AMATEUR RADIO 73

VHF SUMMER SPECIAL

#130
July 1971
One Dollar

73 MAGAZINE

#130 JULY 1971

STAFF

FEATURES

CONTENTS

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Cover: From the dusty reaches of the W2NSD/1 garage comes this collection of ham license plates. We invite all 73 readers to send us their old call plates so we can replace all the shingles on the 73 barn with call plates.

Amateur Radio News Page

JULY MCMLXXI | Monthly Ham News of the World | 73 MAGAZINE

"EYEBANK" INQUIRY PLANNED

The "Eyebank" controversy has had its impact on the FCC, with the result that the Commission will conduct an inquiry into applicable "Rules."

The Commission's Rules governing the amateur radio service prohibit issuance of an amateur station license to a "school, company, corporation, association or other organization, nor for its use . . . " (Section 97.39). The only exception is for "a bonafide amateur organization or society." Another Section, 97.107, permits an exception during declared emergencies when normal communications are disrupted.

Over the years, however, amateur stations have been used for nonemergency communications in behalf of certain nonamateur organizations such as the Red Cross, Eyebank Association, and the March of Dimes. There has been general agreement that these operations are meritorious.

Recent developments have required a closer look at the requirements of the rules in relation to operation in the interest of other than amateur organizations. "There is evidence of a considerable proliferation of nonamateur organizations with an interest in the use of amateur frequencies and amateur stations for purposes which may well lack the universal acceptability of Red Cross and Eyebank objec-international communications transmitted by amateur stations "to messages of a technical nature relating to tests and to remarks of a personal character for which by reason of their unimportance, recourse to the public telecommunications service is not justified." While there is no similar provision applicable to domestic operations, Section 3(q) of the Communications Act in effect defines an amateur operation "as a person interested in radio technique solely with a personal aim." Extensive use of amateur radio for any third party would not appear to be compatible with that definition.

As previously noted, there is general recognition of the public benefit derived from limited use of amateur stations on behalf of such organizations as the Red Cross, Eyebank, and the National Cystic Fibrosis Foundation. Such recognition may not, however, be nearly as universal when considering the possible use of amateur radio on behalf of other nonprofit, public service organizations such as political parties, student organizations, various churches and missionary societies and a large number of other and more controversial groups.

In order to assist the Commission in making determinations in these important and controversial areas, all

National Releases New Receiver

National Radio Company, Inc. of Melrose, Mass. recently announced the attainment of a major milestone in the company's revitalization program. The HRO-600 VLF-HF Full-coverage Receiving System was successfully tested and qualified against an up-graded specification invoked by the United Kingdom Ministry of Post and Telecommunications. NRCI's HRO-600, frequency range in AM, CW, SSB, FSK, FAX modes, and will accept any one of several frequency control plug-in units (VFO, Synthesizer, Fixed Channel Crystal Control). Both the VFO and Synthesized versions were tested and qualified. The design configurations provide for a wide variety of multimode and multipurpose applications. Additional markets for the

WALKER NAMED FCC CHIEF

A. Prose Walker, an engineering consultant and former FCC staff member, has been named chief of the Amateur and Citizens Division succeeding Everett G. Henry, who retired earlier this year. Mr. Walker had headed his own consulting firm after serving as a consultant with a Washington, D.C. engineering group. He was employed by Collins Radio from 1961 to 1968 in various positions, including most recently, manager of broadcast and general communications in Washington, D.C. From 1953 to 1961 he was manager of engineering for the National Association of Broadcasters and in 1960 was the editor-in-chief of the NAB Engineering Handbook. Mr. Walker joined the FCC in 1940. During World War II he worked in the area of radio intelligence and direction-finding, moving to the Broadcast Bureau in 1946. As chief of the TV allocations branch, he participated in the 1947 Atlantic City World Administrative Radio Conference and attended the high frequency broadcast conferences as a member of U.S. delegations.

tives," the FCC said. Unlimited operation in behalf of such organizations could generate large numbers of new networks and the use of amamateur radio as a medium for the organized advocacy of social, political or economic views could preempt amateur frequencies to the exclusion of the individual amateur for whom the service was intended.

The current rule is clear and unambiguous. It permits no such operation other than as previously noted. Therefore, while the Commission essentially agrees with those amateurs who believe that limited communications in behalf of the Red Cross, Eyebank, March of Dimes, National Cystic Fibrosis Foundation, and similarly oriented organizations are meritorious, it concludes that they are not permissible under Sections 97.39 and 97.107 as they now read and, if the communications are to be permitted, the rules must be amended.

If this is done, the question is raised as to whether some restrictions on the kind of organizations to be included and limitations on the type of communications so permitted will be required. The lines of demarcation between organizations to be made eligible and the types of communications to be permitted are by no means clear. It is one of the purposes of this Notice of Inquiry to elicit information and comment on the extent, if any, to which restrictions and limitations should be imposed.

Another factor to be considered is that Section 2 of Article 41 of the International Radio Regulations limits interested parties are requested to submit comments and suggestions relevant to the following issues:

I. Are any restrictions on the use of amateur stations in behalf of nonamateur organizations warranted?

II. If amateur radio stations should be permitted to furnish a communication service to nonamateur organizations;

(A) To what types of organizations?

(B) What types of activity or communication should be permitted?

(C) If there is to be a distinction between emergency and nonemergency communications, should emergency communications be limited only to those situations where normal communications are disrupted?

In accordance with provisions of Section 1.419 of the Rules, an original and 14 copies of all comments, suggestions, pleadings, briefs, or other documents shall be furnished the Commission. Tell the boys in Washington what you think.

HW-100 OWNERS

Jim Isham W8TXX of the Heath Company recently stated in the Philmont Mobile Radio Club *Blurb* if the HW-100 owners wanted to increase their receiver sensitivity they can change V-10 and V-11 to 6HS6's and they will see a marked change in receiver sensitivity. No other changes are necessary, just the tubes.

REGENCY ANNOUNCES AQUISITION

Instrument Flight Research, Wichita, Kanses, has been acquired by Regency Electronics of Indianapolis, Indiana. Floyd O. Ritter, Regency president, said the purchase was consummated by exchange of Regency stock for all assets and business of the IFR company.

IFR manufactures aviation electronics test equipment. Regency Aviation Division marketing officials, who will assume IFR sales responsibility, state that combining the two companies should result in great sales efficiency for both firms.

the latest in a 40-year genetic line of high frequency radio receivers, is the first U.S.-designed and manufactured equipment to pass this specification. The specification is intended for use by the world-wide maritime services for a ship's main and/or single sideband receiver.

The HRO-600 is capable of operating over the 10 kHz to 30 MHz receiver are: maritime shore stations, air-ground facilities, overseas communications networks, VLF-HF monitor installations, radio frequency control activities, and instrumentation programs.

Quantity production of the HRO-600 is currently underway, and it is anticipated that the receiver will be available for delivery in August, 1971.

Price Reduction: SMALL-SIGNAL PLASTIC TRANSISTORS

Phoenix . . . Motorola has just announced lowered prices for eight popular small-signal plastic transistors. Old and new prices are as follows:

The eight transistor types are backed by more than 25,000,000 device-hours of reliability testing, and exhibit failure rates which are among

Type	Quantity/Price		
	1-99	100-999	1000-499
1N3903	$0.55 ($0.75)	$0.39 ($0.50)	$0.29 ($0.37)
2N3904	0.55 (0.82	0.39 (0.55)	0.29 (0.41)
2N3905	0.55 (0.75)	0.39 (0.50)	0.30 (0.37)
2N3906	0.55 (0.82)	0.39 (0.55)	0.30 (0.41)
2N4123	0.39 (0.52)	0.27 (0.35)	0.16 (0.26)
2N4124	0.40 (0.60)	0.28 (0.40)	0.17 (0.30)
2N4125	0.40 (0.52)	0.28 (0.35)	0.17 (0.26)
2N4126	0.41 (0.60)	0.29 (0.40)	0.18 (0.30)

(Note: Figures in parentheses are the former prices.)

These devices include low noise, general purpose, switching, and amplifying transistors, useful to 300 MHz. All are rated at 310 mW power dissipation.

Types 2N3903 and 2N3904 are NPN high speed low-noise devices, while types 2N3905 and 2N3906 are their PNP complements.

The 2N4123 and 2N4124 devides are general purpose NPN transistors, with types 2N4125 and 2N4126 being the PNP complements.

the very lowest in the industry.

For more information, contact the Technical Information Center, Motorola Semiconductor Products Div Box 20924, Phoenix AZ 85036

Moving? Please Let Us Know!

ARRL OFFERS TVI INFORMATION

The ARRL has published a sheet on TV set manufacturers who will supply a high pass filter for the suppression of interference. The list of twelve manufacturers is available free for a SASE sent to the League's headquarters, 225 Main St., Newington CT 06111.

REPEATER DIRECTORY UPDATE

We try to keep our open repeater directory current and up-to-date. However, new repeaters are coming on the air every day and others are changing frequency and adding channels. As a result of all this activity many errors and omissions have crept into our directory.

Below are the changes and corrections since the publication of our last comprehensive directory in the April 1971 issue of 73. We invite our readers to write in with any corrections and new information on repeaters anywhere in the world. With continued help from our friends we can maintain the most complete repeater directory available.

34/94 means the standard channel of 146.34 MHz input and 146.94 MHz output. All other frequencies are listed in megahertz with the input channel frequency first.

There is a new repeater in Rodsville MD on 52.80/52.68. The call is WA3BMM.

The K3PQZ repeater in York PA is no longer on the air on 34/76.

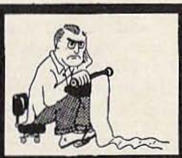
K8SXO in Ridgeley WV is reported to have moved and is off 34/76, 146.76/52.525, and 52.525/146.76.

There is a new repeater in Dunkirk NY: W2SB is on 34/94 and 146.25/146.85.

There is a new repeater on 146.37/146.97 in Manassas VA with the call WB4URR.

VE7CAP, Kimberley, B.C. has changed from 146.46/147.33 to 34/94.

Again – please keep 73 informed of any other changes or errors.



NEVER SAY DIE

...de W2NSD/1

EDITORIAL BY WAYNE GREEN

An Old Editor?

Ken Sessions, who leaves us with this issue, has been one of the best editors 73 has ever had. Ken was responsible for the new and flashy layouts of the articles, the heavy emphasis on FM, and the virtual elimination of speling errers. Under his guidance 73 has continued to grow during a time of depression in the electronic fields which has severely hurt some of the other ham magazines.

All of us at 73 will miss the warm personal friendship and enthusiasm he brought to the job. Ken has promised to continue to write articles and keep the FM information coming in, so he will certainly not be dropping out completely. We all wish him well at his new and bigger job.

All of which means that you are stuck with me as editor again. On the plus side I should point out that whatever I lack in maturity and common sense I make up for in impulsiveness.

Good luck, Ken . . . good luck, 73 readers.

FM in 73

Has there been too much FM coverage in 73? A few readers have complained about this. Even more readers are in favor of the FM coverage. Perhaps some perspective is in order – call it justification, if you like.

Amateur radio has been kind of dragging along with little new to fire the imagination since the change to sideband some ten years ago. The changes in the General class band you can get a fine little FM rig and you are on the air through the local repeaters. You can use it in the car, at home, at work, or even in a boat. More and more hand units are coming out, too. While not too many of us can plunk down a long one for a sideband station, two short ones aren't all that hard to come by.

While I may be patting 73 on the back more than it deserves, I do note that a little over a year ago there were only a couple of FM rigs available and today there are over a dozen and the big problem is back orders. Distributors are raising cain trying to keep units in stock. This is fine for the amateur equipment industry (and they needed something like this pretty desperately), but the main benefactor is amateur radio itself . . . with thousands of stations coming on FM and having a ball.

While we won't be hitting FM quite as hard in the future, more due to Ken moving on to a much bigger job than any change in our thinking, we will be running all the good technical and construction material we can get our hands on plus keeping little items such as the repeater directory up to date, testing new FM gear and the like. Keep those articles acoming in . . . and those repeater changes and additions.

Errors in 73?

Some naive readers have the ridiculous idea that the gammatical, spelling and typesetting mistakes in 73 are accidental. No such thing. This is merely one aspect of our attempt to maintain our image as an amateur magazine. Perfection would be too

WWV-WWVH CHANGES BROADCAST FORMAT

Reported by W2AXU

When you tune in WWV for time signals or propagation information after 0000 hours Greenwich Mean Time (GMT) July 1, 1971, you will hear a different program format than you have been accustomed to over the years. The Morse code transmissions will be gone and the announcements of time and other information will be made in voice. The time will be announced every minute instead of every five minutes. A male voice will be used by WWV and a female voice by WWVH to distinguish between them. The carrier frequencies will remain the same – 2.5 MHz, 5.0 MHz, 10.0 MHz, 15.0 MHz, 20.0 MHz and 25.0 MHz. The frequency accuracy of the two stations is controlled by the NBS Atomic Frequency Standard at Boulder, Colorado. WWV is in Colorado and WWVH is located in Hawaii.

