.25
309K	$1.15	7912	$1.25
7805	$1.00	7915	$1.25

Shrink Tubing Nubs

Nice precut pces of shrink size: 1" x ¼" shrink to ⅛". Great for splices. **50/$1.00**

Mini TO-92 Heat Sinks

Thermalloy Brand **5 for $1.00**
To-220 Heat Sinks **3 for $1.00**

Opto Isolators - 4N28 type **$.50 ea.**
Opto Reflectors - Photo diode + LED **$1.00 ea.**

Molex Pins

Molex already precut in length of 7. Perfect for 14 pin sockets. **20 strips for $1.00**

CDS Photocells

Resistance varies with light, 250 ohms to over 3 meg **3 for $1.00**

See List of Advertisers on page 114

UTIC Mini Stereo AM/FM Receiver

WITH HEADPHONES — For Joggers, Cyclists, Skaters & Sports Events

FEATURES: Lightweight headphones. Left/right balance control. Full fidelity stereo sound. Additional black soft carrying case & shoulder strap. Belt clip (hands free). Operates on 3 AA cell batteries (not incl.). Compact size: 3⅞" x 4⅞" x 1". Wt. 6 oz.

Model 2830 List Price $89.95 .... **$34.95**

SPEAKERS

2¼" Round — 8 Ohm .25 Watt (4" Leads) Size: 2¼" x ¾"

Part No. A0201 .... $1.25 or 2/1.98

2½" Square — 16 Ohm .25 Watt (4 mount. holes) Large Ceramic Magnet Size: 2⅝" x 2⅝" x ¾"

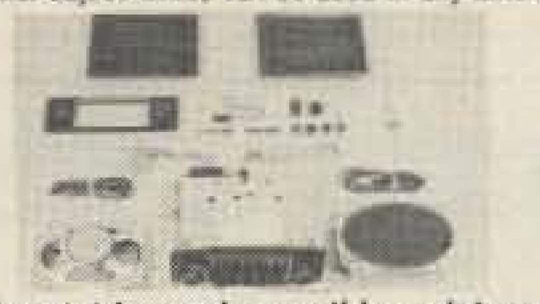
Part No. SF-25016 .. $1.39 or 2/2.98

MOTOROLA

AM/FM Stereo Push Button CAR RADIO

FOR VOLKSWAGEN SCIROCCO, RABBIT, AUDI 5000 AND FOX

(with minor adjustments, can be used in any automobile)



Includes bezel trim and everything pictured. Two each 4x6 speakers and grille (1½" deep). All cables and leads for hook-up. Includes all instruction Manuals for easy installation. Cut-out dimensions: 7"W x 1¾"H x 6½"L.

Model 5VW3901 .... **$49.95**

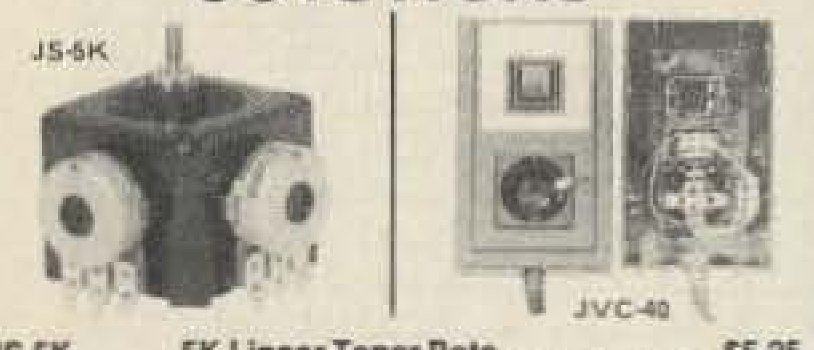
UV-EPROM Eraser

Erases 2708, 2716, 2732, 2764, 2516, 2532, 2564. Erases up to 8 chips within 51 minutes (1 chip in 37 minutes). Maintains constant exposure distance of one inch. Special conductive foam liner eliminates static build-up. Built-in safety lock to prevent UV exposure. Compact — only 9.00" x 3.70" x 2.60". Complete with holding tray for 8 chips.

UVS-11EL Replacement Bulb **$16.95**

DE-4 UV-EPROM Eraser $79.95

JOYSTICKS



JS-5K

JVC-40

JS-5K	5K Linear Taper Pots	$5.25
JS-100K	100K Linear Taper Pots	$4.95
JS-150K	150K Linear Taper Pots	$4.75
JVC-40	40K (2) Video Controller in case	$4.95

5¼" Mini-Floppy Disc Drive

Pertec Computer Corp.

