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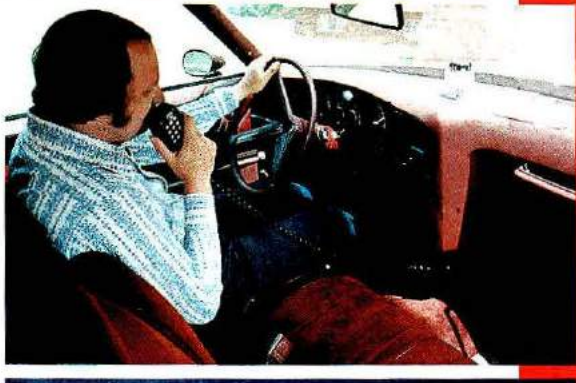
# HAM RADIO HORIZONS



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## Citizens Band
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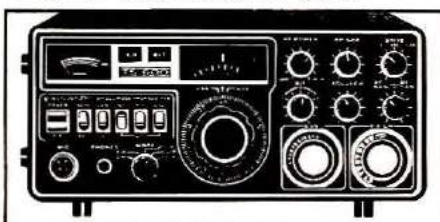

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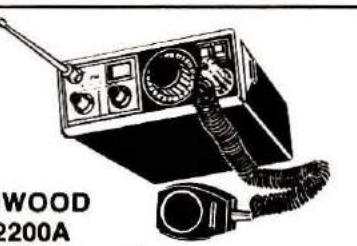

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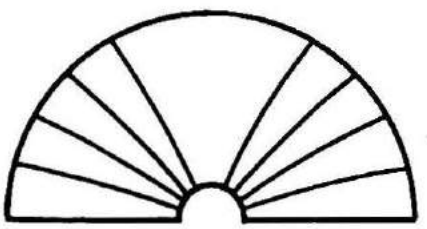

# HORIZONS

### Amateur FM — CB Class-D

The Amateur Radio Service and the Citizens Radio Service were formed for two distinct and different purposes, yet they can complement each other — perhaps because of that difference in purpose. Active Amateur and CBer Sundstrom takes a binocular view of the two, and tells it as he sees it. Learn why you should choose both, not one or the other.

### The Vox Box

Many older transmitters and transceivers have push-to-talk circuits, but no built-in voice-operated transmit/receive circuits. For less than five dollars you can build this vox circuit and add it to either a transmitter or transceiver, bringing your station up to date and making two-way operation as easy and natural as talking.

### CQ Hospital

You've probably worked amateurs who operate from a hospital bed. In the past, such operation meant using a rather large equipment setup. Hospital personnel sometimes objected to the clutter, but operation was permitted anyway. Things have changed today. Recently some amateur and CB operators have found increasing resistance to radio operation from hospitals — and for very good reasons, as this article points out. In fact, many hospitals ban radio operations outright.

### How To Be DX

Like to experience the thrill of having a pileup on frequency calling you? How about a low-budget DXpedition — without even leaving your living room? It's easy, and W4NXD tells you how it happened to him. Problem is, it's usually a one-shot deal.

### Improving Audio

Older fm transceivers may suffer from weak and distorted receiver audio output. Ian MacFarlane shows how the versatile LM380N integrated circuit can be used to cure the problem and provide lots of pleasant audio for even noisy environments.

### Advice From Me To You

The first solo performance in any field of endeavor is always nerve-racking. The fear of making mistakes makes you so nervous that you make mistakes; WB9OJA knows because she has been there. As an old-timer of two and one half years on the air, she is qualified to offer advice and reassurance about your first trip through the ham bands. Get a firm grip on your resolve, tighten up your courage, and go.

### They Always Came Back

The station you called always answered, the transmitter always worked, the antenna was just the right length, and the static was never too bad. What we would give today for a dream station like that. W7ZC tells about a lad who had it all. It makes you wonder if, in this modern world, we haven't lost some irretrievable thing.

### Questions And Answers

This second part of the license-study series covers such subjects as the term of your license, what the limitations of your antenna might be, and who is responsible for what. W1SL also shows what the activity of the sun has to do with propagation and working DX.

### Dummy Loads

It isn't necessary to put a signal on the air to tune up your transmitter. Use a dummy load as a substitute for your antenna, keeping your rig — and the FCC — happy. If you can't afford a commercial dummy load, try building one with a paint can, a handful of resistors, and some old-fashioned ingenuity.

**HAM RADIO HORIZONS** October 1977, Volume 1, No. 8. Published monthly by Communications Technology, Inc., Greenville, New Hampshire 03048. One-year subscription rate, $10.00; three-year subscription rate, $24.00. Second-class postage paid at Greenville, New Hampshire 03048 and additional offices.

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October, 1977
**Volume 1, Number 8**

# HAM RADIO HORIZONS

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**James R. Fisk, W1HR**
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Managing Editor

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Ham Radio Horizons
is published monthly by
Communications Technology, Inc
Greenville, New Hampshire 03048
Telephone 603-878-1441

Subscription rates are
$10.00 per year, worldwide



Microfilm copies
are available from
University Microfilms, International
Ann Arbor, Michigan 48103

**The Cover**

CB and Ham Radio are both for personal communications. The small sample on our cover includes Cobra and Standard CB units, Drake and Heath ham radio equipment. Find out what your dune buggy or van or base station should be equipped with, starting on page 12.

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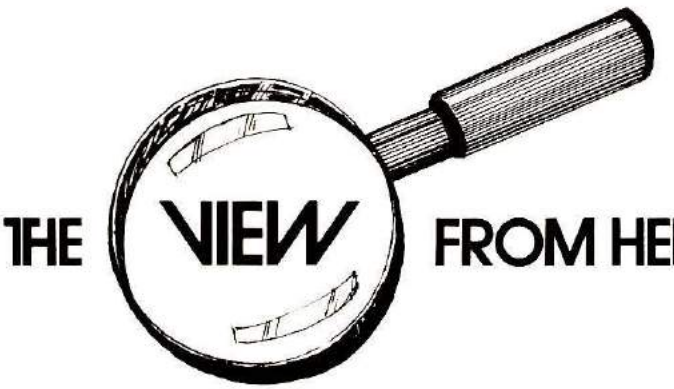


There are so many nooks and crannies to the hobby of amateur radio that it's difficult to say which one is the most popular. There's certainly tremendous fm activity on two meters, and there are a host of operators up on the six-meter band, trying to add another state to their Worked All States list. Down on 75 meters there are nets of rag chewers who gather on the same frequency, night after night. Then there is RTTY, slow-scan television, traffic handlers, brass pounders, county hunters, and vhf nuts. The list goes on and on . . .

However, from listening on the air, I'd have to say that one amateur radio activity which is near the top of the list is certificate chasing and DXing. Actually the two go together — what serious DXer do you know who doesn't have DXCC (as well as WAZ, WPX, and at least a few others)?

With all the interest in certificates and awards, everybody and his brother is busy churning out another new one (with seals), for working continents, countries, counties, town and club sites, all one mode and band seals, 25 cents extra. If you're looking for wallpaper, some of the certificates are worth applying for, but all too often they are poorly printed on a lousy grade of paper and don't even warrant space in your round file.

It's been my experience, as a one-time certificate chaser, that operating awards offered by national amateur radio societies (ARRL, RSGB, and NZART, for example) are well done; awards offered by national magazines are usually worthwhile as are the beautiful awards sponsored by the YL International SSBers. But, for every nice certificate available, there are a dozen others that would make passable toiletries.

You can usually predict the type of certificate you're going to get by return mail by considering the sponsor, the difficulty of the award, and the cost. If the award is for working three members of the Podunk Amateur Radio Club while on safari to Omallabug county, and they want 50 cents to cover postage and handling, don't expect too much! On the other hand, when the Organization of American States Association offers an award for working all member nations (Worked All Alliance Nations) at no cost, you can look forward to a handsome certificate.

It is unfortunate that the biggest bulk of junk certificates seems to originate in the United States. The certificates from overseas are almost always very tastefully done and are a welcome addition to the hamshack wall. I think it's high time we brought some of our homegrown awards up to snuff.

If your club offers a certificate of any kind, get it out and take a good, close unbiased look at it. Is it printed on a good grade of paper? (It doesn't have to be on parchment, but the paper shouldn't look like it escaped from a newsprint factory, either.) How about the printing? Are the letters clear and sharp? Are there ink smudges and dirty fingerprints, deposited by a careless printer? Finally, was your name and callsign scribbed on the certificate by some refugee from the third grade, or is it carefully lettered or typewritten?

If your club award passes these three simple tests, congratulations! Put it back in its frame and hang it on the wall. If it doesn't pass, resolve to take it up with your fellow club members at the next meeting. Let's relegate all those junk certificates to the trash can.

**Jim Fisk, W1HR**
**editor-in-chief**

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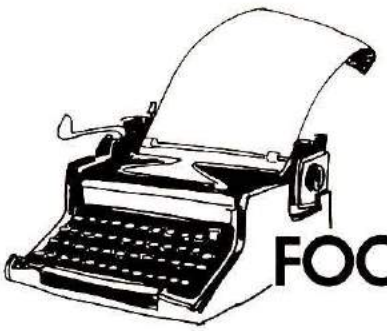

# FOCUS & COMMENT

The feature article in this month's *Horizons* is one that is designed to help both the amateur and the CBer to get acquainted with each other's personal radio service. It is by no means the complete story, but it should serve to enlighten many people who had incomplete or incorrect information about either CB or Amateur Radio. The article is bound to raise some voices of protest, as has some of our previous material that suggested that amateurs should try to help Citizens Band people advance to this more varied and interesting part of communications.

There is not much that can be done about attitudes like that, but then our purpose is to provide help to the newcomer, no matter where he comes from; we want to help people become amateurs, and to help amateurs become better amateurs.

There is another group of people in the electronics world who should not be amateurs — in fact they should be encouraged to be non-amateurs (professionals). I am talking about the people who manufacture and market equipment for the amateur world. They should borrow some of the professionalism that has been applied to the CB-equipment field.

Admittedly, there is not a lot of design freedom with a mobile unit when you consider the environment it will be in, and the use it will get. But, even so, most mobile CB units are somewhat dressy, have a variety of styles, manage to work well, and present an attractive appearance at the same time. Some amateur fm rigs are not far behind in this respect.

It is when you get to CB base stations (home stations to amateurs) that you can see the unamateur approach. A great many of the units are almost decorative. They still do the job for which they were designed, still meet the specifications set down for them, and you can use one to talk to someone without owning an engineering degree.

True, the average amateur set had a reason for being what it is. (Note that I said *had*). Starting from the time when a majority of amateurs built their own, most equipment was functional in appearance because of the need to repair it yourself, or because you had to use parts that were sold for the purpose, or because "it's always been done that way." Only recently have a very few rigs been offered that are getting away from the "square black box full of knobs and dials and switches" image. Show an interior decorator a ham rig to be worked into the decor, and she'll run for the tranquilizers (or hide the rigs in the attic, closet, or basement, where they have been for too long).

No where is the difference in approach more apparent than when you start looking for artwork to support an article such as our feature in this issue. It was downright difficult to find photographs of amateur equipment that presented the amateur station and service in a favorable light. By contrast, many of the CB photographs and advertisements had what can only be called "class;" professionalism in design and marketing was very evident.

Of course, some stations and fields of interest will always require more than the simple, one-box, uncluttered approach, and I wouldn't want that to change. Experimentation, competition, versatility, should be retained and encouraged; this, too, is a vital part of Amateur Radio.

But for the great numbers of people who just want to talk to each other, to enjoy the hobby of being friendly, a unit that doesn't look like a leftover from a battleship or from the space effort would do the job just fine.

CB manufacturers are not alone in fitting their rigs and methods to the market — the personal computer people are aware that a sleek, TV-set-like, modern terminal with a quiet keyboard is much more acceptable in the home than is a mechanical printer or *Teletype* unit.

What does all this have to do with amateurs? Just this: manufacturers are going through some design changes to see that amateur equipment meets the new FCC specifications on spurious output — maybe now is the time to say, "Think a bit harder, and give us a rig that looks good, too." And when they offer you one for trial, don't drag out that old myth that "anything that pretty can't work." They might surprise you.

**Thomas McMullen, W1SL**
**Managing Editor**

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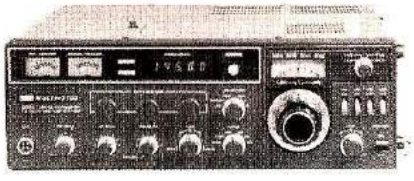

**KLM 2700**
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**KENWOOD TS-700A**
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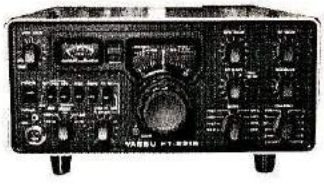

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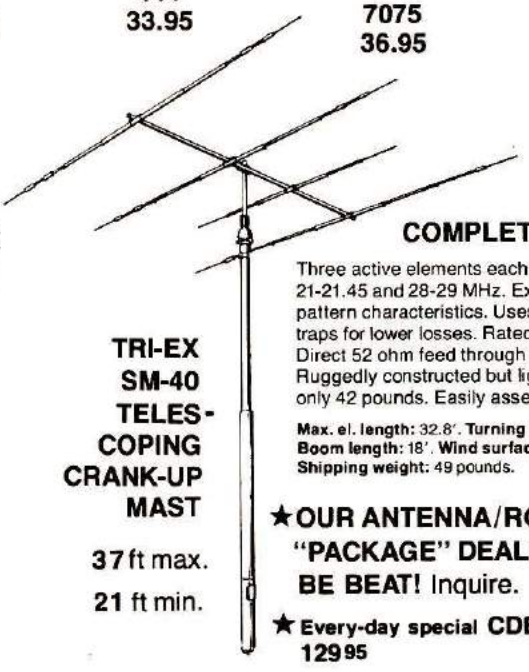

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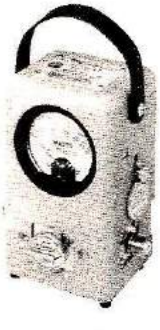

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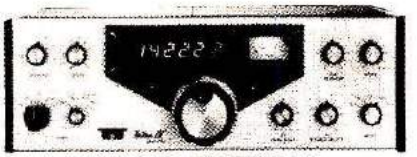



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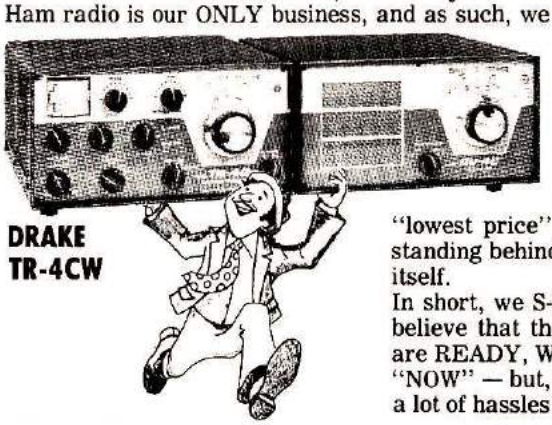


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# NEWSLINE

IMMINENT COMMUNICATOR LICENSE action is being rumored by several industry sources. Departing Chairman Dick Wiley's support of the Communicator concept and his reported desire to see it realized before he steps down is one very strong argument; it's probable impact on the Personal Radio Division's budget, which will be reviewed shortly along with next year's proposed budget, is another.

It Appears Very Likely that the Communicator license will see some sort of official review soon; what will come out of that review is another question.

EXISTING AMATEUR TRANSMITTERS WERE "GRANDFATHERED" June 2nd by an FCC modification to the first Report and Order on Docket 20777 that had become effective April 15. Under the modification all Amateur transmitters and transceivers (but not amplifiers) manufactured before April 15 are permanently exempted from the Report and Order's harmonic and spurious specifications. All Amateur equipment made after April 15 must meet the new specs, of course, but existing new equipment made before that date can be marketed until January 1, 1978. Individual Amateurs, however, are still responsible for meeting the 40-dB harmonic and spurious specifications of the FCC's first Report and Order on Docket 20777 in the operation of their own stations, even though the equipment itself has been grandfathered. The FCC's June 2nd relaxation applied only to the sale of non-complying equipment, and users are still expected to use it in such a way (with appropriate filters or an antenna tuner) that their stations meet the tighter requirement. Officially, the relaxation became effective July 18th.

A SIGNIFICANT POLICY DECISION by ARMA (Amateur Radio Manufacturer's Association) supporting the widely-held position that point-of-sale is the place to limit Amateur transmitter purchases by non-Amateurs, has been announced. The policy statement strongly urges the distributors of ARMA member's products to make every effort to see that transmitting equipment goes only to licensed Amateurs.

UNRETURNED NOVICE EXAMS are still a big problem with the FCC in Gettysburg despite the dropping of multiple-exam mailings. Volunteer examiners have a major responsibility to see that a Novice exam, whether or not the applicant actually takes it, is returned to Gettysburg on time. Failure to do so can jeopardize the volunteer examiner's own license, and continuation of the present "unacceptable" number of unreturned exams could trigger drastic changes in Novice licensing!

FCC-HOSTED "MEDIA WORKSHOP" in Washington July 13th provided an FCC-Amateur rap session that was rated "simply outstanding" by the 50 or so who attended. As an open, public meeting the limits placed on Amateur-FCC dialogue by the Home Box Office rule did not apply (July Newsline). Personal Radio Division Chief John Johnston chaired the session smoothly but flexibly, with give-and-take rather than formal type presentations the format.

Key Representatives Of All major Amateur publications attended, along with representatives of various manufacturers, repeater groups, clubs, and other publications. The FCC in turn brought in key people from all parts of the FCC pertaining to Amateur Radio.

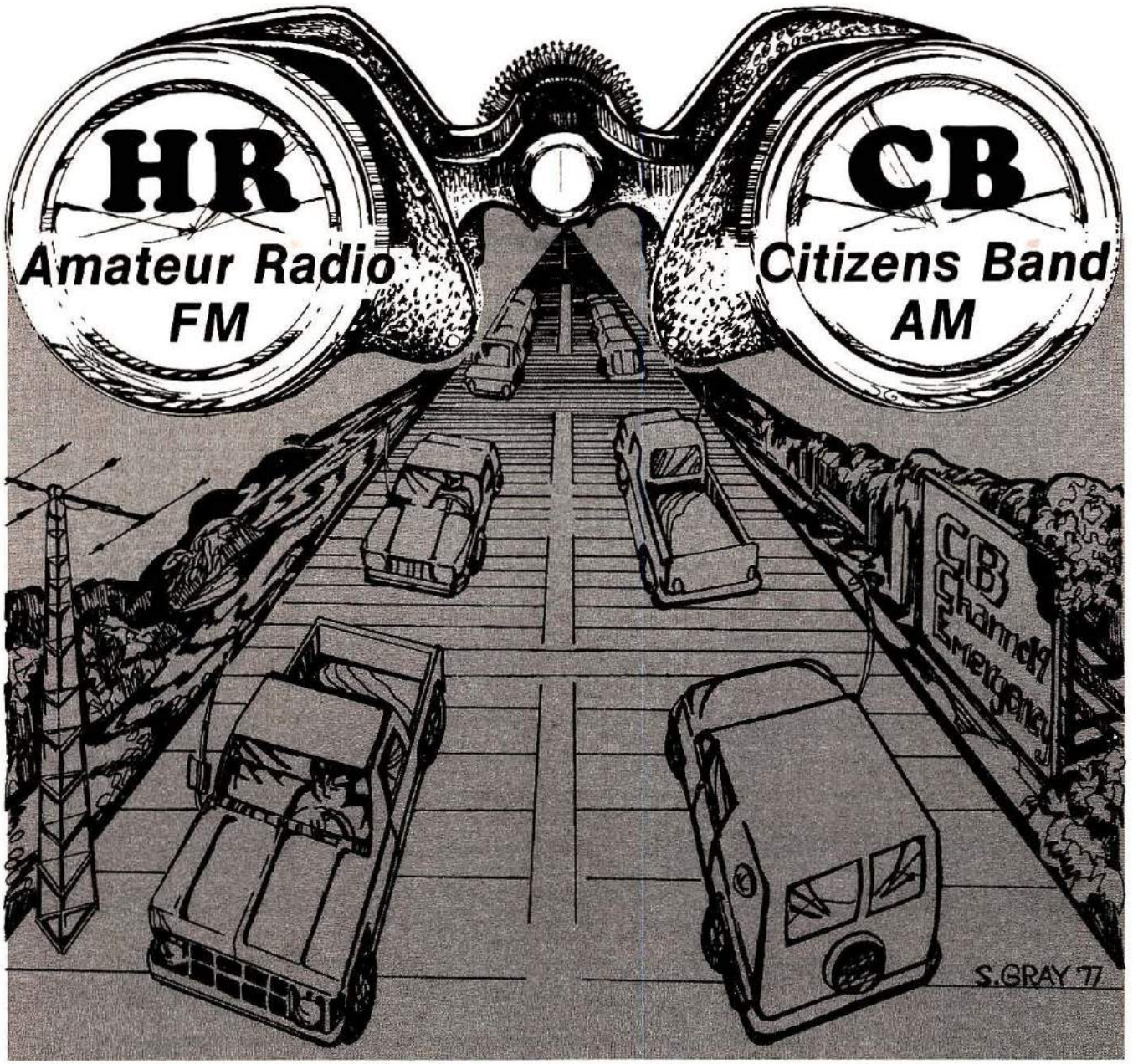
"GUILTY ON TWO COUNTS" was the verdict the jury handed down June 6th in the trial of FCC Special Licensing Chief Richard Ziegler (August Newsline). One of the original four counts of bribery for the issuance of special Amateur callsigns was dropped and the jury failed to reach a decision on the second during the two-day trial.

A NEWLY-UPDATED EDITION of the FCC's Amateur Radio Rules, including all Part 97 changes through March 7, is now available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. It's stock number 004-000-00338-1 and postpaid price is $1.30.

A RUSSIAN AMATEUR SPACECRAFT does exist and is ready to go, waiting for a launch opportunity, according to one European Amateur who says he's seen it. It contains a single 2- to 10-meter transponder and beacons on 20.08 and around 29.5 MHz.

CY AND CK PREFIXES have been authorized for VE and VO use respectively for the remainder of Queen Elizabeth's Silver Jubilee year, in response to a CARF request to the Canadian Department of Communications.

ARRL'S 1977-78 REPEATER DIRECTORY is now available — send a large SASE with 46¢ postage to the League to receive a copy.




# You miss half the picture if you close one eye

BY THOMAS R. SUNDSTROM, WB2AYA

Citizens' Band or Amateur Radio? At one time that question, if asked, on the frequencies occupied by either service, would have raised a discussion — or a heated debate — that might have lasted for hours. But, times are changing, and both radio services are solving their problems; each is taking a new, and careful, look at the other. CBers who enjoy tinkering with equipment and like to take part in round table conversations have found that they are missing a lot of fun by not venturing into Amateur radio. Amateurs who have overlooked some of CB's assets are now beginning to discover that they have denied themselves a useful service.

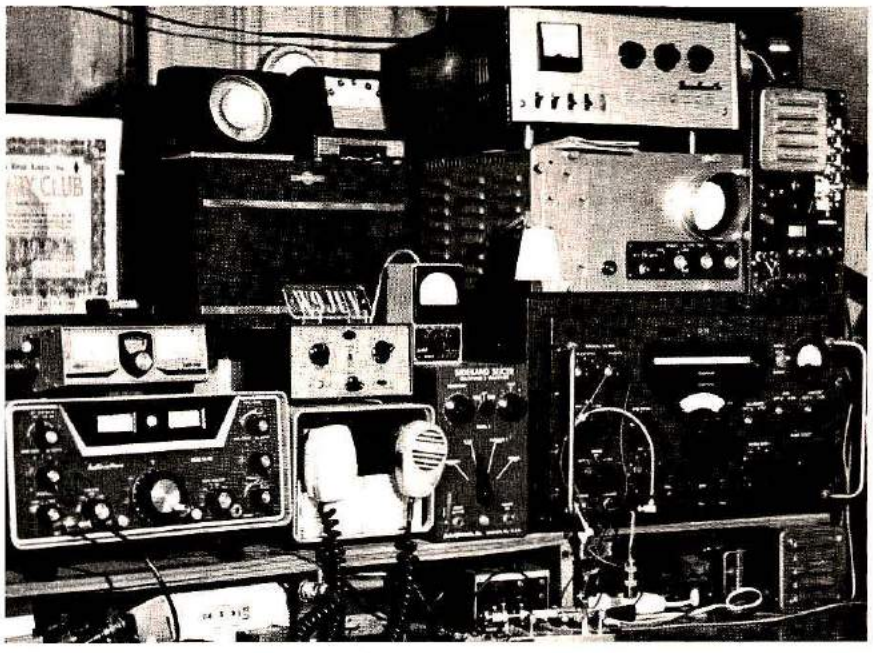
The purpose of this article is to take a closer look at both services and to explore some of the pros and cons of each. Vhf and uhf Amateur-band allocations are rapidly filling with former CBers who now hold Technician class Amateur tickets. Vhf-fm rigs have swept the market, and two meters (144-148 MHz) has turned into the number-one mobile operating band.

Although vhf/uhf fm, and two meters in particular, bears the brunt of this inspection, let me

point out that this is by no means the largest and most enthusiastic section of Amateur radio activity. Two-meter fm probably comes to the attention of more non-amateurs than does the lower frequencies, because, for one reason, there are numerous scanners available that can listen to these repeater bands.

Also, some of the tunable vhf-monitor types of receivers start their frequency coverage at the middle of the Amateur two-meter band. So, the intention is to offer an explanation of something that many non-hams have heard about, rather than to ignore the many attractions of the high-frequency bands, which are a world unto themselves.

Let's look at this recent phenomenon, and see how CB and vhf fm radio can peacefully co-exist.



Amateurs who have been at the hobby for any length of time tend to accumulate a lot of equipment. This station includes gear for all the amateur high-frequency bands, as well as for vhf, uhf, and repeater operation. Some of the equipment is new, some is war surplus, and some is adapted from the commercial two-way radio services.

### Authorizations

The Citizens' Radio Service is described by FCC Rules and Regulations as " . . . a radio-communications service of fixed, land, and mobile stations intended for short distance personal or business radio communications . . . "[1] which includes Class D stations "licensed to be operated for radio telephony, only."[2] Class-D authorization is a *station*, not an operator, license; so more than one person in a household or business can legally operate a unit[3] with only a few common-sense restrictions on the types of communication allowed.

A piece of new CB equipment on the scene is this transceiver by Texas Instruments, Inc. All control and operating functions can be selected from the buttons on the combination microphone and control head; there are no knobs on the main chassis. A readout panel on the microphone indicates channel number, mode (upper sideband, lower sideband, or a-m), and signal strength. It can also indicate power and standing-wave ratio.

These restrictions include, among others, prohibition of the " . . . advertising or soliciting the sale of goods," and on transmitting music, or " . . . program material for retransmission . . . on a broadcast facility."[4]

The Amateur radio service is limited to " . . . non-commercial radio communication by or among Amateur radio stations solely with a personal aim and without pecuniary or business interest."[5] A licensed Amateur radio station must be controlled by a licensed operator.[6]

You'll see from these quotations that Class-D Citizens' Band and Amateur radio are markedly different in purpose, in what you are

**Table 1** — Frequencies available for Class-D use.

| Channel number | MHz | Channel number | MHz |
|---|---|---|---|
| 1 | 26.965 | 21 | 27.215 |
| 2 | 26.975 | 22 | 27.225 |
| 3 | 26.985 | 24 | 27.235 |
| 4 | 27.005 | 25 | 27.245 |
| 5 | 27.015 | 23 | 27.255 |
| 6 | 27.025 | 26 | 27.265 |
| 7 | 27.035 | 27 | 27.275 |
| 8 | 27.055 | 28 | 27.285 |
| 9* | 27.065 | 29 | 27.295 |
| 10 | 27.075 | 30 | 27.305 |
| 11 | 27.085 | 31 | 27.315 |
| 12 | 27.105 | 32 | 27.325 |
| 13 | 27.115 | 33 | 27.335 |
| 14 | 27.125 | 34 | 27.345 |
| 15 | 27.135 | 35 | 27.355 |
| 16 | 27.155 | 36 | 27.365 |
| 17 | 27.165 | 37 | 27.375 |
| 18 | 27.175 | 38 | 27.385 |
| 19 | 27.185 | 39 | 27.395 |
| 20 | 27.205 | 40 | 27.405 |

*restricted to emergency traffic only (Part 95.41 (3)).

allowed to do, and how you are allowed to use your radio. A business, seeking a low-cost two-way radio system must use Class-D or move to an expensive and sophisticated business-radio system. A housewife who does not have an Amateur radio license, but needs two-way radio communication — either at home or when driving in her car — has no alternative but to apply for a Class-D CB license. Note again that Class-D licenses the station, whereas the Amateur Radio Service licenses both the operator *and* the station.

### Frequencies

The 11-meter Class-D Citizens' Band Radio Service was created in 1957. Twenty-three frequencies (channels) were allocated in the then-existing 11-meter band, which the Amateurs shared with the Industrial, Scientific, and Medical (ISM) services. The band was then withdrawn from the Amateur Service allocations. On January 1, 1977, an additional 17 channels were allocated by the FCC to alleviate severe overcrowding of the band. Expansion of the Class-D spectrum was limited to 440-kHz between the highest and lowest frequencies to eliminate potential mixing products.[7] Because 455 kHz is a popular intermediate frequency, commonly used in a-m receivers; and because there would very likely be two Class-D signals on the air at the same time and from the same area, the use of band limits spaced apart by 455 or 460 kHz would create interference with every clock radio in the neighborhood.

The 27-MHz Class-D frequencies (**Table 1**) are located in the radio spectrum near the boundary between high-frequency and vhf portions of the radio frequency spectrum. Normal propagation modes on the Citizens' Band are groundwave and skywave. Whereas FCC rules permit contacts at distances of up to 150 miles (240km),[8] with the intent that transmissions be limited to groundwave only, the daily and seasonal cycles of the maximum usable frequency often result in skywave reflections of signals from an ionospheric layer (the E-layer) about 60 miles (95km) up. These "bounces" cause tremendous interference to groundwave signals, and at times makes CB almost useless.