The format of the broadcasts from the two stations will be similar but to avoid confusion between the two stations, they will use alternate time slots for the transmission of tones, announcements, etc. The standard time tick each second will remain.

Each hour will be divided into one minute slots. Each minute (except the first) will begin with an 0.8 second 1000 Hz tone at WWV and 1200 Hz at WWVH. The first minute of each hour will begin with a 1500 Hz tone at both stations. The one minute slots will be divided into a 45 second segment and two 7.5 second segments. On alternate minutes the 45 second segment will contain either a standard tone (possibly 600 Hz) or an announcement.

It is interesting to note that the announcement slots will be available

the FM scene

by K6MVH

Repeater Problems

It certainly is easy for me to sympathize with people who write in telling me of their repeater problems. Perhaps a better word would be "empathize." I've installed a number of repeaters over the past few years and I've never unleashed one yet without controversy, complaint, and hard feelings on the part of at least a vociferous handful.

Here in New England there are dozens of repeaters operating successfully; but the road to success was rocky indeed for virtually all of them. The W1ALE repeater, for example, went up some time ago near Concord, N.H. Its duty cycle was the source of controversy, because it was on the popular .34/.94 set for 12 minutes, then it reverted to .46/.94 and 52.525/.94 for 3 minutes. If the latter operational sets were active, the repeater stayed in that mode, leaving the .34/.94 users with no repeater.

Then one day along came another amateur and another repeater. This repeater, assigned to K1ZJH, was to operate .34/.94 continuously. The only trouble was the fact that the repeater's range overlapped with W1ALE, so a few people – those most affected by the overlap – complained. The K1ZJH machine was running too much power on the output, and mobiles with low power couldn't key the repeater even when they could copy the machine full quieting. The output, they said, was causing interference in some places with W1ALE. But John Bertini, the repeater owner, was convinced that the low-power mobiles should increase their power if they in addition to all of Rhode Island, most of Connecticut and Vermont, all of New Hampahire, all of Massachusetts, and the greater part of Maine.

Needless to say, the repeater drew its share of fire from the members of the other repeater groups. Amateurs who were not members of the other groups, of course, were delighted with the repeater and the coverage it offered. But stations in Boston found that they could key the 73 Magazine repeater (WA1KGO) as well as their own local machine with each transmission. And to their dismay, the output of the WA1KGO repeater was as potent in Boston as the Boston repeater itself. Users of W1ALE and K1ZJH had similar reports. They found it difficult to communicate on their own private repeater when the WA1KGO repeater was being used.

Wayne and I decided to move the repeater to another set of frequencies (146.37/146.73) to avoid further interference to the other repeaters, but we met with a number of objections from the amateurs who liked the extended .34/.94 coverage.

Should we change the repeater output? Should we leave the repeater on .34/.94? We at 73 are faced with a dilemma of concepts: On the one hand, there are people who believe that .34/.94 should give saturated coverage over as much area as possible – the whole U.S., if such were feasible. On the other hand, there are others who feel that .34/.94 should be used for limited coverage over small areas only. Those who take this latter view feel that transients get the advantage of a repeater no matter where segments, the dropping sunspot numbers, and other factors have worked to lessen enthusiasm . . . and fun.

Something new was in order. Something fun. Two-meter FM looked to me as if it would fill the bill. Repeaters had added that certain something which changed 2 meters from a frustration to great fun. As soon as I had my first personal experience through a repeater I knew that this was the way to go and, through great luck, was able to get Ken Sessions to guide 73 on the path to FM. Sure, we've gone a bit overboard, but wasn't it worth it? Thousands of 73 readers have succumbed to the siren call and are having the time of their lives.

Look at it this way. A low-band station generally runs about $1000 by the time you have the transceiver, tower, and antenna. For about $200

professional and put us in a class with, ugh, QST. In order to avoid this we intentionally include fourteen errors in each and every issue, thus preserving our image as blundering amateurs, not only at the radio hobby, but at publishing. We are preparing certificates of merit for readers who manage to spot all fourteen errors three months running.

Why Sideways?

The news pages are printed sideways and in small type for one basic reason: the material is of far less long-term value than the articles and thus doesn't really justify taking as much space as the articles do.

The side pages permit us to get almost 25% more material on a page. The smaller type increases this even more with the result that we are able to cram about two and a half pages of material onto each news page. If we were to print the news the same size as the articles, six double pages of news, letters and caveat emptor would fill over 30 pages of the magazine. Now be honest . . . wouldn't you rather have a little eyestrain on the news and have that many more articles? Your eyes certainly aren't any worse than mine, and I can read the news if I put on my glasses.

. . .W2NSD/1 ■

to Government agencies to use for their own purposes. The slots not used will be filled by another standard tone, probably 500 Hz. To prevent interference between the two stations where they can be received simultaneously, one station's announcements will coincide with the other's tone.

The first 7.5 second segment following the 45 second segment will be used by WWVH to announce time while WWV will be silent. The second 7.5 second segment will be used by WWV to announce time, WWVH being silent.

Each station will omit for 5 minutes of each hour all tones and announcements during the 45 second segments. This period will begin for WWV at 45 minutes past the hour and for WWVH at 15 minutes past the hour.

A special 440 Hz tone will be broadcast by WWV for 45 seconds beginning one minute past the hour and by WWVH two minutes past the hour. This tone can be used to mark the hours on strip-chart recorders or other instruments. The tone will be omitted during the zero hour of each UT day.

In summary, the standard time and frequency stations WWV and WWVH will revise their transmission program format on July 1, 1971 at 0000 hours GMT. Time announcements will be made in voice every minute – a male voice from WWV and a female voice from WWVH.

Courtesy of W2AXU and the Mt. Airy VHF Radio Club newsletter *Cheese Bits.*

wanted to use his repeater, and he held his ground. Eventually, the inhabitants of both repeaters grew accustomed to having them both on the air, and the controversy abated.

Then along came WA1NJR, a repeater in Boston. This repeater was installed because neither ALE nor ZJH offered any kind of coverage from the big city. But the people who were using the K1ZJH repeater moaned and groaned because the NJR machine was cramping their style near the fringe areas between the two repeaters. Clearly, the shoe was on the other foot.

To placate the people using the other repeaters, I'm told, the officers of the WA1NJR repeater lowered their power, thereby reducing coverage to the immediate vicinity of Boston. It didn't stop the gripes, but it reduced them to an insignificant whisper. And three repeaters were operational on the .34/.94 pair, all of which had a restricted area of coverage, and all of which overlapped with the others in some places.

Here in New Hampshire, we were repeater shy. Inhabitants of the Peterborough area (and indeed virtually all of Southern New Hampshire) could key any one of the three .34/.94 machines if they were equipped with fairly high-power base stations and efficient beams. But mobile operation was out of the question. So I installed a .34/.94 repeater on a mountaintop near Peterborough.

As it happens, the repeater I put up has no measurable desensitization; this fact, coupled with the elevation at which the system is mounted, accorded a degree of coverage that surprised everyone, including me. With a 10W output signal on the repeater transmitter, reliable two-way communication range can be maintained between 10W mobiles as far south as the New York border to as far north as the central portions of Maine. In essence, the repeater range includes all the areas covered by the three previously mentioned repeaters, they go because of the proclivity of repeaters operating on that pair of channels. Proponents of the former idea feel that .34/.94 should be a universal, superrange set of frequencies, and that local repeaters should be on off-channels.

So I ask for the opinions of the amateur FM world at large. What do you think? Do you feel that supermachines should dominate .34/.94? Do you think local-coverage repeaters should dominate .34/.94? What we do with the WA1KGO repeater will depend on the opinions and reasoning of the FM readers who write in. Tell me what you think.

. . .K6MVH ■

ANN LANDERS IN 73??????

DEAR ANN LANDERS: A few years ago my husband used to play a lot of cards. Harry was gone five nights a week. The only time I saw him was when he'd have the card game at our house. I got fed up making sandwiches, emptying ashtrays and cutting my way through cigar smoke. One day a friend told me how she cured her husband of the same thing. She got him interested in a ham radio.

This is not a cheap hobby, but I decided it was worth it. I bought Harry a set as a surprise birthday gift. Within weeks he gave up the cards to stay home and ham it up. Now he has started a short-wave romance with some woman who lives in San Antonio, Tex. She has a voice like Lady Bird Johnson. Their three-hour conversations are making me sick. Harry rushes home from work, bolts his dinner and makes a beeline for the radio.

Last week he couldn't contact the lady for three days and he was a wreck. When he finally reached her she explained she'd been out of town. He scolded her for not letting him know she was leaving . . . said he was "worried sick." The whole thing was so cozy I felt like belting him one. Furthermore, this ham thing is interfering with our sex life because Harry stays up until 2 a.m. most nights. (I think she does it on purpose.)

Now I wish he were back playing cards. What should I do? – DUMMY

DEAR DUMMY: Keep quiet. These two will probably talk themselves out. A woman who can't lure her man away from a piece of machinery has no imagination, Toots.

(Reprinted by permission of Publishers-Hall Syndicate and Ann Landers.)

REWARD

From Mars Newsletter England and *Cheese Bits*

A reward is offered for information leading to the capture of Eddy Current, charged with the induction of an 18 year old coil called Milli Amp, found half choked and robbed of valuable jeules. The unrectified criminal, armed with a carbon rod escaped from a primary cell where he had been kept in ions. The escape was planned in 3 phases. First he refused the electrolytes, then he climbed through a grid, despite the impedance of wardens and finally went to earth in a magnetic field. He has been missing since Faraday. It is thought that he escaped on a megacycle. Amen.

WINDSOR AWARDS

International Freedom
Festival Award

All contacts must be made in the period from June 24 to July 20, 1971. Only contacts with Windsor club-members shall be counted.

Two-way communications with an exchange of reports must be established. Continental USA & Canada require 5 contacts; DX stations require 3 contacts; Essex county, Ontario, requires 10 contacts.

Send certified copy of log to Windsor Amateur Radio Club, Box 1322, Windsor 14, Ontario, Canada.

Rose City Award

All contacts (after Sept. 1) must be made with members of the WARC.

Two-way communications with exchange of reports must be established. Essex county amateurs require 15 contacts and all other stations are required to work a minimum of 5 stations.

Send certified copy of log to Windsor Amateur Radio Club.

There is no charge for either award.

WORK THE CAPITOL

There is a nice certificate for working W3USS located in the U.S. Senate. They are often active Mondays through Fridays from 1800 to about 1900 GMT. The best place to look for them is between 21350 and 21360 kHz. For the certificate, send 2 IRCs and a large envelope to W3USS, Capitol Hill ARC, Box 73, Senate Office Bldg., Washington DC 20510.

Christian Amateur Radio Fellowship

The Christian Amateur Radio Fellowship will hold a workshop at the North American Christian Convention to be held in Dallas TX July 8, 1971.

'71 DELTA QSO PARTY

All amateurs are invited to participate in the second annual Delta QSO Party which is sponsored by the Delta Division of the American Radio Relay League.

Contacts must take place from 2000 GMT Aug 28 to 0200 Aug 30. No time or power restrictions.

Amateurs outside the Delta Division will attempt to contact as many amateurs inside the Delta Division (ARK, LA, MISS, TENN) as possible. Delta Division amateurs will attempt to contact as many amateurs as possible both inside and outside of the Delta Division.

The exchange will consist of QSO Number, RST, and QTH (ARRL section for non-Delta Division, county and state for Delta Division). Logs must include date/time, station worked, exchange, band, emission, and multiplier. Stations may be worked on each band/mode. Mobiles may be reworked if they change counties.

For more info, write: Malcolm P. Keown W5RUB, 213 Moonmist, Vicksburg, Miss. 39180.

PENNSYLVANIA

The 34th annual hamfest of the South Hills Brass Pounders and Modulators will be held on August 1 from noon til dusk at St. Clair Beach, McMurray PA, 5 miles south of Mt. Lebanon on Rt. 19. Swap and shop, picnic space for the family, mobile check-in on 29.0 and 50.4. Information and preregistration at $1.50 per ticket ($2 at door) from Lou Cowan, 26 Graper St., Pittsburgh PA 15227).

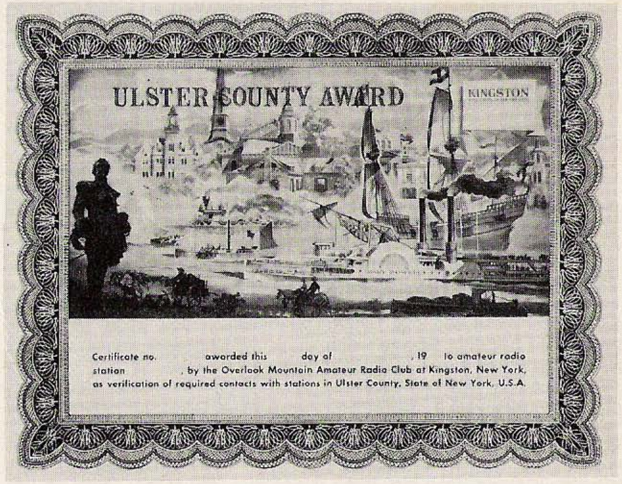
The Two Rivers Amateur Radio Club of McKeesport will conduct its seventh annual hamfest on Sunday, July 18. This event will be held at the Balkan grounds, Coulter Road, McKeesport, Pennsylvania. Our past ham-

WAS-AT AWARD

The Dayton Amateur Radio Association will sponsor a "worked all states-by amateur television" award to encourage and promote the latest mode of communication by amateur slow-scan television. A handsomely engraved plaque will be presented to the *first amateur* who completes 50 state two-way contacts by SSTV. At this time there may not be SSTV stations in all 50 states, but this novel means of communication is growing so rapidly that all states will soon be covered. In fact, a DX-ATV Centry Club (Worked 100 Countries) recognition is very possible within the next year.