FOR TRS-80 MODEL I, III (Industry Standard)

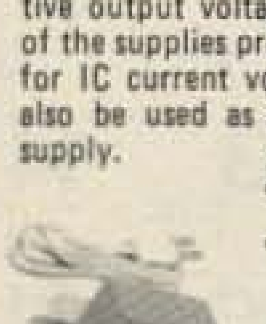
Features single or double density. Recording mode: FM single, MFM double density. Power: +12VDC (±0.6V) 1.6 amps max., 5VDC (±0.25V) 0.8 amps max. Unit as pictured at left (does not incl. case, power supply or cables). 30-page data book included. Weighs 3½ pounds. Size: 5¾"W x 8"D x 3¼"H

Limited Quantity!

Part No.		Price
FD200	Single-sided, 40 tracks, 250K bytes capacity	$179.95
FD250	Double-sided, 35 tracks, 438K bytes capacity	$199.95

JE215 Adjustable Dual Power Supply

General Description: The JE215 is a Dual Power Supply with independent adjustable positive and negative output voltages. A separate adjustment for each of the supplies provides the user unlimited applications for IC current voltage requirements. The supply can also be used as a general all-purpose variable power supply.

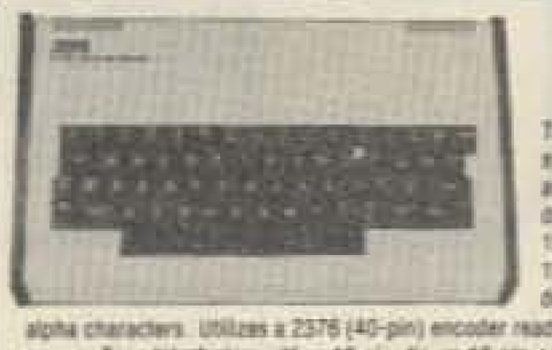


FEATURES:
- Adjustable regulated power supplies, pos. and neg. 1.2VDC to 15VDC.
- Power Output (each supply): 5VDC @ 500mA, 10VDC @ 750mA, 12VDC @ 500mA, and 15VDC @ 175mA.
- Two, 3-terminal adj. IC regulators with thermal overload protection.
- Heat sink regulator cooling
- LED "on" indicator
- Printed Board Construction
- 120VAC input
- Size: 3-1/2"w x 5-1/16"L x 2"H

JE215 Adj. Dual Power Supply Kit (as shown) .. $24.95

(Picture not shown but similar in construction to above)
JE200 Reg. Power Supply Kit (5VDC, 1 amp) .. $14.95
JE205 Adapter Brd. (to JE200) ±5,±9 & ±12V. $12.95
JE210 Var. Pwr. Sply. Kit, 5-15VDC, to 1.5amp. $19.95

KEYBOARDS — POWER SUPPLIES



JE610 ASCII Encoded Keyboard Kit

The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and −12V @ 10mA for operation. Features: 60 keys generate the 128 characters, upper and lower case ASCII set. Fully buffered. Two user-define keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL or MOS logic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector. Size: 3½"H x 14½"W x 8¾"D.

JE610/DTE-AK (After assembly as pictured above) **$124.95**

JE610 Kit 62-Key Keyboard, PC Board & Components (no case) ...... **$ 79.95**
K62 62-Key Keyboard (Keyboard only) .... **$ 34.95**
DTE-AK (case only — 3¼"H x 11"W x 8¾"D) .... **$ 49.95**

JE212 — Negative 12VDC Adapter Board Kit for JE610 ASCII KEYBOARD KIT
Provides —12VDC from incoming 5VDC $9.95

JE600 Hexadecimal Encoder Kit

FULL 8-BIT LATCHED OUTPUT 19-KEY KEYBOARD

The JE600 Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Debounce circuit provided for all 19 keys. Nine LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector, only +5VDC required for operation. Size: 3½"H x 8¼"W x 8¾"D.