On the other hand, groundwave propagation, only, is normal and expected on vhf and uhf Amateur bands. Other kinds of propagation are *relatively* rare, but can and do occur under certain conditions of weather or solar activity.

The Amateur services are allocated a total of seven vhf and uhf bands above 50 MHz,[9] (**Table 2**) but only four have any significant usage: 50, 144, 220, and 420 MHz. Special attention to equipment, antennas, and engineering design precludes many Amateurs from operating and experimenting on Amateur bands above 450 MHz.

**Table 2** — Vhf and uhf Amateur bands above 50 MHz.

| MHz | Band |
|---|---|
| 50-54 | 6 meters |
| 144-148 | 2 meters |
| 220-225 | 1¼ meters |
| 420-450 | ¾ meters |
| 1,215-1,300 | 23 cm |
| 2,300-2,450 | 13 cm |
| 3,300-3,500 | 9 cm |

**Table 3** — Two-meter repeater and simplex frequencies.

| Repeater Pairs | |
|---|---|
| **146. MHz** | **147. MHz** |
| In Out | In Out |
| 146.01 - .61 | 147.60 - .00 |
| .04 - .64 | .63 - .03 |
| .07 - .67 | .66 - .06 |
| .10 - .70 | .69 - .09 |
| .13 - .73 | .72 - .12 |
| .16 - .76 | .75 - .15 |
| .19 - .79 | .78 - .18 |
| .22 - .82 | .81 - .21 |
| .25 - .85 | .84 - .24 |
| .28 - .88 | .87 - .27 |
| .31 - .91 | .90 - .30 |
| .34 - .94 | .93 - .33 |
| .37 - .97 | .96 - .36 |
| 146.40 - 147.00 | 147.99 - .39 |

| Simplex Channels | |
|---|---|
| .43 | .42 |
| .46 | .45 |
| .49 | .48 |
| .52 | .51 |
| .55 | .54 |
| .58 | .57 |

**Note:** In some crowded metropolitan areas, repeaters using a 1-MHz split may be using 15- or 30-kHz spacings with outputs between 146.415 and 146.49. Inputs are in the 147-MHz range.

### Transmission modes

CB uses a rather inefficient amplitude modulation (a-m) system. Half of the transmitted power is used for the carrier which contains no intelligence, while the remaining half is used for two, symmetrical, sidebands of information. Utilizing the principles discussed by *Horizons* Managing Editor Thomas McMullen, W1SL, in "Taking the Mystery Out of SSB,"[10] single sideband is a very efficient mode of communications for the crowded CB channels and ssb is allowed on *all* Class-D frequencies.[11]

The advantage of ssb over a-m is that the maximum bandwidth allowed for ssb (4 kHz) is only one-half of the maximum bandwidth allowed for a-m (8 kHz).[12] Elimination of the carrier gets away from the hetrodyning noise of multiple signals on one channel. Talking range increases, as does intelligibility.

Modes allowed on two meters are a-m, CW, fm, ssb, and RTTY (radio teletype). The band is divided into two sections: 144 to 146 and 146 to 148 MHz. CW is permitted from 144 to 148 MHz, while a-m and ssb are conventionally found between 144.1 and 146 MHz. Fm and some RTTY are usually above 146 MHz.[13]

By specific action, the FCC has also allocated certain frequency bands "for repeater stations, including both input (receiving) and output (transmitting)," which includes the 146- to 148-MHz segment of two meters.[14]

Repeaters are the lifeblood of portable and mobile Amateur stations on vhf and uhf bands, but repeaters are not authorized in the Class-D CB service.

### Repeaters

The most obvious difference between CB and vhf fm is the advent of repeaters for radio Amateurs. Fm repeaters are not new; records reveal 5-meter repeater stations in use as long ago as 1932.[15] The mushrooming growth of narrow-band fm equipment and repeaters really took off in the 1970's, and is still gathering momentum.

A repeater extends the range of base and mobile units, to distances of 100 miles (160km) or more, but on these high frequencies, antenna height is all important.

An approximate rule-of-thumb for calculating transmission (or reception) range, subject to a variety of factors, is that vhf and uhf signals propagate a distance of $4/3\ H$, where $H$ = distance to the horizon.[16]

The distance to the horizon can be calculated by

$$D = 2Rh + h^2$$

where

$D$ = line-of-sight distance from the observing point to the horizon.
$R$ = radius of the earth to the average terrain surrounding the observing point.
$h$ = height of the observing point above the average terrain.[17*]

Fm repeater frequencies are "channelized," and each repeater has at least one input and one output frequency. When W1AAA transmits on the repeater input frequency, the repeater essentially amplifies the incoming signal and retransmits it on the repeater output frequency where W1ZZZ is listening. The process reverses when W1ZZZ answers W1AAA. The construction of the repeater permits simultaneous reception and transmission of the signals by spacing the input and output frequencies 600 kHz, or in some cases 1 MHz, apart. See **Fig. 1**.

### Fm repeater frequencies

The fm repeater portion of two meters is channelized into repeater and simplex frequencies on 30 kHz spacings (**Table 3**).

Simplex operation does *not* involve the use of a repeater, but alternating communications on a common, single, frequency just as CBers communicate on a particular channel. Common practice is to use 146.52 or 146.94 MHz as a simplex frequency, except in areas where a repeater might use the latter as an output frequency. Although I've not seen any studies on what would be the most popular simplex frequencies, personal observations would rank 146.52, 146.58, and 146.55 MHz, in that order, as most popular.

Simplex frequencies (**Table 3**) are spaced in between repeater input and output frequencies. Repeater frequencies are set by voluntary Amateur cooperation. There is nothing in the FCC Rules and Regulations limiting

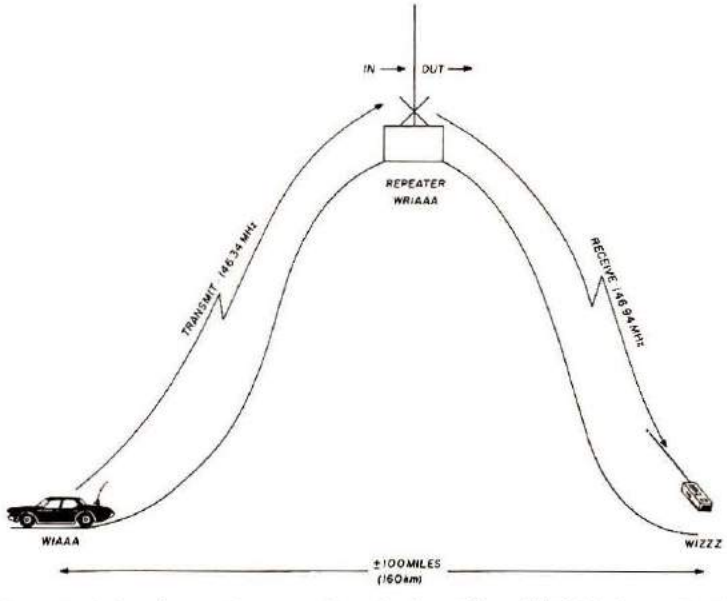



**Fig. 1.** The principle of repeater operation. A signal from W1AAA is received by the repeater on its *input* frequency, amplified, and retransmitted by the repeater on its *output* frequency where it is received by W1ZZZ. Since the input and output frequencies are different, no interference is caused at the repeater, and simultaneous reception and transmission can take place; since the mobile and hand-held are transmitting and receiving on different frequencies, they do not interfere with each other.

*You may use any units of measure you like, provided that the same units are used consistently throughout the equation. The answer will be in the same unit.

An idea of the coverage of amateur repeaters across the country is given by this map. The shaded areas are based on an estimated 35-mile (56km) radius coverage area centered on the repeater location. Some repeaters will exceed this figure, and some will have coverage patterns shaped to include a specific area to the exclusion of others. Information based on the 1976/77 *ARRL* Repeater Directory listing.

the choice of repeater frequencies within those band segments allotted for repeaters. Amateurs in the various sections of the country act as "area frequency coordinators" to suggest repeater assignments and minimize interference on the same or adjacent channels. A current list of frequency coordinators is available from the American Radio Relay League, Newington, Connecticut 06111.

The two-meter band plan[18] is firmly entrenched now, and area frequency coordinators have things under reasonably good control by advising on choice of band, frequency, and location. As with troublemakers anywhere, there are a few Amateurs or Amateur groups who install repeaters without consulting the coordinator, but peer-group pressure will usually encourage behavior modification. Eventually, the repeater is moved to a "coordinated" status, following appropriate changes.

In the crowded metropolitan areas, there are 1-MHz "splits" having inputs between 147- and 148-MHz, and outputs between 146- and 148-MHz; arranged high-to-low (input/output) so that simplex operation does not activate the repeaters. In many areas of the country, 15-kHz "split-frequency" assignments have been made between the 30-kHz assignments. Except in California, the 15-kHz splits — frequencies ending in the digit 5 — run in the same direction as the 30-kHz assignments. In California, the splits are inverted with respect to the 30-kHz allocations.

What are the most popular repeater frequencies? Mathematical studies indicate that with four pairs of crystals you can operate almost half of the available two-meter repeaters in existence.[19,20] See **Table 4**.

**Table 4.** The popular repeater frequencies are listed in ranking order below. Note the practice of dropping the leading prefix "146" or "147" and the decimal point, and referring only to the suffix. If two frequencies are given, the repeater input frequency is given first, followed by the output frequency. If one frequency is given, it is the output frequency with the 600-kHz spacing understood. For example, 34/94 or 94 refers to 146.34 in — 146.94 out; 96/36 or 36 refers to 147.96 in — 147.36 out.

| In order of popularity | | |
|---|---|---|
| 34/94 | 19/79 | 01/61 |
| 16/76 | 25/85 | 04/64 |
| 22/82 | 07/67 | 10/70 |
| 28/88 | 13/73 | 37/97 |

### Cooperation on CB

Class-D operators don't have repeaters, and with the crowded frequencies, there are many arguments and fights — yes, even shootings — over who has the "right to the channel." One such murder was within two miles (3km) of my home, and that channel was rather quiet for a while thereafter.

Fortunately, common sense prevails with the majority of users. A local CB club in Willingboro, New Jersey, for example, has discouraged the constant banter on one frequency by the simple action of *not* acknowledging the continuous requests for a 10-36 (time check) or a "radio check." The frequency is now relatively clear for base-to-mobile communications within the township.

"Col. Klink," otherwise known as Sgt. Paul Solow of the Willingboro Police Department, has taken up residence on channel 19 to perform three functions: 1) to warn motorists of traffic hazards; 2) to reduce vehicle speeds; and 3) to educate the public to road safety habits.[21] "Klink" is just one example of the growth of the use of CB by police departments at the local, county, and state levels.

Recently the Federal government has made grants available to law enforcement agencies to install CB-monitoring equipment at various base station installations, and some additional funds are being set aside for educational and training programs for the CB motorist. By early 1977, the

An increasing number of police departments are taking advantage of CBs ability to reach the average motorist for reasons of safety and emergency messages. This Missouri State Highway patrolman monitors channel 9, and uses the call KMO-0911. The 911 number is a reminder that in many areas you can reach help quickly by dailing those digits (*photo courtesy Missouri State Highway Patrol*).

**Table 5** — Preferred CB channels.

| | | |
|---|---|---|
| Channel | 8 | Agricultural operations |
| Channel | 9 | Emergencies only (FCC-designated channel) |
| Channel | 13 | Maritime |
| Channel | 15 | Motorcyclists |
| Channel | 16 | Ssb operations only |
| Channel | 18 | Ssb operations only |
| Channel | 19 | Motorists/ truckers in transit |
| Channel | 36-40 | Ssb operations only |

New Jersey State Police will have 21 posts capable of monitoring emergency channel 9, and all three dispatching points (Newark, New Brunswick, and Moorestown) for the New Jersey Turnpike will be covered.[22]

This kind of activity has already taken place in a couple of states, with Ohio and Missouri being prime examples of what can be done. Other groups have identified themselves with certain channels,[23] detailed in **Table 5**, but there is nothing in the FCC Rules and Regulations to dictate such use. The one exception is channel 9, the FCC-designated emergency channel, which has had a rocky — but basically successful — history.[24]

Even with the expanded 40-channel band, frequencies are still crowded. Limiting conversations to those that are necessary and purposeful, and keeping transmissions as short as possible, are keys to giving all a chance to use the channel. Courtesy and patience are virtues that are too often ingored.

### Cooperation on two-meter fm

Hams have the ability to do a variety of things not available to Class-D CB operators, but they, too, have problems.

In years past, there have been repeater "wars," particularly in the large metropolitan areas, between coordinated and uncoordinated repeaters. With the growth in occupancy of the two-meter band, and increasing pressure, problems have increased.

There have been some unfortunate arguments on repeaters about how to locate stolen sets. From time to time (unfortunately, the problem seems to be increasing) 2-meter sets are being stolen from automobiles and sold as CB sets to unknowing individuals. Out of frustration, and sometimes deliberately, these unlicensed individuals "jam" a repeater. When this happens, many of the repeater users face a period of frustration until the situation is resolved. Fortunately, many clubs have members with enough technical savvy to work out a methodical approach to apprehending the individual who is causing the disruption. Although the FCC rules prohibit an amateur from talking with an unlicensed station,[25] there has been relatively little enforcement of this where the purpose has been to recover stolen gear or to apprehend a jammer.

In defiance of the spirit of cooperation, some Amateur groups "close" their repeater. Devices known as tone-burst generators producing audible frequencies around 2-kHz or systems producing subaudible

Many amateurs convert equipment that was once used in commercial service so they can be used through vhf repeaters or remote base stations. A control head, like this Motorola unit, and a tone-generating control panel (for control purposes) are often seen in mobile installations (*photo courtesy W6JYP*).

Even when he is walking, an amateur can extend the range of a 2- to 5-watt portable transceiver by taking advantage of a repeater a few miles away. This feature not only adds to the pleasure of casual hamming, but also helps in emergency situations where it is impossible to reach the scene except on foot (*photo courtesy R. L. Drake Co.*).

tones prevent just anyone from accessing a particular repeater. Unfortunately, some "closed" repeaters occupy the more commonly-used repeater frequencies (**Table 4**). To activate a "closed" repeater, a 2-meter transceiver must contain an appropriate device to trigger that particular repeater.

Fortunately, such situations are minimal. I can sympathize with repeater owners and operators who put up time and money to construct a properly operating machine, and then object to local freeloaders who tie it up. But, a few proper comments can go a long way toward building friendships and reducing conflicts.

There are other reasons for using a tone-access repeater, particularly in the large metropolitan areas where there are simply not enough repeater frequencies to go around. This leads to repeaters being located close to the coverage area of each other, with the result that some mobile stations will unavoidably open more than one repeater when they transmit. In a note-worthy effort to maintain local control but still maintain emergency

communication capability, some area clubs use individual tones for their particular repeater, and also have a common "all-call" tone to permit a motorist in trouble to summon help, even if he is out of range of the repeater he normally uses.

Although I disagree with the concept of closed repeaters, one solution that closes a repeater to "locals" but makes it available to travelling hams, is exemplified by WR2ADJ, 146.16/76, in Sayreville, New Jersey, near New Brunswick. The repeater has a second, carrier-accessible, input receiver located near the New Jersey Turnpike. The input receiver activates the repeater three consecutive times before shutting down for a short time; a member, with PL (Private Line), can talk with that transient Amateur — *PL* to non-*PL* — to render assistance.

**Autopatch**

Personal-use telephone capability is available to hams through repeaters. The two-tone frequencies generated by *Touch-Tone** pads can control repeater functions, including connection to, and release from, telephone lines, assuming the necessary circuitry is installed on the repeater.

Most autopatch systems are limited to member use even though the repeater itself may be open. Most repeater groups whose repeaters are autopatch equipped will activate the telephone lines for non-members with emergency traffic. There are a few repeaters with autopatch facilities that are open for any ham, having a *Touch-Tone* pad, to dial 911 (where that emergency-service number exists) should the need arise. Again, this kind of public-service spirit can only survive with cooperation.

Autopatch capabilities are expensive, and telephone charges consume a large chunk of any sponsor's budget. Accordingly, an autopatch should be used only for non-business personal messages of importance, and not just idle chit-chat. If you have any questions on the functioning of the autopatch on a particular repeater, a control operator monitoring the repeater will answer any questions about the system.

*Touch-Tone is a registered trademark of the American Telephone and Telegraph Company.

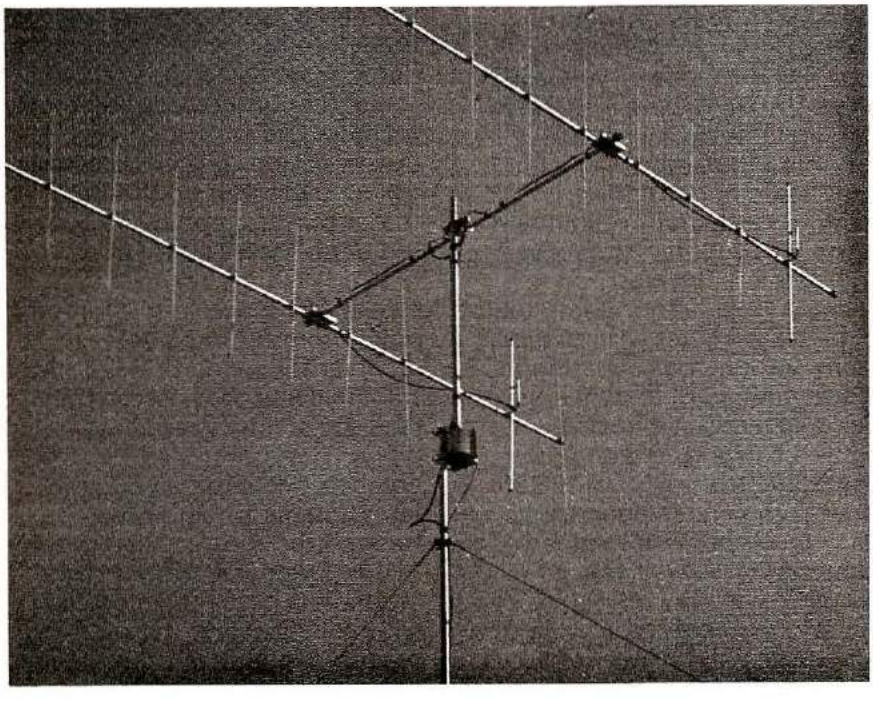
**Operating**

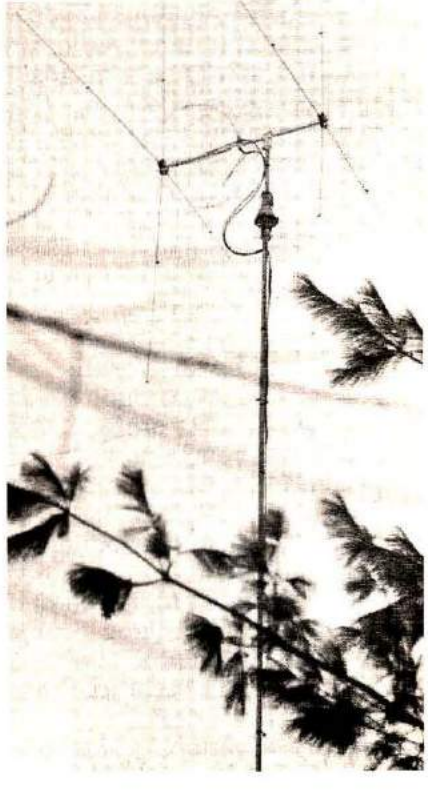
Operating procedures are markedly different between CB and the two-meter Amateur fm band.

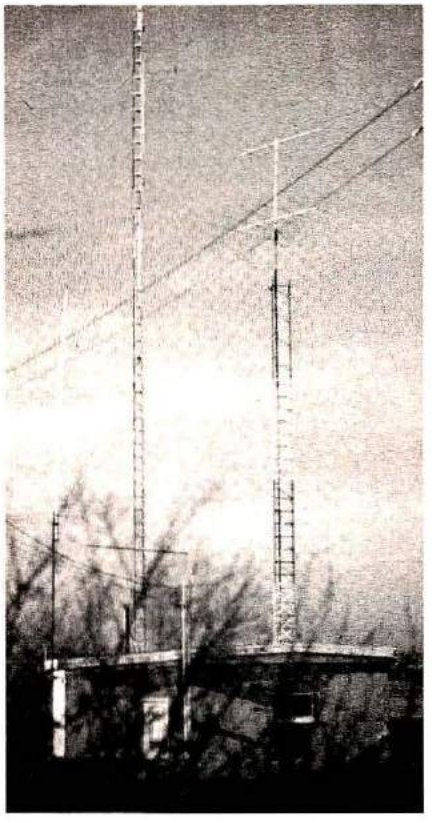
The method of striking up a conversation on CB is usually to say "Break, Channel 19" (or whatever channel is being used), "This is KOG—2427", although there is nothing in the FCC rules to state that you must ask for use of the frequency. Usually someone will respond "C'mon Breaker" and the conversation is started.

Recent changes in the FCC rules state that the operator need only identify his own station with the assigned call, a "handle" may be added to the identification, at the "beginning and the end of each transmission or series of transmissions, but at least at intervals not to exceed

The CB 2-element quad, right, is large and bulky requiring a heavy duty rotor and multiple guy lines, whereas the 2-meter 22-element beam, below, is somewhat smaller, lighter, and easier to install. The 22-element beam performs well for both simplex and repeater frequencies.







W2ZQ's (Delaware Valley Radio Association's) location is outside Trenton, New Jersey on high ground, housing the WR2ADE repeater and other hf and vhf equipment for club members. The repeater tower is the tallest one in the middle of the photograph.

ten (10) minutes."[26]

On the lower Amateur bands (10-160 meters) it is common practice to call *CQ* as a means of announcing an intent to begin a contact with another station. This is not so on repeaters, where acceptable practice is to say, if the repeater is not in use, "WB2AYA Listening" or "This is WB2AYA Listening on 94" (the frequency given is the output of the repeater or the simplex frequency, dropping the 146- or 147-MHz prefix).

To join an already-in-progress conversation on CB, common practice is to say break and then wait to be acknowledged by one of the stations.

On many repeaters, the term *break* should *not* be used except in emergencies. The proper way, if you must join the conversation in a non-emergency situation, is just to insert your call once in the momentary silence between one station turning over the conversation to another, and wait to be acknowledged.

It is a good idea, when using a repeater, to delay — for two or three seconds — between transmissions to permit someone else to access the repeater, either to join the conversation or to get help in an emergency situation.

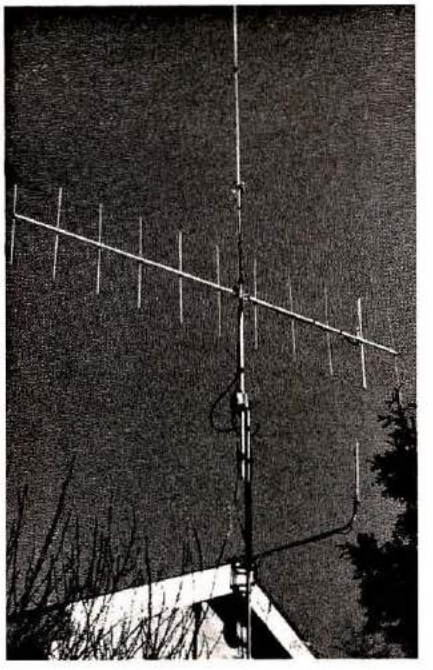
Some repeater groups firmly and politely insist upon this rule — and it's a good one.

Just as some CB channels have taken on certain characteristics (**Table 5**), some fm repeaters have developed reputations for a particular type of activity.

Repeaters can be local or regional in coverage, and some have special interests. For example, WR2AHM, 146.265/865, in Pine Hill, New Jersey, is dedicated to autopatch use by members in the Camden County area. On this repeater autopatch carries top priority, excepting emergencies, over all other contacts in progress, which must cease while the member makes his non-business telephone call.

Another kind of service — a wide-area regional coverage — is provided by WR3AHZ, 146.385/985, in Parkesburg, Pennsylvania, placed at one of the higher spots between Valley Forge and Lancaster. Until the high-power WR3AHZ came on, there was difficulty in obtaining adequate repeater coverage in parts of Chester and Lancaster counties, Pennsylvania and in Cecil and Hartford counties, Maryland.

Repeaters develop "personalities" too. Some tend to be rather quiet with two or more stations participating in longer-than-normal conversations, whereas others are limited to short, in-and-out, contacts. WR2AHU, 147.96/36, New York City, is an extremely busy machine with stations jumping on and off the frequency all day long; but, by 10 PM each night, a couple of Amateurs establish a semi-formal roundtable which somewhat stabilizes the utilization pattern.



An omnidirectional antenna can be installed atop a beam, if roof space is limited, when operating two-meters. The antenna on the lower right is for the VHF (152-174 MHz) Public Service Band.

When operating a repeater for the first time, the new user should determine if there are any special operating rules — such as a 3-second pause, or autopatch priority — and the length of its timer.

A timer is a device to prevent the transmitter in the repeater from coming on and staying on the air, either by accident or on purpose (yes, it happens). A timing circuit disengages the repeater transmitter after a preset period of time. Repeater timers can reset on the input or the output frequency, depending upon the circuitry used.

The first-time listener to a repeater will notice a burst of noise from the repeater receiver following the end of a transmission, but before the repeater transmitter shuts down. That burst, known as a squelch tail, can be varied in length by settings on the transmitter.

If the repeater timer resets on the input, the squelch tail will be longer and the replying station can pick up the conversation without letting the

repeater transmitter drop off the air. If the repeater resets on the output, the replying station must wait for the second squelch indicating the repeater transmitter had also stopped transmitting. Failure to wait for the second squelch will result in timing out the repeater, when the whole system shuts down and goes through a recycling process.

Many heavily-used repeaters, such as WR2ADT, 146.34/94, Greenbrook, New Jersey, have timers that time-out the repeater in less than one minute, but the norm is a 3-minute timer. A rule-of-thumb is to keep transmissions short and to the point, one topic at a time, especially during commuter-travel periods in the morning and evening. Mobiles and portables should have priority over high-powered base stations in use of repeaters during such periods.

It's not a bad idea, when possible, to use simplex in lieu of a repeater, and leave the repeater free for those who need it.[27] It's rather silly for base stations within a couple of miles (3km) of each other to tie up an area repeater in a lengthy conversation. Keep the repeater open for the low-powered mobile and hand-held units that can use the extra help afforded by a repeater.

**Emergencies**

In the establishment of the Citizens Radio Service for personal and business use, the FCC recognized its potential for providing communications during times of emergencies.[28] FCC Rules and Regulations for the Amateur Service also include, as part of the definitions of the service, a statement on public service in times of emergencies . . . in fact, that is the first definition given.[29]

Activities along the New Jersey shore during Hurricane Belle's visit of August 8-9, 1976, were representative of the kind of assistance CBers and hams can render in times of disaster. What took place in New Jersey has been repeated over and over again elsewhere . . . the tornados in Ohio, and the hurricanes making landfall along the Gulf Coast.

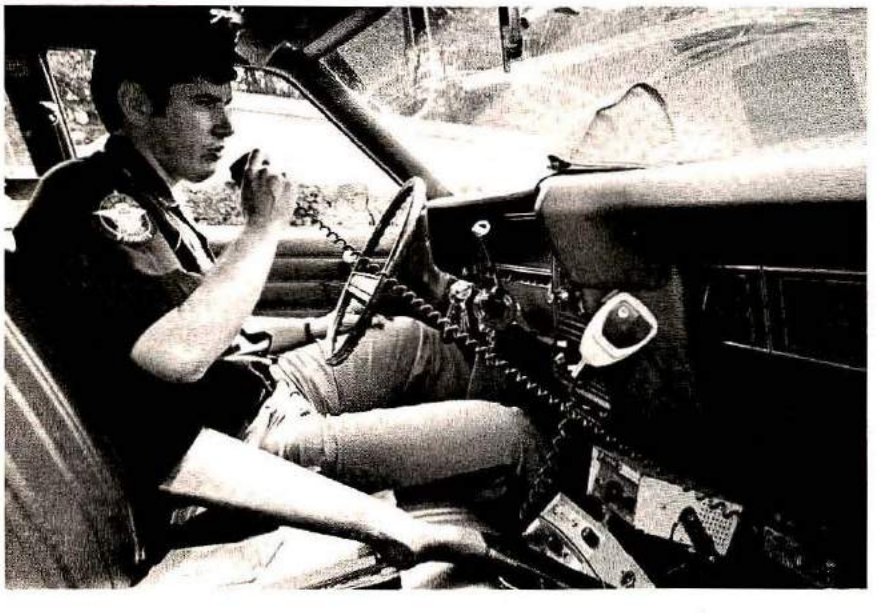
Quite frankly, the clutter of hetrodynes caused by a large number of operators attempting to use a single CB channel limits communications to relatively short distances, but that doesn't stop CBers from giving a hand. During Hurricane Belle, CB communications coordinated the movements of Red Cross vehicles on Long Beach Island, and provided communications between the vehicles and headquarters at the Long Beach Island municipal building. From that control point, 2-meter fm stations relayed messages 20 miles (32km) north to Ocean County Civil Defense headquarters in Toms River, New Jersey.

Depending upon the nature of the request and its destination, some messages were relayed across the state on two-meters and others were put into the NTS (National Traffic System) via the New Jersey Phone Net on the 75-meter Amateur band.

At the same time in the Philadelphia area, a flood watch was set up on most of the suburban creeks known to have a history of overflowing their banks in low lying areas.


Channel 9 is the generally recognized nationwide emergency calling frequency on CB. Volunteers often monitor this channel around the clock, and in some areas the police use this channel for fast response to trouble calls from motorists. Much good publicity for CB is generated by signs like this one posted near the city or town limits (*photo courtesy CB Life Magazine*).

Although a major use of CB in the car was to give out "Smokey" reports, police were quick to recognize it as a way of getting in direct contact with the motoring public. Many travelers are glad to be advised of hazardous conditons or traffic problems ahead, allowing them to seek a different route. An E. F. Johnson CB unit takes its place under the dash for this officer in the Sheriff's Department in Northern California's Sumter County (*photo courtesy CB Life Magazine*).



CB mobile units were stationed along the various streams, and local communications, at each stream site, was coordinated by someone with both CB and 2-meter equipment. Information, via fm, was passed on to county disaster-control agencies.