The WAS-AT award will be made with adequate recognition and publicity to the various radio publications at the time of the presentation. The following rules are established for this DARA award:

1. Contacts must be made to all 50 states from the same transmitter location starting April 14, 1971.
2. Proof of the SSTV contact shall be a photograph taken of a readable received picture showing the contacted station's call letters or his symbol. In lieu of a photograph, a recorded tape (¼" audio) may be submitted, showing the received picture of the call letters or symbol.
3. A log shall also be submitted showing the station contacted, location, time and date, frequency used, and the type of video equipment of the contacted station. A statement shall accompany the log, stating that the contacts listed are in accordance with the regular station's log and that FCC rules have been complied with on all contacts.
4. Photos and recorded video tapes which are submitted, may be copied by the DARA for the record, but will be returned to the contestant after the award is made.



ULSTER COUNTY AWARD.

County Award. This certificate is issued by the Overlook Mountain Amateur Radio Club, Kingston, N.Y. for contacting amateur radio stations in Ulster County, New York. No time, mode or band limitations. DX stations (including KH6, KL7) must contact any two stations in Ulster County, N.Y., U.S. amateurs must contact three stations. Charge: 50 cents to W-K stations; 4 IRC's for DX stations. Send log data to Harold Twiss, WA2RXF, Country Lane, Lake Katrine, NY 12449.

in advance are $2; at door are $2.50. Children 5–12, 75¢. For raffles and tickets write to Eric Strassler WA2NLP, Ticket Chairman, 15 Crescent Ave., Passaic NJ 07055.

MASSACHUSETTS

The first Nobarc hamfest will be held August 22 at the Little Red Schoolhouse, Williamstown, Mass., 11:00 a.m. - 7:00 p.m. Activities include technical talks, demonstrations, transmitter hunts, YL demonstrations, family activities, flea market, and, displays. Talk-in on 146.94

MANITOBA B.C.

The eighth annual international hamfest will be held July 10 and 11 at the International Peace Garden. This hamfest is jointly aponsored by the Grand Forks, N.D. Amateur Radio Club and the Amateur Radio League of Manitoba, and is held annually in the beautiful Peace Gardens bordering North Dakota, U.S.A. and Manitoba, Canada. Activities include transmitter hunts, mobile displays, games, dancing, swap tables, prizes – fun for all with good camping facilities.

KELOWNA B.C.

The Penticton Civil Defense Ama-

Fred Basye (K5HOJ) is conducting the workshop entitled, "Ham Radio – Keeping Touch Around the World." CARF is also putting a station on the air during the convention July 6–9 with the sign K9IGB/5.

TEXAS

Swapfest & Picnic, Sunday, August 1, at the city park in Levelland, Texas. Sponsored by the Northwest Texas Emergency Net and the Hockley County Amateur Radio Club. This event is for the entire family. Bring your own picnic basket. Registration begins at 0930. Lunch at 1300. Caprock Repeater Club meeting at 1430. Mobile talk-in is the net frequencies: 3950, 146.94 FM, or through the Lubbock repeater on 146.34.

PENNSYLVANIA

The Foothills Radio Club, Inc. of Greensburg, Pennsylvania, will hold its fourth annual hamfest on July 11 at Wendel Ball Field, Wendel, Pa., 2.4 miles from the Irwin interchange of the Pa. turnpike. Over $600 in prizes plus 50/50 drawing. There will be check-ins on 10 and 6 meters. Refreshments at moderate prices and BINGO for the Ladies. Just follow the signs if you want to have fun in '71.

MICHIGAN

Cascades Amateur Radio Society announces its second annual swap-and-shop, Sunday, July 25, at the Jackson Armory, 100 Armory Court, Jackson, Michigan. Doors open at 8:00 a.m.; auction at 4:00 p.m. Donation: $1 in advance, $1.50 at the door. Table reservations are $1 ($1.50 for reserved table). Door prizes, free parking, many tables. Mobile talk-in on 146.94 FM and 3.915 MHz. For tickets, accommodations, or further information, contact Cascades ARS, Box 512, Jackson MI 49201.

fests have been very well attended by hams and others from several states.

OHIO

Mark Sept. 26 for the 1971 Cincinnati 34th Annual STAG hamfest, the one big STAG amateur radio event of the year. Meet all of your friends here. The event will be held at Stricker's Grove, Compton Road, Mt. Healthy, Cincinnati, Ohio. Door prizes each hour, raffle, lots of food, flea market, model aircraft flying, and contests. Identify "Mr. Hamfest" and win prize. $5 cost covers everything. For further details, contact John Bruning W8DSR, 6307 Fairhurst Ave., Cincinnati OH 45213.

INDIANA

This year the Original FM Hamfest is slated for the first Sunday in August, and it will be held rain or shine, according to members of the Fort Wayne Repeater Association, sponsors of the annual affair. The hamfest is to be held adjacent to Crooked Lake, where plenty of campsites and a nice park are available. A flea market is on the schedule, so load up the family and take your goodies with you. Head for Steuben Co. 4H fairgrounds – take 169, and go 3 miles south of the Indiana Tollway (Hwy 80–90). First prize will be a Regency HR-2 2m FM transceiver. Registration is only $1.50 per amateur, which includes a ticket for the main prize drawing. Talk-in frequencies: .34/.76 repeater, .46/.88 repeater, .94 direct, and 52.525 direct – all FM, of course.

Indiana Radio Club Council's annual picnic Sunday, July 11th, LaPorte County Fairgrounds, LaPorte, Indiana. Large flea market with reserved locations available for large exhibitors and vendors on the midway and main building. Mobile FM clinic. Prizes. Tech sessions. For flyer write: Dave Osborn K9BPV, Box 272, LaPorte IN 46350.

5. Logs, photos, and tape shall be sent to WAS-AT Award, Dayton Amateur Radio Association, P.O. Box 44, Dayton, Ohio 45401.

6. Any question of contact authenticity will be submitted to an impartial committee, the members of which are not in the contest. Such members will be selected from the various net control stations of the Saturday SSTV Net which operates on 14,230 kHz at 1900 GMT.

The contest has already started, so start recording those SSTV contacts now.

ILLINOIS

The 14th annual hamfest of the Six Meter Club of Chicago Inc. will be held Sunday August 1 at the picnic grove on U.S. 45, 1 mile north of U.S. 30, 5 miles south of U.S. 6, Frankfort IL. Food and drinks will be available. Swap-and-shop section provided. Advance registration $1.50, admission at the gate $2. For tickets and further information contact Al Bagdon K9YJQ, 7804 66th Place, Argo P.O., IL 60501. Talk-in frequencies will be on 50.40 MHz AM and 146.94 MHz FM.

NEW JERSEY

The Knight Raiders VHF Club, K2DEL, will hold its 5th annual hamfest at Westbrook Park, West Milford NJ on Sunday, Aug. 15. Manufacturers' displays, gigantic flea market, contests, auction, 2m transmitter hunt, FM session, Navy MARS meeting, and a good time for all. Main door prize is the Drake TR-22 wm FM transceiver; other door prizes also. Big raffle for the Drake ML-2 2m FM transceiver; raffles are 3 for $1 and are avaiable now. Free beer, swimming, picnic tables, and barbeque pits available. Refreshment stand on premises. Talk-in Station K2DEL/2 will operate on 50.425 MHz AM, 145.71 MHz AM, 146.94 MHz FM using Drake ML-2 transceiver, plus operation on local Navy MARS repeater. Follow signs to hamfest site from Route 23. Tickets MHz FM, 50.4 MHz AM, WA1KFZ repeater 146.04/146.91 output FM, or WA1KGO repeater (146.34/146.94). Admission: $2 advance registration; $3 at the door per ham; family, YLs, etc.: Free! For details and advance registration, contact: Charles Doran, 240 North St., Williamstown MA 01267.

MONTANA

The annual WIMU hamfest will be held at Mack's Inn, Idaho, 23 miles south of West Yellowstone, Montana on U.S. 191. The dates are August 6, 7, 8th. Pre-registration is $3.50 per person before July 24th. Mail pre-registrations to Owen H. Wood WA7IZR, 407 North Main, Livingston, Montana 59047. Registration at the hamfest will be $4 per person.

TEXAS

Texas VHF-FM Society.
Date: The weekend of Aug. 14.
Location: Cibola Inn, Box 1145, Arlington TX 76010. U.S. Highway 80 near Collins Ave. Approximately midway between Dallas and Fort Worth.
Host: North Texas Repeater Association (an association representing FM repeaters around Fort Worth and Dallas).
Saturday events: Equipment displays, technical sessions, hospitality room, registration, fashion show and luncheon, then trip to Six Flags Mall for XYL's (tentative), visit to Six Flags Over Texas, caucuses as required to prepare for business meeting Sunday.
Sunday events: Business meeting, door prizes, raffle.
Cost: No registration fee. Amateurs attending will pay own cost of lodging, meals, and entertainment. Refreshments in hospitality room free.
Raffle: Motorola HT-200 will be raffled. Motorola C & E is making the unit available at reduced price, Sentry Manufacturing Company is providing crystals free.

teur Radio Club is pleased to announce their sponsorship of the annual International Okanagan Hamfest in cooperation with the clubs in Kelowna, Vernon, and Kamloops. Motels, trailer, tenting and camping space are all available, as well as shower, washroom, laundry, small lake and pool with crystal water. There will be a giant auction, transmitter hunt, contests, and games for both young and old. Evening entertainment assured. A registration door prize and a big raffle prize. Admission for licensed OMs $3, YLs and XYLs $2; family ticket $5. Registration begins at 10:00 a.m. Saturday July 24. For further information contact Denny Warner VE7ASY, RR 4, Crawford Road, Kelowna, B.C. Canada.

FT. GEORGE AWARD

The Fort George Radio Amateur Club has made available an award certificate for all amateur radio stations making five contacts with any amateur station in the city of Prince George. These contacts are to be five *different* stations on any mode on any band. Logs should show date, time, mode and call of station worked and should be sent to: Fort George Radio Amateur Club, Box 835, Prince George, B.C., Canada.

CALI VI PAN-AMERICAN GAMES

All radio amateurs of America are invited to take part in the "CALI VI PAN-AMERICAN GAMES" contest. Only amateurs from the Pan-American countries are allowed to take part. Contacts are valid on the 15, 20, and 40m bands. The objective will be to contact as many stations as possible to get points:
Contacts with station HK5 CCP, 20 points
Contacts with station HK5 VD, 10 points.
Contacts with HK5 stations, 5 points.
Contacts with other stations, 2 points.

For further details write Liga Colombiana de Radioaficionados, Apt. 102, Cali, Colombia, S.A.

NEW PRODUCTS

ANTENNA NOISE BRIDGE

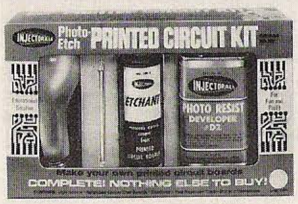
Higher frequency range amateur radio gear – including the popular 2m FM systems – can now be tested for resonant frequency and operation impedance with the Omega-t Systems Extended Range Antenna Noise Bridge. The unit combines precision and measurement flexibility normally found only in a collection of expensive laboratory equipment, according to Jack Finney, of Omega-t Systems. "We have previously developed a lower range antenna noise bridge, and now we are moving into high frequencies," he said. Able to be used over the entire range from 1 to 300 MHz, the bridge allows testing and tuning for optimum performance from an antenna and receiver without the use of additional equipment over the HF and VHF spectrum. It also replaces vswr bridges with a more accurate test system. *Omega-t Systems, 300 Terrace Village, Richardson TX 75080.*

QT-5 Continuous Tone Encoder

Alpha Electronic Services introduces the new QT-5 miniature solid-state subaudible continuous tone encoder, especially designed for use in the new amateur FM communications equipment. The unit provides an excellent, reliable method of repeater or multi-function control. The QT-5 is based on the same highly successful design concept used by Alpha for years

Now, with Injectorall's new No. 650 photo-etch PC kit, anyone, beginner or professional, can make professional printed circuits first time, every time. Injectorall's 650 is a completely packaged kit (nothing else to buy) using a photosensitive method for producing professional quality printed circuits. It can be used with assurance by engineers developing a prototype or a hobbyist constructing a home-lab project.