JE600/DTE-HK (After assembly as pictured above) **$99.95**

JE600 Kit 19-Key Hexadecimal Keyboard, PC Board & Components (no case) **$59.95**
K19 19-Key Keyboard (Keyboard only) **$14.95**
DTE-HK (case only — 3½"H x 8¼"W x 8¾"D) **$44.95**

9½"Lx4¼"Wx1"H

ALPS 26-KEY CALCULATOR KEYBOARD
Gray Key Caps with blue, green and white back drop. Mechanical SPST Switching: 22-pin Edge Card Connection.
Part No. KB26 .... $2.95 each or 2/$4.95

16⅞"L x 5¼"W x 1⅜"H

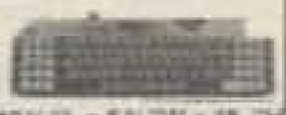
MICRO SWITCH 69-KEY KEYBOARD
Data Entry Keyboard, Encoded Output: 8-bit Parallel EBC DIC. Switching: Hall Effect, 24-pin Edge Card Connection. Complete with Pin Connection.
Part No. KB69SD12-2 .... $19.95 each

16¾"L x 5½"W x 1⅞"H

DATANETICS 74-KEY KEYBOARD
ASCII Encoded Keyboard, Output: Even Parity ASCII, Supply voltage +5, -12 volt. Switching: Mechanical SPST — 50-pin Connection. Complete with Pin Connection.
Part No. KB354 .... $29.95 each

23"Lx5¾"Wx1-3/8"H

MICRO SWITCH 85-KEY KEYBOARD
Data Entry Keyboard. Switching: Hall Effect, 13-pin Edge Card Connection. Metal frame, dark brown key caps.
Part No. 85SD18-1 .... $29.95 each



18⅝"L x 5¾"W x 1⅞"H

MICRO SWITCH 88-KEY KEYBOARD
Data Entry Keyboard used in a Diablo 1640 Terminal. Supply Voltage: +5V, -12V. Switching: Hall Effect — 10-pin Edge Card Connection. Schematic included.
Part No. 88SD22 .... $69.95 each

POWER SUPPLIES

POWER SUPPLY — 5VDC @ 1 AMP REGULATED Transaction Tech
Output +5VDC @ 1 amp (also +30VDC) reg. Input 115VAC 60Hz. Two-tone (black/beige) self-enclosed case. 6 ft., 3 cond. black power cord. Size: 6½"W x 7"D x 2¾"H. Wt. 3 lbs.
Part No. PS51194 .... $19.95 each

POWER SUPPLY — 5VDC @ 1 AMP REGULATED B Industries
Output +5VDC @ 1 amp, +36-42VDC adj. 400mA or less, 30VAC (isol.) @ 1.5 amp. Input 115VAC 60Hz. Circ. brkr. re-set button. Blk. self-encl. case w/4 rubber feet. 6 ft., 3 cond. blk. pow. cord. On/off switch. 6¾"W x 7¾"D x 3-7/8"H - wt. 7 lbs.
Part No. PS407D .... $24.95 each

POWER SUPPLY — 5VDC @ 7.5 AMP, 12VDC @ 1.5 AMP SWITCHING
Input: 115VAC, 50-60Hz @ 3 amp/230VAC, 50Hz @ 1.6 amp. Fan volt./power supply select switches (115/230VAC). Output: 5VDC @ 7.6 amp, 12VDC @ 1.6 amp. 8 ft. blk. pow. cord. 11½"W x 13¾"D x 3¾"H. Wt. 6 lbs.
Part No. PS94VO .... $49.95 each

POWER PAC — Heavy Duty Multi-Voltage Power Supply — 5VDC, 12VDC, 24VDC
Output: +5VDC @ 30A, +12VDC @ 2A, -12VDC @ 4A & +24VDC @ 3A. Input: 115VAC, 7A, 220VAC, 3.5A. Reg.: ± .15% line & load comb. Ripple: 10MV peak to peak (3MV RMS). Overvolt. protect.: 5V, +12V, -12V. Overcur. protect. incl. 15⅝"L x 6"H x 11-7/8"D. Wt. 40 lbs.
Part No. 285-016 .... $89.95 each

★ SHIPMENT IN 24 HOURS ★
6:00 AM to 6:00 PM (PST)
Call: (415) 592-8097

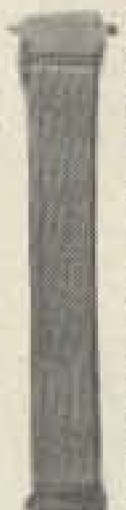
JUMPER AND CABLE ASSEMBLIES

Custom Jumpers! *Custom Cables!*

STANDARD DIP JUMPERS

All jumpers use low profile dip plugs with heavy duty pins for repeated disconnect applications.