Public-service work is not limited to emergencies. Newspaper, radio, and TV stories recount, daily, the incidents of hams and CBers locating lost children, helping the handicapped, and coordinating bike-a-thons and walk-a-thons for charity. Hams and CBers, together and separately, have assisted in these exercises. The media doesn't always assign credit to the proper group, but the end result of a job well done is the same.

**Travelling**

If there is any one single justification for having a CB set, it is putting it in the car when driving the open road!

There are now approximately 9-million station licenses issued in the Citizens Radio Service[30] — which means any family member or employee of the business can pick up a microphone.

Contrast this with less than 300,000 licensed Amateur radio operators *eligible* to operate on two-meters,[31] and with only a small percentage of those amateurs actually operating on the band, and the point becomes clear.

The odds of finding a local mobile station, or a base station near your location, is much higher on CB than on 2-meter fm. In a situation where emergency help or specific directions are needed, you are more likely to find immediate and local response on CB.

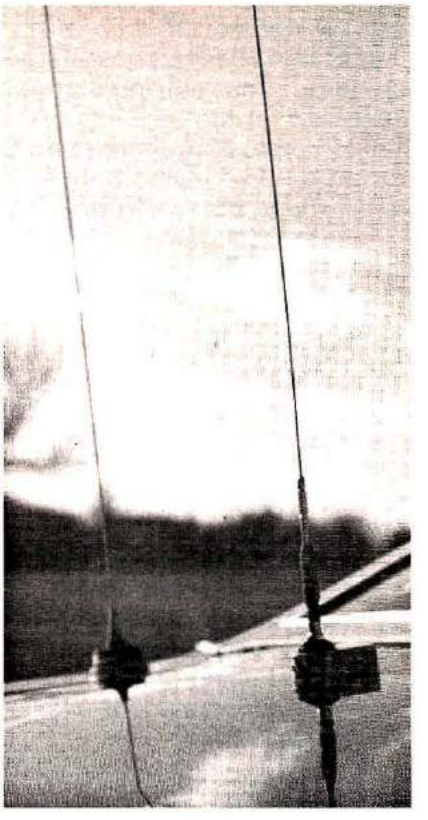
CB's drawback is its short effective transmitting range. On channel 19, or channel 10, in some areas of the country, the range can be less than a mile (1.6km) because of interference from local and skip stations.

In the Northeast Corridor, where Amateurs have continuous coverage of the terrain by repeaters, the probability is still high that the replying station may be located many miles away and relatively unable to render immediate assistance — even if required.

The situation is worse elsewhere. The Amateur travelling through North Dakota, for example, can travel for 200 or 300 miles (300-650km) between areas of repeater coverage, and seldom can anyone be found on the national simplex calling frequencies of 146.52 or 146.94 MHz. High-frequency band (80- through 10-meters) equipment is the order of the day for Amateur mobiles in the wide-open spaces.

A Technician Class licensee (but not a General or higher class, licensee) has an additional problem when travelling in Canada. Whereas CB licensees may operate under Tourist Radio Service rules, a Technician cannot operate under reciprocal Amateur licensing agreements because Canada has no license comparable to the Technician ticket.

At the time this is being written, however, the Canadian Department of Communications (DOC) is considering an Experimental Amateur Radio Operator's



No apparent degradation of antenna performance on either CB or two meters is noticed, despite the close proximity of mobile antennas.

In addition to repeaters, amateurs in many areas use remote base stations. These stations make use of a good location and antenna to relay signals from amateurs in poor locations, and often do so on an amateur band that is different from that used by the amateur in his home or mobile station. The use of remote base stations is not necessarily restricted to vhf, and control and access can be by either wire (telephone lines) or radio signals (*photo courtesy W6JYP*).

Brackets to hang the CB set above the police radio and other equipment put all radios in easy reach. In Willingboro, New Jersey, officers (such as Lt. Cjeske here) use their own equipment in township patrol cars.

Certificate[32] that, upon final adoption may be comparable to the Technician license. The Technician licensee should check with the ARRL, Newington, Connecticut 06111, or directly with one of the DOC regional offices. The Toronto office has been quite responsive to requests for reciprocal CB and ham licenses. The address is: Regional Superintendent, Telecommunications Regulation, Department of Communication, 55 St. Clair Avenue, East, Toronto, Ontario M4T 1M2, CANADA.

So where does all of this leave us? Two-meter fm is great for covering long distances through repeaters, and for holding conversations of any duration, but CB — and especially channel 19 — keeps the motorist up to date on road conditions, weather, accidents, and yes, even speed traps. In checking channel 19 around the New York City and Philadelphia areas, there seems to be a decrease of emphasis on spotting "Smokey the Bear" with the "picture taker." In some states, such as Maryland, where there is a reputation for tight law enforcement, I'm sure things haven't changed.

Some states have directed troopers not to talk on their CB radios, but the patrolling officers often listen and learn of potential problems — such as an erratic driver, hijackers trailing tractor trailers, or accidents — before their dispatcher knows of them.

Is there a place for both types of radios in your car? You bet! With the small physical size of radios, antennas, and the small current demand of sets today, there is no problem installing two radios in most cars.

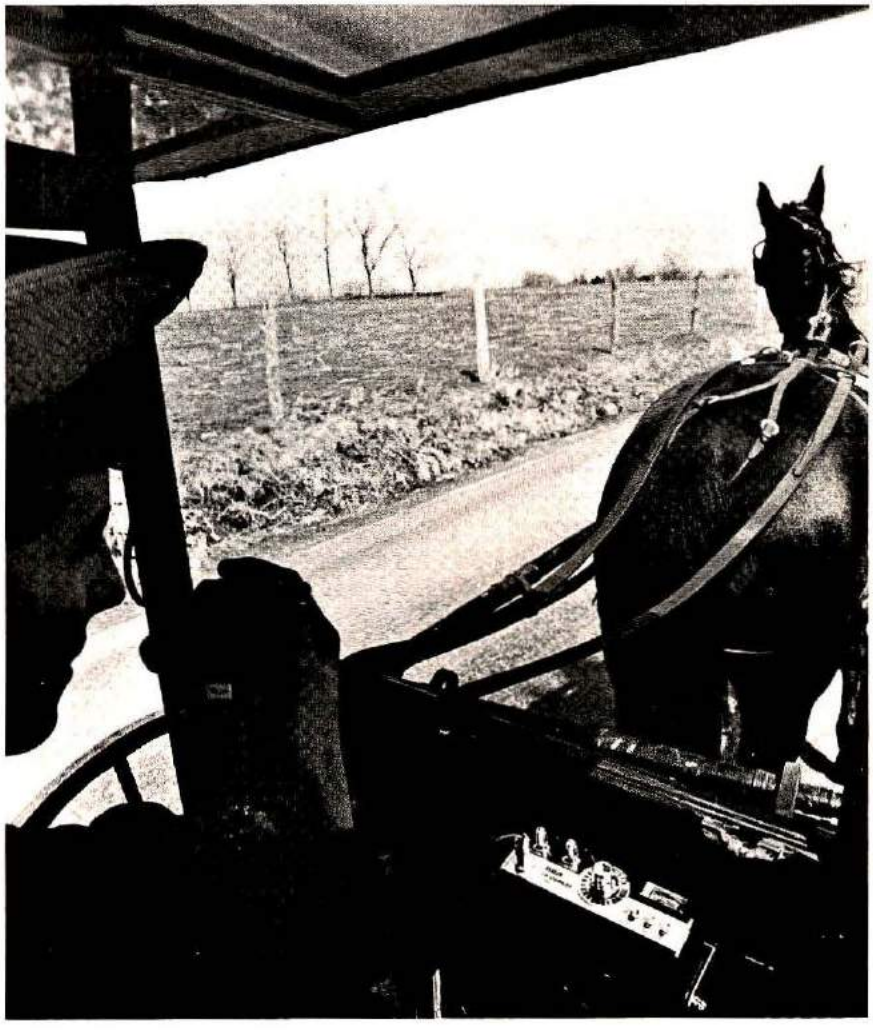
There have been numerous articles written about how to install equipment in a car, so I won't attempt to discuss the procedure in detail, but one little trick is worth mentioning: Use male and female connectors in the power supply line, and wire all cars and home-station power supplies in the same way. Put the female connectors on the power and the automobile fuse block, and put the male connectors on the radios. In this way, all radios will interchange with all power sources, making installation and removal of the radios from the car — to prevent theft — quick and easy. This system is cheaper than slide mounts, is just as quick, and affords a sure connection to the power source.

**Conclusion**

CB radio should not be overlooked by the radio Amateur as a useful tool to supplement communications on 2-meter fm and other ham bands.

One idea not discussed before is the use of CB hand-held units which are a lot less expensive than the vhf fm equivalent. Installing and adjusting a complicated antenna array, with one ham in the shack and another on the roof or tower, is a lot easier

You've seen CB rigs on bicycles and motorcycles and snowmobiles, but how about this? An RCA CB Copilot installed in this one-horsepower vehicle allows the driver to keep in touch with family or friends.



when radio communication is substituted for "lung power." Clubs providing communications for a public service-activity in a restricted area can easily come up with inexpensive CB hand-held units, whereas few club members have, or can afford, the relatively expensive hand-held Amateur radios being marketed for 144, 220, and 450 MHz.

Sure, CB has its problems with crowded frequencies, unthinking and uncaring people doing their level best to make a nuisance of themselves, but ham radio has those same problems — to a lesser degree — only perhaps because of the fewer Amateur stations on the air. Amateurs police themselves, for the most part, and the FCC needs to do relatively little enforcing, except in the most serious cases where Amateurs cannot agree to settle things between themselves. Enforcement of the CB frequencies is another matter, and sheer numbers of CB operators prevent the undermanned FCC field offices from doing anything but a cursory job.

Despite the problems on 27 MHz, there is a need for low-cost personal communications, and the radio Amateur should not overlook its potential. On the other hand, CBers frustrated with noise and interference and limitation of communication distance should consider becoming radio Amateurs. Recent procedural changes have simplified getting an Amateur license, although Morse Code is still a requirement.

Five words per minute in code isn't as fast as you may think, and the written test (actually multiple-choice questions, 20 for the Novice and 50 for the Technician/General test) is straightforward. There are numerous aids available from *ham radio's* Communications Bookstore,* and code and theory classes are offered by Amateur radio clubs and many adult evening schools. Check around, through a local ham, CB or electronics store, or through a county CD radio officer; or put an ad in the local paper. There is always a ham nearby to help those interested in getting their Amateur licenses.

CB and Amateur radio can co-exist, and both serve useful — if different — purposes. Don't sell either one short. Common sense and courtesy is the name of the game.

*The Novice study aids available include ARRL publications such as *Tune In the World With Ham Radio*, *The Radio Amateur's License Manual*, and the *Ham Radio Operating Guide*; Ameco study guides and cassette tapes; MFJ code-practice oscillator and key. For these and other packaged study material at special prices, write to *ham radio's* Communications Bookstore, Greenville, New Hampshire 03048.

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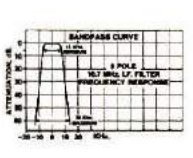
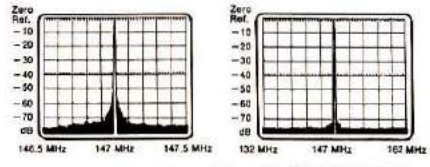



An 8-pole IF crystal filter greatly reduces adjacent channel interference.




Actual spectrum analyzer photos of the HW-2036 transmitter output operating at 147 MHz. Spurs within 20 MHz of carrier are down a full 70 dB!

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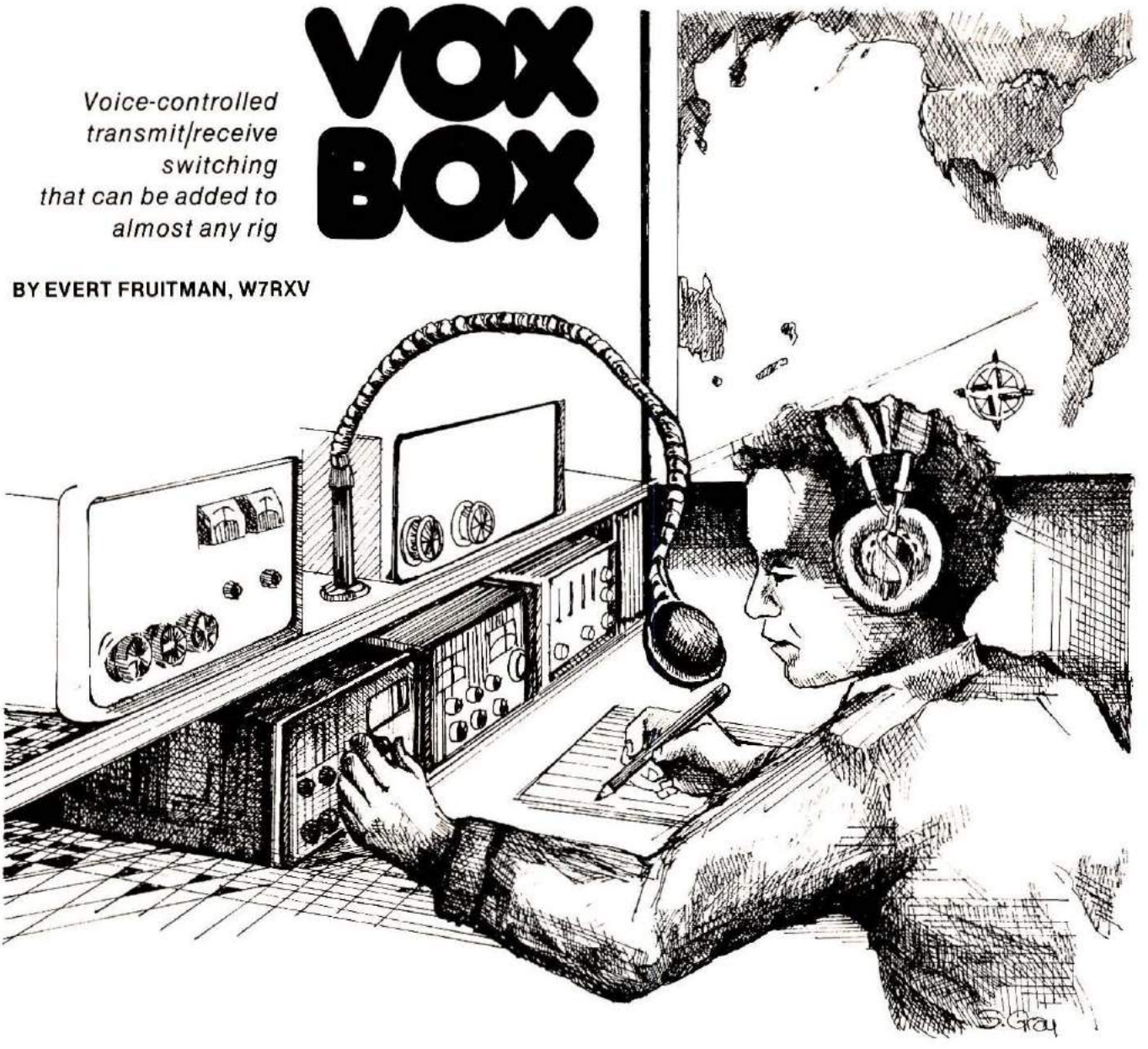


In its early days, Amateur radio voice operation sounded much like broadcasting. You tuned in a station, listened awhile — perhaps ten minutes or longer — and, when it was your turn to transmit, you turned off (muted) your receiver, turned on your transmitter, and began a monologue of your own. Each time, you manually operated separate switches, one for each piece of equipment that had to be turned off or on. Under these primitive conditions, break-in voice operation was virtually unknown, and those who tried it looked something like octopuses with hands, arms — even feet — flying.

But the trend of Amateur radio has always been from the complicated to the simple; towards easier, faster, and more efficient operation. Sooner or later, stilted, long-winded monologues (lectures) had to give way to a more natural, relaxed dialogue between hams; something like a two-way telephone conversation. The change did not take place overnight, nor did it arrive without much experimentation and trial and error.

**Push-to-talk**

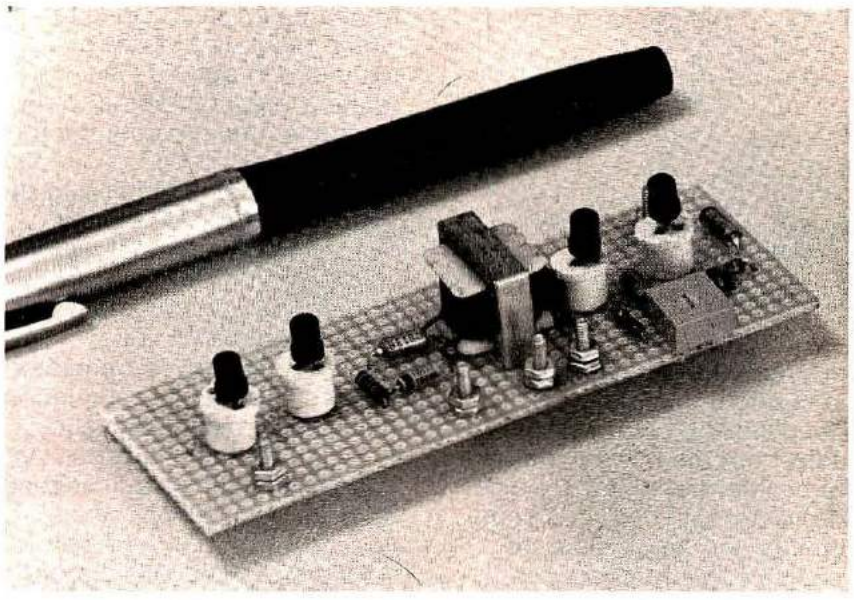
Amateurs and other voice operators who needed to speed up their two-way conversations found that multiple switches could be replaced by a single switch that operated a relay having multiple contacts: A pair to take care of transmitter switching, a pair to handle receiver switching, and others to perform numerous other switching functions. It was just a simple step to mount that

single switch on the station microphone — and push-to-talk (PTT) was born! Now, by simply pushing one switch, an entire sequence of relay-controlled functions could be initiated. PTT is still in use everywhere, and particularly in mobile radio service.

### VOX is born

Still . . . there had to be an even better way to turn the equipment on and off quickly; a "no hands" approach that would relieve the operator of the necessity to even throw one switch. Inventors and experimenters asked themselves: "Wouldn't it be great if the human voice could be used to do the switching?" Following this idea, ingenious circuit designers developed the VOX (Voice Operated Transmit) circuit, but they had some clues to help them along the way.

One good clue was the use of sound-activated circuits by photographers who wanted to make stop-action photographs of a bursting balloon, or a bullet in flight. The sound of the explosion, fed through a microphone placed near the action, triggered a circuit that tripped the shutter and electronic flash at exactly the right time. Of course, it was necessary to time the device properly so that the sound caused the tripping action neither too soon nor too late, but this was simple, and workable devices soon became commonplace.



The relative size of the assembled circuit can be seen by comparison with the fountain pen. Input to the board is to the right. The small square component near the first transistor is the trimmer potentiometer to adjust sensitivity. Perforated board makes the assembly easy, and small bolts and nuts serve as connecting terminals.

Single-sideband techniques really gave vox operation the boost it needed; or, perhaps, it was the other way around, but regardless of whether the chicken or the egg came first, ssb and vox have been working hand-in-hand ever since. Virtually all of the newer single-sideband transmitters and transceivers incorporate vox circuits. There are, however, some older transmitters — and even transceivers — that do not have vox, perhaps because of their age, or because they were built as inexpensively as possible. If your rig doesn't have a vox circuit, you've undoubtedly wished you had one. Well, you needn't wish any longer, because this article is intended just for you.

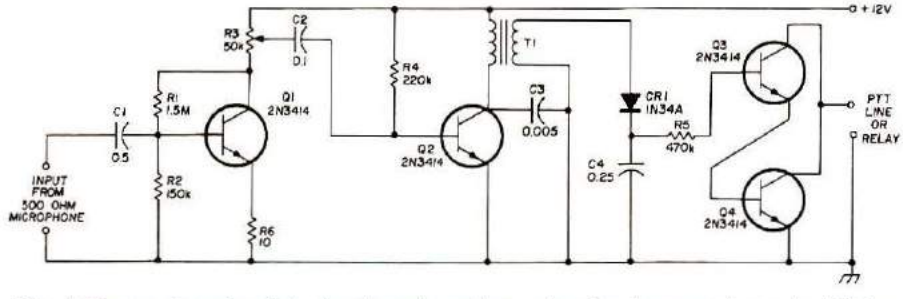



**Fig. 1.** The vox-box circuit is simple and requires only a few inexpensive parts. Wiring is non-critical. T1 is a small transistor interstage transformer, 1000-ohm primary, with a secondary of either 1000 or 2000 ohms, center tapped.

### Construction

The voice activated relay vox circuit shown in **Fig. 1**, is simple and inexpensive. If all of the parts are purchased new at your nearby electronic marketplace, they shouldn't cost much more than about $4.00. The unit may be built into its own enclosure and plugged into an existing rig that is not to be modified, or it may be built into a transmitter or receiver that you don't mind modifying.

The transformer sells for about $1.00, and the transistors cost only 15 to 35 cents each. Since you'll need four of them, that's half of the budget. Sockets are not essential, but are useful for testing questionable transistors fresh from the scrap box, and also make it easy to mount them in the finished circuit. The four capacitors should cost about one more dollar, and the potentiometer should sell for about half that amount. Some 2-56 (M2) nuts and screws make convenient and inexpensive IN/OUT terminals. Add to these items a small piece of

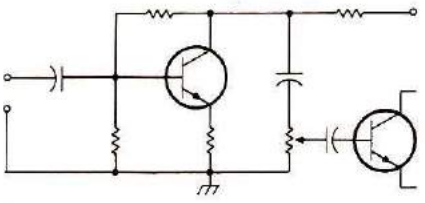


**Fig. 2.** An audio volume control may be connected as shown here, but requires two more components than the arrangement shown in **Fig. 1**.

perforated board, and the parts list is about complete.

Capacitor C1 couples the audio from the microphone into the base of transistor Q1. The Q1 emitter resistor adds some stability and helps raise the transistor input impedence, which is desirable to prevent loading the microphone.

Base bias for the transistor is provided by resistors R1, R2, and R3. R2 is connected between the collector and base, which supplies some negative feedback and, therefore, a small amount of additional stability. R3 is the collector load and, since its value is large, Q1 has rather high gain. The whole system has been designed for maximum gain rather than high fidelity, and is satisfactory because it is intended to drive a relay and not a loudspeaker.

To keep size and cost down, an uncommon sensitivity control method is used. If control R4 is moved while the power is applied, there will be a shift in the voltage level developed across capacitor C2, which will appear as a signal at the base of Q2 and will be passed on to the rest of the amplifier. This "noise" could not be tolerated in normal audio circuits, but in this set-and-forget system, it is an effective method for adjusting the gain. **Fig. 2** shows the more conventional way of connecting a volume control between two stages, but note that it requires two more parts.

Resistor R4 supplies base bias for transistor Q2, while capacitor C3 is a high-frequency bypass capacitor which tends to cut down response to stray rf. The transformer, connected to give a voltage step-up, couples the signal to the diode.

When audio is applied to the input, capacitor C4 rapidly charges to approximately 10 volts, and it slowly discharges through R5. As soon as C4 reaches about 1.5 volts, transistor Q3 drives transistor Q4 into saturation, completing the push-to-talk circuit and turning on the transmitter. A couple of hundred milliseconds after the audio stops, the voltage across C4 falls below 1.5 volts and the PTT circuit opens, putting the rig back in the receive mode.

With the time constants used, the circuit will pick up quickly enough so that the first voice syllable is not missed, and it will not drop out between syllables. The sensitivity control is adjusted so that extraneous noise doesn't trigger the transmitter.

Although some of the commercially built rigs use solid-state switching to go from receive to transmit, many of them use a relay. They probably have a diode across the relay coil to limit the "back" voltage (voltage surge) that appears when the current to the coil is suddenly cut off.

Transistors Q3 and Q4 are still in good condition after extensive tests without a diode across the T-R (transmit/receive) relay. Since the voltage across the coil decays rather slowly, in about 200 milliseconds or so, the surge voltage is quite small, and has caused no trouble. If it is possible to get into your rig and install a diode across the coil, so much the better. If not, its absence isn't likely to cause trouble.

Normally, vox systems have some form of anti-vox (anti-trip circuit) to prevent false triggering caused by received audio getting back into the

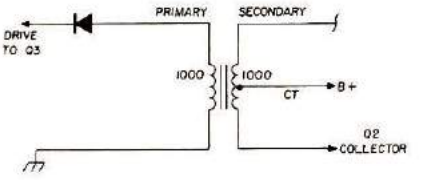



**Fig. 3.** Audio interstage transformer, T1, is connected as shown here. The primary winding is connected between diode CR1 and ground, and half of the secondary winding is connected between B+ and the collector of transistor Q2. The other half of the secondary winding is not used. Connecting the transformer as shown provides a voltage step-up.

microphone from the loudspeaker. The system presented here was designed for use in a transceiver that has a telephone-type handset, which prevents received audio from getting in where it doesn't belong. In a mobile installation where a close talking microphone is used, the same should hold true.

Normally, the push-to-talk switch in a transceiver grounds a circuit. The unit described here should be able to handle the current and voltage encountered in the average push-to-talk circuit.

As noted earlier, 2N3414 transistors which sell for about 15 cents or so have worked very well. For a little extra safety margin, use a 2N3053 or 2N2102 transistor for Q4. If you would like to provide a longer drop-out time, *i.e.* the time required to go from transmit to receive, increase the value of capacitor C4. For faster dropout time, decrease the value of resistor R5.

Although there is a fair amount of gain in the system, the layout is not really critical. Follow normal precautions, such as keeping the input circuit away from the output.

When a headset, consisting of earphones and microphone (either commercially built or custom engineered at home), is used in conjunction with the *Vox-Box*, it makes for a hands-free operation and real operating convenience. **HRH**

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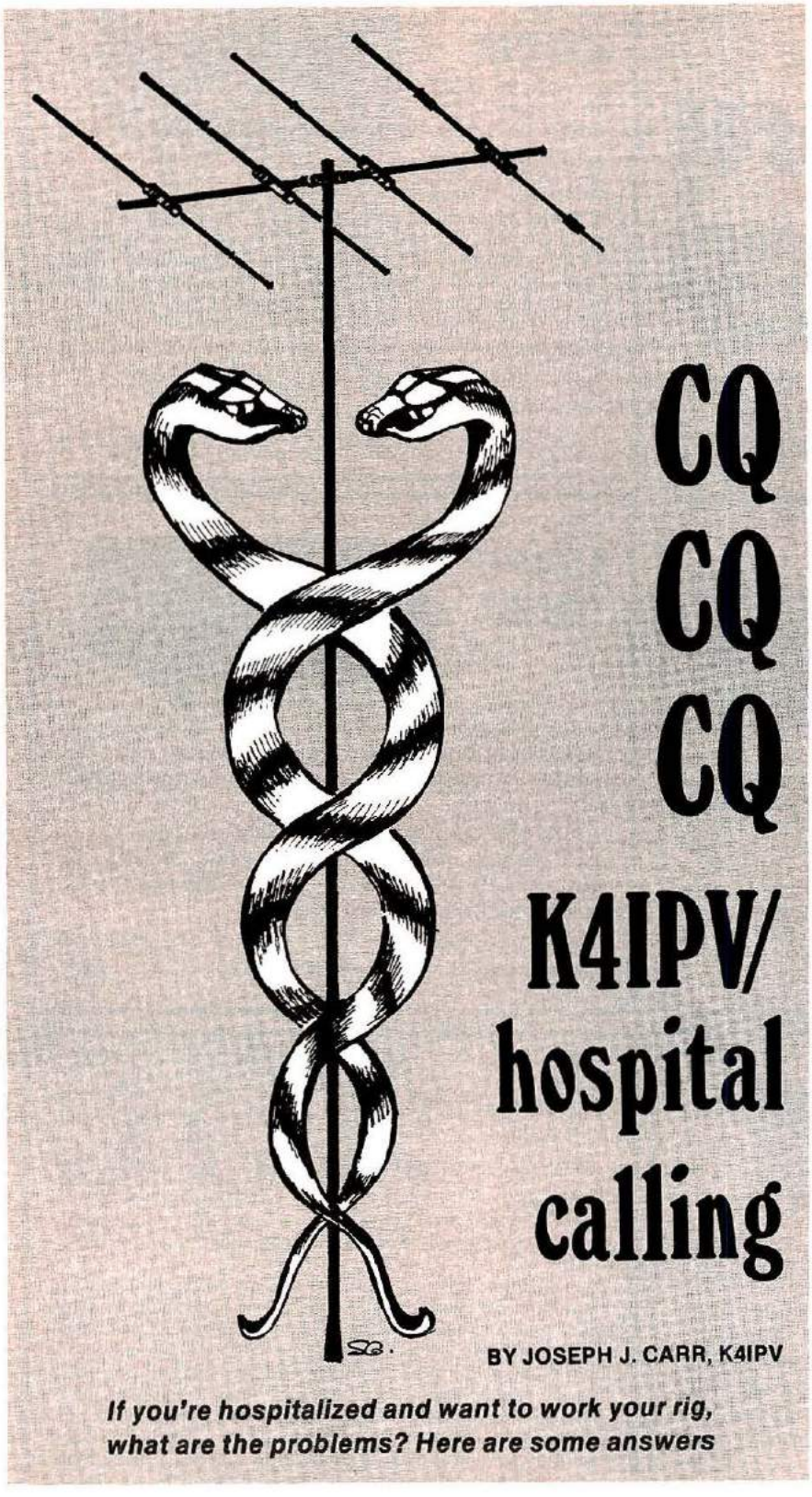


# CQ CQ CQ K4IPV/ hospital calling

BY JOSEPH J. CARR, K4IPV

***If you're hospitalized and want to work your rig, what are the problems? Here are some answers***

Professionally I'm part of a medical electronics department in a large University hospital. We recently had to deal with exactly this type problem. A local amateur was hospitalized and wanted to operate his two-meter station. In our city we can *hit* numerous repeaters, so operation would have been very enjoyable for him. At first the patient wanted to bring in a 10-watt synthesized mobile rig that was attached to a dc power supply and later a Drake TR-22. Unfortunately, we couldn't officially sanction *any* rig, despite the fact that members of our organization are also amateurs. In this article I'd like to present some reasons why sometimes we have to be hardnosed — something normally uncharacteristic of amateur radio operators.