With Injectorall's Kit 650 you don't need a darkroom and you can completely eliminate commercially made boards. And if a magazine has a drawing you want to use, Kit 650 has materials included to let you make negatives from magazine circuits. Hobbyists and professionals alike have found it ideal for solid-state and integrated circuitry.



Kit 650 contains two photo-sensitized 3 x 4 in. copper-clad boards, a photographic test negative, and an ultraviolet light source. It also contains an exposure glass, clamps, developer, etchant, trays, resist remover, drill and complete instructions.

This low-cost easy way of making quality printed circuit boards is now available at all major distributors and retails for only $10.80.

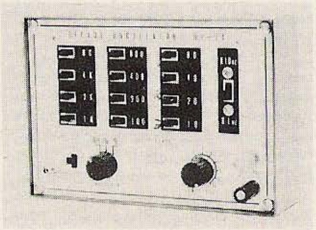
Hobbyist Tool Kit

A seven-piece hobbyists' tool kit – an ideal base upon which electronic hobbyists and kitbuilders can build

tor. The standard CM 41 series Tri-A-Lite is available with a choice of six different indicator colors and any long-life Chicago Miniature T-1 lamp. *Chicago Miniature, 4433 N. Ravenswood Ave., Chicago IL 60640.*

Miniature Sine/Square Wave Generator Gives High Accuracy at Low Cost

A miniature transistorized sine/square-wave generator, Model DF-24, is designed especially for exacting electronic work where high frequency accuracy is required, yet it is priced at only $65. Frequency range, in three bands, is 10 Hz to 166.5 kHz for sine wave . . . 20 Hz to 20.0 kHz for square wave. Frequency accuracy for sine and square wave is 1% + Hz, accured by the use of solid-state components and accurate calibration. Output signal amplitude is controlled by a variable attenuator with high resolution.



Weighing just over 2 lb, measuring 7 x 3 x 5 in. and requiring no external source of power, the unit may be used anywhere. Power is furnished by self-contained penlight batteries, giving low distortion and constant output . . . or, if desired, by any external 12V dc source. The unit is available from *Electronic Tools Division, C. H. Mitchell Co., 14614 Raymer St., Van Nuys CA 91405.*

NEW LITERATURE

SIGNETICS

Quantities of the popular "Applications Memos" handbook are once again available from Signetics, free for the asking. Containing approximately 400 pages, the 5½ x 7 in. paperback handbook contains an introduction to digital logic and discusses digital considerations by family, decoding and steering, counters, shift registers and memories, interface and display elements, linear considerations, timing circuits, and parallel data handling. All of these subjects are quite important to the electronic designer or amateur operator who may be unfamiliar with the ways in which integrated circuits may be used.

Furthermore, the experts who prepared the handbook at Signetics are available to answer your questions. Let them know if they can help you with information that might shed some light on integrated circuit technology.

TIME

TIME Corporation is offering a 12-page specification guide describing electronic laminates. The brochure is intended as an aid in specifying copper- or other metal-clad continuous-roll laminates for the printed circuit and flexible cable industry. In many cases these laminates are recognized as a major breakthrough in the printed circuit and flexible-cable industry because, for the first time, outstanding bonding agents such as epoxy adhesives and Teflon FEP, which ordinarily require long high temperature curing cycles, are continuously laminated.

Contact Vincent J. Sardo, TIME Corporation, Salem Industrial Park, Salem NH 03079, (603) 893-1661.

NATIONAL SEMICONDUCTOR

A new brochure describing Tri-State logic circuits is now available from National Semiconductor Corp. The 20 page document (TTL-5) describes the Tri-State logic circuit concept, its unusual characteristics and typical uses. Also included are descriptions and specifications for numerous Tri-State devices, including multiplexers, demultiplexers, flip-flops, line drivers, buffers, hexidecimal counter/latch, decade counter/latch and 256-bit read only memory. For a free copy, write to National Semiconductor, 2900 Semiconductor Drive, Santa Clara CA 95051, Attn: Marketing Services.

GC Electronics Catalog

A new general catalog has been published by GC Electronics (number FR-71-72) which lists over 14,000 products from all of the company's various operating divisions. The 312-page catalog includes complete listings for these GC divisions: GC Electronics, Walsco, Electrocraft, Magic Color, Telco, Audiotex and Calectro.

The catalog is the first totally new presentation of all its products turned out by GC Electronics in two years. It contains more than 1800 new items which the major American electronics manufacturer and distributor has added to its line in the intervening period.

GC Electronics product lines represented in the catalog include chemicals, servicing tools, printed circuit materials, servicing aids, automotive connectors and hardware, accessories, replacement parts, electronic hardware, replacement knobs and replacement antennas.

Under the "Walsco" trademark are chassis punches and a comprehensive grouping of replacement rubber belts, drives and pulleys for phonos and tape recorders. The "Electrocraft" line includes plugs and jacks, connectors, adapters, switches, cable clamps and ties. The "Magic Color" line consists

THIRD GENERATION OF MONOLITHIC OP AMPS

12th NEW JERSEY QSO PARTY AUGUST 21–22

The Englewood Amateur Radio Association, Inc., invites all amateurs world over to take part in the 12th New Jersey QSO Party.

RULES: (1) The time of the contest is from 1900 GMT Saturday August 21 to 0600 GMT Sunday August 22 and from 1200 GMT to 2300 GMT on Sunday August 22. (2) Phone and CW are considered the same contest. A station may be contacted once on each band – phone and CW are considered separate bands. New Jersey Stations may work other New Jersey stations. (3) General call is "CQ New Jersey" or "CQ NJ." New Jersey stations are requested to idnetify themselves by signing "DE NJ" on CW and "New Jersey calling" on phone. Suggested frequencies are: 1810, 3555, 3740, 3930, 7060, 7275, 14075, 14280, 21100, 21375, 28800 kHz, 50–50.5, 144–146 MHz. Suggest phone activity on the EVEN HOURS. (4) Exchanges consist of QSO number, RST, and QTH (ARRL Section or country). N.J. Stations will send county for their QTH. (5) Scoring: Out-of-state stations multiply number of complete contacts with New Jersey stations times the number of New Jersey counties worked (maximum of 21). New Jersey stations: W-K-VE-VO QSOs count as 1 point; DX stations count as 3 points. Multiply total number of points times the number of ARRL sections (including NNJ and SNJ – maximum of 74). KP4, KH6, KL7, KZ5 count both as 3 point DX contacts and as section multipliers. (6) Certificates will be awarded to the First place station in each N.J. county, ARRL section, and country. In addition, a second place certificate will be awarded when four or more logs are received. Novice and Technician certificates will also be awarded. (7) Logs must also show

Function Generator IC Produces Square Wave & Triangular Wave Simultaneously

A voltage-controlled oscillator of exceptional stability and linearity is now available in large quantities from stock for application in tone generators, frequency shift keying, frequency modulators, clock generators, signal generators, and function generators. This $6 integrated circuit is capable of performing all the operations of currently popular $300 function generators with equal precision and accuracy.

Designated the Signetics 566 function generator, the oscillator produces two outputs simultaneously: a highly accurate buffered square wave and a highly linear buffered triangular wave. Frequency is extremely stable (100 ppm/° C is typical).

Frequency of oscillation is determined by an external resistor, a capacitor, and the voltage applied to the control terminal. The oscillator can be programmed over a 10:1 frequency range by proper selection of the external resistance, and the device can be modulated over a 10:1 range with exceptional linearity by the control voltage.

'Jean' FG7XT Confirms 1st DXCC on RTTY

DX FOOTNOTES

This is Wolfgang Renner, YA1RG, and his new bride Hannelore. Wolfgang should be familiar to most DXers. He is, of course, one of the big guns in the famous Camel Drivers Radio Club in Afghanistan. From the photo, it should be understandable if Wolfgang is spending a little less time on the air.

One of the simpler ways to boost your countries worked total is to check into some of the DX nets currently active. At almost every check-in there are at least a few good ones ready to give you a new country. One net to look into is the Western Hemisphere Net on 7205 kHz at 0200 GMT. KP4CL is net control station.

For tougher DX there is the Arabian Net on Sautrdays at 1900 GMT on 14295 kHz. Some very rare Middle Eastern stations can be worked including JY, SU, and ST.

Those who are still looking for Swan Island (KS4) should be able to catch WA1ARF/KS4 on the YL-SSB net, 14332 kHz, on weekends. A

as close to 7085 kHz as possible and listens around 7215 kHz between 0330 and 0400 GMT. QSL cards with an SAE and IRCs should be sent to LA3UF.

At the present time, the only legal, genuine, guaranteed for real, operator in Cameroun is TJ1AW. Charlie is a good operator and a fast QSLer. Cards go to Charles Thompson, YAOUNDE, Department of State, Washington DC 20521. Charlie, incidentally, is a life subscriber to 73 – and this is just about a guarantee that he is going to be on the air for at least the next 85 years.

ZM7AG, Jim in Tokelaus, keeps on appearing around 0400 GMT on the low end 20 meter sideband. He is often greeted with huge pileups, but he is getting adept at rapid QSYs . . . so be cagey and do a lot of listening and tuning around when you hear him. The anecdote is getting around DX circles that King Hussein, JY1, made a schedule with Jim in order to bag a new country for His Majesty's countries total. Jim forgot to keep the schedule! Don't you wish you were that rare?

If you are more successful than JY1, you can QSL via the International DX Association (INDXA), Box 125, Simpsonville MD 21150. An SASE speeds things up immeasurably.

RECIPROCAL LICENSING WITH JAMAICA

The Jamaica Amateur Radio Association and the Jamaican government announced the granting of reciprocal licenses between Jamaica (6Y5) and the U.S. The agreement has been in force since the end of April and the Jamaican government is already processing reciprocal license applications.

MORE NEW LITERATURE

New Transistor Substitution Handbook

TRANSISTOR SUBSTITUTION HANDBOOK, 11th Edition, by Howard W. Sams Engineering Staff. Although bipolar transistors are noted for their low failure rate, some of them do have to be replaced. As long as the specific type number required is readily available, replacement of the transistor is no problem because a duplicate of the original should be used whenever possible. All too often, however, the exact replacement cannot be obtained without considerable delay. Furthermore, the great variety of types available make it diffiuclt to determine which transistor can be substituted for the original.

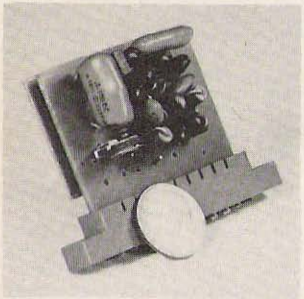
Production of the new 11th edition of this book is possible because of the ability of modern-day electronic computers to handle a large quantity of information in a relatively short length of time. The computer selected the substitutes in this handbook in much the same manner that an individual would select a transistor replacement. The electrical and physical parameters as shown in the manufacturer's published specifications for each bipolar transistor were given to the computer, and then each transistor was compared with all the others. Over one billion comparisons of data have been made in the preparation of this book.

The transistors which matched within given limits are listed as substitutions. Representative types of American, European, and Japanese manufacturers of general-purpose replacement transistors.

A second section contains additional information on general purpose replacement transistors: the manufacturer, the polarity (NPN or PNP), the material (germanium or silicon), and the recommended applications.

The information in this handbook can be used by everyone concerned throughout the commercial communications industry.

No mechanical reeds or relays are required and the frequency determining network is an integrated circuit, enhancing the long-term reliability and stability of the QT-5.



Available assembled and ready to install or in simple-to-build kit form, the unit will adopt to any FM transmitter, and a variety of installation instruction booklets have been prepared to make installation in specific radio models simple and fast.

Tone frequencies are available in a wide choice of standard EIA frequencies from 67.0 to 203.5 Hz or even special frequencies if desired.

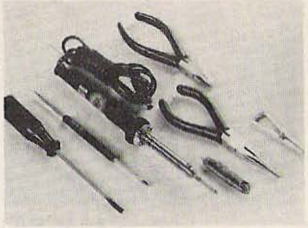
The QT-5 is fully compatible with Alpha's QT-10 decoder or any other standard subaudible tone decoder that meets EIA specification. Call or write *Alpha Electronic Services, 8431 Monroe Ave., Stanton CA 90680.*

PC Kit Aids Beginner or Professional

At one time building an electronics project was hard work for it involved drilling, cutting, reaming and deburring a metal chassis. Some of those early chassis weren't aluminum either, but steel; and so electronics construction meant sore muscles, cut and bleeding fingers, and frazzled nerves.

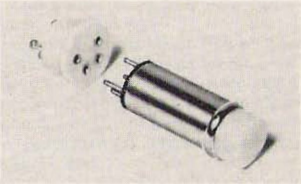
Injectorall Electronics Corp., Great Neck, N.Y. has taken the sweat out of electronics and put pleasure back in.

their tool needs – is a featured item in GC Electronics' new catalog.



The tool kit consists of long-nose and diagonal cutting pliers, screwdriver, soldering iron, soldering aid tool, heatsink tool, and a coil of rosin-core solder – the most-needed items for the hobbyists' tool chest.