JAMECO Part No.	AP Cross-Reference	No. Pins	Description	Wire Length	Price
DJ14-1	924102-12	14	single end	12"	$1.79
DJ14-2	924102-24	14	single end	24"	2.05
DJ14-3	924102-36	14	single end	36"	2.35
DJ14-1-14	924106-12	14	double end	12"	3.20
DJ14-2-14	924106-24	14	double end	24"	3.49
DJ14-3-14	924106-36	14	double end	36"	3.79
DJ16-1	924112-12	16	single end	12"	1.95
DJ16-2	924112-24	16	single end	24"	2.19
DJ16-3	924112-36	16	single end	36"	2.59
DJ16-1-16	924116-12	16	double end	12"	3.35
DJ16-2-16	924116-24	16	double end	24"	3.69
DJ16-3-16	924116-36	16	double end	36"	4.05
DJ24-1	924122-12	24	single end	12"	2.69
DJ24-2	924122-24	24	single end	24"	3.39
DJ24-3	924122-36	24	single end	36"	3.95
DJ24-1-24	924126-12	24	double end	12"	4.79
DJ24-2-24	924126-24	24	double end	24"	5.29
DJ24-3-24	924126-36	24	double end	36"	5.89



JAMECO Part No.	AP Cross-Reference	No. Pins	Description	Wire Length	Price
DJ40-1	924132-12	40	single end	12"	5.69
DJ40-2	924132-24	40	single end	24"	6.79
DJ40-3	924132-36	40	single end	36"	7.69
DJ40-1-40	924136-12	40	double end	12"	10.95
DJ40-2-40	924136-24	40	double end	24"	11.89
DJ40-3-40	924136-36	40	double end	36"	12.79

STANDARD DB25 SERIES CABLES

Now you can order DB25 P or S connectors with the cable necessary to fit your application. Choose from our standard flat cable in 4-foot lengths. **Call today.**

STANDARD CABLES

Part No.	Cable Length	Connectors	Price
DB25P-4	4 feet	1-DB25P	$ 9.95 ea.
DB25S-4	4 feet	1-DB25S	10.95 ea.
DB25P-4-P	4 feet	2-DB25P	16.95 ea.
DB25P-4-S	4 feet	1-DB25P/1-DB25S	17.95 ea.
DB25S-4-S	4 feet	2-DB25S	18.95 ea.

$10.00 Minimum Order — U.S. Funds Only
California Residents Add 6% Sales Tax
Postage — Add 5% plus $1.50 Insurance
Send S.A.S.E. for Monthly Sale Flyer!

Spec Sheets — 25¢ each
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BOOKS

National Semiconductor — Intersil — Intel

30001	National CMOS Data Book (640 pages) 74C, CD4000, and A/D Converters	$5.95
30002	National Interface Data Book (704 pages) DP, DS8000, DS3600, DS75000, etc.	$5.95
30003	National Linear Data Book (1376 pages) LM, LF, ADC, DAC, LH Series	$11.95
30004	National Series 80 — Board Level Computer (224 pages)	$4.95
30005	National TTL Logic Data Book (624 pages) 7400,LS,L,H,S, and DM8000 Series	$8.95

30006 Above (3) 30001,3,5 as set $24.95/lot

010400	Intel Component Data Catalog — Full data sheets for Intel's products incl. memory devices, microproc., peripherals & indust./mil. products (1328 pages)	$14.95
205610	Intel Peripheral Design Handbook — Full data sheets, appl. notes for Intel peripheral device components (644 pages)	$9.95

AC and DC Wall Transformers

Part No. DC6912

With Universal Plug and 9V Battery Snap

Selective voltages: 6,9,12VDC. Polarity selection (+/-), six-foot line from adapter to plugs — six-inch line from adapter to battery snap. 120V/60Hz, 300mA.

Part No.	Input	Output	Price
AC 250	117V/60Hz	12VAC 250mA	$3.95
AC 500	117V/60Hz	12VAC 500mA	$4.95
AC1000	117V/60Hz	12VAC 1 amp	$5.95
AC9004	117V/60Hz	9.2VAC 2.5 amp	$2.95 or 2/$4.95
DC 800	120V/60Hz	8VDC 400mA	$1.95 or 2/$2.95
DC6912 (above)	120V/60Hz	6,9,12VDC 300mA	$9.95
DV5490	117V/60Hz	9.5VDC 275mA	$2.49 or 2/$3.95
DC900	120V/60Hz	9VDC 500mA	$3.95
DC1200	120V/60Hz	12VDC 300mA	$2.95 or 2/$4.95