Two problems are associated with amateur or CB rigs in the hospital environment. One is interference; the other is electrical safety. The second problem is probably the least known outside the medical electronics field.

### Electrical safety

Electrical appliances (including electronic equipment) that are not designed for hospital use can present a significant danger in the hospital environment even though they are *normally* quite safe to use. **Fig. 1** is a simplified drawing of power wiring in most electronic equipment. There's always a capacitance between metal cabinets and the power wiring, and this capacitance can reach surprisingly high values. A 60-Hz leakage current is coupled through these capacitances to the cabinet. In an applicance that has a two-wire power cord, you can connect a micro-ammeter between earth ground and the cabinet and read up to several dozen microamperes. Modern equipment, and that includes *all* equipment used in the hospital, must have *three-wire*

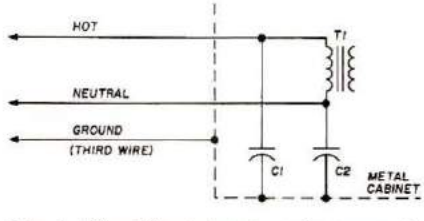


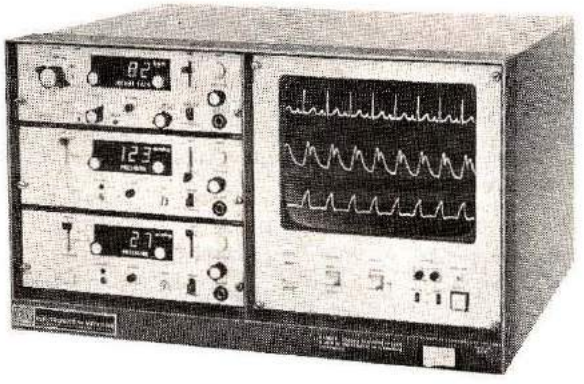

**Fig. 1.** Simplified drawing of power wiring in most electronic equipment. Capacitance between the power wiring and chassis couples a tiny leakage current onto the cabinet. Normally harmless, this current becomes dangerous if allowed to exceed 10 microamperes not passing down the ground wire.

*power cords*, in which the third wire is connected to the chassis or cabinet. The third wire is also connected to the ground (*not* the neutral) of the ac wall outlet. The purpose of this wire is to carry the leakage current to ground, rendering it harmless.

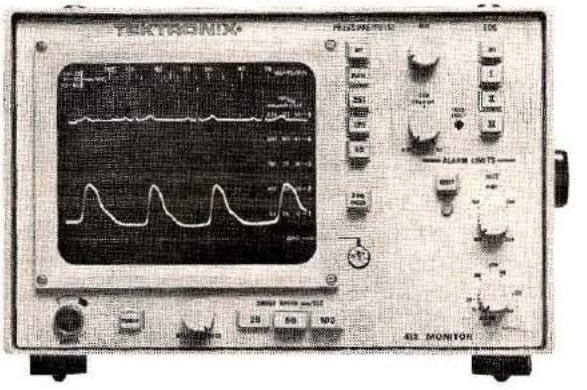
Even if the current were not carried to ground, the current would be of little or no danger under normal circumstances, because it has a relatively low value; and your skin, even when moderately wet, has a relatively high electrical resistance. Some published danger levels put the "threshold of perception" at 5 milliamperes and the "mortal danger region" somewhat above 100 milliamperes. In the hospital environment, however, the situation is *not* normal, and we set the danger level at 10 microamperes. Many instances occur in a hospital where the patient's skin is not intact, so electrical current may find a direct pathway to the heart. Such instances include an intravenous injection into the arm, an indwelling catheter of one type or another, or an electrical pacemaker wire. Under these circumstances, electrical requirements fall into a whole new ballpark.

Why do we consider 10 microamperes to be dangerous? It seems to be a ridiculously small amount of current. The 10-microampere number seems to have come from a series of experiments on dogs. In these tests, a 60-Hz ac current of 20 microamperes caused a fatal cardiac arrhythmia, called *ventricular fibrillation*, in which the lower chambers of the heart quiver rather than beat normally. The number for humans was taken as one-half this amount, or 10 microamperes.

The maximum amount of electrical leakage current allowed to reach a patient from surrounding equipment, then, is 10 microamperes. Nobody really knows for certain just how much current is actually dangerous to humans when introduced directly into the body. It's always difficult to extrapolate data from animals to humans, but existing data is the best obtainable. (To date, no one has volunteered to undergo electrocution so that good data on humans



**Electronics for Medicine**

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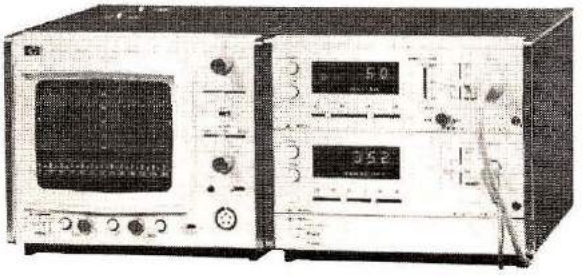

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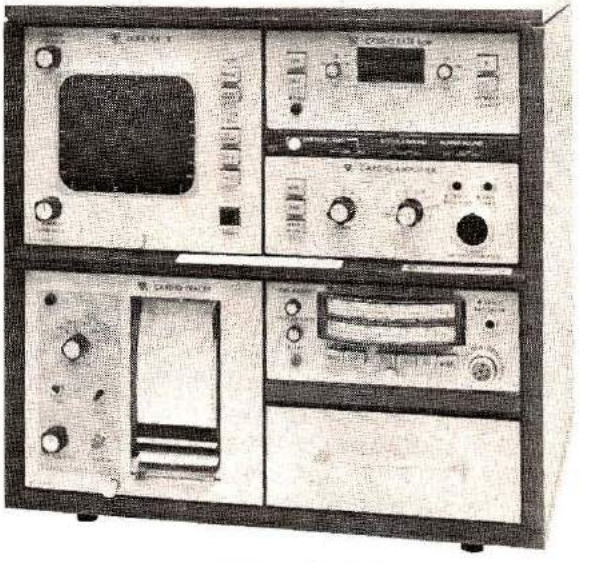

**American Optical**

**Fig. 2.** Typical medical monitoring equipment (*photos courtesy Electronics for Medicine, Tektronix, Hewlett-Packard and American Optical*).

**Fig. 3.** A radio telemetry unit allows the patient to walk around a designated area while nurses monitor his ECG waveform on a receiver at the central nurses' station (*photo courtesy Hewlett-Packard*).

can be obtained!)

Although many knowledgeable people feel that the 10-microamperes limit is too conservative, it's one of the published standards accepted by hospitals, clinical engineers, and insurance carriers. Considering the malpractice problem, hospitals tend to observe the most conservative standard.

Most amateur equipment is not built to the exacting standards imposed on manufacturers of medical electronic and other hospital equipment. For example, it's quite common to see two-wire power cords on amateur equipment. Considering the potential for disaster, it's little wonder that such cords are banned. Similarly, most amateur equipment that does have a three-wire power cord uses the inexpensive molded-type plug, which can lead to a false sense of security. In such plugs the ground wire is often strained to the breaking point, because the ground pin on the plug is *off center*. If the ground wire breaks, and it often does, the device becomes essentially a two-wire appliance and is thus dangerous. The only equipment we allow in our hospital is battery operated, which is completely isolated from the ac power mains. So why do we ban battery-powered amateur and CB sets? Here's why . . .

### Interference

**Fig. 2** shows some of the complex monitoring equipment used to keep tabs on the patient's physiological signals in operating rooms, the emergency department, the intensive care unit, or the coronary care unit. Although medical equipment is built to tighter specs than all consumer equipment and most amateur-radio equipment, there is a potential for interference because such equipment is also very sensitive. The electrocardiograph (ECG or EKG) amplifier, for example, must handle a 1-millivolt signal differentially from a source that has anything *but* good common-mode properties. The electroencephalograph (EEG), which is used to monitor brain waves, is even more sensitive because it handles signals below 100 microvolts. To make matters even worse, the inputs to medical equipment are connected to the patient through wires up to several feet long. Although these wires are usually shielded, they still act as an antenna, as does the patient's body.

This interference will sometimes show up on the oscilloscope or strip-chart recorder, but in these cases the interference is merely annoying and not of great concern. Doctors and nurses using the equipment will recognize the interference as an artifact, so it will be ignored unless it does not go away. More invidious, however, is the type of problem that could result if the interference altered a value or reading taken from an electronic instrument. In that case there might not be an easily recognized artifact to tip off the medical people.

A second type of interference is overload, intermodulation distortion, or harmonics getting into our own in-house radio systems. There may be several systems in operation, so interference potential from an outside system brought into the hospital might be a little difficult to predict. Typically found in most hospitals are a vhf/uhf page system, a vhf/uhf two-way system for security, a metro-wide radio system to other hospitals and to emergency vehicles (as in the TV show *Emergency*), and a cardiac ECG telemetry system.

Many, perhaps most, modern hospitals use radio telemetry units to allow certain heart patients to be ambulatory while recovering. These systems (**Fig. 3**) will radio the patient's ECG waveform picked up by electrodes on the chest to the receiver located at the nurses' station or at a central monitoring console. The patient is allowed to walk around a limited and clearly defined area to get some exercise. The medical staff can

keep tabs on the patient's heart waveform on an oscilloscope connected to the receiver outputs.

A typical ECG telemetry unit consists of several radio channels (8 seems to be a popular number) and appropriate oscilloscopes, heart-rate meters, strip-chart recorders, and alarms. Each patient wears a cigarette-pack-size vhf or uhf radio transmitter. The wires that connect the skin electrodes on the patient's chest to the transmitter are also used as the antenna. **Fig. 4** is a block diagram of a popular vhf model using direct fm. Amplifier A1 is an instrumentation amplifier consisting of three micropower operational amplifiers in a single package. This stage will have a relatively high center-band gain, but the passband is limited to 0.5 to 40 Hz. Amplifier A1 output is applied to a combination crystal oscillator/fm modulator operating in the 10 to 15 MHz range. Modulation is by a varactor connected in series with the crystal. The A1 signal is applied across this varactor to create a deviation that, when multiplied by the following stages, results in a ± 200-kHz output deviation (same as in fm broadcast transmitters). The carrier is 16 times the crystal frequency.

By amateur and even CB standards, the range of these transmitters is terrible. But then again, they must work only over a short distance. Between the low-power levels (as little as 1 and 4 milliwatts in some models) and the inherent antenna mismatch, there's a lot of loss.

To further complicate matters, the frequencies assigned to these transmitters is often in the guard bands of TV broadcast signals. Although the manufacturer has about 70 to 80 vhf frequencies from which to select, the frequencies in the hospital where I work are:

| Channel | Carrier (MHz) |
|---|---|
| 1 | 174.108 |
| 2 | 180.040 |
| 3 | 186.040 |
| 4 | 194.748 |
| 5 | 198.048 |
| 6 | 204.048 |
| 7 | 210.048 |
| 8 | 215.988 |

Proper coverage of even a moderate area requires the use of an amplified antenna system, such as shown in **Fig. 5**. Since the telemetry channels in a vhf system fall in the TV spectrum, it has become standard practice to use TV master antenna-system hardware to acquire these signals. Amplifiers A1-A4 are wideband vhf TV master antenna preamplifiers with a gain of 30 dB. These amplifiers are exactly like those used in apartment building systems, except that the type-F antenna connector has been replaced with a chassis-mount BNC connector. The actual antennas are 17-inch (43cm) whips fitted with a BNC connector so they'll mount directly to the preamplifier input.

Because of the low power levels, it's usually necessary to use one or more preamplifiers in each corridor where patients are allowed to wander. In our case, two amplifiers are required spaced 30 to 50 feet (9-15m) apart in each of the two corridors that form a right angle with its apex at the nurses' station. The amplifiers outputs and the signals from the two trunk lines are mixed in several two-set combiners. These combiners are merely ordinary TV-type two-set couplers operated backwards. Such devices are passive transformer/resistor/capacitor networks. In our case, though, the two outputs that were to connect to two different TV receivers become the inputs, while the output is taken from the port originally intended to be the input from a TV antenna system. A pair of four-set couplers or a single eight-set coupler is used to divide the signals into eight separate paths for the receivers.

The receivers are single-channel wideband types with output circuitry designed to accommodate ECG, rather than audio, signals. Most are also equipped with a signal-loss alarm light. If an alarm on the heart rate meter sounds, and the nurse looks up to see a flat baseline on the oscilloscope, she may assume that the patient is in trouble. But this could also be caused by loss of the rf carrier and have nothing at all to do with the patient's condition. An electrode may have come loose or the battery may be dead, which is shown by the signal-loss lamp. Such a problem would be taken care of immediately, but not with the headlong dispatch that medical people put into resuscitation — which might be required if the flat baseline had represented a mortal danger.

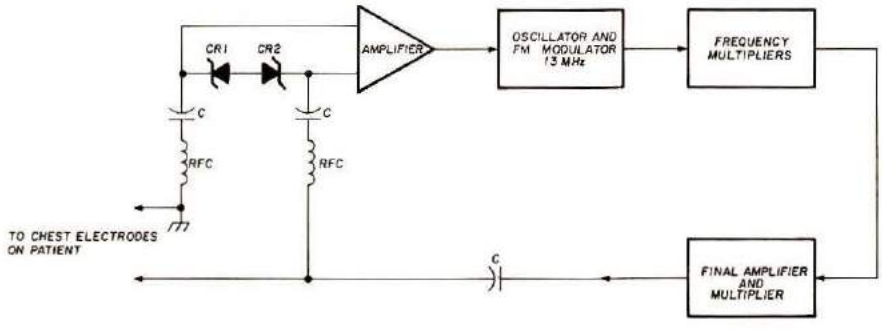


**Fig. 4.** Block diagram of a popular vhf telemetry transmitter.

### Amateur operations

You might not see the problems immediately because the amateur vhf/uhf bands fall outside of the ECG telemetry frequency range, and hf bands are below these frequencies. Keep in mind that the telemetry

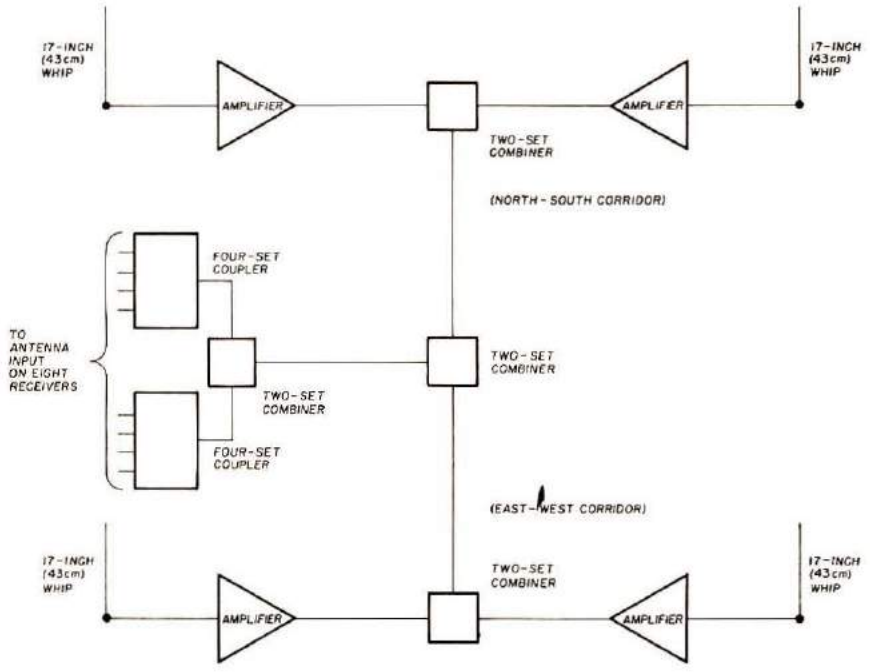


**Fig. 5.** Master TV antenna system components including wideband 30-dB vhf preamplifiers are used in the antenna system.

channels are close to TV channels, and we do occasionally have TVI problems — so interference with medical radio systems is not too unlikely. In the case of ECG systems, we also have the added problem of overload in the 30-dB preamplifiers. When this occurs (and remember your transmitter can present a strong rf field when close to the amplifiers), the amplifier may become nonlinear and generate harmonics and intermodulation products. Also, some early two-meter synthesized or crystal-plexed amateur rigs are known to be full of spurs that could cause problems.

Let's examine a few products that could be generated, and also let's keep in mind that the 200-kHz bandwidth, poor front-end selectivity, and other factors will conspire to create problems — even though the product may be a couple of megahertz from the assigned carrier frequency.

### Vhf bands

The 6-meter amateur band occupies 50 to 54 MHz. Its second and third harmonics cause little trouble directly. But look what could happen to that third harmonic in a nonlinear element: The third harmonic of 54 MHz is 162 MHz. This frequency, added to the 10.7 MHz i-f normally used in these receivers, produces 172.7 MHz. This frequency is close enough to our channel 1 to cause potential problems. The fourth harmonic can create direct problems. The fourth harmonic of 50 MHz is 200 MHz, while that of 54 MHz is 216 MHz.

The fourth harmonics from certain six-meter transmitters could knock out our channels 6 through 8! The exact frequencies of concern are 51.012, 52.512, and 53.997 (all ± 200 kHz/4, or 50 kHz). Of course, a fourth harmonic may be hard to generate in the radio, but in an overloaded preamplifier it might just be too easy to generate!

The two-meter amateur band can also cause trouble. Consider the well-known intermod case where the sums and/or differences of two frequencies conspire in a nonlinear circuit to produce a third frequency, (i.e., $2F_1 - F_2 = F_3$). In our area a repeater is on almost every commonly used frequency on two-meters plus a few frequencies on the higher vhf bands. Many frequencies used for local repeaters will mix to become intermodulation products in the medical telemetry receiver.

### High-frequency bands

High-frequency bands are not without problems. We're pretty familiar with the mechanisms of TVI, and they are just as critical on medical telemetry equipment. If you take a sum or difference frequency between certain amateur and CB high-frequency signals, and some that might be in the vhf land mobile or marine bands, you'll find interference. Again, the problem is the nonlinearity of the overloaded preamplifier. A 14-MHz signal mixed with a 160-MHz signal will interfere with our channel 1. In a similar manner, other high-frequency bands mixing with other vhf signals can create problems.

A CB set, even though low powered and on a frequency low compared with the ECG telemetry signals, can create an interference situation. The 8th harmonic of 27 MHz falls almost exactly on our channel 8.

### Summary

It takes little imagination, given the facts, to see why hospital electronics personnel are a little skeptical when asked whether an amateur radio operator or CBer should be allowed to bring a rig into the hospital. The in-house people might be sympathetic, and in fact they might be hams themselves; but their responsibility is to the hospital — most probably they would require that the rig be taken home. To be sure, we *could* possibly run interference tests and a safety inspection, but the waters would still be murky with respect to our obligations. Besides, it's normal in hospitals to be understaffed, so such tests would prove a nuisance at least and a burden at worst. Leave your rigs at home — okay? **HRH**

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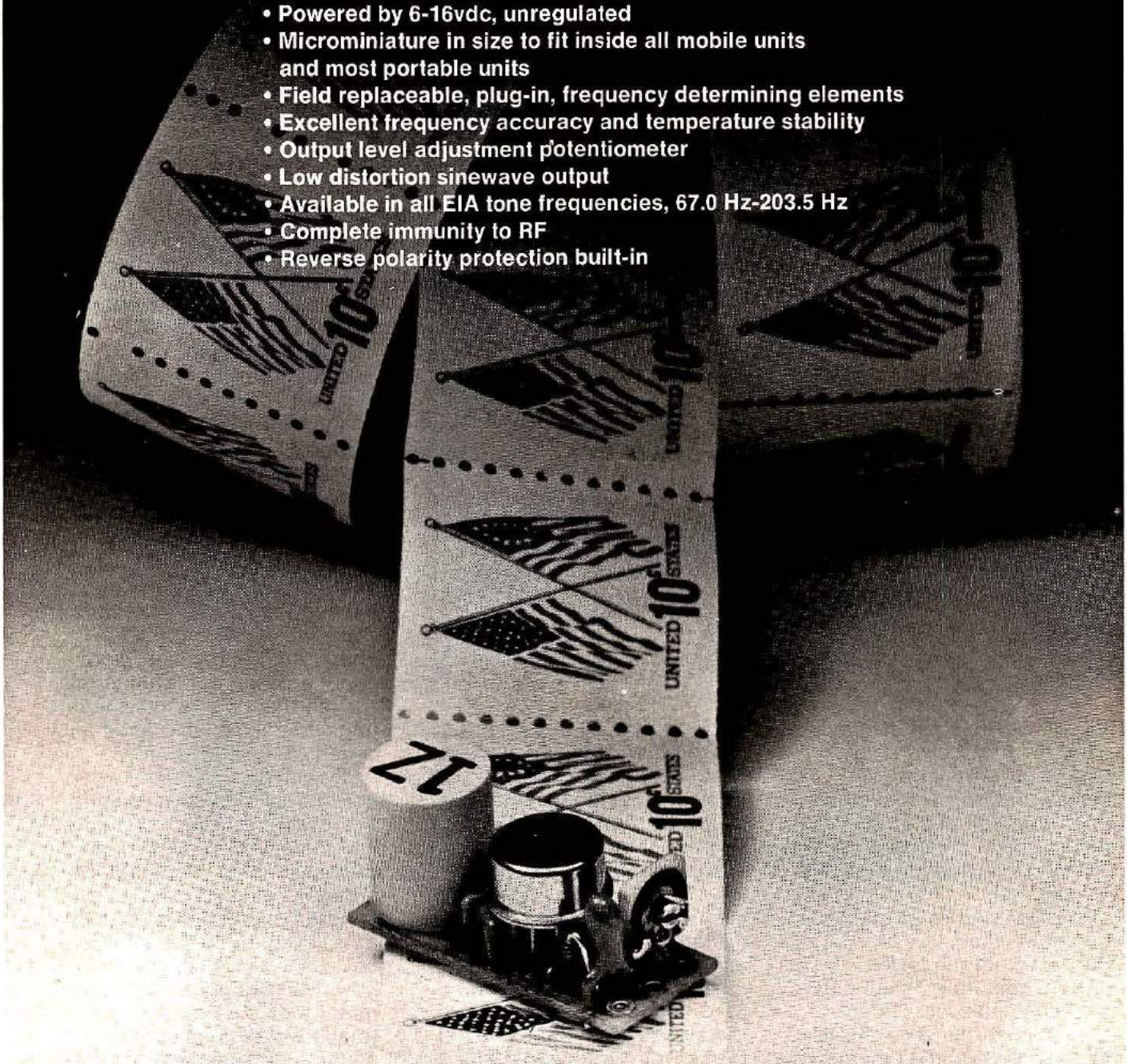

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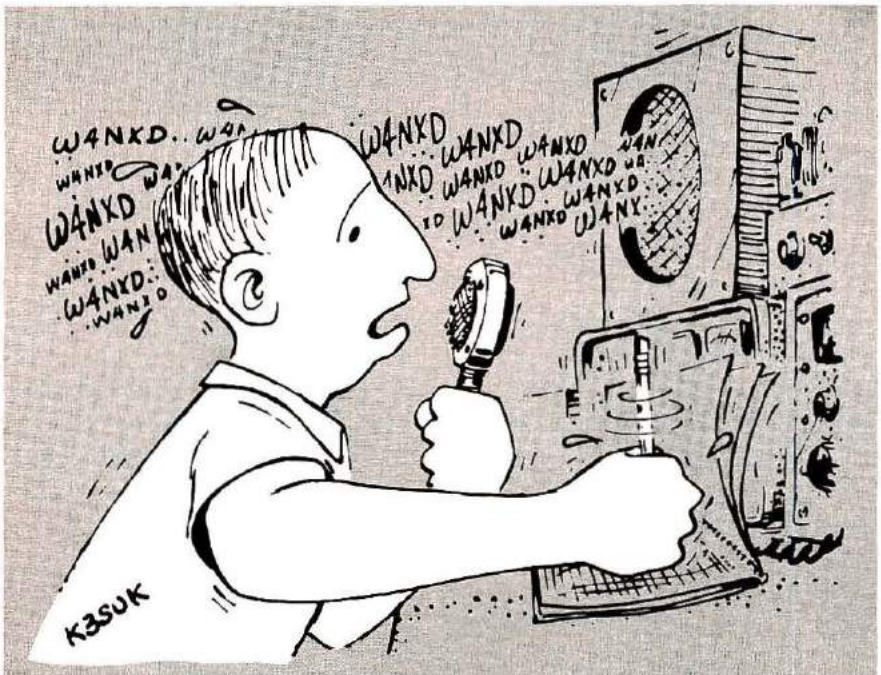



# How To Be DX

***Creating your own pileup***

**BY J. MICHAEL BLASI, W4NXD**

Several weeks ago I decided to see if my transceiver still worked on ssb since I'm usually on CW. I cranked her up on the high end of 20 meters, made sure the final tubes weren't turning pink and gave a listen.

The high end of 20 meters, in the phone band, is a bit different from the lower portion. The stations are only two deep and every 2 kHz there's a net that always tells me they are running emergency traffic from a boy scout on the Island of Gamua to his 112-year old grandmother who thinks he went to the store for bread. This may be a bit exaggerated, but I think you get the idea of the usual conditions. Generally speaking, however, I feel these people do a lot of good.

I found 14.336 MHz clear, so I asked if the frequency was being used. It was. A tremendous signal came on, identified, and told me that he was net control for the Independent County Hunters net — did I want to check in?

Since I'm a cautious person by nature, I inquired what might be the purpose of this organization. I was told they tried to get rare counties on the air so those hams looking for awards could work them. This seemed reasonable to me, and I didn't think I'd get too much traffic for grandmothers. I gave my call, said that I was in Hall County, Georgia, and sat back to drink a cup of coffee while listened. This was not to be — about twenty stations wanted to know who was in Hall County.

This really threw me; I didn't know I was in a rare county, but since most of the local hams operate two-meter fm, I guess I am probably the only one who operates on 20 meters. The net control asked me to QRZ the frequency to see who needed Hall County, I did. This result was unbelievable; everybody was calling "W4NXD." Compared to this, the DXpedition to the sheikdom of Pistachio seemed to be as popular as a W8 calling CQ DX on 20 CW.

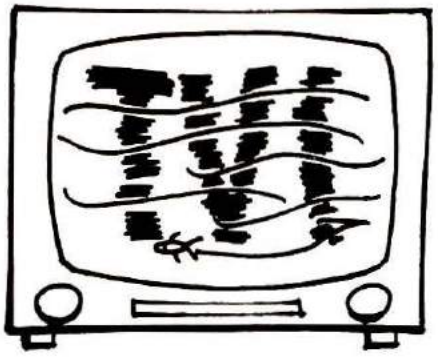
Using my lightning reflexes and years of hot-shot operating, I panicked. There must have been fifty stations on the frequency calling me; well, at least 30; would you believe 10? Seriously, it made Field Day seem like ten meters.

As I said before, my years of operating came through as I pushed the sweaty mike button and said, "QRZ W1 only!" There, right in my ears, were about a dozen W1s calling me. I sifted them out, wrote the info in my log like a jack rabbit and called QRZ for W2s only.

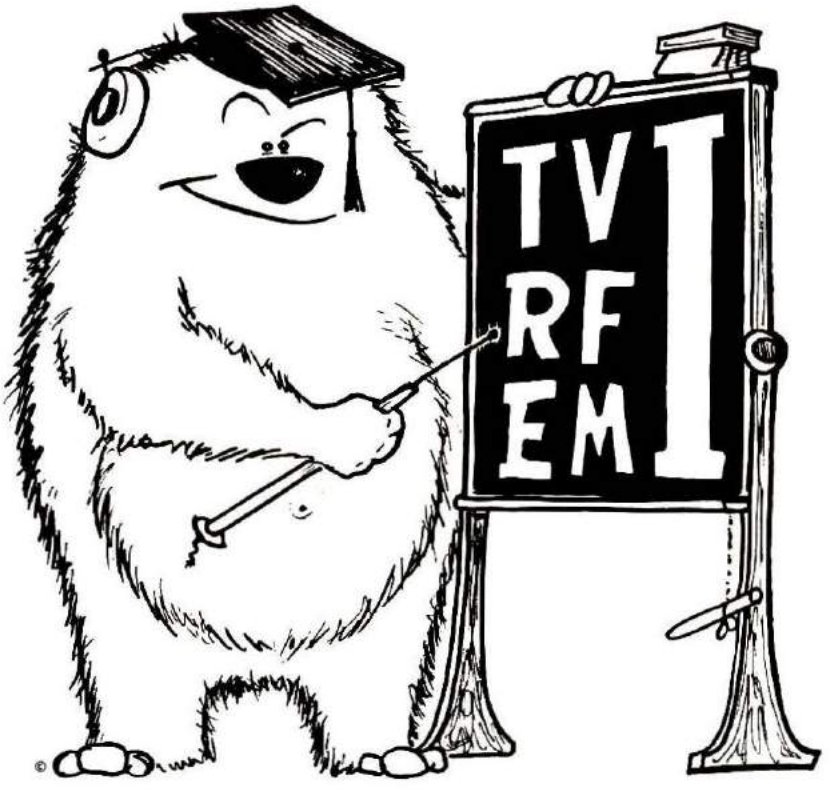
My only trouble came when I got to W9s (they always do it). There were so many I actually had to say, "QRZ W9s in Wisconsin only." In about 40 minutes I worked close to one hundred stations. Yes, little me in Hall County had been a rare one. I say had, because as of now, Hall County is no longer rare. I took care of that. All total, I worked many more stations over the next few days, but nothing like the first time I checked into that net.

So, if you'd like a quick dance in the spotlight, just check in and see if you're a rare one. Enjoy it while they need you, because nothing is sadder than a once rare county.