Marketed through GC Electronics' Calectro Division, the tools are blister packed for store rack display. The kit is designated catalog number H3-378 and retails for $7.95. *GC Electronics, Div. of Hydrometals, Inc., 400 South Wyman St., Rockford IL 61101.*



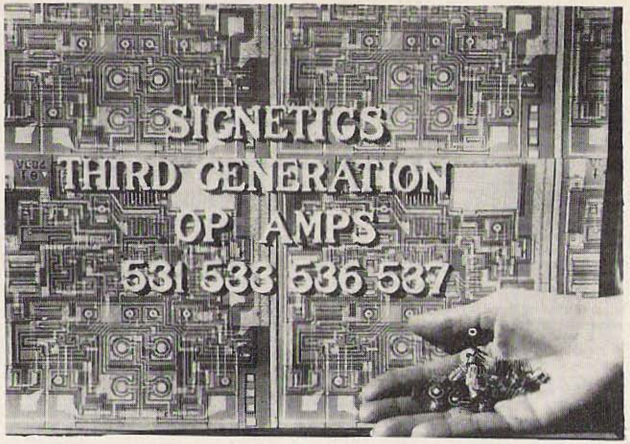
Three-In-One Indicator Lights

The CM 41 series Tri-A-Lite, an exclusive Chicago Miniature design, appears white in the off position and takes on color only when an input voltage is applied to one of its number-coded contacts.

By providing three different colors in a variable sequence, the Chicago Miniature CM 41 Tri-A-Lite takes the place of three separate indicators. The CM 41 Tri-A-Lite color sequence is variable with positioning of the mounting pin configuration, and can be predetermined by the user through coded pins and a companion connec-

of outdoor and indoor TV antennas of all types, couplers and splitters. Antenna installation hardware comprises the bulk of the "Telco" product line.

GC Electronics Division of Hydrometals, Inc., manufactures and distributes a full range of electronic parts, hardware, accessories, chemicals and supplies for service technicians, engineering labs, hobbyists, consumers and industry.



The electronic industry's "third generation" of operational amplifiers, a family of four new linear integrated circuits, has been developed by Signetics Corp. and is now available in quantity from stock. The announcement was made by Paul Kollar who is in charge of marketing the company's standard linear products.

"We define the 'third generation' as the next line of operational amplifiers that will solve specific problems without sacrificing performance, ease of use, or standard pin arrangements," Mr. Kollar said. "Our devices eliminate the major headaches usually associated with state-of-the-art op amps, and they achieve a new level of performance.

First Generation: 1964

The first generation of operational amplifiers was the 709, which appeared in 1964. It was the first useful linear integrated circuit, and it simplified many of the problems that engineers faced in designing analog systems.

Second Generation: 1968

The second generation of op amps appeared in 1968 in the form of the 101/741 devices. By providing input and output protection, simplified compensation, and better specifications, these newer devices eliminated the major problems that were associated with using the 709 op amps.

Since the introduction of the 101/741 devices, designers have tried to give operational amplifiers tighter specifications, but the new units were not easy to use. High slew rate operational amplifiers like the 715 achieved faster speeds, and low-power op amps like the 735 drew less current, but they sacrificed dc stability, ease of compensation, and output protection, the very features which made the 101/741 so popular.

Operational amplifiers with FET (Field-Effect Transistor) inputs, such as the 740, offered much promise but few performance guarantees. Input current specifications were not as good as those for existing low-offset precision op amps. Precision op amps like the 108 offered specifications that were attractive to designers, but they sacrificed intput protection, standard output drive, and offset null.

Third Generation: 1971

The third generation of op amps is being introduced with a family of four new devices: 1) the Signetics 537 precision op amp with extremely low input offset and bias currents, 2) the Signetics 536 general purpose, high performance op amp that uses a high-impedance field-effect transistor (FET) input stage, 3) the Signetics 533 high performance op amp which consumes only 100 microwatts of power at ±3V supplies, and 4) the Signetics 531 high slew rate op amp.

Precision "Punchthrough" Op Amp

"The Signetics 537 is a punch-through op amp, which has the same parameters as the LM108 and LM108A," Mr. Kollar said, "except that our 537 has a maximum differential input voltage of ±30V and the other two devices have a maximum differential input of only 1V. Such a low differential range severely limits the 108's usefulness and makes it susceptible to damage by transients. Why pay for ultraprecision but with no input protection and substandard output drive?"

With standard pinout compatible with the 101/741, the Signetics 537 is packaged in a 8-pin TO can.

"Our 536 is a FET-input op amp," Mr. Kollar said, "that does what op amp design experts said couldn't be done – that is, achieve offset voltages approaching those of general purpose devices and input currents comparable with hybrids. Specially selected 536 units can be supplied which will meet the 7.5V offset specified for the 101 and 748."

GMT date and time, band, and emission, and be received not later than September 18, 1971. The first contact for each claimed multiplier must be indicated and numbered and a checklist should be attached. Multioperator entries should be noted and calls of participating operators listed. Logs and comments should be sent to Englewood Amateur Radio Association, Inc., 303 Tenafly Road, Englewood, New Jersey 07631. A size #10 SASE should be included for results. (8) Stations planning active participation in New Jersey are requested to advise the EARA by August 7th of your intentions so that we may plan for full coverage from all counties.

NEBRASKA QSO PARTY

The Lincoln Amateur Radio Club Inc. of Lincoln, Nebraska announces the 1971 Nebraska QSO Party.

DATE – TIME:

Starts 0000 GMT Sept. 5

ENDS 2300 GMT Sept. 6

FREQUENCIES: 3560– 3982

7060– 7260

14060–14300

21060–21360

18060–28560

QSO EXCHANGE: Nebraska stations; give signal report and county. All other stations; give signal report and state.

SCORING: Nebraska stations; 2 points for each QSO, each mode. Multipliers are each state, each province, and each country. All other stations; 3 points for each QSO, each mode. Multipliers are each Nebr. county. Mobiles in a different county count as a separate QSO and multiplier.

BONUS SCORING

FOR ALL PARTICIPANTS!!!!!

The Lincoln Amateur Radio Club will be operating KQØNEB at the Nebr. State Fair from Sept. 1 to Sept 9. Any contact with KQØNEB during the fair week will count for points in the QSO party, regardless of whether it is during the QSO party. The scoring for working KQØNEB as follows: 10 points each contact, each mode. Also count as a separate multiplier. If KQØNEB is worked at least once on four separate bands, add 1000 points to total score.

Certificates will be issued to the high score in each Nebr. county, high score for each state, province, and DX country. Other certificates will be issued where deemed necessary by the Awards Committee.

To be considered for a certificate, all logs must be sent to the Awards Chairman, Michael Nickolaus, 4921 Tipperary Trail, Lincoln, Nebraska 68512, by October 15, 1971. Logs must be in GMT. Final score must be indicated on a summary sheet. Enclosed business size envelope S.A.S.E., for a copy of the results.

Jean Wegimont, FG7XT of Guadaloupe, became the first ham to make DXCC on RTTY. Jean has actually worked 110 countries, but it took WBØAAB on May 1, 1971, to send his QSL to make one hundred countries confirmed. Congratulations are in order for a real achievement in ham operating.

IOWA

The annual Iowa 75 meter phone net picnic will be held on Sunday, August 15, at Riverview Park in Marshalltown, Iowa. All amateurs are invited. There will be a swap table and nice prizes to be given away. The festivities will start with a potluck dinner at noon with the remainder of the festivities occurring Sunday afternoon.

NEVADA

The Annual Sierra hamfest will be held on Saturday, Aug. 14, at the California Bldg. in Idlewild Park, Reno, Nevada.

particularly good time to look for him is 0130 to 0200 GMT on Fridays. On Saturdays try the same frequency from 2100 GMT onward. This should be a good catch for those who still don't have their Advanced tickets. All QSLs for WA1ARF/KS4 should go to WA6MWG.

MP4MBB in Muscat has a new beam which is reportedly helping him put in a much stronger signal into the U.S. He can generally be found Wednesdays at 2330 GMT on 14218 kHz.

Skepticism is accompanying the appearance of 1A1A. However, those who did not work KD3UMP and C21AA thinking they were bogus, are now among the supporters of Gus, W4BPD, when he says to "Work 'em first and ask questions later."

Italian stations are now using the new prefixes. Italian stations can use the first digit in the Italian version of the Zip Code in their prefix. The only problem being with the area in Northern Italy whose delivery unit begins with "1". In the Piedmont area they can use IP1. Also some of the islands can use special prefixes with Sardinia becoming ISØ and Sicily IT9. There are also other island prefixes running from 1A5 to 1MØ. During the weekends in May you may run across 1BØKDB operating on the band edge on twenty SSB. QSL for this one to Box 143, Palermo, Sicily.

Due to civil strife all ham activity in Ceylon (4S7) has been stopped and the government is reported to have confiscated all ham gear for "safekeeping."

UJ8AC, Tadzhik, is often found on Saturdays between 0200 and 0400 GMT above 14200 kHz.

CR3DN should be on the air now from Portuguese Guinea where he is stationed for the next two years. QSLs should be directed to CT1BH.

TA3AC, Turkey, looks for U.S. stations on 80 and 40. He transmits as close to 3780 kHz as QRM allows and listens on 3805 kHz between 0400 and 0500 GMT. On 40, he transmits

QSL INFORMATION FROM THE W2NSD/1 DX HIDEAWAY

Cards for ZF1WF and 7Q7AA are now being handled by K4CDZ. QSLs for KG6SW go to W7YBX, for VK9FH to WØKHI, and for WA8FPN/KS6 to WA6BKS. The latest QTH we have for HS3AFB is Box 4954, APO San Francisco CA 96288. YB3AAY can be QSLed to Jess Marino, U.S. Embassy, Surabaya, APO San Francisco CA 96356. Cards for KB6CT go to the Federal Electric Corp., APO San Francisco CA 96401. F9MS is QSL manager for FR7ZU/E, /G, and /T. He requests a self-addressed envelope and 3 IRCs.

Jim Vaughan, K4TXJ, has written to 73 to say that he has become QSL manager for Jack, ZS3KC, in Swakopmund, Southwest Africa. Jim's QTH is 5504 Datura Lane, Louisville KY 40258. The usual SASE would be appreciated.

You can QSL Sam, MP4TDM in the Shaikdom of Ras Al Khaimah, through K2DRN, Vernon Damerson, 265 Davis Rd, Beford MA 01730. A SASE is essential for U.S. stations and a SAE and IRCs is essential for DX ops who want the MP4TDM card.

Those who worked Kevin, ZK1BM, while he was on Cook Island, should send their cards to W7VRO.

KW6HA cards should go to Gary Davey, 349 Sanford St., Leucadia CA 92024.

Anybody with information on DX operations, QSL managers, or the like, is invited to send it in to 73. Anybody who sends in a good picture of any DX operation which we eventually publish gets a free year of 73 (it could be worse, it could be two years). Just send in your comments and photos to DX FOOTNOTES, 73 Magazine, Peterborough NH 03458.

with transistor replacment – be it in industrial, commercial, or home-entertainment devices.

TRANSISTOR SUBSTITUTION HANDBOOK, 11th Edition, Catalog No. 20835. Size: 160 pages; 5½" x 8½", softbound. List Price: $2.25 ($2.85 in Canada).

Allied/Radio Shack Catalog

Described as the "first and only catalog of its kind," Allied Radio Shack's new Spring/Summer 1971 Electronic Parts, Accessories and Kits Catalog No. 212 is a handy buying guide for the builder, hobbyist, fix-it man, experimenter, or anyone wanting a full selection of electronic parts, accessories, maintenance items and kits.

The 116-page catalog includes thousands of hard-to-find or specialized items like tubes, transistors, cables, tools, connectors, wire, plugs, adapters, antennas and test equipment. It also lists many exclusive products, and previews Allied Radio Shack's line of Knight-Kits and Science Fair kits for 1972.

Catalog 212 is available free on request from Allied Radio Shack, 2725 W. Seventh St., Fort Worth TX 76107.

Allied Radio Shack, a Tandy Corporation Company (NYSE), is the world's largest chain of consumer electronics stores. The company has more than 950 stores in 49 states.

"KA NET" CHANGES

Tokyo, Japan . . . The Far East Auxiliary Radio Leage (FEARL) has announced a frequency and time change for the "KA Net." Beginning in July, the net will meet twice each Sunday at 0001 GMT and again at 1200 GMT. The net frequency will change to 14.300 MHz. Net call will remain, "CQ Ka Net."

FEARL, sponsor of the "KANet," is composed of amateur radio licensees assigned to United States Forces, Japan.

LETTERS

Old Ads

Enjoyed the 50-year old ads on p. 97 this month. Hope you'll run more of them.

Ron Wyllys
465 Caromar Dr.
Madison WI 53711

Excellent idea on the 50 year old ads – would like to see more of them.

Joseph F. Dineen W1JSS
9 Winter Terrace
Westwood MA 02090

Russia

I was just on a trip to Moscow and Leningrad. Couldn't locate a single Societ ham! My guide didn't even know what I was talking about. Any suggestions in case of future trips??