CONNECTORS

DB25P	D-Subminiature Plug	$2.95
DB25S	D-Subminiature Socket	$3.50
D20418-2	Screw Lock Hdwr. (2) DB25S/P	2/$.99
DB51226	Cover for DB25P/S	$1.75
22/44SE	P.C. Edge (22/44 Pin)	$2.95
UG88/U	BNC Plug	$1.79
UG89/U	BNC Jack	$3.79
UG175/U	UHF Adapter	$ .49
SO239	UHF Panel Recp.	$1.29
PL258	UHF Adapter	$1.60
PL259	UHF Plug	$1.60
UG260/U	BNC Plug	$1.79
UG1094/U	BNC Bulkhead Recp.	$1.29

TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K or 32K

Kit comes complete with:
- 8 ea. MM5290 (UPD416/4116) 16K Dyn. Ram (*ns)
- Documentation for conversion

TRS-16K2 *150ns	$19.95
TRS-16K3 *200ns	$16.95
TRS-16K4 *250ns	$14.95

Mostek DC/DC Converter

+5 VOLTS TO -9 VOLTS

Input: +5V. Output: -9V (regulated) @ 30mA. Printed circuit mounting.

DC10 .... **$2.95 ea. or 2/$4.95**

Sorensen Regulated Power Supplies

Sorensen's open construction (SOC) power supplies are series-regulated solid-state systems, designed to provide regulated DC voltages at six levels (2-28 volt range). Units are open-framed on sturdy black anodized aluminum for excellent mounting.

FEATURES: 115/208/230 VAC Input @ 50-63Hz. Low Ripple: 1.5mVrms, 5mV P-P max. Adjustable current limit. Voltage adjustment control. Temperature-compensated circuitry. Optional over-voltage protection. All schematics and specifications supplied with unit. Series A, B, C, E have 3 mounting surfaces (Series F, bottom mounting only).

SPECIFICATION CHART

Part No.	Series	Output Volt. Adjust. Range min.	max.	Output Current (Adc) 40°C	50°C	60°C	Size (Inches)	Wt. lbs.	Price
SOC 2-6	B	1.9	2.1	6.0	4.9	3.8	5.62x4.88x2.38	4.3	19.95
SOC2-25	E	1.9	2.1	25.0	21.5	17.5	16.00x4.88x4.88	19.0	29.95
SOC5-3	A	4.75	5.25	3.0	2.4	1.8	4.00x4.88x1.62	2.0	24.95
SOC5-18	E	4.25	5.25	18.0	15.0	12.0	14.00x4.88x2.75	12.0	39.95
SOC5-25	F	4.25	5.25	25.0	21.5	17.5	16.00x4.88x4.88	16.0	49.95
SOC12-11	E	11.4	12.6	11.0	9.2	6.8	14.00x4.88x1.62	12.0	44.95
SOC12-15	E	11.4	12.6	15.0	12.75	9.5	16.00x4.88x4.88	18.0	49.95
SOC15-5	C	14.25	15.75	5.0	4.2	3.3	7.00x4.88x3.37	8.6	39.95
SOC15-9.5	E	14.25	15.75	9.5	7.6	5.8	14.00x4.88x1.62	12.3	44.95
SOC15-13	F	14.25	15.75	13.0	10.5	8.0	14.00x4.88x4.88	16.3	49.95
SOC28-6.5	A	26.6	29.4	0.8	.64	.45	4.00x4.88x1.62	2.0	24.95

Pee Wee Boxer Fan

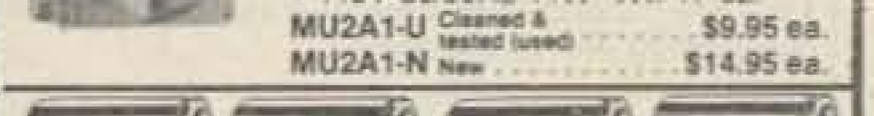
- 36cfm free air delivery
- 3.125" sq. x 1.665" depth
- 10 yrs. cont. duty at 20°C
- 115V 50/60Hz
- For Apple users

PWS2107U Cleaned & tested (used) .... $ 9.95 ea.
PWS2107F New .... $14.95 ea.

Muffin® Fan

- 105cfm free air delivery
- 4.68" sq. x 1.50" depth
- 10 yrs. cont. duty at 20°C
- Impedance protected, ambients to 70°C
- 115V 50/60Hz 14W Wt. 17 oz.