**HRH**



# A properly designed filter can tame the beast...




## Whatever you call it, the common denominator is "I" for Interference.

The study of interference to consumer products such as TV sets, hi-fis, and the like from radio transmitters is a complex subject. For a primer, see p. 11, "QST Magazine" for March, 1976. We do know that radiation interference can be greatly reduced and perhaps eliminated by the use of a well-engineered, quality-built TVI filter. The low-pass type for the transmitter is at times not enough...a high-pass type for the TV set may also be required. But, here's the rub! If a filter is not properly designed and engineered, it may not work like a filter at all. At the R. L. Drake Company, we've been designing and building filters for over 30 years...since before the days of "Uncle Miltie." And, these are real filters...not toys.

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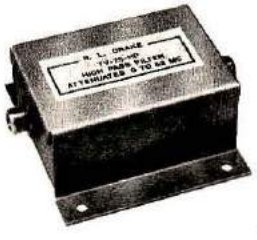

**TV-75-HP**
For 75 ohm TV coaxial cable; TV type connectors installed

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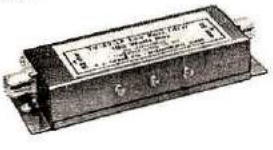

**TV-42-LP**
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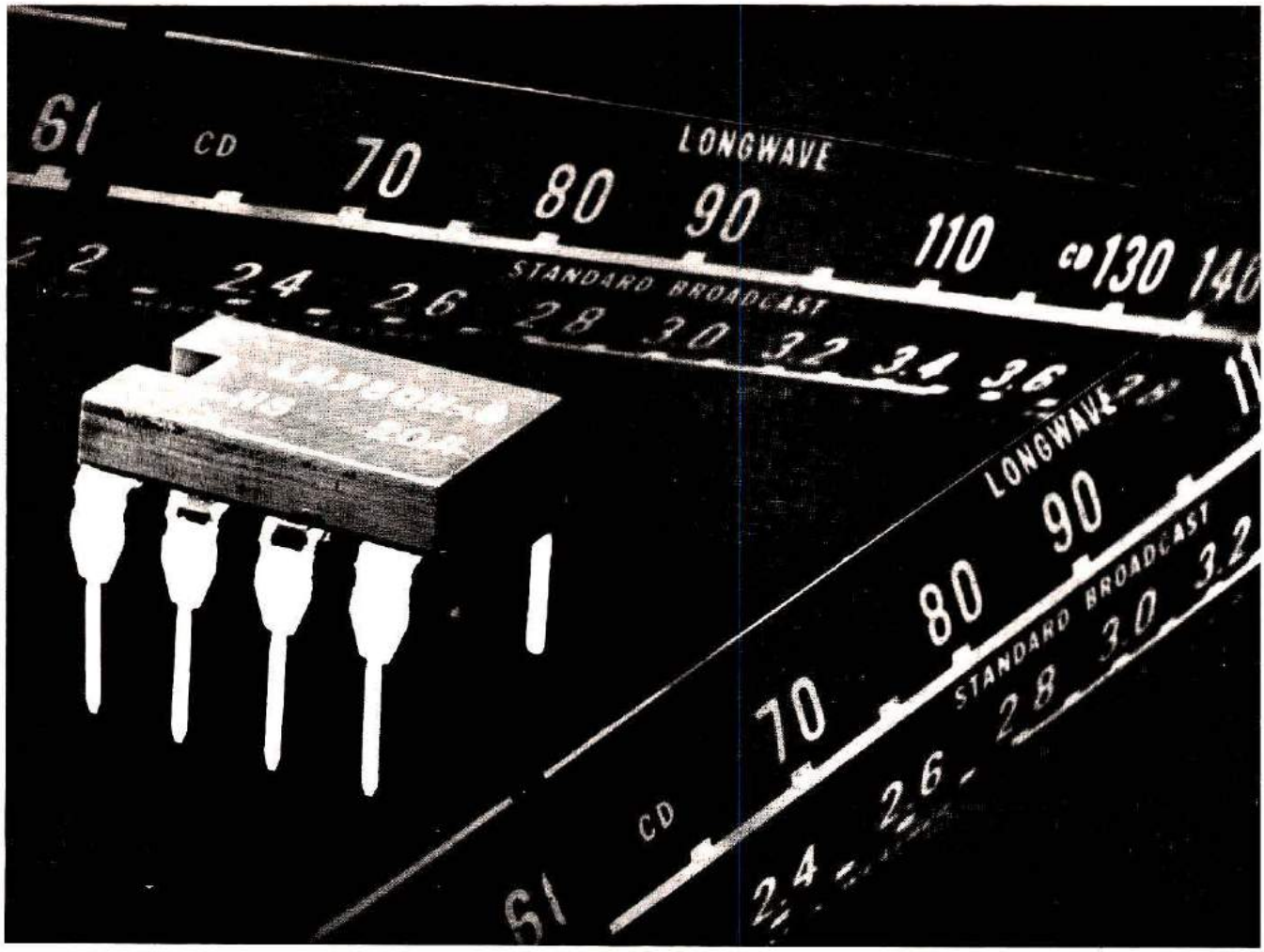



# Improving Receiver Audio Quality

***A versatile and inexpensive IC does your ears a big favor***

**BY IAN MacFARLANE, WA1SNG**

Poor audio quality from the receiver is one characteristic of some early transistorized two-meter fm equipment. Most of this problem can be traced to a high distortion level, and the rest to insufficient audio power (volume) to fill a noisy location. Most of the old rigs used a pair of transistors in a class-B audio output stage, and could provide no more than about 250 to 500 milliwatts of audio at about 10 per cent total harmonic distortion. If you have ever operated for a long period of time when the atmospheric noise level (static) was high, then you know how tiring noise can be. Distortion acts the same way, as far as your ears are concerned, and produces the same tiring effect. The problem is compounded by not being able to turn the audio loud enough to help, particularly when you are mobile.

These problems should have gradually disappeared with the introduction, a few years ago, of integrated-circuit audio power amplifiers, but not all manufacturers were quick to incorporate these chips into the audio sections of their products. This has left many of us with unsatisfactory equipment, but there is a solution.

If your fm transceiver has room enough in its cabinet for a two-by-three-inch (51x76mm) printed circuit board, then you are well on your way to a satisfactory audio system.

In the early 1970's, National Semiconductor introduced the LM380N, a two-watt IC audio amplifier, intended for use with a ceramic cartridge in monophonic record players. The LM380 has a voltage gain of 50, but requires only ± 0.5 volt rms drive into its 150-kilohm input impedance. The maximum output is 14 volts, peak-to-peak, into an 8-ohm load, eliminating the need for an output transformer. As an additional benefit, the chip has a battery-saving idling current of only 7 milliamperes, and can

be powered from a single source that provides between 8 and 22 volts dc.

About the distortion level I mentioned a few paragraphs back: The LM380 has a distortion level of only 0.2 per cent over a 65-kHz bandwidth, and also features a thermal-overload protected, and short-circuit current-limited, output. The short-circuit current can rise to nearly 1.3 amperes without damage, making it very difficult to blow out this integrated circuit.

### Building the amplifier

One word of caution, however: The LM380 IC amplifier has only slight tolerance for large power supply transients, and I have a small pile of dead ICs to prove it! Fortunately, this problem occurs only if you run the chip near its maximum rated supply voltage limit, and rapidly connect and disconnect the power supply — as in breadboarding, for example. Avoid these pitfalls, and you'll have no problem. After all components have been wired and soldered in place, everything is just fine.

Circuit details are given in **Fig. 1**. Although either the inverting or the non-inverting input may be driven, I discovered that the chip generated a lot of hiss when I first hooked it up. I corrected the problem by driving the inverting input and grounding the unused non-inverting input. This is the method shown on the printed-circuit board layout of **Fig. 2**.

Capacitors C3 reduces power supply ripple to an inaudiable level, but is optional and may be omitted. For communications-quality audio, capacitor C2 may have a value as small as 250 microfarads; but larger values improve the audio bandpass characteristics and yield more natural-sounding audio.

Unlike many other transistorized audio amplifiers, the LM380 does not have large heatsink fins. Instead, pins 3, 4, 5, 7, 10, 11, and 12 are connected to at least six square inches (39 square cm) of copper foil, which serves double duty as both ground and heatsink. The board pattern

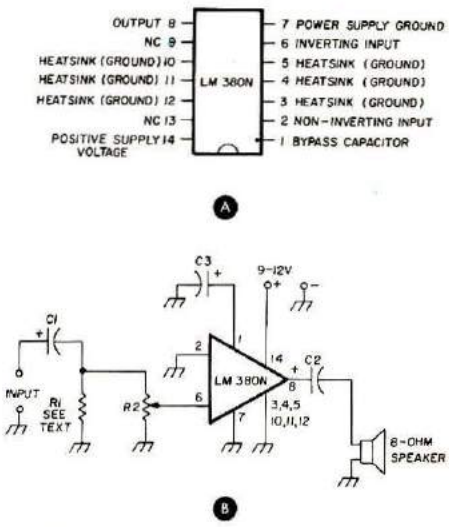


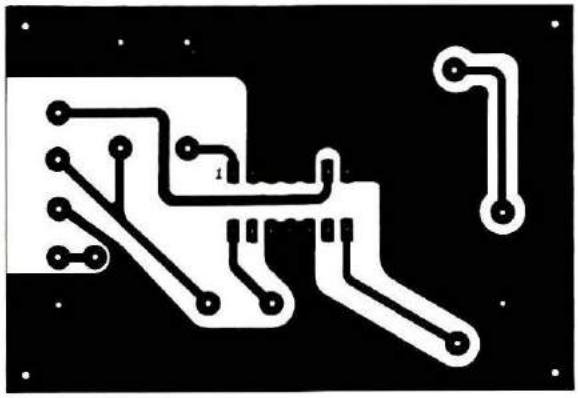

**Fig. 1.** Circuit diagram of the LM380 audio amplifier, showing the top view pin-out diagram of the LM380 at **A**, and the simple, straight forward hookup with few components at **B**. All capacitors are 25-volt electrolytic types with axial leads. The value of C1 may be between 1 and 10 $\mu$F, C2 between 250 and 1000 $\mu$F, and C3 between 5 and 10 $\mu$F. R2 is the original volume control which may require an extra resistor in parallel as explained in the text.

in **Fig. 2** has proven effective even though the heatsink area is minimal. There should be no problems because the amplifier isn't driven continuously during the average QSO, while the two-watt rating is for continuous operation.

To continue to use the original volume control, it may be necessary to add R1. This may be a potentiometer, or a fixed resistor, whose value is chosen to allow the existing volume control to operate over it's original range. The printed-circuit board should be simple enough to be duplicated using an etch resist pen. To provide good heat conduction, the LM380 should be soldered directly to the board, instead of using a socket. Shielded cable is suggested for the input part of the circuit.

This amplifier has given excellent trouble-free performance for nearly a year, but if you ever become dissatisfied with the way it works in your rig, you can use it as a fantastic headphone amplifier in your stereo system.

**HRH**



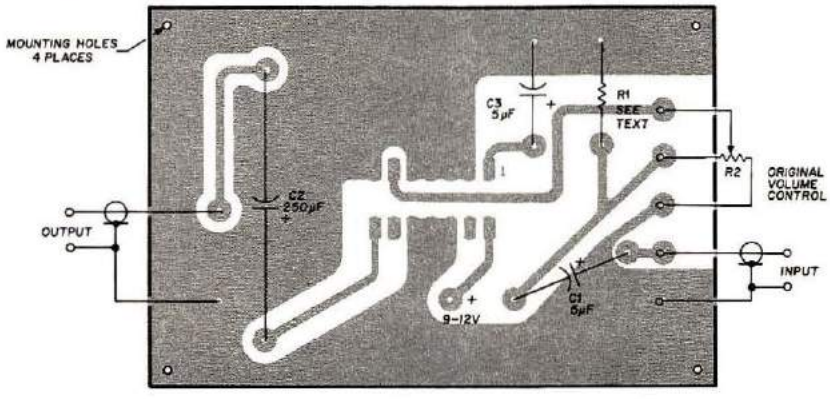



**Fig. 2.** Full-size printed circuit board layout pattern for the audio amplifier. A foil-side view of the board is depicted above. An X-ray view from the component side is shown below.

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# ADVICE to you from me

***First contactitis is only a temporary affliction for the beginner. The symptoms disappear rapidly and recovery is complete. Heed some advice, and reassurance that you'll survive, by someone who made it.***

**BY JANICE SHILLINGTON, WB9OJA**

Dear Novice: I have some advice for you. Yes, you have had plenty of advice, and maybe you are having trouble sorting it out right now, so let's think of it as reassurance, instead. The anxieties and fears of passing the Novice exam and making those first few contacts is still fresh in my mind, so I can tell you it does get easier. As an experienced ham of 2½ years, I know you'll live through it, and love it!

After waiting anxiously for my Novice exam to arrive, I was very relieved to have taken the test for better or worse; at least it was no longer an unknown quantity. It seemed like 10 years before my license came, but it finally did. I had Novice privileges — yippee! Now my hand would touch the key and my signal would be going over the air for the whole world to hear!

Naturally, as soon as the transmitter was turned on every Morse Code letter completely left my mind. It was a good thing that I had notes. Boy, did I have notes! I even had notes on how to spell my name!

You'll have nerves galore . . . but do it anyway. Dive right in and swim. You have already passed your swimming test. Go ahead, you have earned the right to use the airwaves, the same as your fellow Novices.

Now, looking back, it is easy for me to reassure you. Mistakes don't matter, really. Just be sure to give the calls correctly, even if you must start over 10 times, and identify every 10 minutes, you will make it.

Of course your rig must be in good working order, but you can see to that before you

Two-meter fm provides a chance for many chats through the local repeater or on simplex. The handheld unit is great for one of my favorite pastimes — fox hunts. The voice privileges needed to operate on the two-meter band come as a welcome reward for the experience you gain on the lower bands, and for the study you devote to the license manual.

Antenna work is part of the fun of amateur radio too. The Hy-Gain 14AVQ vertical antenna serves well for the Novice bands and for frequencies used by the General Class licensee too.

actually take the plunge and go on the air. Practice with a dummy load connected instead of an antenna. Get familiar with the equipment so you can concentrate on the operating.

This is what the Novice bands and programs are for — to get experience. The only way to get the experience is to get on and operate. Even after 2½ years I will send a word and make a mistake, and sometimes I keep making the same error, but that doesn't stop me. I just xxx out with di di di di di di dit (the error signal), and start over — eventually it comes out okay. I really like CW, and I use it whenever I get a chance. No one is laughing at you; we all had to go through it. Many hams really enjoy helping out newcomers to repay the kindness which they received when they started out themselves.

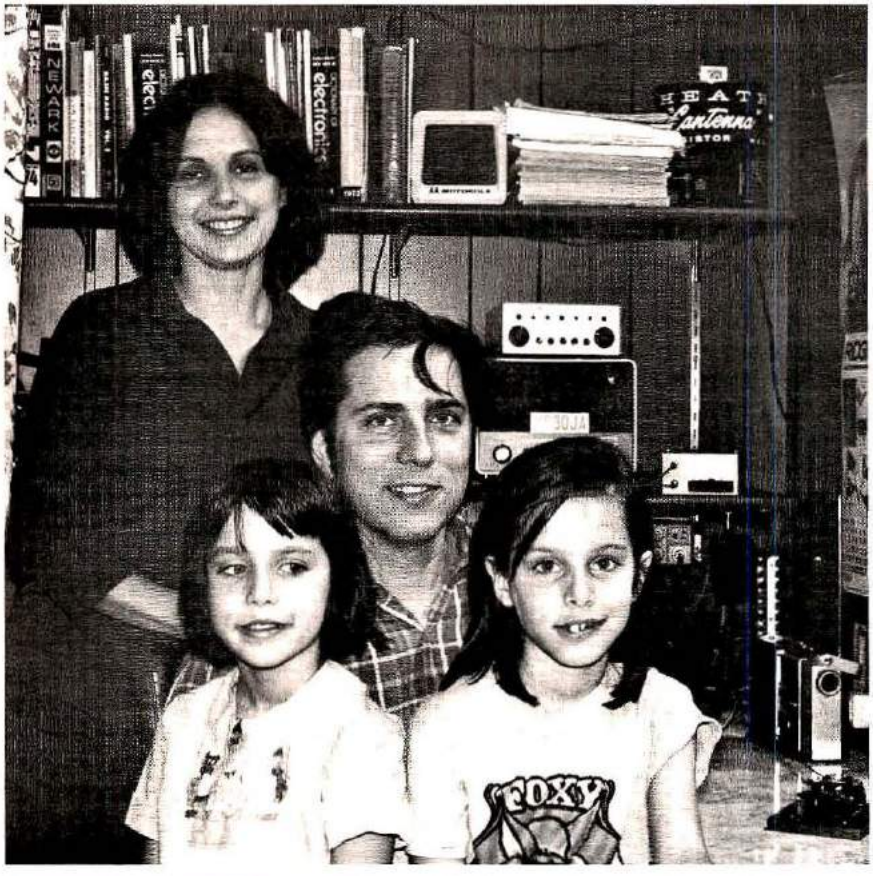
To me amateur radio is not so much resistors and transistors, but it is people. I like to talk to people — they are all interesting. Through amateur radio I can reach out to the whole world from my ranch home in a small suburb. Imagine that! You can do it, too.

"What will I say?" Don't worry about it; there's plenty to talk about. In the first place, you all have a common bond in your struggle to master the Morse Code, and in hitting the books for the theory. Then you all had to get your station set up to operate. Perhaps you are interested in the other fellow's antenna because you might want to build one like it. You can ask about his experiences with the antenna (or his rig, or key, or any piece of equipment). You might be interested in how and when and where he got his ticket, or what he does for a living. If you talk to someone who lives near Niagara Falls, you can ask what they are like. I talked to one fellow who lives near Yellowstone Park. He has a fascinating sideline; he picks up moose antlers after they have been shed, and then carves them into things to sell. Then there is always the weather. You can make some interesting comparisons, like, here we are in cold and snow in Illinois, talking to a ham in Germany who is watching the raindrops. Or, here I am enjoying some nice fall weather and talking to a man up in Canada, sitting by a window and watching people ice fishing on a lake.

The time will go fast — you'll both give signal (RST) reports, location (QTH), names, and QSL information — but by then the signals may start to fade, or one of you has to leave to do something else. Has half an hour gone by already? Incredible!

Are you going for the next higher grade of license? Just

The fox went that way . . . A hidden transmitter is called the fox, and we have great fun trying to outwit him. My two girls enjoy the sport almost as much as I. The Wheaton Community Radio Amateurs Club sponsors many foxhunts — and I have just been elected treasurer.




Six-year old Patti and eight-year old Karen join Tom and I in the radio shack. The equipment is out of sight behind us, but it covers the amateur h-f bands and two-meter fm. We have a cozy corner from which we can talk to friends all over the world.

take it one step at a time. I remember studying for the Novice license, and looking at the General and Extra study material and thinking, "I will never, never, get all that." But you can — one step at a time. There are many books and classes, and willing hams, to help you study for the tests. I have always found that the FCC tests were a challenge. If it was too easy, you would not have the thrill of accomplishment that comes when you finally do pass.

I found that the tests were fair. Studying various books, especially the *ARRL License Manual*, helped me to feel ready for whatever the tests could throw at me. I always went to take the exams with the attitude that I would give it my best shot and if I flunked, so what? The earth would not tremble nor the oceans run dry — I would simply come back next month. After taking an exam I would look back in the books to see if I had answered correctly. Sometimes I did, sometimes I didn't, but the answers were there. Maybe the question was upside-down or backwards, but it was there.

So dive in and have fun. Enjoy amateur radio and explore the different avenues of interest. I have never worked OSCAR, but it was a thrill to listen to a satellite. You can meet a lot of local hams and make a few friends on two meters. Radio clubs have a lot to offer and there's plenty to do in them. There is public service work in the Emergency Corps, and you can handle messages on nets that meet every night on the air. Contests can be a great experience; I've only operated in one but it was a ball. You certainly have a wide choice of activities to enter.

My husband, WB9OKL, and I have just started fox hunting. That is where one ham (the fox) hides and transmits. All the others (the hounds) try to locate him by listening to his signal with directional devices. We fox hunt as a family — my two little girls love it, and are always asking if we have found the fox yet. Knowledge of the area and roads is helpful.

I like to relive the hunt afterward: "If I had just gone one more block and turned here" or, "If I had just gone down the hill and across the lake (it was frozen) I would have nabbed the fox." The friendly competition is a lot of fun.

So, smile, jump in, and enjoy ham radio. When your hands tremble and your palms get sticky, remember that it has happened to all of us. It will soon get easier, honest. **HRH**

The *ARRL* License Manual and other study guides are available from *ham radio's Communications Bookstore*, Greenville, New Hampshire 03048.

"Ever since somebody ripped off Judge Parker's unit this town has been bad news for radio thieves."

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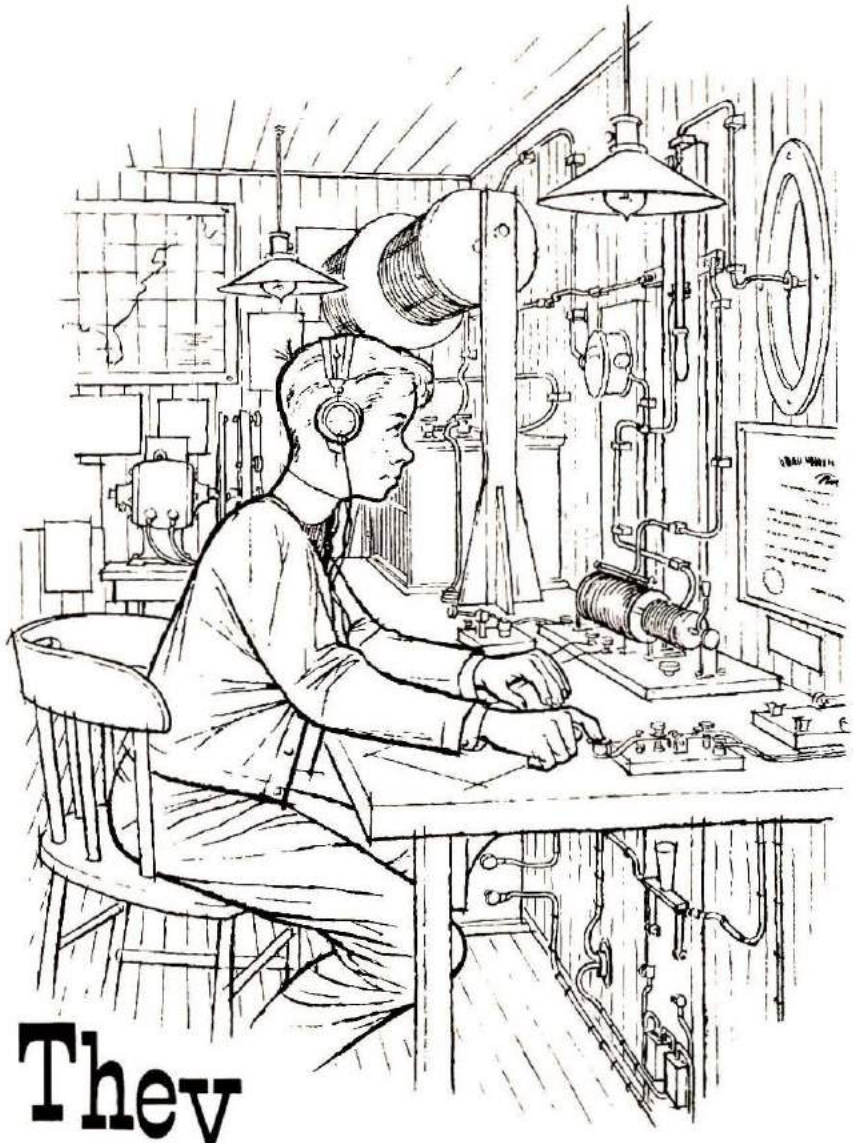


# They Always Came Back

## *A perfect station and a skillful operator*

BY A. DAVID MIDDELTON, W7ZC

It's a mid-summer day, just prior to World War One, in a small town in the West Virginia hills. We are standing outside a neat wooden shack in the back yard of an ordinary home. In one wall of the shack is a round hole covered with glass. A ship's porthole?

Take a peek in through this porthole. There is a small boy — intense, concentrating — sitting in front of a complicated-looking set of electrical equipment.

His nimble fingers move dexterously over the array of switches and knobs. He adjusts the receiving set. You recognize, now, that this is a wireless outfit, circa 1917.

The boy leans back, a smile of victory on his keen young face. His eyes roam over the map-filled walls. Now he leans forward, slams shut a switch on the desk, and his fingers beat out a steady tattoo on the lever key on the desk. He sends a streak of code, then shuts off the sending set. He smiles contentedly as he makes an entry in his log book. He is oblivious to us. Do not worry, we are not disturbing him.

As we watch, the lad calls up station after station scattered over the entire United States. He appears to be exchanging message and signal reports with them. There is seemingly no limit to the range of *this* station, and to the skill of the operator.

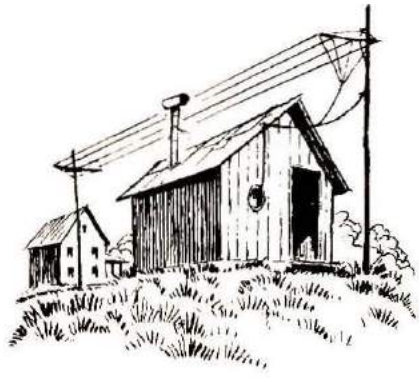
We are impressed. This wireless station looks to be equipped with the very latest apparatus, according to all contemporary magazine layouts we have seen.

Overhead we can look up and see long, gleaming strands of copper wire hung between wide spreaders on huge poles. A fan-leadin comes down and connects to the wall insulator in a professional fashion.

Although our young operator has to wait his turn, he never fails to raise any station he calls. For — at this station — *they always came back*!

The quiet of the mid-summer day is punctuated only by the sound of switches being thrown in the wireless shack, by the exclamations of the young lad at the controls, by the rising whine of the rotary-gap wheel, followed by the flashing spark of the transmitter. Our noses tingle as a fleeting scent of ozone filters out to us.

Truly, this is an unusually



successful wireless station to be able to reach out and to raise and talk to those distant stations.

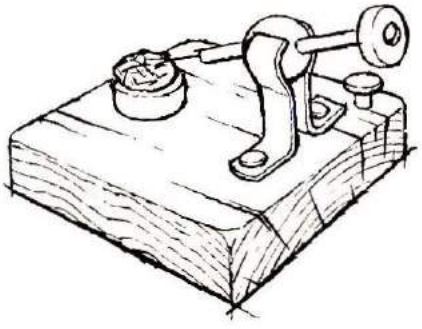
To what can the success of this station be attributed? The excellence of the elaborately constructed equipment? The location of the station? Could it be just good propagation characteristics? Or, maybe it could be entirely due to the operating and engineering skills of the station builder and operator.

Who is this lad, anyway? As station owner and operator, his certificate of station license and call assignment are right there on the wall. Let's look.

But, please, don't look too closely at that certification. You would be surprised to learn they are only painstakingly well-done facsimiles of the real thing, even though they look legal enough!

Move up closer, old friend, and let's take an understanding look at the entire layout. No, do not disturb the boy. He is lost in his work and is roaming the wide world — in his fashion. He will not know we are watching. He is lost in his imagination!

Above us rise the poles, but on second look they are not as tall as they appeared. Just trimmed saplings and not very high at that! Back-guys hold up the crooked poles against the strain of the big antenna. The wide spreaders are sticks carefully patched and spliced. The shining glass insulators? Why, they are necks from medicine bottles, carefully cut off (the old burning-string technique), and smoothed down. Those long spans of copper wire? Old friend, there are scores of Western Union splices in those spans. How else could one get those long lengths except by splices, when the only source of wire was odd lengths of discarded house wire? How come the copper shines so brightly? Did you ever hear of stripping the insulation off wire by pulling it through a hole in a board, and then by cleaning off the tar residue with lots of elbow grease and wet sand? The fan leadin connects to a bolt running through the glass insulator. Yes, the glass is cracked. In spite of lots of care and plenty of time in rotating



the broken-off-file bit the glass finally cracked; it usually did. Glass baking dishes were hard to come by

On the wall, inside the shack, see that porcelain-based antenna change-over switch and the power-on switch? Take another look. That porcelain base is merely an excellently painted board — done with white enamel! Do the fittings on the switch look familiar? Yes, they should, for they are strips, brackets, and fittings from an old Meccano construction set. The switch handle? Oh, that is a pot holder.

On the operating desk sits a beautifully constructed receiver in the 1917 style. A loose coupler, a crystal-detector stand with swivel arm, and a condenser block to which is connected the leads to the earphone. Those leads? Just plain old carpenter's twine, but they *do* look like wire and they *are* flexible. However, the 1917 earphone was only a single unit, and it looks strangely like a watch case (which is what they called earphones in those days). It should, for that is exactly what it is: an old watch case carefully fastened to a head strap that could be made of only one thing — a corset stay, skillfully bent!

The loose coupler! Say, that is not wire around the forms, it is more string! The forms? Why, they are metal cans. But does not there appear to be a bright copper sheen to the open-surfaced strip on the wire for the contact to run upon? Just a strip of golden radiator paint, old friend.

The rotary gap machine. Is that, too, a model? Yes, that unit is cleverly done, with great pride. There is a wooden rotor wheel and cut-off bolts in the right places for studs. Note that it does not turn very fast with that over-worked motor. Take another look at that motor. Sure, it's the one available to a kid from an Erector set! Now, that *did* take some skillful horse-trading to get that motor away from its previous owner. The spark-coil looks strangely like a battered Ford coil (which it is) but to the lad, it is a Thordarson ¼ kW transformer.

The transmitter coils are just more patched shiny copper wire but the dowel pins and end pieces are properly made and assembled. The unit looks

**About this story**

"They Always Came Back" has been in print before, for a limited segment of amateur radio.

It was published by the Antique Wireless Association as Monograph number 3. Members of that association received it well, and thanks are due to the AWA and to Bruce Kelley, W2ICE, for permission to present it here for the readers of *Horizons*, where we hope it will please both the newcomer and the old-timer.