Lee Barnes
132 Starlite Drive
San Mateo CA 94402

Drop a note to Box 88, Moscow and tell them you plan to be there . . . and watch for the Red carpet.

. . . Wayne

Two Points

Two subjects:

Referring to the first question on page 80 of May 73 Magazine (Questions, Questions), the answer given states that FM has worse signal-to-noise ratio characteristics than AM or SSB. This may or may not be the case depending on the basis of comparison. This is clearly pointed out in an article that appeared in Vol. 3, #5 of FM Magazine entitled *How Does FM Stack Up?*, and in standard textbooks on communication theory (for example see Chapters 5 & 6 of "Communication Theory: Transmission of Waveforms and Digital Information," by D. J. Sakrison). Both the FM article and confirming the accuracy of my forecasts.

John Nelson

Beginner

I have been buying 73 for the past four months and I like it a lot. I am trying to decide whether to subscribe or not. I would subscribe in a minute if I could be sure that there would be something for the beginner in each issue. Sure, the first thing I'll do when I get my General is to get on 2 meter FM and all, but right now all I'm interested in is getting my Novice. 73 is my favorite magazine but I get no help from it right now. I am 15, just starting out in radio, and sure need all the help I can get. Thanks a lot.

Mike Lonas
1020 Karenwood Dr.
Maryville TN

We've got some excellent series slated and plenty of good beginner articles in the works. Keep reading!

. . . Ken

No Study Course

Just a note to inquire why the General Class License Study Guide did not appear in the April issue? If it was there, I could not find it. In 7 articles, you have covered 28 of the 52 questions in the FCC list. Please keep up the good work.

F. C. Van Widden WA5FF3 (Tech.)
607 E. Oklahoma St.
Weatherford OK 73096

April was FM month. The General series is back now, though.

. . . Ken

Outmoded

Shades of the U.S. Army and my many years of operating FM with and without repeaters. I was rather disappointed in the magazine when it was discovered that it exalted an archaic means of communication. When I received my last discharge from the Army I hoped that I would never again have to use, read or listen to this dated mode again. To have a magazine

Caveat Emptor?

Price — $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agencydiscount. Include your check with order.

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We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

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6 METER FM (postpaid): RT-176/PRC-10 transceiver, $30; RT-70/GRC transceiver, $30. Also T-150, $40; 300 watt gasoline AC generator, $32.50. WB4GEW, CPO 2183, Berea KY 40403.

REALISTIC TRANSMITTER BARGAINS: Johnson Valiants $89; Johnson Factory Wired Valiant with Johnson SSB Adaptor $189; Many More. Get Complete Listing. Stan Burghardt WØIT, Box 73, Watertown SD 57201.

MILITARY SURPLUS. 12PDT 24V dual 400 ohm coil, relay 95¢. Silicon dielectric grease 8 oz. tube, $1.45. 10 pound surplus assortment, $4.00. All new and postpaid USA. Catalog on request. Electronic Systems. P.O. Box 206, New Egypt NJ 08533.

MECHANICAL FILTERS: 455 Khz Center Frequency. 2.1 Khz. $18.95. 300 Hz $22.95. J.A. Fredricks, 314 South 13th Avenue, Yakima WA 98902.

SWAN 270 with Swantenna, Shure 404C mike. Year old. $390.00, you pay postage. WN6OOK, 409 Beverly Drive, Redlands CA 92373.

MOTOROLA X53GTV-10, 4 xmit, 2 rcve, $100. 2 GE high band, MA36W – 4 xmit, 3 rcve – MA/E36B, 4 xmit, 4 rcve, $110. Ca. All accessories except ovens. You pay shipping. R. Eckton, 1021 W. Cedar, Redlands CA 92373.

DUAL-GATE MOSFET 2-METER PREAMP. PC construction, 18 db gain, 3 db NF typ. Fully wired and guaranteed, only $13.95 ppd in U.S. Mich. res. 4% sales tax. HALE ELECTRONICS, 803 17th St., Bay City MI 48706.

73 MAGS OCT 1960 THRU DEC 1969 National 2 Meter FM BASE RX & TX BEST Offer. W3YB, 580 Durham Rd., Penndel PA 19047.

RD-112 CW INKING RECORDER. 0–350WPM. Uses standard 3/8" tape. 115v–60Hz. Great for making visual copy of CW. Used Good $125. – TV-10B Tube Tester $65.00. Mike Tewksbury, Box 8324, Norfolk VA 23503.

VHF SELLOUT: Ameco TX 62 $89; Gonset GC105 $69; Johnson 6N2 Transmitter $69; Swan 250C/TV2B/117CX $549; Swan TV2B New $229. More Items. Get Complete Listing. Stan Burghardt WØIT, Box 73, Watertown SD 57201.

MANUALS – $6.50 each: R-390/URR, SP-600JX, CV-591A/URR, URM-25D, LM-21, URT-7, BC-639A, UPM-45, UPN-12, FR-5/U, FR-38/U, BC-779B, OS-8C/U, ARR-7. S. Consalvo, 4905 Roanne Drive, Washington DC 20021.

TRADE: GT550, AC supply, vox, calibrator. Perfect condition. Interested in T4XB or SB220 or best cash offer. Jim Fleming, 7528 Brynmawr, Chicago IL 60631. 775-8179.

WEST COAST HAMS buy their gear from Amrad Supply Inc. Send for flyer. 1025 Harrison St., Oakland CA 94607, 451-7755, area code 415.

SELL: 73 Magazine $1.00 per year. Hoehner Melodica w/music $5.00. Greystone 20 volume Encyclopedia of Photography. (Cost $80) $20.00. Koss Pro 4A headphones $15.00. Stephen Clifton WA2TYF, 800 W. End Ave., New York NY 10025.

NEW SIGNAL-ONE, CX7, unopened carton, warranty, latest model. Sell/trade, want Collins, Drake. Don Payne, K4ID, Box 525, Springfield TN 37172. Days (615) 384-5573, nights (615) 384-5643.

SELLING OUT WAREHOUSE full of teletype and facsimile machines, parts and equipment. Loads of electronics. No fair, reasonable offer refused. Weekdays 10–4, Saturdays & Sundays by appointment. C. G. Goodman Co., 5826 S. Western Ave., Chicago IL 60636. Phone 312-GR-6-8200.

FM HAMFEST SUNDAY AUGUST 1, NEAR ANGOLA, INDIANA. Big prizes, free flea market, entertainment for the ladies and kids. Picnic grounds campsites, boating, food, soft drinks available, rain or shine. Call in Freq. 146.34/146.76, 146.94, 52.525. For information contact Fort Wayne Repeater Assn., Box 6022, Fort Wayne IN 46806.

CRYSTALS for Regency, Varitronics, Drake, & Galaxy transceivers and for police monitors. Receive – $4.50 postpaid; Transmit – prices vary – write. One week delivery. Derrick Electronics, Box 457, Broken Arrow OK 74012.

CINCY STAG HAMFEST: Attention hams; Mark this date, Sept. 26, for the 1971 Cincinnati 34th Annual STAG Hamfest, the one big STAG Amateur Radio event of the '71 year. Meet all of your friends here. More details later. W8DSR, Hamfest Secretary.

FOR SALE: Gonset sidewinder–2 mtr. SSB, CW & AM transceiver with a.c. power supply, & manual. Excellent condition. $195.00. Gonset d.c. supply (new) $50.00. W1VYB the text point out that FM has better signal-to-noise characteristics than AM or SSB when the bandwidth of the FM signal is increased. The improvement in S/N of FM over SSB is proportional to roughly the FM bandwidth squared. The FM Magazine article states that in comparing a 15 kHz deviation FM signal with either AM or SSB, the transmitting power being equal, FM is clearly better by a significant margin (27.6 dB difference in S/N provided that the FM signal is above threshold).

I will be set up shortly to operate FM on the 80–10 meter bands. Admittedly, I will have to limit the bandwidth to comply with FCC rules and therefore can't take full advantage of the capabilities of FM. I am looking for stations that desire to experiment with FM on these bands to see what the effect of QRM etc. is. If anyone is interested in participating in such experiments, I would appreciate a letter from them.

H. Stanley Staten WA7IKJ/NØPWS
545 University Village
Salt Lake City UT 84108

Those of us who have used narrowband FM on the lower bands in years gone by found that the major problem with it was the lack of FM detectors on receivers. FM does not stack up with AM and SSB when slope detection is used. Since there seems to be no prospect whatever of getting FM detectors built into amateur lowband receivers, there is little prospect for successful use of NBFM on these bands.

. . . Wayne

DX Forecasts

The May issue of 73 has a letter from Bill Peterson K9OWQ saying that I used to forecast VHF-DX but do not do it anymore. He wants to know how come. It is true, I used to forecast VHF-DX but I quit because I did not have proper data to use for research purposes and I had no way of that calls itself a ham magazine devote so much of its effort to FM puzzles me. Why not rename it *FM, a magazine dedicated to the elimination of tuning controls,* or *The Senior Citizens Band FM Journal – a magazine dedicated to channelized communications.*

Joe Wimmer W6RPX

Because there are probably already magazines using those names.

. . . Ken

Encroachment

In the past year the Raritan Bay Radio Amateurs (R.B.R.A.) have been approached and asked if 146.460 MHz can be used as a repeater input channel. The R.B.R.A. has been on .460 for 15 years with 24-hour monitoring by club members. Could you publish the fact that 146.460 is active in the Sayreville, New Jersey area.

Mark Dzuban WB2IRX
329 Lee Ave.
New Brunswick NJ 08902

We'll publish the info, but we suggest you get your net to go over to FM. Stay on 146.46 and use the repeater for check-in. You'll be using the frequency you want in the mode for which it has been adopted as a national channel. Nobody loses!

. . . Ken

Stolen Rig

I would really appreciate it if you would print the following information: Somebody stole my Heathkit HX-30 6 meter sideband exciter (serial no. 6233), a Dow-Key DK-60 relay and a Turner SSB+2 mike. The sideband exciter is the piece of equipment which is most easy to spot because of the serial number but maybe the guy who ripped it off from me will also try to fence the mike and the relay at the same time.

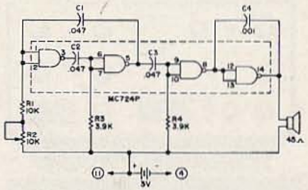
At least they didn't steal my back issues of 73. Those are irreplaceable, y'know.

Any information concerning the stuff should be sent to me (WA1IVB) or the Stoughton (Mass.) Police.

Norman B. Blake WA1IVB
23 Oriole Rd.
Stoughton MA 02072

IC "8-Transistor" Oscillator

I had some trouble building the code oscillator (Sessions, March 1971); keying was unreliable. I made some changes, and the overall operation was improved. Operation was made a great deal more reliable and keying is very consistent. Here is my modification:



Stan
5204 Penelope Lane
Knoxville TN 37918

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VHF ANTENNAS This handbook is a complete collection of up-to-date information about VHF and UHF antennas, with design hints, construction and theory. If you've been wondering what array you need, this book will give you enough background to make the right decision.
1003 . . . . $3

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1005 . . . . $3

73 USEFUL TRANSISTOR CIRCUITS If you've been looking for a transistor circuit to do a special job, chances are there is a circuit in this book that will give you a head start. It covers circuits for audio, receivers, transmitters and test equipment.
1006 . . . . $1

SIMPLIFIED MATH Does math scare you? It shouldn't. This easy-to-understand book explains the simplified exponential system of arithmetic, simple formulas, logarithms, and their application to the ham shack.
1007 . . . . $50¢

1004 1006

AMATEUR TEST AND MEASUREMENTS By W5REZ. Using VOM, Scope VTVM, dipper, SWR bridges, etc. Covers amateur users of test equipment in the ham station. 208 pages, softbound. Interestingly written, covers tuning receivers, all kinds of transmitters, etc. Invaluable for every hamshack.
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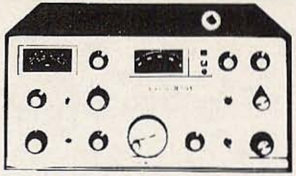
ELECTRONICS FOR THE AMATEUR By W5REZ. Hardbound book, 272 pages. Covers entire theory needed for passing amateur licenses. Fine book for instructors, and for amateurs wanting a refresher course before exposing themselves to the FCC examiners. Hardbook books look nice and last.
1013 . . . . $7.95

NCX-1000



NATIONAL NCX-1000 TRANSCEIVER Transistorized transceiver (except for driver and final) runs 1000 watts, yet is just a bit larger than ordinary transceiver! Complete kilowatt ham station in one small, light unit. Tested by 73 staff and found to be a really great unit. The world of transistors and ICs makes it possible to have a complete kilowatt all band ham station in one small unit! Not much larger than normal transceiver yet runs solid 1000 watts. Extremely sensitive, processed speech for maximum umphs when wanted, everything you need in one little package. Only tubes are driver and final. The NCX-1000 lists for $1100 and is an unusual bargain at that price. The 73 test unit, used a few days and under brand new factory warranty, is available to the first $700 check received.