MU2A1-U Cleaned & tested (used) .... $9.95 ea.
MU2A1-N New .... $14.95 ea.



1/2 PRICE SALE! — COMPUTER GRADE CAPACITORS

mfd	wvdc	price	mfd	wvdc	price	mfd	wvdc	price	mfd	wvdc	price
250	150	1.95	4,500	50	3.95	20,000	20	2.95	43,000	10	5.95
500	200	2.49	5,500	25	4.49	21,000	15	3.95	45,000	5	5.95
1,250	3	.99	6,100	40	2.49	22,000	15	4.95	62,000	20	5.95
1,500	25	1.95	7,000	60	4.95	23,000	[illegible]	[illegible]	65,000	15	5.95
1,500	30	2.95	10,000	15	2.95	23,000	10	2.95	68,000	20	5.95
2,000	10	2.95	10,000	16	3.95	23,000	20	3.95	65,000	10	7.95
2,100	200	2.95	11,000	19	4.95	24,000	20	2.95	73,000	5	7.95
2,250	100	3.95	13,000	16	2.95	27,000	10	2.95	80,000	15	5.95
2,300	33	2.95	14,000	13	2.95	32,500	25	4.95	90,000	15	6.95
2,500	15	1.95	14,000	35	3.95	40,000	25	5.95	120,000	15	10.95
3,000	25	1.95	18,000	10	3.95	42,000	15	4.95	160,000	10	5.95
3,600	40	3.95									

OVER 200 OTHER VALUES AVAILABLE

SALE! Just deduct 50% of price listed above!

✓See List of Advertisers on page 114

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The Southwest's most progressive communications company stocking Kenwood, ICOM, Yaesu, MFJ, B&W, Astron, Larsen, Cushcraft, Hy-Gain, Bearcat, and more. Would like to serve you! **Power Communications Corp., 1640 West Camelback Rd., Phoenix AZ 85015, 241-Watt.**

Fontana CA

Complete lines ICOM, DenTron, Ten-Tec, Mirage, Cubic, Lunar, over 4000 electronic products for hobbyist, technician, experimenter. Also CB radio, landmobile. **Fontana Electronics, 8628 Sierra Ave., Fontana CA 92335, 822-7710.**

San Diego CA

We buy and sell Surplus Army Navy Electronics, also Terminated Material. What do you want to sell? Write for catalogue. **Electronictown, Inc., 440-7th Avenue, PO Box 2048, San Diego CA 92112, 232-9379.**

San Jose CA

Bay area's newest Amateur Radio store. New & used Amateur Radio sales & service. We feature Kenwood, ICOM, Azden, Yaesu, Ten-Tec, Santee & many more. **Shaver Radio, Inc., 1378 So. Basoom Ave., San Jose CA 95128, 998-1103.**

Smyrna GA

For your Kenwood, Yaesu, ICOM, Drake and other amateur needs, come to see us. **Britt's Two-Way Radio, 2506 N. Atlanta Rd., Smyrna GA 30080, 432-8006.**

Preston ID

Ross WB7BYZ has the Largest Stock of Amateur Gear in the Intermountain West and the Best Prices. Call me for all your ham needs. **Ross Distributing, 78 So. State, Preston ID 83263, 852-0830.**

Terre Haute IN

Your ham headquarters located in the heart of the midwest. **Hoosier Electronics, Inc., #9 Meadows Center, P.O. Box 3300, Terre Haute IN 478003, 238-1456.**

Baltimore MD

Always buying lab grade test equipment HP, Tek, Gr, L&N, Etc. Also buy microwave coaxial & waveguide HP, fxr, waveline, Etc. Prefer "K", "P", "R" but will consider larger wg too. **Cadisco 514 Ensor St. Balto, MD 21202, 685-1893.**

Littleton MA

The ham store of N.E. you can rely on. Kenwood, ICOM, Wilson, Yaesu, DenTron, KLM amps, B&W switches & wattmeters. Whistler radar detectors, Bearcat, Regency, antennas by Larsen, Wilson, Hustler, GAM. **TEL-COM Inc. Communications & Electronics. 675 Great Rd., Rt. 119, Littleton MA 01460, 486-3040.**

Ann Arbor MI

See us for products like Ten-Tec, R. L. Drake, DenTron and many more. Open Monday through Saturday, 0830 to 1730. WB8VGR, WB8UXO, WD8OKN and W8RP behind the counter. **Purchase Radio Supply, 327 E. Hoover Ave., Ann Arbor MI 48104, 668-8696.**