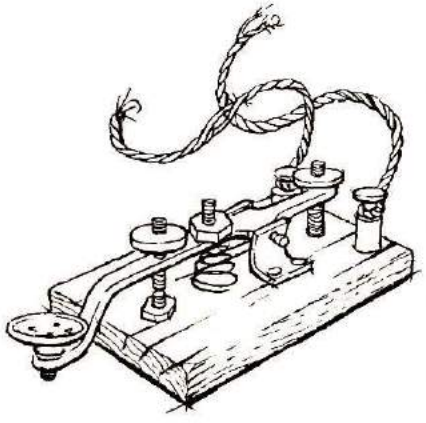
The drawings for "They Always Came Back" are by Jim Triggs, son of W2YBK. Jim has done many fine illustrations for *Gun Digest, True,* and other publications. This was Jim's first crack at antique wireless gear; there may be an inadvertent short circuit here and there.

But the single finger on the key is a deliberate rebuke to Jim's OM (W2YBK) who learned to send Morse Code with his hand bandaged up, only one finger outside, due to poison ivy!

just like the pictures in the W. B. Duck Co. catalog.

The condenser blocking unit at the earphone leads? Another simulation; this time a block of wood painted black. All other parts of the entire stations are mockups — just make-believe units that resemble the real thing.

Sure, it's a laugh! But, old friend, please do not mention it out loud. What does it matter? To us, it is a make-believe wireless station. To the boy it's as real as life. He can roam the ether, talk to ships at sea, and to land stations all over the map. He can perhaps, in his imagination, talk directly to the operator aboard one of the new dirigibles he has read about. To top it off, NAA will probably reply to his calls! Youth, plus imagination, knows no barriers!



Be careful not to disturb him. Let him tinker with the cat's whisker and his piece of coal (well, it does *look* like galena!). Let him operate switches, pound his hand-made key and start and stop his rotary in the approved fashion.

Do not laugh, old friend. Some day you might envy this lad. He might turn out to be one of the really greats in amateur radio, for he has already discovered its deepest secrets, and understands its capabilities and techniques!

Come with me, let us steal silently away and let the boy operate. For now, and probably for the only time in his life — *they'll always come back to his calls*! **HRH**

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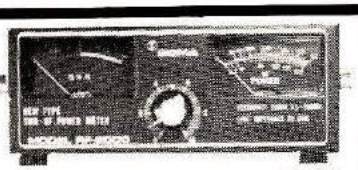

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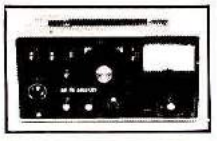

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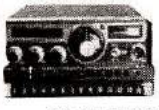

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**NOTICE:** 73 MAGAZINE printed an untrue report in the June, 1977, issue regarding the KDK FM144. They are now printing a retraction regarding this untrue report. The FM144 does not need tuning to cover the full 5 MHz range.

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# QUESTIONS & ANSWERS

*License terms, limitations, and ionized layers*

**BY THOMAS McMULLEN, W1SL**

In the previous part of this series of questions that you might find on your license examination, and some answers to them, I looked into Basis and Purpose, Definitions, and Novice Class operator Privileges as outlined in the FCC study guide.

Now, let's look at the next subject, Limitations. Of course there are limitations to what you can do as an amateur. You didn't expect complete freedom, did you? Well, don't let it bother you — other services have even greater restrictions. For instance, the operator of a commercial shortwave station, handling messages or news text, can only move to a specific frequency in another part of the spectrum. He cannot use a variable-frequency oscillator (vfo) to slide around the band like you can. If there is interference on his frequency, he has to just tough it out. If the propagation changes, he can go to another precise, prearranged, frequency but nowhere else. Not only that, if he happens to hear someone on a nearby frequency, and wants to chat with him, nothing doing! He has to stick to business. So, it is worth putting up with a few common-sense restrictions in order to have the degree of freedom that no other service has.

There are two subjects under the Limitations heading: license term and antenna structures. The license term is described in this paragraph of the FCC Regulations:

**97.59 License term.**

**(a)** Amateur operator licenses are normally valid for a period of 5 years from the date of issuance of a new or renewed license, except the Novice Class which is normally valid for a period of 2 years from the date of issuance.

**(b)** The license for an amateur station is normally valid for a period of 5 years from the date of issuance of a new or renewed license, except that an amateur station license issued to the holder of a Novice Class amateur operator license is normally valid for a period of 2 years from the date of issuance. All amateur station licenses, regardless of when issued, will expire on the same date as the licensee's amateur operator license.

**(c)** A duplicate license or a modified license which is not being renewed shall bear the same expiration date as the license for which it is a modification or duplicate.

There is not really much to remember in that section, is there? Two years for the Novice license, and five for everyone else. And the station license (or any other amateur license you have) goes right along with the operator's license. At one time the Novice license was not renewable but recent changes have made it possible to take the exam again and receive a new ticket. Other classes of license can be renewed upon application.

The antenna structures part will most likely apply to only a small percentage of the amateur population, but you must be aware of the possibility of restrictions:

**97.45 Limitations on antenna structures.**

**(a)** Except a provided in paragraph (b) of this section, an antenna for a station in the Amateur Radio Service which exceeds the following height limitations may not be erected or used unless notice has been filed with both the FAA on FAA Form 7460-1 and with the Commission on Form 714 or on the license application form, and prior approval by the Commission has been obtained for:

**(1)** Any construction or alteration of more than 200 feet in height above ground level at its site (17.7 (a) of this chapter).

**(2)** Any construction or alteration of greater height than an imaginary surface extending outward and upward at one of the following slopes (17.7 (a) of this chapter).

**(3)** Any construction or alteration on an airport listed in the Airport Directory of the Airman's Information Manual. (17.7 (c) of this chapter).

**(b)** A notification to the Federal Aviation Administration is not required for any of the following construction or alteration:

**(i)** 100 to 1 for a horizontal distance of 20,000 feet from the nearest point of the nearest runway of each airport with at least one runway more than 3,200 feet in length, excluding heliports and seaplane bases without specified boundaries, if that airport is either listed in the Airport Directory of the current Airman's Information Manual or is operated by a Federal military agency.

**(ii)** 50 to 1 for a horizontal distance of 10,000 feet from the nearest point of the nearest runway of each airport with its longest runway no more than 3,200 feet in length, excluding heliports and seaplane bases without specified boundaries, if that airport is either listed in the Airport Directory or is operated by a Federal military agency.

**(iii)** 25 to 1 for a horizontal distance of 5,000 feet from the nearest point of the nearest landing and take off area of each heliport listed in the Airport Directory or operated by a Federal military agency.

(1) Any object that would be shielded by existing structures of a permanent and substantial character or by natural terrain or topographic features of equal or greater height, and would be located in the congested area of a city, town, or settlement where it is evident beyond all reasonable doubt that the structure so shielded will not adversely affect safety in air navigation. Applicants claiming such exemption shall submit a statement with their application to the Commission explaining the basis in detail for their finding. (17.14 (a) of this chapter).

(2) Any antenna structure of 20 feet or less in height except one that would increase the height of another antenna structure. (17.14 (b) of this chapter).

(c) Further details as to whether an aeronautical study and/or obstruction marking and lighting may be required, and specifications for obstruction marking and lighting when required, may be obtained from Part 17 of this chapter, "Construction, Marking, and Lighting of Antenna Structures." Information regarding the inspection and maintenance of antenna structures requiring obstruction marking and lighting is also contained in Part 17 of this chapter.

Don't let the legal-sounding language scare you — what it all boils down to is that if you are going to put up a tower or antenna that will be high enough to be a hazard to aircraft, they want to know about it. This is not at all an unreasonable request, and if you were a pilot, I'm sure you would agree.

Incidently, the Part 17 referred to in this section is the Federal Register designation for the FCC Rules that apply to other radio services.

It is not likely that many amateurs will put up a tower that is more than 200 feet, (60 meters) high, or that they will be so close to a runway at an airport that they will need to file the information with the FAA as required. However, it pays to check your surroundings before you put up any large tower. If the question about antenna structures does not appear on your examination, you will still have to face it on the Form 610 (application for license) when you fill it out. If you do not answer that part, the application will bounce back to you for completion.

Note that this restriction has nothing to do with local laws or building codes, or with environmentalist groups. You'll have to find out what the problems are in your own town or area. These restrictions (if any) are entirely outside the jurisdiction of the FCC, and therefore not covered in the license-study material. So, before you put up any attention-getting structure, check into building codes, permits, limitations, and the like; many towns have the legal power to make you take down a tower that you put up without obtaining the proper paperwork beforehand.

### Responsibilities

Let's look at one more category under the Rules and Regulations section, then we can go on to a more interesting subject to close this portion of the *Questions and Answer* series. Your responsibilities in operating an amateur radio station are:

**97.77 Practice to be observed by all licensees.**

In all respects not specifically covered by these regulations each amateur station shall be operated in accordance with good engineering and good amateur practice.

**97.79 Control operator requirements.**

(a) The licensee of an amateur station shall be responsible for its proper operation.

(b) Every amateur radio station, when in operation, shall have a control point. The control operator shall be on duty, except where the station is operated under automatic control. The control operator may be the station licensee, if a licensed amateur radio operator, or may be another amateur radio operator with the required class of license and designated by the station licensee. The control operator shall also be responsible, together with the station licensee, for the proper operation of the station.

(c) An amateur station may only be operated in the manner and to the extent permitted by the operator privileges authorized for the class of license held by the control operator, but may exceed those of the station licensee provided proper station identification procedures are performed.

(d) The licensee of an amateur radio station may permit any third party to participate in amateur radio communication from his station, provided that a control operator is present and continuously monitors and supervises the radio communication to insure compliance with the rules.

That first part, 97.77, is what is known as a catch-all. It saves the FCC from having to spell out a lot of small details about an amateur station (and you know they have enough paperwork as it is).

For instance, they don't have to write down a rule that says that you must not operate your equipment with high voltage exposed, creating a hazard to you or anyone in the shack. This comes under the heading of good amateur and engineering practice, and you could be cited for violation of that section if you had such an unsafe condition in your ham shack.

The section about control operator and licensee is there to pin down the person responsible for proper operation of the station. It keeps the FCC from being caught in the middle of a squabble between you and another amateur over something that one or the other of you did at your station. I touched on this same subject in the first of these articles. The licensee is responsible for the proper operation of his station, and so is any control operator whom you might designate; if something goes wrong and the FCC sends you a notice, you both have to answer for it. No pointing fingers and saying "he did it!"

Paragraph (c) is very interesting, and can sometimes lead to a lot of "what if . . ." types of question. What it really says is that how a station is operated is determined by the privileges of the licensee *of that station*. If I came over to your Novice station and you invited me to operate it, I would

use your call and operate in the portion of the band alloted to Novices. However, if I heard an old buddy of mine down in the other part of the band, and wanted to chat with him, I could do so (with your permission). I would still have to use your call (because it is the station licensed at that location), but would have to follow it with my own, thus, WB1XXX/W1SL. Anyone listening would then know that I was operating at a Novice station but that I, as a guest operator, had met the requirements permitting me to operate in other portions of the band.

Third-party operation, as mentioned in (d), allows you to let an unlicensed friend or relative operate your station provided that you are in complete control while they do so. This is fine for chats within this country, and a few others, but you have to watch it with any country that does not allow third-party traffic. Remember, any person other than the licensee, and the other station he is in contact with, is a third party. I'll get into the third-party business again when that section of the Rules comes along.

**Radio phenomena**

Now we can get back to the more interesting part like I promised. I gave you the list of different topics covered in this section last month. If you think about them for a moment, you'll see that they all have to do with the propagation of radio signals. While there is (as yet) no way that the FCC can regulate propagation, they still want you to know what is going on there so you will be aware of the possibilities of communication on the amateur radio frequencies. Additionally, it is one of the greatest guessing games in the world — trying to figure out what band will be best for DX at any particular time. You'll enjoy your hobby a lot more if you can visualize how signals get from one place to another.

I told you about wavelength,

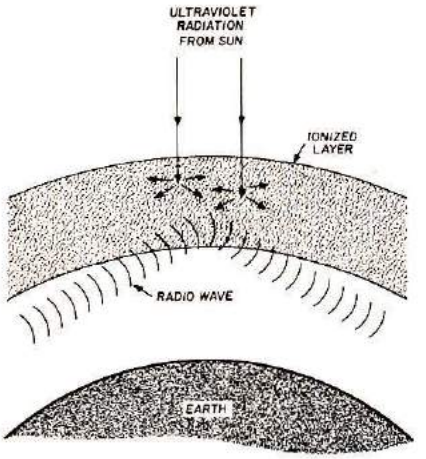


**Fig. 1.** Ultraviolet radiation from the sun is absorbed by the upper atmosphere, where the energy is used to ionize the thin gases there. These gases tend to form layers or bands about the earth, and are called the *ionosphere*. Some radio waves are bent or reflected when they reach the layer, returning to earth at a distant point. Generally speaking, the longer wavelengths tend to be absorbed by the layers, and the very short wavelengths pass through into space. Those in between are partially or completely reflected, giving amateurs the chance to communicate over long distances when the waves return to earth.

and said that it had a lot to do with propagation. Well, it does. It may take a bit of imagination on your part, and mine, to explain it, but let's try.

You've heard of the so-called one-way mirror. One side reflects light, so that you can see your image in it. The other side lets light through, and you can see a person on the other side of it. This is because it is partly reflective — the reflective coating is not as dense as a normal mirror coating would be. The more dense the coating, the more light it reflects from one side, and the less it passes from the other. It is sort of a filter.

Well, the atmosphere is somewhat the same way. It is indeed a filter, a selective one, filtering out the ultraviolet rays that reach us from the sun. If it did not do so, earth and the life on it would not be as they are today. Now, you cannot just stop those rays in the middle of nowhere; the energy has to be accounted for, and it is. The ultraviolet energy is absorbed by exciting the very thin atmosphere at a great height. (150-200 miles or 240-320km). It becomes *ionized*, which means that some atoms become electrically charged and form a partially conducting layer. The more energy that is used in ionizing the upper atmosphere, the more dense the layer will be, and thus the more reflective, to put it in the simplest of terms.

However, it never becomes completely reflective, because we know that some frequencies — vhf for instance — are not reflected and keep on going out into space. Other frequencies are reflected only part of the time.

It all depends upon just how dense the ionized layers are. The more ionization there is, the higher the frequency that will be reflected, and this is called the "Maximum Usable Frequency," or MUF. This doesn't mean that frequencies above the MUF are useless; it is just that they will not get to the distant point that you want them to.

This reflection does not take place from a hard surface or a solid point in the atmosphere, but rather skims through the bottom of the layer. It actually penetrates a bit into the ionized gasses, and is bent as it does so, see **Fig. 1**. Now here is where the wavelength becomes important. Some wavelengths will be bent just a little bit at a time, others more sharply, and some very abruptly. The degree of bending is determined by the interaction between the radio waves and the ionized gases. If the ionosphere is very dense, it will interact with wavelengths that are short, and the MUF will be high (short wavelengths = higher frequencies). But there is a catch to this: if the ionization is *too* great, the layer becomes too thick, and the radio energy is absorbed in trying to get through, never to be heard again! That is why bursts of high solar activity can

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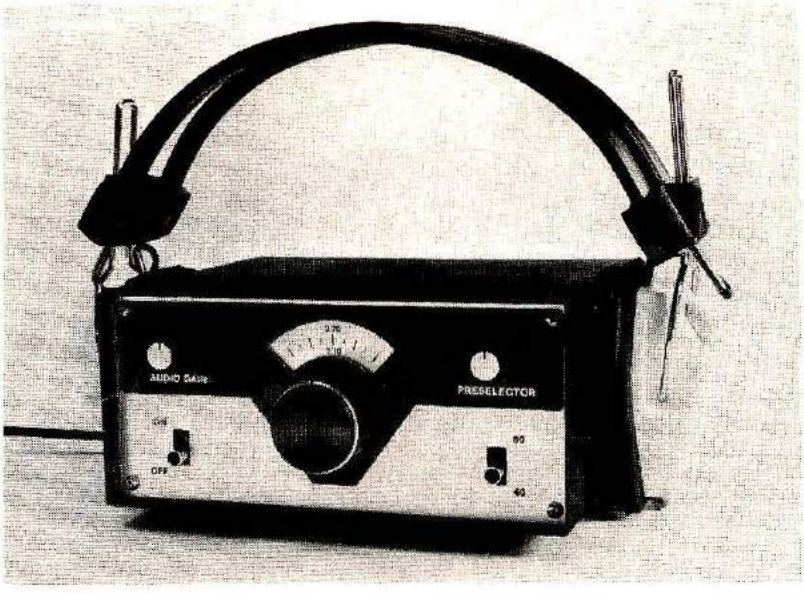


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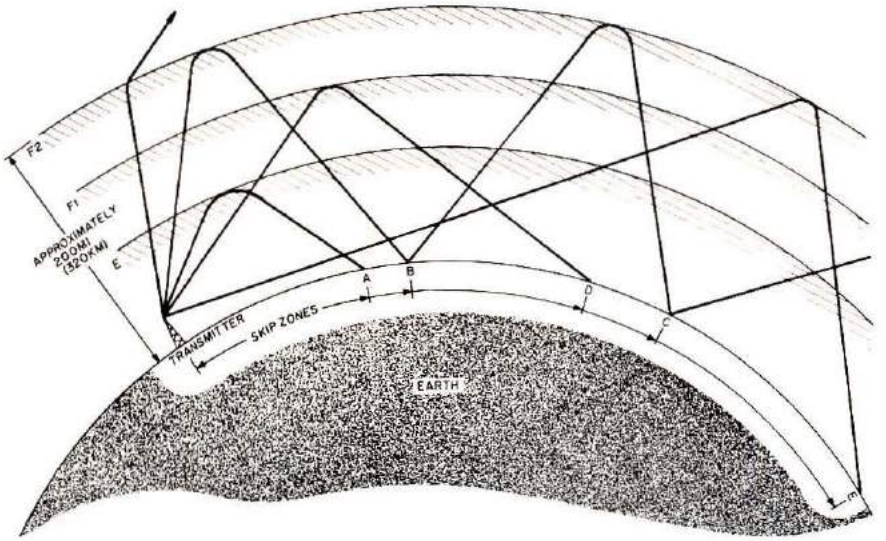


**Fig. 2.** Three principle layers that determine the type and distance of propagation are shown here, with the E layer nearest to earth and the F2 layer highest. There is a D layer, but it has mostly to do with absorbing lower-frequency signals during the daytime. Some high-angle radiation penetrates the layers, and continues into space. Some frequencies are reflected by the E layer for short skip distances, as at **A**. Other waves can skip to fill in the distances between those of the E or F2 layers. Amateurs try to obtain the lowest angle of radiation from their antennas because it increases the skip distance to a maximum, shown at **E**. Multiple low-angle skips can reach the other side of the world.

cause radio blackouts.

Because the layer (actually there are several) is curved around the earth, the signals get bounced back down to earth at some distant point (**Fig. 2**). The most useful layers are termed F1 and F2, and are at different heights above the earth.

Other modes of propagation help your signal to get around, but the explanation of all of them is far too much to go into here. I recommend that you study the propagation chapter of *The Radio Amateur's Handbook*, published by the ARRL, and read some of the excellent articles that have appeared in *Ham Radio Horizons* — specifically "The Strange World of Sunspots," by W6SAI, in the July, 1977, issue.

Oh, yes . . . what makes the signals propagate when the sun is not shining? Well, it's like this. There is such a vast amount of energy reaching the atmosphere all day that it agitates some parts of it very highly. It takes the ionized layer a long time to settle down after the sun sets — long enough that, most of the time, it will still reflect the longer wavelengths all night. That is why you can hear stations on the lower bands coming through at night, while the higher ones go dead. Remember how you could hear the a-m broadcast stations from the other end of the country late at night? The ionosphere had not "calmed down" yet, and could reflect the longer wavelengths.

### Band characteristics

A thumb-nail sketch of what bands will be most useful for DX during the various times of day would look something like this:

**160 meters:** greatest distance at night. Its longer wavelength is absorbed during the daytime ionization. Behavior is similar to the a-m broadcast band nearby.

**80 meters:** very much like 160 meters, perhaps just a bit more range during the daytime. Very good signals at nighttime. Its wavelength is partially absorbed by the daylight ionosphere.

**40 meters:** fair during the day, and often very active at night. Very reliable for long distance work at night. At sunrise (or just before), it is often possible to work the other side of the world.

**20 meters:** the mainstay of daytime DX work. Wavelength is generally reflected from the ionosphere, and the distance worked depends mainly upon how high the ionized layer is. Signals during the day can be very strong. Band usually starts to die out after sunset as the ionosphere calms down. High solar activity can, however, cause the ionosphere to remain partly active all night, thus permitting the band to be good later than usual.

**15 meters:** an intermittent daytime DX band. Opens later than 20, and closes down earlier. When open, signal strengths can be very good, and low power rigs will do well. Seldom open late at night.

**10 meters:** similar to 15 meters, but usually opens later than 15. Because the wavelength is almost totally reflected, signals are very strong when the band is open. This is a good place for local rag-chews during the evening because there are no DX signals to cause interference.

Of course, this is just a general description of what to expect. Any variation in the solar activity will cause the bands to do strange things. The activity of the ionosphere also changes with the seasons; when the sun is more nearly overhead in the northern hemisphere (in the summer) it has more time to ionize the upper layers, which stretches the time that the daytime DX bands are open. During our winter, the sun is working on the southern hemisphere, and we get shorter openings.

Next month I'll try to finish up the Rules and Regulations section, tell you more about propagation, and perhaps pick another subject from the FCC study guide, space permitting.

**HRH**

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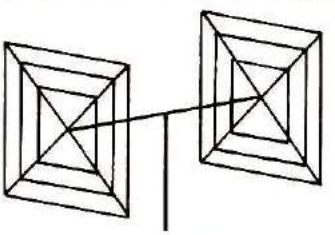

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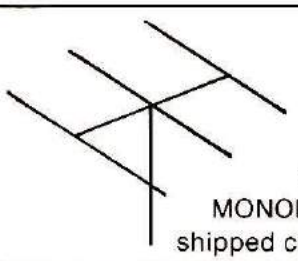

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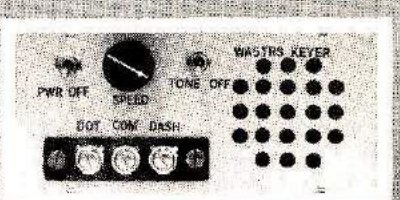


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BY BILL WILDENHEIN, W8YFB

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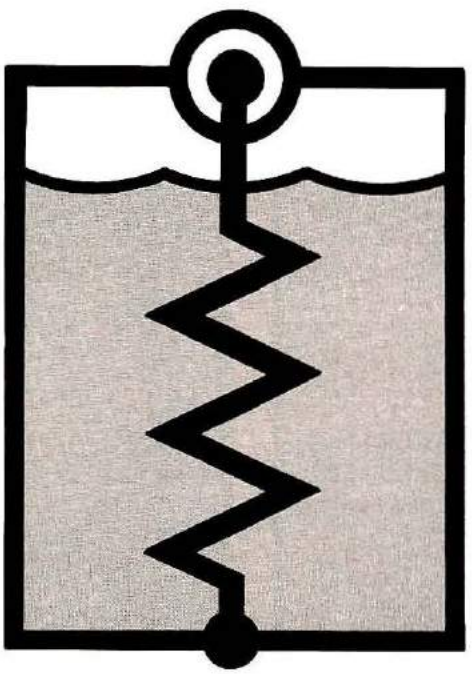

Have you ever had a pleasant contact ruined by a powerful carrier parked on your frequency for minutes at a time? This all-too-common experience could have been the result of a well-meaning, but uninformed, Amateur tuning his transmitter on the air, perhaps even at low power, thinking that his signal wouldn't bother anybody. Don't believe it! Under certain conditions, even a low-power rig attached to a mediocre antenna can put a surprisingly powerful signal into a particular area. I used to work a young fellow in Kansas on 40 meters every morning. His signals were always solid, even though he ran only one-watt input to a single 1S4 tube, and used a plain dipole antenna. Moral: You can't tune up a rig — even a low-power rig — *on the air*, without disturbing someone else's QSO!

What is the answer, then? A *dummy load*: A nominal 50- or 75-ohm resistance at all frequencies you're likely to transmit, and one that can dissipate the full power of your transmitter without putting a signal on the air.* The dummy load "looks" like an antenna to your transmitter, but doesn't radiate a signal into space. Commercial or laboratory loads achieve this ideal, but are expensive. The Heathkit *Cantenna* is relatively inexpensive, and does an excellent job, but you may want something that costs even less. Can you afford up to three or four dollars? If so, read on.

*Most modern transmitters are designed to operate into 50- or 75-ohm loads. This value of load resistance conveniently matches the feedpoint impedance of a dipole antenna and the characteristic impedance of coaxial cable. For more information about coaxial cable see **Reference 1**.

The dummy load described in this article, if properly constructed, will remain accurate for many years and will also serve as a useful piece of test equipment. For example, connected in series with an rf ammeter as shown in **Fig. 1**, the dummy load will allow you to measure your transmitter's rf output in watts. Notice that the interconnecting leads are made from coaxial cable, and that the meter is enclosed in a metal box, preventing stray rf energy from putting a signal on the air. Your power output, in watts, is equal to the rf current, in amperes, squared and multiplied by the load resistance.

$$W = I^2 \times R$$

where

$W$ = power in watts
$I$ = rf current in amperes
$R$ = load resistance in ohms

Let's say that, when connected to your transmitter, the rf ammeter reads 2 amperes. Two amperes squared equals four which, when multiplied by 50 ohms, the resistance of your dummy load, gives 200 watts — your power output. If your dummy load is 75 ohms, the rf ammeter would read 1.63 amperes. Using the formula, 1.63 amperes squared, multiplied by 75 ohms, gives 200 watts — your power output.

The rf ammeter is a true *rms* device that reads *average* power, not peak power. Therefore your dummy load/wattmeter will yield accurate results, even if your transmitter's output waveform has some distortion, and is not a true sine wave. A vacuum-tube voltmeter (vtvm) with an rf probe could also be used for power measurement, but will not be quite as accurate because the vtvm is a peak-reading device, and any distortion of the waveform will cause the voltage reading to be higher. The reading you get under these conditions will make you think that your transmitter has a higher output than it actually produces.

When using a vtvm, the power reading is calculated according to the following simple formula:

$$W = \frac{E^2}{R}$$

where

$W$ = power in watts
$E$ = voltmeter reading in volts
$R$ = load resistance in ohms

Let's say that you obtain a reading of 100 volts:

$$W = \frac{100^2}{50} = \frac{10000}{50} = 200 \text{ watts}$$

This is your transmitter's output.

If your load resistance is 75 ohms, the vtvm would read 122.5 volts.

$$W = \frac{(122.5)^2}{7} = \frac{15000}{75} = 200 \text{ watts}$$

**Measuring antenna current**

Up until now, we've talked about measuring your transmitter's power output into a dummy load by using an rf ammeter or a vtvm. Be careful when selecting the range (full-scale reading) of the rf ammeter you use, and take care when using it, because it will not take much abuse. If you have a choice between an rf ammeter that has a full-scale reading of 1 ampere, and one that has a full-scale reading of 3 amperes, it might be better to select the one having the higher full-scale reading. Then you will be less likely to damage the meter.

Now, suppose you want to make some antenna measurements using the rf ammeter, but replacing the dummy load with your antenna. If the rf ammeter reading is different from what it was when using the dummy load, it means that the antenna is not *matched*. Don't worry about it if the difference is a small one, unless you are running an input power near the 250-watt Novice limit.

Coaxial cable can be used as a power attenuator; that is, it will permit you to use a 50-watt dummy load with a transmitter having a 100-watt output, simply by connecting a long piece of coaxial cable between the transmitter output and the dummy load. For example, 125 feet (38m) of RG-58/U or RG-59/U cable will provide a 3-dB (half power) loss at 28 MHz.[1] Other lengths would be required for different bands. Half of the power output is dissipated in the cable and the remaining half, 50 watts, reaches the dummy load.

**Resistive dummy load**

Carbon composition resistors

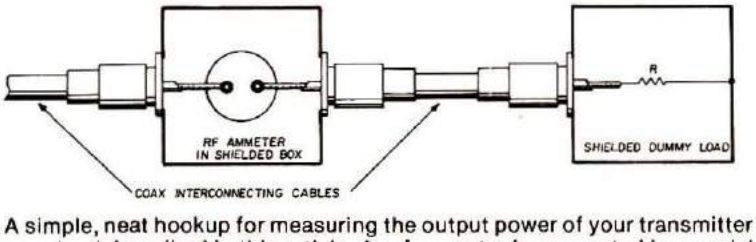


**Fig. 1.** A simple, neat hookup for measuring the output power of your transmitter using the dummy load described in this article. An rf ammeter is connected by coaxial cable between the antenna output terminal of your transmitter and the input terminal of the dummy load. The text describes some do's and don'ts for power measurement.

The completed resistor stack is shown attached to the connector and lid of the paint can, before it is inserted into the can and final soldering completed.

make very good dummy loads, provided that you don't add a lot of stray inductance when wiring them into a usable package. Wattage ratings can be doubled if you immerse them in oil, because the oil acts as a heatsink, preventing the resistors from overheating as quickly while dissipating your transmitter's output power.

A good rule-of-thumb practice is to load at twice the normal rated wattage for 5-minutes, and then allow a 10-minute cooling-off period. If you run at triple the wattage rating, apply power for only one minute, and then allow a 10-minute cooling-off period. This practice will assure you a reasonable lifespan for your dummy load. A dummy load I built over ten years ago, and have since used regularly in experimental work, is still completely reliable.

### Carbon composition resistors

A little warning is in order about carbon composition resistors: Some resistors that appear to be carbon composition resistors are not; they are, in fact, wirewound resistors and are inductive at radio frequencies! An example of this type of resistor is found in World War II surplus stocks.

There are three general types of carbon composition resistors. You will probably not be able to find the type shown in the assembly photograph of my dummy load because they are old and scarce. They are pre-war resistors that sometimes show up on the surplus market. A number of years ago I saw an advertisement for "100 assorted 2-watt resistors for a dollar," so I bought them. Surprise! They all turned out to be one value: 150 ohms. Most hams would have an apoplexy when they opened the box of "assorted" resistors, but I knew from experience that they would work well in rf service. These resistors are identified by the following characteristics: A 2-watt type is about 2-inches (51mm) long and about 1/2-inch (13mm) in diameter. Generally, they have a hexagonal cross-section and are color-coded with the color dots applied to one end of the resistor body.