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W2NSD/1

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LAPEL BADGES Name and call identifies you at club meetings, hamfests, busted pot parties. Hand engraved by skilled New Hampshire craftsman with loving care. Only one lousy dollar. Send first name and call.
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1208 . . . . only $10
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We have a few of these in stock and when they are gone, that's it!

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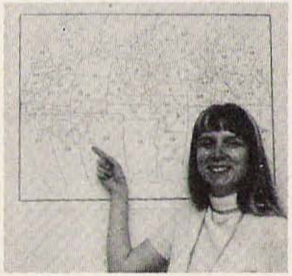
CUSTOM MADE DX CHARTS When you need a DX bearing you need it immediately. You don't want to have to look it up on a map or fiddle with a globe. These Custom DX Charts are computer printouts for your exact shack location and give the bearing and mileage for every country in the world. They are printed out by call prefix for speed of location and the capital city is indicated.
Custom DX Chart, 1206ppd $4



FABULOUS DX MAP OF THE WORLD Show visitors DX you've worked. Wall sized (23" x 31"); shipped flat in mailing tube; suitable for framing; most complete map available; up-to-date world prefixes shown; color in countries as worked; shows islands, reefs, rare DX spots; use colored map pins for different bands.
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DX HANDBOOK Includes giant world country-zone wall map. Articles on QSL design secrets, winning DX contests, DXCC rules, DXpeditions, reciprocal licensing and many more. World postage rates, WAZ record lists, time charts, propagation, etc. Special ham maps and bearing charts. A must for the DXer.
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FM BOOKS

FM ANTHOLOGY Vol. 1. This book is largely a collection from FM Bulletin, edited by K6MVH and WA8UTB. The material is taken from the editions of February 1967 through February 1968.
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FM REPEATER HANDBOOK K6MVH. Book is required for all repeater operators and must reading for all FM'ers. Only complete book on the subject. It is also one of the best selling books in amateur radio today.
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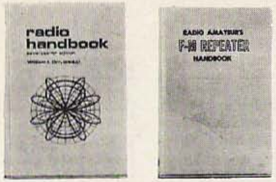
"THE BEST OF FM" A huge selection of FM Journal's finest technical and conversion articles, never before reprinted in any other magainze. The concluding segments of those controversial "CHRONICLES"! Selected FM editorials to show a broad view of the problems faced by FM'ers. This book comprises Volume II of the FM anthology, and includes an "Editor's Choice" selection of topflight articles from FM Journal, from March 1968 to May 1969.
1011 . . . . $4.95



1019 *1010*

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SCHEMATICS AVAILABLE $1 each.
1101. ARR-15 from June 1965 73, page 78.
1102. ARC-27 2M Guard Channel Receiver.
1103. SSB Transeiver, Nov. 1961 73 Page 23.

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GUNSMOKE? Blow your mind on our back issue bargain bunch, 30 (count 'em) assorted (we hope) back issues, all before 1968, for the incredibly low price of $6 postpaid (hardly pays for the postage). These are packed by slave labor (to cut costs) so please ignore notes calling for help, etc., that may be slipped into the bundles.
1204 . . . . $6

SPECIAL! RARE BACK ISSUES The back issue of 73 you need to complete your full set — or that has the continued article you only read the end of — can be yours for a mere pittance! Most issues are in stock and are available for $1 each. The exceptions that prove the rule are listed below:
Dec.68, Nov.69, Feb.70, Oct. 70. . . . . $2
Jan.65, Apr.65, Jan.66, Jan. 67. . . . . $3
Jan.61, Dec.63, Jun.66, Jul. 66. . . . . $100

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DESK CALL PLATE Up to 20 letters on a desk plate, embossed white letters on walnut background; ebony stand. Looks great on rig with your name and call. Watch envy race through your neighborhood. Send along 20 well chosen letters (spaces count as letters too), include a nice fresh two dollar bill, and give us a strong hint on where to mail the exquisite piece of craftsmanship.
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An IC Audio Processor

To write about another type of speech compressor and still, yet, to call it an "ultimate" type may seem a bit overdone at a time when speech compressor circuits of every variety are commonplace. But the unit to be described is by no means just another garden-variety speech compressor.

The phrase "audio processor" as used in the title, may, on the other hand, seem a bit nondefinitive, but it has been used to indicate that the unit provides a far more useful function than just speech compression alone. In fact, it is meant to convey the idea that it has processed a speech waveform on an af basis to such a degree that the waveform is the best possible to be fed to a transmitter for full modulation.

The unit makes use of two ICs – an SL630 amplifier and an SL620* automatic gain control unit. The two ICs were designed to mate together for a speech processing function and, therefore, should be used together even if one is tempted to replace the relatively simple amplifier IC by another type of IC.

The complete schematic of the unit is shown in Fig. 1. The unit is designed for both a low impedance input and output and a matching transformer is necessary for use with a high-impedance microphone. Usually, no transformer is needed on the output even if it is connected to a high-impedance audio input on a transmitter because of the amplitude of the output voltage. The input provides either for a

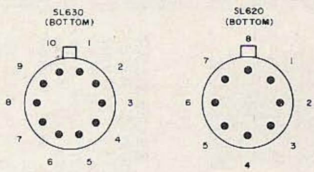
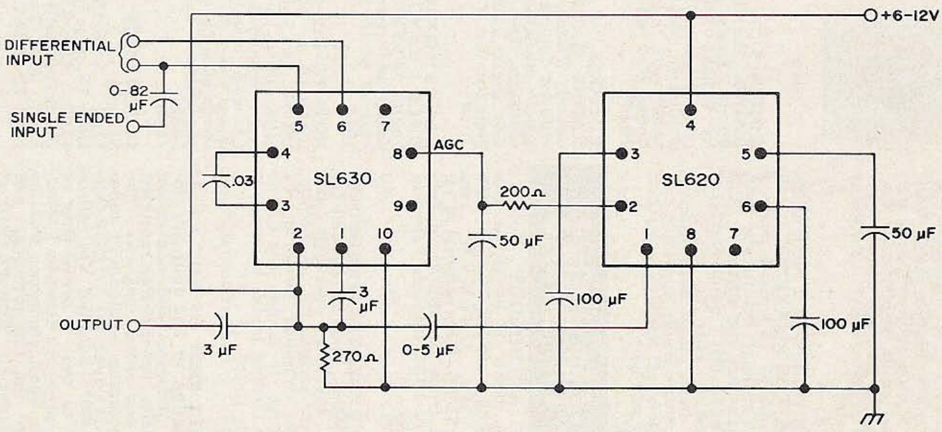


Fig. 1. Complete schematic of the IC audio processor.



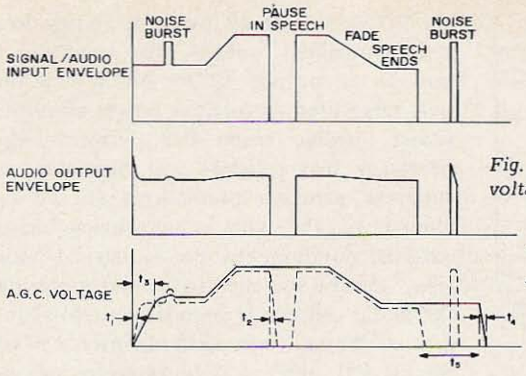


Fig. 2. Illustration of the input/output and agc voltage characteristic of the processor.

balanced or an unbalanced type of microphone input. The former can be quite useful since by having both microphone leads ungrounded, many problems with noise pickup, rf pickup, etc. on the microphone leads are automatically avoided. If the usual type of unbalanced input is used, however, it is connected to pin 5 of the SL630 via a 1 μF capacitor. Pin 6 is then left unconnected. The capacitor between pins 3 and 4 of the SL630 provides a high-frequency rolloff characteristic. The values shown provide a rolloff starting at 3 kHz, but this can be changed, if desired, by experimenting with the capacitor value.

The output is taken from pin 1 of the SL630 via the two 3 μF coupling capacitors. Part of this output is coupled to pin 1 of the SL620 IC via the 0.5 μF capacitor. The SL620 IC uses this voltage to generate an agc voltage which is eventually available at pin 2 of the SL620. From there it is coupled to pin 8 of the SL630 to control the gain of the latter IC. What these two little ICs can accomplish is shown nicely by Fig. 2. The upper curve shows a varying speech input, while the second curve shows how the audio output appears after processing. Notice that when the speech input either rises rapdily or falls rapidly the output remains essentially constant. Noise bursts, because of their much shorter time duration, are recognized separately by the unit. The noise burst shown occurring during speech, although much higher in amplitude than the speech level, produces practically no increase in output. An automatic squelch feature is also provided. When there is a pause in speech, the output is disabled to prevent the background noise buildup common to most simple compressors. The pause time before the output is disabled is about 1 second and can be changed, if desired, by varying the value of the capacitor from pin 6 of the SL620 to ground.

The control range of the unit is illustrated by Fig. 3. Only a very slight change in agc voltage is necessary to control the output over a 60 dB range. In practice, the input can change over a 35 dB range and the output level will remain between 70 and 87 mV.

Construction

The photograph shows how the author constructed a unit on perforated board stock. The parts layout is in no way critical and is just a matter of convenience. The photograph of the underside of the board is just shown to illustrate how easily the unit could be adapted for etched PC board construction as a club project since only one wire crossover is necessary and even that can probably be eliminated by experimenting with the parts layout.

The units will operate equally well with a 6 or 12V dc supply and draw up to about 15 mA. The operating voltage can be borrowed from a well filtered point in a transmitter or a battery supply used. In the latter case, a usual 9V battery is ideal to use. There are no controls to the unit and so it may be housed easily inside a transmitter, avoiding only any location near high rf fields.

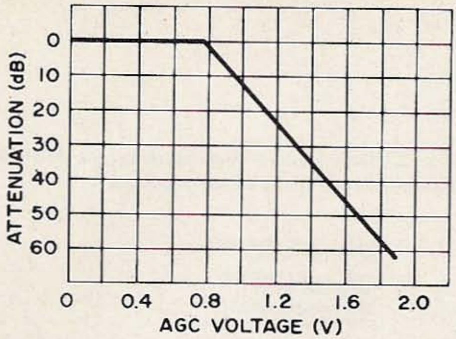


Fig. 3. Control range of the unit excees 60 dB. The graph illustrates the control of the input signal by the SL630 with agc voltage supplied by the SL620.

Operating Results

I compared operation of the unit to several types of conventional audio compressors. In every case, the unit described exhibited a much smoother compression action without pops, clicks, etc. It simply sounded more like the type of quality speech processing found on commercial circuits rather than the usual harsh, noisy compressor type action, which usually has to be disabled for local contacts because the inherent distortion then becomes so noticeable. The squelch and noise immunity features added also a great deal to the cleanliness of the speech output and should be particularly useful in a mobile type situation where a great deal of extraneous background noise can exist.

The IC Internals

The circuitry of the SL630 audio amplifier is not too different from that of many IC audio amplifiers, except that it includes provision for agc control of its output over a wide range. The input is coupled to a differential amplifier directly without the use of coupling capacitors for a balanced input. The agc voltage (pin 8) controls the emitter current flow return for the differential amplifier via the transistor whose base goes to pin 8 and a 3.6 kΩ resistor. The 750Ω resistor between base and collector acts as a "linearizing" element to give the smooth control range shown in Fig. 3. The rest of the unit continues to provide amplification (40 dB overall), ending in a series-connected output pair, which can provide an output up to 250 mW if the unit were used as solely a power amplifier device. Unlike many ICS, however, the necessary bias resistors and capacitors to suppress parasitic oscillations are all included in the unit, thus saving many external components. Pin 7, marked "muting," can be switched to ground to disable the audio output. If manual control of the gain of the unit were desired (instead of by the SL620 unit), a potentiometer can be connected between pins 9 and 2 with the wiper arm going to pin 8.

The circuitry of the SL620 unit, on the other hand, is quite different than most ICs because of its specialized functions. T1 through T4 are the input af amplifiers. The af output is coupled to a dc output amplifier (T16-T19) by means of two detectors (T14 and T15). T14 in conjunction with C1 has a short rise and fall time constant. T15 in conjunction with C2 has a long rise and fall time constant. Thus, any input signal will rapidly initiate agc action via T14 (in 20 ms), but after a longer time (200 ms) T15 takes over to control the agc. The effect is rapid initial agc response but not false agc response to sudden peaks after the speech input has started. T6–T8 form a trigger circuit which detects sudden peak inputs above 4 mV, such as noise bursts. When such a burst occurs during a pause in input it prevents via T10 and T13 the output from being turned on.

T9 in conjunction with C3 forms a sort of memory circuit having a time constant of about 1 second. So long as a speech input is present, it does not act but during a pause exceeding one second, C3 discharges to turn on T12 via T11 and turn off the audio output of the SL630/SL620 combination. The capacitors mentioned above for the various time constants, C1, C2, and C3, are external to the IC and their value can be experimentally changed to suit individual preferences.