Hudson NH

New England's Distributor and Authorized Service Center for all Major Amateur Lines. **Tufts Radio Electronics, Inc., 61 Lowell Road, Hudson NH 03051, 883-5005.**

Somerset NJ

New Jersey's only factory-authorized ICOM and Yaesu distributor. Large inventory of new and used specials. Most major brands in stock. Complete service and facilities. **Radios Unlimited, 1760 Easton Avenue, P.O. Box 347, Somerset NJ 08873, 469-4599.**

Buffalo NY
WESTERN NEW YORK

Niagara Frontier's only full stocking Amateur dealer. Also Shortwave, CB, Scanners, Marine, Commercial. Operating displays featuring Kenwood and others. Towers, Antennas, Sales and Service. **DX Communications, 3214 Transit Road, West Seneca NY, 668-8873.**

Amsterdam NY
UPSTATE NEW YORK

Kenwood, ICOM, Drake, plus many other lines, Amateur Dealer for over 35 years. **Adirondack Radio Supply, Inc., 185 West Main Street, Amsterdam NY 12010, 842-8350.**

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Featuring: Kenwood, Yaesu, ICOM, Drake, Ten-Tec, Swan, DenTron, Alpha, Robot, MFJ, Tempo, Astron, KLM, Hy-Gain, Mosley, Larsen, Cushcraft, Hustler, Mini Products. You won't be disappointed with equipment/service. **Radio World, Oneida County Airport-Terminal Building, Oriskany NY 13424, 337-0203.**

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Waveguide & Coaxial Microwave Components & Equipment. Laboratory Grade Test Instruments, Power Supplies, Buy, Sell & Trade all popular makes—HP, GR, FXR, ESI, Sorensen, Singer, etc. **Lectronic Research Labs, 1423 Ferry Ave., Camden NJ 08104, 541-4200.**

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Dealer in Used Computer Hardware & Electronic Parts. Special on Daisy Wheel Printers. Xerox Word Processing Equipment, Dual Card Printers and Display Systems. Catalog $1.00. **Rondure Company (The Computer Room) Dept. 73, 2522 Butler St., Dallas TX 75235, 630-4621.**

San Antonio TX

Amateur, Commercial 2-way. Selling Antenna Specialists, Avanti, Azden, Bird, Hy-Gain, Standard, Vibroplex, Midland, Henry, Cushcraft, Dielectric, Hustler, ICOM, MFJ, Nye, Shure, Cubic, Tempo, Ten-Tec and others. **Appliance & Equipment Co., Inc. 2317 Vance Jackson Road, San Antonio TX 78213, 734-7793.**

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Your company name and message can contain up to 25 words for as little as $150 yearly (prepaid), or $15 per month (prepaid quarterly). No mention of mail-order business or area code permitted. Directory text and payment must reach us 60 days in advance of publication. For example, advertising for the Oct. '82 issue must be in our hands by Aug. 1st. Mail to 73 Magazine, Peterborough NH 03458. ATTN: Nancy Ciampa.

PROPAGATION

J. H. Nelson
4 Plymouth Dr.
Whiting NJ 08759

EASTERN 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	21A
AUSTRALIA	14	14	14	14B	7B	7B	7B	14B	7B	7B	14A	21
CANAL ZONE	21A	14	14	14	7	7	14	14	21	21	21A	21A
ENGLAND	7A	7	7	7	7	7A	14	14	21	21	21	14
HAWAII	21	14	14	7	7	7	7	14	14	14	14A	21
INDIA	14	14	7B	7B	7B	7B	14	14	14	14	14	14
JAPAN	14	14	7B	7B	7B	7B	7B	14	14	14	14	14
MEXICO	14A	14	14	7	7	7	7A	14	14	14A	21	21
PHILIPPINES	14	14	14	7B	7B	7B	7B	14B	14	14	14	14
PUERTO RICO	14	14	7A	7	7	7	14	14	14	14	14A	14A
SOUTH AFRICA	14	7B	7B	7A	14	14	14A	21	21A	21A	21	14
U.S.S.R.	7	7	7	7	7	7A	14	14	14A	14A	14A	14
WEST COAST	21	14A	14	7A	7	7	7	14	14A	14A	21	21