The next series appeared in the 1940s; resistors of this type are about 1-11/16 inches (43mm) long and about 5/16 inch (8mm) in diameter. They are conventionally color-coded with three color bands located at one end of the resistor body, but *beware of this type*! Although the outward appearance is that of a carbon composition resistor, it may be wirewound and therefore useless for dummy load purposes because of its inductance at radio frequencies. Nevertheless, these resistors are fine for power supply and other circuit uses. Modern versions of this wirewound resistor type have identifying color bands in which one band is much wider than the others. Earlier versions, however, did not all have the wide-band identification.

The latest series of carbon composition resistors includes resistors about 3/4-inch (19mm) long and 5/16-inch (8mm) in diameter, having the one wider band of identifying color if they are wirewound. If not, the three-color bands are all the same width, indicating their suitability for dummy load use.

Another type of resistor that might fool you is the type marked "non-inductive wirewound." Although resistors of this type are better for rf use than conventional wirewound types, they are *not good enough* for use in a dummy load.

All resistors have a tolerance rating, meaning that their

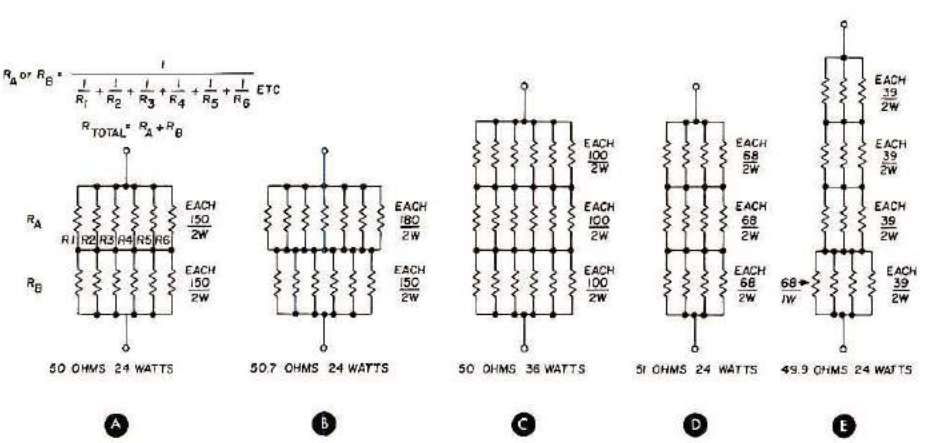


**Fig. 2.** Series-parallel combinations of resistors that will produce a nominal 50-ohm resistance for your dummy load. At **A**, twelve 2-watt, 150-ohm resistors are connected to produce a 50-ohm, 48-watt load. The wattage rating of the resistors *alone* is 24; immersing them in oil increases the rating to the 48-watt value given here and in the text. At **B**, seven 180-ohm resistors are combined with six 150-ohm resistors to provide a 50.7-ohm, 48-watt dummy load. At **C**, eighteen 100-ohm resistors are combined to produce a 50-ohm, 72-watt load, suitable for transmitters in the 100-watt input category. **D** illustrates the use of 68-ohm resistors, while **E** shows how 39-ohm resistors, plus a *correcting* resistor can provide a dummy load of 49.9 ohms. The text describes these combinations, and those for 75-ohm loads in greater detail.

actual resistance will fall within some percentage of the marked value. For example, a gold band indicates 5% tolerance; silver, 10% tolerance; and no band, 20% tolerance. For dummy load purposes, the 10% tolerance is satisfactory because when a number of them are wired together to build the dummy load, individual variations tend to cancel each other, and the final package will be well within 10% of the desired combined value.

### Building the dummy load

The first requirement is to find a group of 12 resistors that can be connected in a series-parallel arrangement to produce a total resistance of about 50 ohms and a power-handling capability of at least 50 watts. All of the resistors you plan to combine should have the same resistance value (within 10% tolerance) so they can be combined properly. It is possible to use different values, but this is complicated and requires some fancy calculation to guarantee that individual resistors won't be overheated.

**Fig. 2** shows several possible combinations. Combination **A** is the one I used for the dummy load shown in the photographs. Twelve 2-watt resistors are combined to produce a 24-watt power handling capability that can be increased to 48 watts if you immerse them in oil. Combination **B** illustrates the use of two different values of resistance. Although 13 resistors are shown, the power rating is not increased because the same number of 150-ohm resistors is used in combination **A**. Although the stack of 150-ohm resistors operates at a bit more than double its normal wattage rating, the 180-ohm stack operates at somewhat less than double its normal power rating, evening things up for the total package.

Combination **C** shows a higher-powered dummy load, and **E** shows how you can adjust the value of a group of resistors that has a resistance that is slightly too high. Each parallel group of three 39-ohm resistors has a value of $39/3 = 13$ *ohms*. Four of these 13-ohm groups in series produces a resistance value of $13 \times 4 = 52$ *ohms*. By adding the 68-ohm, 1-watt resistor in parallel with the lowest stack, that stack's resistance is reduced to 10.9 ohms. Now, by adding the *compensated* stack to the others, you will obtain a total resistance of 49.9 ohms — close enough to the desired 50 ohms. I've given you several different combinations, including the one shown at **D**, so that you can begin scrounging resistors to make up your own dummy load.

### Other resistance combinations

Although many Amateurs prefer to set up their dummy loads for the 50-ohm value, there are still a great many who prefer a 72- or 75-ohm value for several reasons. One, of course, is the fact that 72 ohms represents the center impedance of a half-wave dipole at a height of one-half wavelength above ground. Another is that many hams have 75-ohm coaxial transmission line on hand, or readily available. As far as the transmitter is concerned, it will load equally well into resistive loads of either 50, 72, or 75 ohms. As a matter of fact, the transmitter will probably load into resistance between 35 and 100 ohms or so.

If you would prefer a 72-ohm dummy load, just use the configuration of **Fig. 2A**. Connect twelve 220-ohm, 2-watt resistors together in the arrangement shown. The resulting resistance is 73.3 ohms, close enough for most purposes, being about half way between 72 and 75 ohms.

If you would prefer a 75-ohm, 72-watt dummy load, use the configuration of **Fig. 2C** and replace the resistors shown with eighteen 150-ohm, two-watt resistors.

Other combinations will

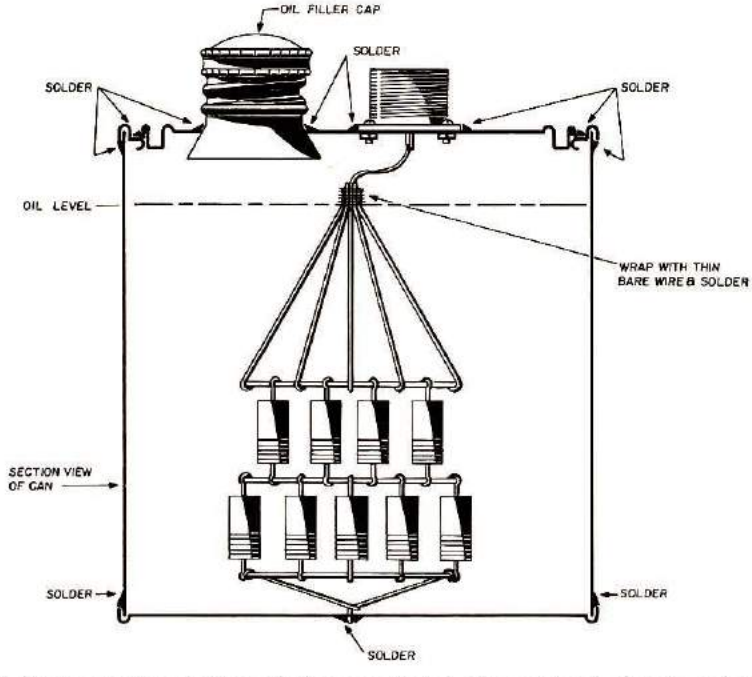


**Fig. 3.** Cross-sectional view of the completed dummy load showing details of assembly. Note the cone of wires used to connect the top of the upper resistor stack to the rf connector mounted in the lid of the can. This arrangement keeps inductance to a minimum. All seams must be soldered well, and a small air space left above the oil level permits expansion of the oil due to heating of the resistors.

A group of resistors are immersed in oil in a paint can to make a convenient rf load for transmitter tune up. A screw-top cap from a discarded can has been soldered to the lid to allow ease in filling the assembly with cooling oil, and to provide pressure relief.

occur to you after you have had some fun calculating various values just to become familiar with the method.

Incidentally, I ought to warn you that the deposited carbon or *film-type* resistors are unsatisfactory for rf purposes and should *not* be used. These resistors are trimmed to the desired value during manufacture by cutting a spiral of carbon away, like cutting a thread on an engine lathe, which creates an undesirable inductance! You may be able to reduce costs by searching for resistors of the type you need in scrapped TV sets, at surplus sales, at hamfests, and the like. In groups of ten or more, new 10% resistors cost about 20¢ each.

The next item you'll need is a quart paint can and a metal can with a screw top. Both should be clean and free from rust. The screw top makes it easy to fill the load with oil and provides a pressure relief in operation. Since oil expands with heat, you loosen the top to prevent a ruptured seam in the can that holds the oil.

Begin by thoroughly cleaning the top and bottom seams of the can, and solder the seams. It will be helpful to use a sheet-metal soldering flux such as *Tinner's Ruby Fluid*, muriatic acid, or *Nokorode* soldering paste. Cut the screw top from the can and cut a hole in the paint can lid to fit this screw top, using a socket punch or scroll saw. Now, solder the screw cap into the paint-can lid, making sure that the surfaces being soldered are bright and shiny, and enough flux is used.

Mount the socket-type (SO239) connector in the lid of the paint can, but don't depend on the screws to make a good connection. Use a heavy-duty soldering iron and flow a nice bead of solder between the connector base and the lid. After soldering, wipe all surfaces clean and dry to remove all traces of the somewhat corrosive flux.

Next, make some heavy wire rings out of bus bar or solid, heavy copper wire. Make the ring diameter large enough so that when the resistors are soldered by their leads to the rings, there will be space between them on all sides to permit free oil flow for cooling. The cutaway view of **Fig. 3** shows the assembly. Connect the resistors to the rings with short leads. Instead of running a single lead from the ring to the rf connector, make a cone of leads from left-over resistor wires, or other solid, tinned wire. Wrap the top end of the cone with fine copper wire to hold the bundle together while soldering it to the center pin of the connector. In this way you can minimize lead inductance.

The bottom lead that passes through a hole in the bottom of the can should be left long, so that it can be guided into position when fitting the lid (containing the resistor stack) on the can. After soldering the top cone wire to the connector, put the lid on the can and tamp it down securely all around the rim. Solder the lead to the bottom of the can where it pokes through, and snip it off. Finally, seal the lid of the can with solder, making sure you get a tight, leak-proof joint.

Perhaps you've wondered why I didn't run a wire from the bottom of the resistor stack back up to the base of the connector. That would add a surprising amount of inductance, which is undesirable. Instead, by using the entire inside wall surface of the can as a return ground path, the inductance practically vanishes. This is one way of achieving *pure* resistance that I mentioned earlier. For the same reason, select a group of long resistors such as shown at **E** in **Fig. 2**, which makes the stack almost as tall as the can is deep, reducing the length of the wires from the top of the resistor stack to the center pin of the connector and minimizing stray inductance. If you choose a can with bright, tinned, inside surfaces, it will be a good conductor of rf energy, and the oil will prevent rusting.

Fill the can nearly full with mineral oil of the drugstore kind and congratulate yourself; you have just created a good dummy load!

What can you expect from your new dummy load in the way of performance? Well, I've made a number of them, ranging from little 10-watters to big 250-watters, and found that all of them tend to be slightly inductive; inductive enough that the load impedance rises slightly with frequency, which is why I try to achieve a resistance as close as possible to the desired 50 ohms. Because my coaxial cable has a nominal (characteristic) impedance of 53 ohms, and the dummy loads I build reach that value at about 21 MHz, things work out well for the entire range. The dummy load shown in the photographs was measured with a laboratory-type bridge, yielding the following impedance values:

| frequency | impedance |
|---|---|
| 2 MHz | 50 ohms |
| 7 MHz | 50.94 ohms |
| 22 MHz | 53.70 ohms |
| 29 MHz | 54.70 ohms |
| 55 MHz | 54.90 ohms |
| 100 MHz | 56.50 ohms |
| 150 MHz | 58.40 ohms |

All of the dummy loads I have built have performed well to at least 30 MHz, and have been useful to 150 MHz, in spite of impedance variations in the 50- to 150 MHz region.

### Input and output power levels

Most transmitters are rated in terms of *input* power rather than output power. For example, if you have a multiband transmitter which uses a class-C final amplifier rated at 100 watts input power, the output power would be 70 watts or less because the efficiency of a class-C amplifier seldom exceeds 70 per cent.

A rig running 75-watts input will seldom exceed 52-watts output, and a 50-watter will generally put out approximately 35 watts. Therefore, the dummy loads I have described will handle the output power of most of the older Novice class rigs.

If you intend to use an rf ammeter to determine true output power, don't be surprised if some older rigs show only 40 per cent efficiency on 15 and 10 meters! This doesn't necessarily mean that your rig is in need of repair. All multiband rigs have compromises in the design, with the majority of the compromise falling at the upper end of their frequency range.

And my last strong suggestion: make every solder joint perfect. If a solder joint inside the can fails, you'll have a real mess on your hands!

### References

1. J. R. Fisk, W1HR, "Transmission Lines . . . Your Pipeline to the Outside World," *Ham Radio Horizons*, May, 1977, page 32. **HRH**

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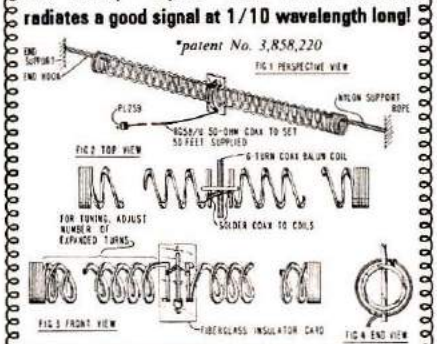


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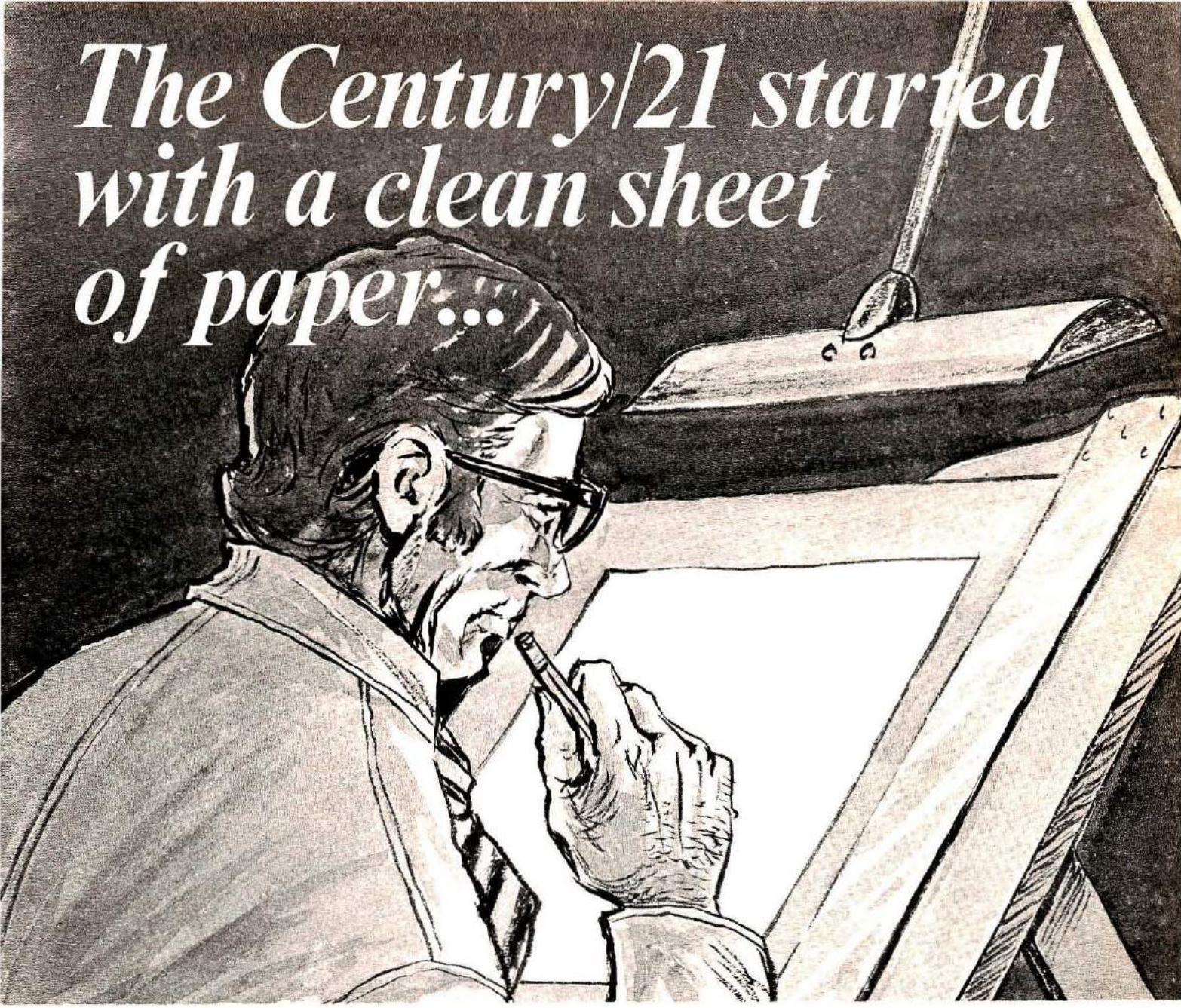


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**CRITERIA:** Cw transmit, cw and ssb receive. Full break-in. 70 watts input. Full band coverage 80-15 meters, 1 MHz on 10. All solid state. Instant, no-tune band change. Built-in regulated power supply. Overload protection. Linear crystal mixed VFO. Direct frequency readout. Offset receiver tuning, defeatable. Built-in speaker. Sensitive receiver section. High selectivity — three position. Sidetone with adjustable level. Full line of matching accessories.

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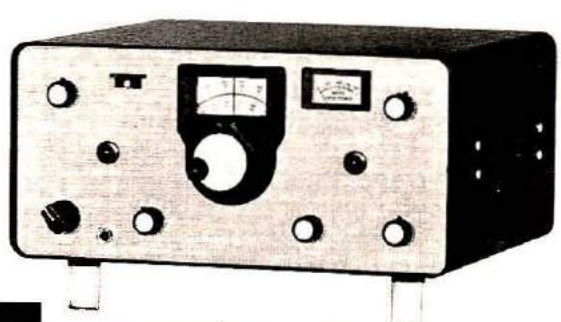

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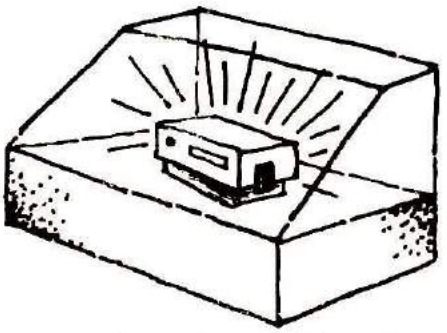
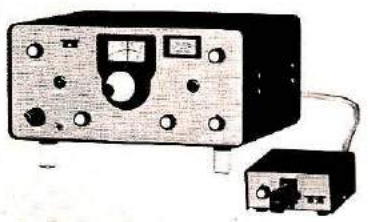
# PRODUCT



# SHOWCASE

## Ten-Tec Century/21 Transceiver



Ten-Tec was among the first of the Amateur equipment manufacturers to anticipate the need and desire among hams for small, lightweight, broad-tuning, instant break-in, dc-powered transceivers of high quality and modest power that could go anywhere and do anything. Whether Ten-Tec created the desire or satisfied it, or both, is now moot; what is significant is that they may be about to do it again!

The *Century/21* is a new, and nearly ideal, high-frequency transceiver for either the Novice or the experienced CW buff. It is priced to encourage a newcomer to enter amateur radio with only a modest initial investment, yet featuring so many state-of-the-art advantages that it will attract the old timer as well.

This new solid-state transceiver includes all of the desirable operating features normally found only in transceivers priced three or four times as high: Instant band change, full break-in, built-in power supply, adjustable-level sidetone, built-in speaker, and excellent receiver performance.

The receiver section of the *Century/21* is designed around a unique double-direct-conversion circuit that performs as well as the conventional superhet circuit, yet is broad-banded enough to permit changing from one end of the band to the other, or even changing bands, with only the need to dial the desired frequency and adjust the audio volume to a comfortable listening level. Cross-modulation characteristics are excellent and offset tuning allows reception of the incoming station on either side of zero beat — a feature that, in many cases, will eliminate interfering signals.

A front-panel control selects one of three available selectivity characteristics ranging from the normal 2.5kHz position for ssb reception, through the 1-kHz position for normal CW reception, to the 500-Hz position for elimination of adjacent frequency interference. Separate audio and rf gain controls, a headphone jack, and a built-in speaker are standard equipment.

The solid-state, 70-watt transmitting section features a push-pull final amplifier that operates in Class AB, minimizing the possibility of TVI. Individual low-pass filters are switched into the antenna line with the band switch to reduce further any unwanted and harmonic radiations. When changing frequencies or bands, no tune-up whatsoever is required, and the instant break-in system allows incoming signal to be heard between transmitted characters — a luxury desired by all CW operators but enjoyed by only a few.

The built-in power supply monitors the current being drawn by the transmitter and, if the *drive* control is advanced too far, or if there is an antenna mismatch that presents a demand for excessive current from the final amplifier transistors, the power supply automatically shuts down. A front-panel meter that indicates input watts to the final amplifier facilitates proper setting of the drive control to prevent premature shut-down but, if the band is changed without readjustment of drive, or if the wrong antenna is attached inadvertently, the automatic cut-off feature protects the transmitter from harm.

A common vfo controls both the transmitter and receiver sections. The oscillator is permeability tuned and presents a linear frequency-read-out scale. The basic vfo frequency range is between 5.0 and 5.5 MHz, and its output is mixed with various crystal-controlled oscillators to produce the desired output frequency. In this way, frequency stability and bandspread characteristics are the same for all ham bands, making operations on the ten-meter band as stable and easy as the eighty-meter band. Crystals are provided to cover the 80-, 20-, and 40-meter bands, and plug-in crystals for the 15-meter band and the 28.0- to 29.0-MHz portion of the 10-meter band are available as accessories.

The vfo, and consequently the transmitter, can be set to zero-beat an incoming signal by depressing the *zero beat* push-button switch on the front panel, which disengages the *offset* control. An incoming signal can then be received on either side of zero beat by use of the offset control without changing the transmitter's frequency setting.

A full line of matching accessories will be available for the *Century/21* for those who want all the operating conveniences of a complete station, but — as received — it can be put into operation with only a key, or keyer, and an antenna.

A matching calibrator, featuring Ten-Tec's famous pulsed calibration signal that is so easy to detect among a host of other signals, can be plugged into a rear-panel socket and will provide marker signals every 25- or 100-kHz throughout the entire frequency range of the transceiver. Other accessories, including an antenna kit, an swr

meter, and an antenna tuner, are also available.

The *Century/21* Model 570, is priced at $289; *Century* keyer, Model 670, $29; *Century* Calibrator, Model 276, $29; Crystals: Model 271 (21.0-21.5 MHz) $5; Model 272 (28.0-28.5 MHz) $5; Model 273 (28.5-29.0 MHz) $5.

For additional information about the *Century/21*, write to Ten-Tec, Inc., Sevierville, Tennessee 27862; or use *ad check* on page 78.

## Magnetic Mobile Radio Mount

Hey, mobilers — do you want a simple, fool-proof, under-the-dashboard mounting system for your two-way radio? How about instant connect/disconnect including antenna and power, too? Look no further, Cornell-Dubilier Electronics has introduced their new *Easy Mount* (trade mark by Cornell-Dubilier), the first mount expressly designed for two-way mobile communications equipment. Your transceiver is held in place magnetically, allowing instant attachment and easy removal of the radio to prevent theft.

Three powerful permanent magnets make positive contact, assuring maximum signal transfer and good vswr match. Installation is extremely simple and provides a neat, flush mount appearance. You have the choice of installing *Easy Mount* under the dash or on the transmission hump, and all necessary hardware and detailed instructions are included. That's not all, either — additional top sections are available so that you can instantly transfer your radio between vehicles, or to a boat, trailer, office, or home.

*Easy Mount* specifications include: cadmium-plated contacts, molded filled ABS high-impact plastic frame, and U-channeled permanent-ceramic-magnet retaining structure. *Easy Mount* weighs only 1.25 pounds (0.57kg), has a low 1-1/8-inch (2.86cm) profile, occupies a mounting area only 4-3/8 inches (11.1cm) wide by 3-1/4 inches (8.26 cm) deep, and comes with a full one-year warranty.

For additional information, contact Mr. Gary Alspach, Cornell-Dubilier Electronics, 150 Avenue L, Newark, New Jersey 07101; telephone (201) 589-7500; or use *ad check* on page 78.

## Janel Laboratories Preamplifiers

**An outboard two-meter preamp.** Janel Laboratories has just announced their new QSA 5 preamplifier for transceivers that improves the receiving sensitivity (noise figure = 2dB) without requiring any modification of the transceiver. The new QSA 5 can be used with all two-meter transceivers and all modes, including fm, ssb, a-m, or CW. Automatic bypass switching is provided by an internal relay whenever transmitter rf power is sensed, and an LED shows the status of the QSA 5 at a glance. If desired, a front-panel switch can be used to bypass the preamp (remove it from the circuit entirely) while receiving.

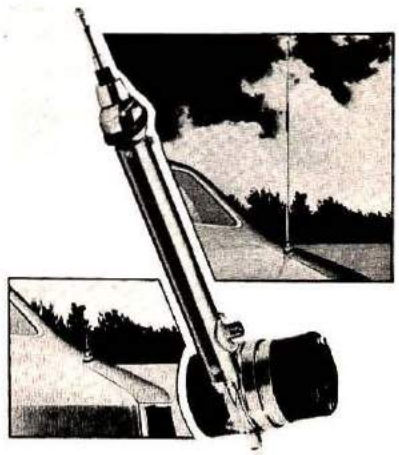
The QSA 5 is very compact, measuring only 1 x 4 x 3-3/4 inches (25x102x95mm), covers the entire two-meter band from 144 to 148 MHz, and provides a 15-dB receiving gain. It is useable with transceivers having 1 to 20 watts output power, and requires only 12 volts at 60 milliamperes for operation. In the transmit position (internal bypass) the vswr is only 1.2:1, meaning that there is negligible loss in straight-through operation. The preamplifier is priced at $39.95.

**Two-Meter receiver preamp module.** Another new product from Janel Laboratories is their tiny new preamplifier module that is designed to be incorporated into new or existing two-meter equipment. The module, designated 144PM, is a complete, sealed, ready-to-install package that has external solder pins for mounting to a printed-circuit board or for direct attachment to wire or coaxial cable. Low-noise Janel mosfet circuitry is used, and each module is fully tested for gain and noise figure before shipment.

The 144PM is really small, but boasts a gain of 16 dB, minimum, and a noise figure of 2 dB, maximum. Useable over the entire two-meter band from 144 to 148 MHz, the 144PM requires only about 5 milliamperes at between 9 and 15 volts dc, making it ideal for operation from a small battery source or from a receiver, or transceiver, power supply.

The 144PM is priced at only $16.95, ready for installation. For ordering or more information, write to Janel Laboratories, 3312 S. E. Van Buren Boulevard, Corvallis, Oregon 97330, or use *ad check* on page 78.

## Motorized Retractable Antenna



Radio Shack has just announced its new, motorized, retractable, Citizens Band antenna for mobile installations. This new antenna, marketed under the Archer brand name, can extend to its full 33-inch (84cm) length, or retract into the fender of your car, at the flip of a switch. It can be easily wired to turn the CB radio on automatically when it extends, or off, when it retracts.

Designed to deter thieves when not in use, the telescoping, stainless-steel antenna is powered by a rugged all-steel motor drive system. You won't need any special tools for installation; and the antenna comes complete with a toggle switch for dashboard mounting, an 18-foot (5.5m) coaxial cable, a wiring harness, and all mounting hardware.

The new Archer antenna sells for only $59.95, and is available from Radio Shack stores and dealers, nationwide. For additional information, write to H.L. Siegel, 2617 West Seventh Street, Fort Worth, Texas 76107, see it at your local Radio Shack, or use *ad check* on page 78.

## Weatheralert's New Forecaster

Weatheralert, a privately-owned Chicago firm that was founded in 1974 to market a high-quality line of weather station receivers, has just announced its new *Forecaster*. The *Forecaster* provides three switch-selectable channels especially adapted to receive weather broadcasts from the National Weather Service stations being constructed all across the country.

The *Forecaster* is crystal-controlled for stability, and has dual-conversion circuitry and a tuned rf stage for selectivity and sensitivity — all enclosed in a tough molded styrene case that measures only 6 x 4 x 1-3/4 inches (15x10x4.5cm) and also contains a 2-1/4 inch (5.7cm) full-fidelity speaker.

A 25-inch (10cm) telescoping antenna, an LED power indicator, a slide *on-off* switch,

and slide volume control are also part of this compact weather receiver that can be operated from a 9-volt battery (not included) and costs less than $20.

The weather broadcast pick-up range of the *Forecaster* is about 35-40 miles (55-65km) and it will soon be in radio and electronic supply stores around the country. For additional information, write to Keroff & Rosenberg Advertising, Inc., 230 North Michigan Avenue, Chicago, Illinois 60601, or use *ad check* on page 78.

## equipment directory

Have you ever searched through a pile of magazines, a loose-leaf collection of product releases, or a collection of dog-eared catalogs looking for a particular antenna, the specs on a new transceiver, or the nearest distributor-dealer for a certain brand of amateur equipment, only to give up in frustration?

Well, you don't have to repeat that futile exercise this year. The new *1977 Amateur Radio Equipment Directory*, published by Kengore Corporation, got it all together just for you. Here is a comprehensive catalog of amateur equipment, complete with the names and addresses of manufacturers and distributors, together with product photographs, specifications, and prices, conveniently and attractively bound between soft covers for your reference library.

Not every last item made by every manufacturer is listed, nor do the prices reflect recent price increases, but the catalog lists telephone numbers where you can get the latest, correct information. In spite of these minor (and expected) shortcomings, you'll have to look a long time before finding anything nearly as useful or informative. For your copy, send $2.95 to Kengore Corporation, 9 James Avenue, Kendall Park, New Jersey 08824 or use *ad check* on page 78.

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**CLEVELAND, OHIO** Hamfest Saturday, Sept. 10th, at the German Central Farms (Deutsche Centrale), 7863 York Road at Sprague. Mobile checkins and info on 146.52 from 0600 with W8-QV. Large Picnic area, Family and Y.L. Activities, large Flea Market, Indoor Commercial Displays. Eats for all. Grand Prize at 1530. Donations $2.00 at Main Gate opening at 0700. Flea Market add'l $1.00 per car space — Gold Rush at 0600. For info write: Cleveland Hamfest Association, Box 43413, Cleveland, Ohio 44143.

**TOROIDS** 88 or 44 mH. Same day shipment. 5 for $3.50 postpaid. Gull Electronics, 12690 Rt. 30, N. Huntington, PA 15642.

**FREE LICENSING CLASSES** In Flushing, NY area. Send inquiries to FRATS (Flushing Radio Amateur Technical Society), 62026 Boelsen Crescent, Rego Park, NY 11374.

**GEORGIA** Lanierland A.R.C. Fourth Annual Hamnic will be held on September 18, 1977 at the Dogwood Pavillion of Lake Lanier Islands. Main prize ICOM 22-S. Talk-In on .07/.67. Please contact Terry Jones WB4FMJ for further information.

**DEALERS.** Stock HAM RADIO and HAM RADIO HORIZONS in your store. Call 800-258-5353 for complete details.

**QSL's** with class! Unbeatable quality — reasonable price. Samples. QSL's Unlimited, Box 27553, Atlanta, GA 30327.

**HAMFEST** Lima, Ohio October 9. The Northwest Ohio ARC 3rd annual hamfest at the Allen County Fairgrounds. Two large buildings, tables and table space available. Dealers welcome. For information and reservations write, N.O.A.R.C., P.O. Box 211, Lima, Ohio 45802 Phone 640-1433 or 991-2716.

**DISCOVER RADIO ASTRONOMY,** the newest branch of amateur radio! Learn how in The Radio Observer, the only magazine devoted entirely to the hobby. Sample copy $1.00 from The Peterson Press, 657HR Circle Drive, Santa Barbara, CA 93108.

**NEW YORK:** Greater Syracuse (RAGS) Hamfest Saturday, October 8 from 9 A.M. to 6 P.M. at the Syracuse Auto Auction, 4 miles south of Syracuse, N.Y. on U.S. Route 11 between Nedrow and LaFayette. Flea market, cw and wiring contests, forums, panels and eyeball QSOs. Lunch counter, nearby campsite and Apple Festival for the family. Talk-in on 31/91. Tickets are $1.50 before October 1 and $2.00 at the gate. For further information, contact Roger Hamilton, WA2AEW, c/o RAGS, P.O. Box 88, Liverpool, New York 13088.

**CODE PRACTICE OSCILLATORS,** hand keys, electronics keyers, other products. Free catalog. Globalman Products, Box 246, El Toro, CA 92630. 714-533-4400.

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**VARIABLE AND TRIMMER CAPACITORS** — RF chokes — Miniductors; stocked for immediate shipment. First class stamp for flyer. D & V Radio Parts, Rt#2, 12805 Sarle, Freeland, Michigan 48623.

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More details? Ad Check page 78.

# DX forecaster

## October, 1977

### Last-minute Special

Propagation conditions for October should be generally good on all bands, with rapidly-increasing sunspot activity boosting the MUF to better-than-ever levels. Watch those 18-minute after-the-hour WWV broadcasts for clues to sudden disturbances, particularly on the 4th, the 12th through 15th, and the 20th of the month. The *CQ Worldwide DX Contest* on the 29th and and 30th (phone weekend) may have some surprises — ionospherically speaking — and the normally good conditions on 40 and 80 meters could suffer, while DX on 10, 15, and 20 meters could be better than ever. On other days, the ionosphere is expected to be relatively stable.

October's contest calendar usually includes the VK/ZL Oceania contest (Phone on the first weekend, CW on the second); RSGB's 21/28-MHz Phone contest (second weekend); and RSGB's 7-MHz CW contest (third weekend). Although contesting may not be your cup of tea, it provides an ideal opportunity for you to experience worldwide propagation conditions over a variety of paths, and compare your findings with predictions.

### Band outlook

*20 meters* will continue to be the top DX band, followed closely by 15 meters. Twenty should be good from morning until well after dark, while fifteen will open later and close earlier. Some excellent 10-meter openings, even to Europe, Africa, and the Pacific, may take place on days when the *Solar Flux Index* is high, and the *K* index is low. Expect DX openings on 10 and 15 meters more than ten days of the month.

*40 and 80 meters* come into their own during the fall and winter months because static noise has just about disappeared for the season, and absorption levels are low. Look for excellent DX to Europe after dark on both bands, and even into the South Pacific and Asia between six and eight AM, local time.

*160 meters* also begins to perk up at this time of year, and you can expect the top band to be open mornings as well as late afternoon and evening hours. Look for DX around sunrise and sunset, plus or minus one-half hour.

*Sporadic-E Propagation* is about nil, so skip distances tend to be medium-to-long on all bands, compared to summertime conditions.

*6 and 2 meters* will be active via both the ionosphere and troposphere during or following disturbances. Also look out for auroral propagation on the disturbed days, after about six PM. Tropo will bring some good catches on 220 and 432 MHz, as well.

Meteor scatter propagation for vhfers will take place on Friday and Saturday evenings, October 21 and 22, due to the annual Orionid shower. Have your rigs ready. **HRH**

## WESTERN USA

| GMT | PDT | N | NE | E | SE | S | SW | W | NW |
|---|---|---|---|---|---|---|---|---|---|
| 0000 | 5:00 | — | — | 20 | 20* | — | 15* | 15 | 20* |
| 0100 | 6:00 | 20 | — | — | 20* | — | — | 15 | 20 |
| 0200 | 7:00 | 20 | — | — | 20 | — | 20 | 20 | 20 |
| 0300 | 8:00 | 20 | — | 40 | 20 | 20 | 20 | 20 | 20 |
| 0400 | 9:00 | — | 40 | 40 | 20 | 20 | 20 | 20 | 20 |
| 0500 | 10:00 | — | 40 | 40 | 40 | 20 | 20 | 20 | — |
| 0600 | 11:00 | — | 40 | — | 40 | 20 | 40 | — | — |
| 0700 | 12:00 | — | 40 | — | 40 | — | 40 | — | — |
| 0800 | 1:00 | — | — | — | 40 | — | 40 | — | 40 |
| 0900 | 2:00 | — | — | — | 40 | — | 40 | — | 80* |
| 1000 | 3:00 | — | — | — | 40 | 40 | — | — | 80* |
| 1100 | 4:00 | — | — | — | — | 40 | — | 40 | 80* |
| 1200 | 5:00 | — | — | — | — | 40 | — | 80* | 80* |
| 1300 | 6:00 | — | — | — | — | — | — | 80* | 80* |
| 1400 | 7:00 | — | — | — | — | — | — | 80* | 40 |
| 1500 | 8:00 | — | 20 | — | 20 | — | — | 40 | 40 |
| 1600 | 9:00 | — | 20 | — | 20 | — | 20 | 20 | — |
| 1700 | 10:00 | — | 20 | 20 | 20 | — | 20 | 20 | — |
| 1800 | 11:00 | — | 20 | 15 | 15 | — | 20 | 20 | — |
| 1900 | 12:00 | — | 20 | 15 | 15* | — | 20 | 20 | — |
| 2000 | 1:00 | — | 20 | 15 | 15* | — | — | 15 | — |
| 2100 | 2:00 | — | — | 15 | 15* | — | — | 15 | 15 |
| 2200 | 3:00 | — | — | 20 | 15 | — | 15* | 15 | 15 |
| 2300 | 4:00 | — | — | 20 | 15 | — | 15* | 15 | 15 |

## MID USA

| MDT | N | NE | E | SE | S | SW | W | NW |
|---|---|---|---|---|---|---|---|---|
| 6:00 | — | 40 | 20 | 20 | — | 15 | 20* | — |
| 7:00 | 20 | 40 | — | 20 | — | 15 | 15 | 20 |
| 8:00 | 20 | 40 | 40 | 20 | — | 15 | — | 20 |
| 9:00 | 20 | 40 | 40 | 20 | 20 | — | 20 | 20 |
| 10:00 | — | 40 | 40 | 40 | 20 | — | 20 | — |
| 11:00 | — | 40 | 40 | 40 | 20 | — | 20 | — |
| 12:00 | — | 80 | — | 40 | 20 | — | 20 | — |
| 1:00 | — | 80 | — | 80* | — | — | — | — |
| 2:00 | — | 40 | — | 80* | — | 40 | — | — |
| 3:00 | — | 40 | — | 80* | 40 | 80* | — | 40 |
| 4:00 | — | — | — | 80* | 40 | 80* | — | 40 |
| 5:00 | — | — | — | 80* | 40 | 80* | 40 | 40 |
| 6:00 | — | — | — | — | 40 | 80* | 40 | 80 |
| 7:00 | — | — | — | 20 | — | 80* | 40 | 40 |
| 8:00 | — | — | — | 20 | — | 40* | 20 | 40 |
| 9:00 | 20 | 20 | — | 20 | — | 20 | 20 | 20 |
| 10:00 | 20 | 15 | — | 15 | — | 20 | 20 | 20 |
| 11:00 | 20 | 15 | 15 | 15 | — | 20 | 20 | 20 |
| 12:00 | — | 15 | 15 | 15* | — | 20 | 20 | — |
| 1:00 | — | 20 | 15 | 15* | — | 20 | — | — |
| 2:00 | — | 20 | 15 | 15* | — | 15 | 20 | — |
| 3:00 | — | 20 | 20 | 15 | — | 15 | 20* | — |
| 4:00 | — | — | 20 | 20 | — | 15 | 20* | — |
| 5:00 | — | 40 | 20 | 20 | — | 15 | 20* | — |

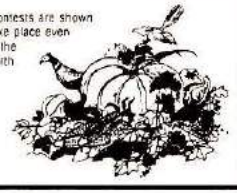
## EASTERN USA

| EDT | N | NE | E | SE | S | SW | W | NW |
|---|---|---|---|---|---|---|---|---|
| 8:00 | 20 | 40 | — | 40 | 20 | 20 | — | — |
| 9:00 | 20 | 40 | 40 | 40 | 20 | 20 | 20 | 20 |
| 10:00 | 20 | 80* | 40 | 40 | 80* | 20 | 20 | 20 |
| 11:00 | — | 80* | 40 | 40 | 80* | 20 | 20 | 20 |
| 12:00 | — | 80* | 40 | — | 80* | — | — | — |
| 1:00 | — | 80* | 40 | — | 80* | — | — | — |
| 2:00 | — | 80* | 40 | — | 80* | — | — | — |
| 3:00 | — | 80* | 40 | — | 80* | — | — | — |
| 4:00 | — | 40 | — | — | 80* | 40 | — | — |
| 5:00 | — | — | — | — | 80* | 80* | 40 | 40 |
| 6:00 | — | — | — | — | 80* | 80* | 40 | 80* |
| 7:00 | — | — | — | — | — | 80* | 40 | 80* |
| 8:00 | — | 20 | — | — | — | 80* | 40* | 80* |
| 9:00 | 20 | 20 | — | — | 15 | 40* | 20 | 40 |
| 10:00 | 20 | 20* | 15 | 10 | 15 | 20 | 20 | 20 |
| 11:00 | 20 | 20* | 15 | 15 | 15 | 20 | — | — |
| 12:00 | — | 20* | 15 | 15 | 15* | 20 | — | — |
| 1:00 | — | 20 | 15 | 15 | 15* | — | — | — |
| 2:00 | — | 20 | 15 | 15 | 15* | — | — | — |
| 3:00 | — | 20 | 20 | 15 | 20* | — | — | — |
| 4:00 | — | — | 20 | 20 | 20* | 15 | 10 | 20 |
| 5:00 | — | — | 20 | 20 | 20 | 15 | 15 | 15 |
| 6:00 | — | — | 20 | 20 | 20 | 20 | 15 | 15 |
| 7:00 | — | 40 | 20 | — | 20 | 20 | 15 | 15 |

| OCTOBER | CENTRAL ASIA | EUROPE | S. AFRICA | S. AMERICA | ANTARCTICA | NEW ZEALAND | W. AUSTRALIA OCEANIA | FAR EAST |
|---|---|---|---|---|---|---|---|---|
| CDT | CENTRAL ASIA | EUROPE | S. AFRICA | S. AMERICA | ANTARCTICA | NEW ZEALAND | AUSTRALIA | FAR EAST |
| EDT | FAR EAST | EUROPE | CENTRAL AFRICA | S. AFRICA | S. AMERICA | OCEANIA | W. AUSTRALIA NEW ZEALAND | AUSTRALIA |

# HAM CALENDAR

# October 1977

| SUNDAY | MONDAY | TUESDAY | WEDNESDAY | THURSDAY | FRIDAY | SATURDAY |
|---|---|---|---|---|---|---|
| *All international events such as contests are shown on the GMT days on which they take place even though they may actually begin on the evening of the preceding day in North America.<br>  | The 65th Annual World Dental Congress, under the auspices of the Federation Dentaire International (FDI) will take place October 22 through 28 1977 in Toronto at the Canadian National Exhibition Fairgrounds. This unique event will include a special amateur station set up on the mezzanine of the Automotive Building, using the call VE3DDS (Dr. Howard Young). The special events station will be operating on all bands and modes 80 through 2 meters, with primary operation on 20-meter SSB. Special QSLs will be issued. Info: Arthur Gee, VE3DHQ, Box 2780, Don Mills, Ontario, Canada M3C 3G1. | | California QSO Party — By the Northern California Contest Club — 1800Z 10/1 - 2400Z 10/2. Of the thirty hour period, the maximum operating time shall not exceed 24 hours. Times on and off must be clearly marked in the log. Each time off shall not be less than 15 minutes. All amateur bands may be used, and stations may be worked once on phone and once on CW on each band. Suggested frequencies — CW: 1805, 3560, 7060, 14060, 21060, 28060 — SSB: 1815, 3895, 7230, 14280, 21355, 28560 — NOVICE: 3725, 7125, 21125, 28125. Try 10 meters on the hour and 15 meters on the half hour between 1800 and 2200Z. All entries must be sent to the NCCC, C/O Lew Jenkins, N6VV, 1750 Eucalyptus Ct., Concord, CA 94521, and must be postmarked not later than Oct. 31, 1977. A large business-size self-addressed stamped envelope is requested with each entry. Further information may be obtained at the above address. | See Oct. 1-5-8-18-22<br>California QSO Party<br>Scout Jamboree<br>  | Memphis ARRL-Sponsored Hamfest — State Technical Institute — Interstate 40 at Macon Road — Memphis, TN — W4SCF — 1-2<br>Mt. Airy VHF RC Hamarama — Treadway Inn on Easton Road — Willow Grove, PA — 1-2<br>Ohio Area Repeater Council Meeting — Delaware County Historical Society — Delaware, OH<br>"Open" CD Party — CW — 1-2<br>VK/ZL/Oceania — Phone — 1-2<br>**1** |
| ARRL Cedar Valley ARC Hamfest — Hawkeye Downs Exhibition Building — Cedar Rapids, IA<br>**2** | **3** | AMSAT Eastcoast Net 3850 kHz 9PM EDST (0100Z Wednesday Morning)<br>AMSAT Mid-Continent Net 3850 kHz 9PM CDST (0200Z Wednesday Morning)<br>AMSAT Westcoast Net 3850 kHz 8PM PDST (0300Z Wednesday Morning)<br>**4** | West Coast Qualifying Run<br>**5** | **6** | ARRL Midwest Div. Convention By the Wichita ARC Inc. Wichita, KS — 7-9<br>ARRL SW Div. Convention Santa Maria, CA — 7-9<br>**7** | AMSAT annual meeting — Goddard Space Flight Center Employees Recreation Center — Greenbelt, MD — For map and list of talks send SASE to AMSAT, Box 27, Washington, DC 20044<br>ARRL West Gulf Div. Convention — Austin, TX — 8-9<br>Knight Raiders VHF Club Auction/Flea market — St. Joseph's Church — East Rutherford, NJ<br>Radio Amateurs of Greater Syracuse Hamfest — Syracuse Auto Auction Building, Route 11 — Nedrow, NY<br>VK/ZL/Oceania — CW — 8-9<br>**8** |
| Hamfest — Redmond Field, Cooke Avenue — Yonkers, NY — Info WA2AUJ, 411 Bellevue Avenue, Yonkers, NY 10703<br>**9** | **10** | AMSAT Eastcoast Net 3850 kHz 9PM EDST (0100Z Wednesday Morning)<br>AMSAT Mid-Continent Net 3850 kHz 9PM CDST (0200Z Wednesday Morning)<br>AMSAT Westcoast Net 3850 kHz 8PM PDST (0300Z Wednesday Morning)<br>**11** | **12** | **13** | **14** | ARRL Pacific Div. Convention — San Mateo, CA — 15-16<br>Manitoba QSO Party — 2200Z 10/15 - 0200Z 10/17*<br>"Open" CD Party — Phone — 15-16<br>**15** |
| **16** | **17** | AMSAT Eastcoast Net 3850 kHz 9PM EDST (0100Z Wednesday Morning)<br>AMSAT Mid-Continent Net 3850 kHz 9PM CDST (0200Z Wednesday Morning)<br>AMSAT Westcoast Net 3850 kHz 8PM PDST (0300Z Wednesday Morning)<br>W1AW Qualifying Run<br>**18** | **19** | **20** | **21** | CQ-WE Contest (Western Electric, Bell Labs, AT&T, AT&T Long Lines & Teletype Corp. employees/retirees) Begins 1700Z 10/22 and there are sections for phone, CW/RTTY. Bell Labs Murray Hill ARC is host for this year's event, and details can be had by sending SASE to W2EME.<br>**22** |
| **23** | **24** | AMSAT Eastcoast Net 3850 kHz 9PM EDST (0100Z Wednesday Morning)<br>AMSAT Mid-Continent Net 3850 kHz 9PM CDST (0200Z Wednesday Morning)<br>AMSAT Westcoast Net 3850 kHz 8PM PDST (0300Z Wednesday Morning)<br>**25** | **26** | **27** | **28** | CQ WW DX Phone Contest — 29-30<br>International Pan-American Ham/Exposition Jamboree — Info: Broward ARC, Capt. S. F. "Red" Crise, WA4ZRW, 3701 State Road 84, Fort Lauderdale, FL 33312 — 29-30<br>**29** |
| Marshall County ARC Radio & Electronic Swap & Shop — National Guard Armory — 1220 W. Madison St. — Plymouth, IN — WA9INM<br>**30** | Halloween<br>**31** | Boy Scouts of America On-The-Air Jamboree — By the World Scout Bureau in Geneva, Switzerland — October 15-16. K2BSA, the Boy Scout Headquarters/Boys' Life Radio Club Station will be on the air for the entire period. In addition to CW and phone, some stations will be using teletype, amateur TV, and some will bounce signals off an orbiting amateur radio satellite. CB stations will join in too. A highlight of the weekend will be a message from the President of the United States. The greetings will be transmitted by W1AW, on regular bulletin frequencies, some of which follow | Time, CDST — Code or Phone<br>4:00 PM — slow code<br>7:00 PM — fast code<br>8:30 PM — phone<br>10:00 PM — slow code<br>11:30 PM — phone<br>Code frequencies: 1.835, 3.58, 7.08, 14.08, 21.08<br>Phone frequencies: 1.835, 3.99, 7.29, 14.29, 21.39<br>K2BSA will send participation certificates to all operators, ham or CB, to SWLs, in addition to Scouts, Cub Scouts, Explorers, and Scouters who visit ham stations. Send reports to K2BSA, Boy Scouts of America, North Brunswick, NJ 08902 | | Jamboree operating frequencies are as follows:<br>CW: 3590, 3740, 7090, 7140, 14070, 21.14, 28.19<br>Phone: 3740, 3940, 7240, 14290, 21.36, 28.99 |

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OCTOBER, 1977

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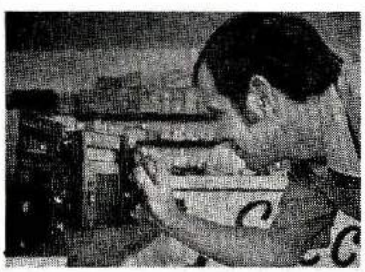

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73,

Art Housholder

Art Housholder, K9TRG
Vice President

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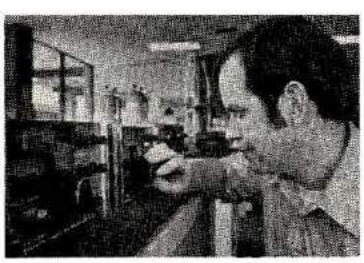




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*THE TR-8300 IS KENWOOD'S NEWEST OFFERING . . . A 450 MHz MOBILE/BASE STATION RUNNING 10 WATTS WITH 22 CHANNEL CAPABILITY.

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ALTHOUGH EVERY KENWOOD PRODUCT LINE IS CAREFULLY MANUFACTURED, FACTORY TESTED AND TESTED AGAIN UPON ARRIVAL IN OUR CALIFORNIA FACILITY, A UNIT MAY NEED SERVICE AT SOME FUTURE DATE. IN ORDER TO GUARANTEE THE BEST LOCAL SERVICE NATIONWIDE, KENWOOD HAS CAREFULLY SCREENED AND CHOSEN A SELECT GROUP OF DEALERS WHOSE SALES AND SERVICE PERSONNEL ARE THOROUGHLY FAMILIAR WITH KENWOOD PRODUCTS, WHO STOCK THE CORRECT PARTS, WHO ARE KEPT UP TO DATE ON SERVICING TECHNIQUES AND WHO, OF COURSE, HAVE THE SOLID BACKING OF KENWOOD'S FACTORY TRAINED STAFF.

WHEN YOU BUY YOUR KENWOOD PRODUCT FROM AN *AUTHORIZED KENWOOD DEALER* YOU CAN BUY WITH CONFIDENCE.

FOLLOWING IS A LIST OF AUTHORIZED DEALERS.

(As of May 31, 1977)

**ARIZONA**

**Power Communications***
6012 North 27th Ave.
Phoenix, AZ 85017

**ALABAMA**

**Long's Electronics**
3521 10th Ave. North
Birmingham, AL 35234

**CALIFORNIA**

**Gary Radio**
8199 Clairemont Mesa Blvd
San Diego, CA 92112

**Ham Radio Outlet**
999 Howard Ave.
Burlingame, CA 94010

**Ham Radio Outlet**
13754 Victory Blvd.
Van Nuys, CA 91401

**Henry Radio, Inc.**
11240 West Olympic Blvd.
Los Angeles, CA 90064

**Henry Radio, Inc.**
931 North Euclid
Anaheim, CA 92801

**Webster Radio**
2602 East Ashlan
Fresno, CA 93726

**COLORADO**

**CW Electronics**
1401 Blake St.
Denver, CO 80202

**FLORIDA**

**Amateur Electronic Supply**
621 Commonwealth
Orlando, FL 32803

**Amateur Radio Center**
2805 N.E. Second Ave.
Miami, FL 33137

**Grice Electronics**
320 East Gregory St.
Pensacola, FL 32501

**HAWAII**

**Lafayette Radio Company**
1111 Mc Cully St.
Honolulu, HI 96814

**ILLINOIS**

**Erickson Communications**
5935 North Milwaukee Ave.
Chicago, IL 60646

**Klaus Radio, Inc.**
8400 North Pioneer Parkway
Peoria, IL 61614

**INDIANA**

**Graham Electronics**
133 South Pennsylvania
Indianapolis, IN 46240

**Hoosier Electronics**
43 B Meadows Shopping Center
Terre Haute, IN 47802

**IOWA**

**HI, Inc.**
1601 Avenue "D"
Council Bluffs, IA 51501

**KANSAS**

**Associated Radio Comm.**
8012 Conser
Overland Park, KS 66204

**MAINE**

**Craig Radio Company**
Route 1 By-Pass South
Kittery, ME 03904

**MARYLAND**

**Electronic International Service**
11305 Elkin St.
Wheaton, MD 20902

**Professional Electronics**
1710 Joan St.
Baltimore, MD 21204

**MICHIGAN**

**Electronic Distributors**
1960 Peck St.
Muskegon, MI 49441

**Radio Supply & Engineering**
1207 W. 14 Mile Rd.
Clawson, MI 48017

**MINNESOTA**

**Electronic Center**
127 Third Ave. North
Minneapolis, MN 55401

**MISSOURI**

**Ham Radio Center**
8342 Olive Blvd.
St. Louis, MS 63132

**Henry Radio Company**
211 North Main St.
Butler, MS 64730

**Midcom Electronics, Inc.**
2506 South Brentwood Blvd
St. Louis, MS 63144

**MONTANA**

**Conley Radio Supply**
318 North 16th St.
Billings, MT 59101

**NEW MEXICO**

**Electronic Module**
601 North Turner
Hobbs, NM 88240

**NEW YORK**

**Adirondack Radio Supply**
185 West Main St.
Amsterdam, NY 12012

**Harrison Radio Corporation**
20 Smith St.
Farmingdale, L.I., NY 11735

**NORTH CAROLINA**

**Freck Radio Supply**
252 Patton Ave.
Asheville, NC 28801

**Vickers Electronics**
500 East Main St.
Durham, NC 27702

**OHIO**

**Amateur Electronic Supply**
17929 Euclid Ave.
Cleveland, OH 44112

**Srepco Electronics**
314 Leo St.
Dayton, OH 45404

**OKLAHOMA**

**Derrick Electronics**
714 West Kenosha
Broken Arrow, OK 74012

**Radio Inc.**
1000 South Main
Tulsa, OK 74119

**OREGON**

**Portland Radio Supply**
1234 S.W. Stark St.
Portland, OR 97205

**PENNSYLVANIA**

**Electronic Exchange**
136 Main St.
Souderton, PA 18964

**Hamtronics**
4033 Brownsville Rd.
Trevose, PA 19047

**JRS Distributors**
646 West Market St.
York, PA 17404

**SOUTH CAROLINA**

**Accutek, Inc.**
420 Laurens Rd.
Greenville, SC 29607

**SOUTH DAKOTA**

**Burghardt Amateur Center**
124 First Ave. N.W.
Watertown, SD 57201

**TENNESSEE**

**Sere-Rose & Spencer Elec.**
1465 Wells Station Rd.
Memphis, TN 38108

**TEXAS**

**AGL Electronics***
3068 Forest Lane #309
Dallas, TX 75234

**Douglas Electronics**
1118 South Staples
Corpus Christi, TX 78404

**Electronics Center**
2929 North Haskell
Dallas, TX 75204

**Madison Electronics**
1508 McKinney Ave.
Houston, TX 77002

**UTAH**

**Manwill Supply Company**
2780 South Main St.
Salt Lake City, UT 84115

**WASHINGTON**

**ABC Communications**
17541 15th Ave. N.E.
Seattle, WA 98155

**Amateur Radio Supply Company**
6213 — 13th Ave. South
Seattle, WA 98108

**WISCONSIN**

**Amateur Electronic Supply**
4828 West Fond Du Lac Ave.
Milwaukee, WI 53216

*Pending

TRIO-KENWOOD COMMUNICATIONS INC. 1111 WEST WALNUT/COMPTON, CALIFORNIA 90220

KENWOOD
...pacesetter in amateur radio

# This is the ultimate in a ham radio station


# ATLAS 350-XL

## ALL SOLID STATE SSB / CW TRANSCEIVER
## 350 WATTS • 10-160 METERS

The 350-XL was designed to fill all the operating requirements of the ham operator. Whether you operate fixed, portable, or mobile, SSB, CW, RTTY, or SSTV, the 350-XL can handle it.

### 1. ALL SOLID STATE CONSTRUCTION

Eight IC's, 44 transistors, and 49 diodes. Final transistors are fully protected against infinite SWR and thermal runaway.

### 2. AUXILIARY FREQUENCY RANGES

The 350-XL will operate on up to 10 additional 500 kHz segments of the spectrum between 2 and 23 MHz by insertion of optional crystals in the auxiliary range selector. This will provide for MARS operation, reception of WWV, and certain commercial or semi-military applications.

On band 6, the 350-XL will operate only from 28 to 30 MHz. It will not operate between 23 and 28 MHz.

### 3. DIGITAL READOUT

This accessory provides precise frequency readout to within 50 Hz. Dot Matrix L.E.D.'s with 6 digit display.

### 4. MATCHING AC SUPPLY

Provides 14 volts filtered and regulated DC for both low and high current circuits of the 350-XL. Has front facing speaker and phone jack, and provision for installation of additional accessories soon to be announced. Operates on 100 to 130 and 200 to 260 volts AC, 50-60 Hertz.

### 5. AUXILIARY VFO

With the optional Model 305 Auxiliary VFO you have a second tuneable VFO for tuning to a separate transmit or receive frequency covering the same 500 kHz range as the primary VFO. Colored LED's indicate VFO being used.

Alternately the Model 311 crystal oscillator may be inserted to provide up to eleven crystal controlled channels.

| | |
|---|---|
| Atlas 350-XL (less options) | $895. |
| Model DD6-XL Digital Dial Readout | $195. |
| Model 305 Plug-in Auxiliary VFO | $155. |
| Model 311 Plug-in Auxiliary Crystal Oscillator | $135. |
| Model 350-PS Matching AC Supply | $195. |
| Plug-in Mobile Mounting Bracket | $ 65. |

*Other optional features to be announced.*

**ATLAS RADIO INC.**

417 Via Del Monte, Oceanside, Ca. 92054
Phone (714) 433-1983