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	14	21	21A	21A	21A
AUSTRALIA	21	14A	14	14	14B	7B	7B	14B	7B	7B	14A	21
CANAL ZONE	21A	14	14	14	7	7	14	14	21	21	21A	21A
ENGLAND	7A	7	7	7	7	7	7	14	14	14	14	14
HAWAII	21	21	14	7	7	7	7	14	14	14A	21	21
INDIA	14	14	7B	7B	7B	7B	7B	14B	14	14	14	14
JAPAN	14	14	14	7B	7B	7B	7B	14	14	14	14	14
MEXICO	14	14	7	7	7	7	7	7A	14	14	14	14A
PHILIPPINES	14	14	14	7B	7B	7B	7B	14B	14	14	14	14
PUERTO RICO	14A	14	14	7A	7	7	14	14	14A	14A	21	21
SOUTH AFRICA	14	7B	7B	7B	7B	7B	14	14	14A	21	14	14
U.S.S.R.	7	7	7	7	7	7	14B	14	14	14	14	14

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	7	14	14	14
ARGENTINA	21	14A	14	14	14	7	7	14	21	21A	21A	21A
AUSTRALIA	21A	21A	21	14	14	14	14	14B	7B	7B	14A	21
CANAL ZONE	21A	21	14	14	7	7	7	14	21	21	21A	21A
ENGLAND	7A	7B	7	7	7	7	7B	14B	14	14	14	14
HAWAII	21A	21	21	14	14	14	7A	14	14	21	21	21A
INDIA	14	14	14	7B	7B	7B	7B	7B	14	14	14	14
JAPAN	14A	14A	14	14	14	7	7	14	14	14	14	14A
MEXICO	21	14	14	7	7	7	14	14	14	14	14A	14A
PHILIPPINES	14A	14A	14	14	14B	7	7B	14B	14	14	14	14A
PUERTO RICO	21	14A	14	14	7	7	7A	14	14A	21	21	21
SOUTH AFRICA	14	7B	7B	7B	7B	7B	7B	14	14	14A	14A	14
U.S.S.R.	7B	7B	7	7	7	7B	7B	14B	14	14	14	14
EAST COAST	21	14A	14	7A	7	7	7	14	14A	14A	21	21

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.

AUGUST

SUN	MON	TUE	WED	THU	FRI	SAT
1 F/F	2 F/F	3 F/F*	4 P/F*	5 F/F*	6 F/G	7 G/G
8 G/G	9 G/G	10 G/G	11 G/G	12 F/F	13 F/F	14 F/G
15 G/G	16 G/G	17 G/G	18 G/G	19 F/G	20 F/G	21 G/G
22 G/G	23 G/G	24 G/G	25 F/F	26 P/F	27 P/F	28 F/G
29 F/G	30 F/G	31 G/G				

Reader Service for facing page ✓83→

FT-230R: QUITE A SIGHT! (AND EASY TO SEE, TOO!!)

Sporting an all-new Liquid Crystal Display, the FT-230R is Yaesu's high-performance answer to your call for a very affordable 2 meter mobile rig with an easy-to-read frequency display! The FT-230R combines microprocessor convenience, a sensitive receiver, a powerful yet clean transmitter strip, and the new dimension of LCD frequency readout. See your Authorized Yaesu Dealer today — and go home with your new FT-230R!

SALE SUBJECT
FCC CERTIFICATION

- LCD five-digit frequency readout with night light for high visibility day or night.
- Two VFOs for quick QSY across the band.
- Ten memory slots for storage and recall of favorite channels.
- Selectable synthesizer steps (5 kHz or 10 kHz) in dial or scanning mode.
- Priority channel for checking a favorite frequency for activity while monitoring another.
- Unique VFO/Memory Split mode for covering unusual repeater splits.
- Up/Down band scan plus memory scan for busy or clear channel. Scanning microphone included in purchase price.
- Full 25 watts of RF power output from extremely compact package.
- Built-in automatic or manual tone burst.
- Optional synthesized CTCSS Encode and Encode/Decode boards available.
- Lithium memory backup battery with estimated lifetime of five years.
- Optional YM-49 Speaker/Microphone and YM-50 DTMF Encoding Microphone provide maximum operating versatility.

FT-208R
FM Handheld
2 Meters

FT-708R
FM Handheld
70 cm

And don't forget! Yaesu has a complete line of VHF and UHF handheld and battery portable transceivers using LCD display!!!

FT-290R - 2 Meters
SSB/CW/FM Portable

FT-690R - 6 Meters
USB/CW/AM/FM Portable

Price and Specifications Subject To Change Without Notice or Obligation

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