W2EEY■

**If units are not available locally, write to Plessey Microelectronics, 170 Finn Street, Farmingdale, L.I., NY for location of nearest distributor.*

Parker R. Cope W3SGV
President, SCAN, INC.
15 Oak Knoll Road
Cockeysville MD 21030

AUDIO SIGNAL GENERATOR

An audio signal generator is a handy item when checking audio gear, and an af oscillator is a lot more consistent than whistling into the mike – especially if you're snacking on peanut butter sandwiches. The oscillator described here is the answer. It's inexpensive, simple, and can operate from subaudio to rf.

The oscillator basically is a modified Wien bridge using complementary FET and bipolar transistors. Analysis of the Wien bridge of Fig. 1 shows the bridge is balanced when

$$f = \frac{1}{2\pi\sqrt{R1R2C1C2}} \text{ and } C2/C1 = R3/r - R1/R2.$$

When C1 = C2 and R1 = R2 and the frequency is such that $R = X_C$, the impedance $Z2 = \frac{R}{\sqrt{2}} \angle{-45^\circ}$ and $Z1 = R\sqrt{2}\angle{-45^\circ}$.

Consequently, a third of the voltage applied to the bridge between points A and D appears across Z2. When R3 = 2r, one third of the voltage applied to the bridge appears across r, so there is no difference of potential between points B and C, and the bridge is balanced.

In the actual oscillator shown in Fig. 2, R4 and R5 in parallel make the resistance r of Fig. 1 for ac. The reactance of C3 must be less than 10Ω at the frequency of oscillation. R5 is the resistance of a 6W 120V lamp whose positive temperature coefficient regulates the output of the oscillator and insures that signals within the oscillator are not clipped or limited.

A typical 6W 120V lamp has a resistance of 200Ω when the voltage across it is 0.1V rms, and about 550Ω when the voltage is 3V rms. A good operating point is about 0.5V, or a resistance of about 300Ω. The actual operating point is determined by R3 and the particular lamp's characteristics. The larger R3, the higher the lamp operating voltage.

R3 is chosen to be slightly greater than twice the lamp's resistance when the voltage across the lamp is about 0.5V rms, and a value of 680 is about right. Initially, then, the bridge is unbalanced, and oscillations will start when power is applied. The ac voltage across the lamp increases the lamp resistance and brings the bridge toward balance. The bridge is brought to the balance point, which produces a bridge attenuation exactly equal to the amplifier's gain. The attenuation, the ratio of applied voltage (A to D) to output voltage (B to C), is infinite at true balance, and an infinity-gain amplifier would be required. Therefore, the oscillator must operate with some unbalance.

The match of R1 and R2 and C1 and C2 is very important and, although the circuit given can handle 5% tolerance components, a closer match is desired so that greater variations in lamp, amplifier gain, and loading can be tolerated. Loads heavier than 1 kΩ can best be accommodated by adding an emitter-follower buffer on the output of the oscillator.

Matching C1 and C2 can present an interesting problem if you don't have access to a good bridge. The technique I used was slow, but it was a starting point. First, I matched a pair of resistors in the

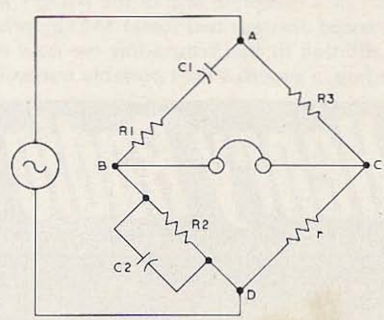


Fig. 1. The basic Wien bridge.

Freq. kHz	C1, C2 'µF	R1, R2, kΩ
.250	.01	63.4
.400	.01	39.2
1.0	.01	15.8
1.8	.001	88.7
2.5	.001	63.4
10	.001	15.8

range of 270 kΩ with an ohmmeter and used them in the bridge shown in Fig. 3 to match the .01 µF capacitors. At the start, you won't know which of the capacitors is smaller, so shunt one of them and note whether the balance improves. Add to the one that improves the null, and try to balance within 2%. In matching the .001 µF, the bridge resistors should be in the order of 2.7 MΩ and a VTVM is essential for detecting the null.

Values of R1 and R2 between 2 kΩ and 1 MΩ and values of C1 and C2 above 470 pF are convenient. Within these bounds, these combinations are available:

The same general circuit approach can be used to make a wide-range variable frequency oscillator. In the variable oscillator, fixed resistors R1 and R2 are replaced with sections of a dual pot. If the tracking of the pot sections is within 5%, the circuit could be used directly, and a 100:1 tuning range could be achieved, but it isn't very likely that you will find such close tracking.

There are two possible solutions to the difficulty. One reduces the tuning range by adding fixed resistance in series with the variable resistances to reduce the percent-

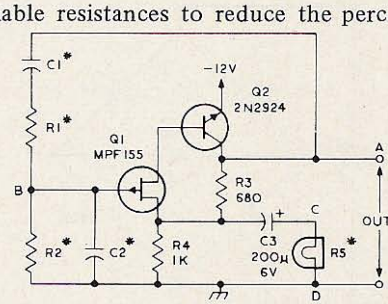


*Fig. 2. Fixed frequency oscillator. All resistors 10% ¼W. *See text for values and tolerance.*

age tracking error, and the other increases the gain of the amplifier so the únavoidable unbalance can be tolerated. In the oscillator shown in Fig. 4, both solutions are used. R_{ab} adds about 2.5 kΩ in series with each of the 100 kΩ pot sections and reduces the tuning range, and Q3 makes a higher voltage gain possible from Q2. The oscillator tunes from about 150 Hz to 6 kHz for the values given.

The pot R_{ab} is adjusted to minimize the percentage difference between R1 + R_a and R2 + R_b as the dual pot is rotated fully clockwise. The power supply for the oscillator is not critical, and any voltage from 12–24V will do for the fixed-frequency oscillator, but the variable frequency oscillator should have a supply above 18V. The current required for the fixed oscillator is about 5 mA without a buffer, and the variable oscillator requires about 18 mA.

The layout of the oscillator is not particularly critical for audio frequencies, but care should be taken to shield the high-impedance sections from power-line pickup. If an external power supply or batteries are used, the normal enclosure will be sufficient. The variable oscillator of Fig. 4 will fit in a minibox if an external power supply is used. The heft will be improved if you bolt a chunk of scrap steel into the bottom of the box.

If you prefer, you can change the polarity of the unit by making these direct substitutions: MPF 155 to MPF 104; 2N2925 to MPF 6518; 2N3638 to 2N2923. Don't forget to change the polarity of the electrolytics. The heavy negative

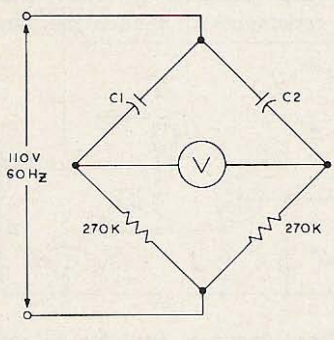


Fig. 3. Capacitor comparison bridge.

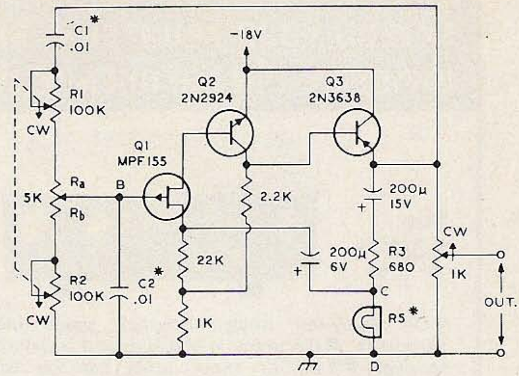


*Fig. 4. Variable frequency oscillator. All resistors 10% ¼W. *See text for tolerance.*

feedback makes the circuit very tolerable of component variations, but the following table of DC voltages may be comforting when you turn the oscillator on for the first time:

Fixed Osc.	Emitter (Source)	Base (Gate)	Collector (Drain)
Q1	- 4.5	0	-11.4
Q2	-12V	11.4	- 7.5

Var. Osc.	Emitter (Source)	Base (Gate)	Collector (Drain)
Q1	- 4.5	0	-17.4
Q2	-18.	-17.4	-14.4
Q3	-18.8	-14.4	-18

An evening or two and a few bucks for parts are all that are needed to build the oscillator. If your junkbox is like mine, full of everything except what you need, it will cost you under $6 to buy all new parts for the fixed oscillator. A pair of these little gems operating at 400 Hz and 1.8 kHz are ideal for generating the signals for adjusting the SSB rig, and you can enjoy your peanut butter sandwich too. . . .W3SGV■

Reference:

Edson, William A: Vacuum-Tube Oscillators, New York, John Wiley & Sons, Inc., pp. 128, 138 to 142, 1953.

Terman, Frederick Emmons, Sc.D: Measurements in Radio Engineering, 1st ed., New York, McGraw-Hill Book Co., Inc., pp. 46, 47, 1935.

The MPF155 ($1.30), 2N2924/HEP 724 (95¢), and 2N3638 (50¢) are available from: Circuit Specialists Co., Box 3047, Scottsdale AZ 85257. Please include 25¢ for shipping.

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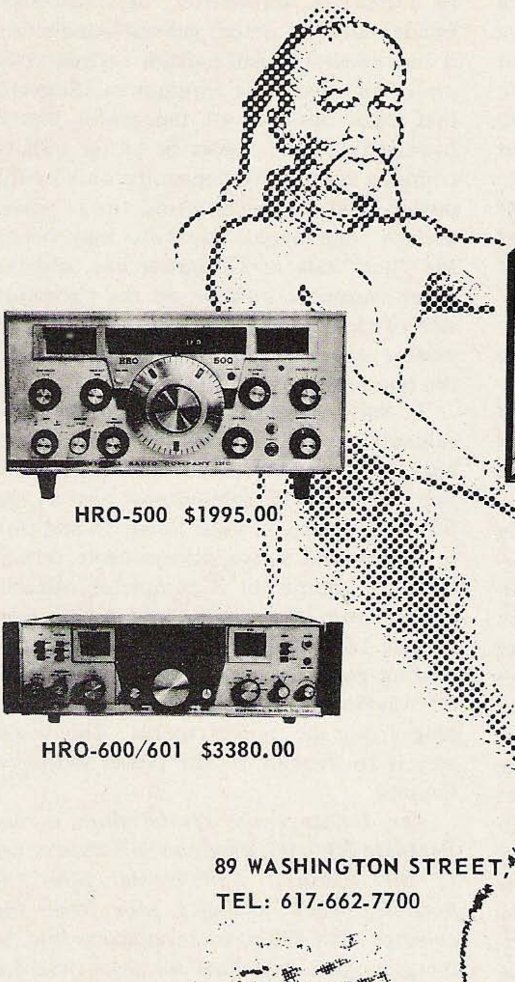

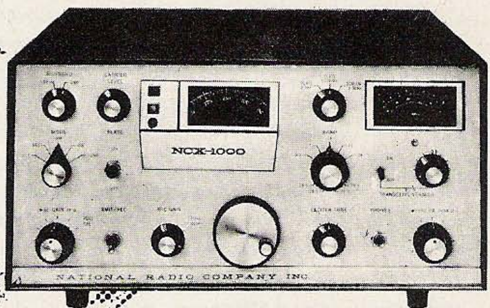

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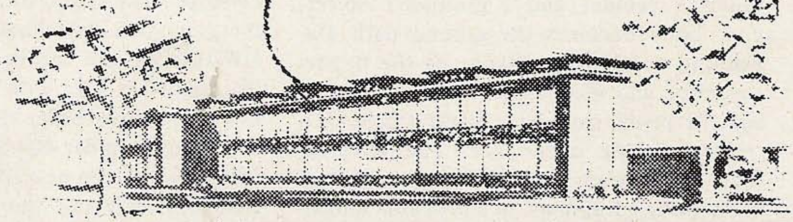

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questions questions questions

Herbert S. Brier W9EGQ
385 Johnson Street
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We do not normally devote as much space to answer one question as we give to our first question this month. But telling anyone how to protect himself and his visitors from the dangers of uncontrolled electrical currents is important enough to command additional space.

I am almost afraid to touch two pieces of equipment in my electronics shack at the same time, because doing so is almost like playing Russian Roulette. One time, I get a nasty shock; the next time, nothing. And when I disconnect or connect an antenna or piece of equipment, sparks often fly, even though all power switches are shut off. Are these things dangerous? How do I correct the trouble? Yes. The conditions you outline are dangerous. Almost any electrical shock can kill under the proper circumstances. Fortunately, however, eliminating the hazards is not difficult. The basic problem is that the primary circuits of virtually all electronic devices operated from the commercial power lines are bypassed to their metal chassis and cabinets through capacitors. Consequently, the cabinets are effectively coupled to the power line via the bypass capacitors. If the cabinets are grounded, however, the resulting alternating currents are harmlessly drained off into the ground. But if the ground is omitted, and you simultaneously touch a cabinet and a grounded object, your body becomes the ground path. Depending on the capacitance of the bypass capacitor and whether it is leaky or shorted, the result may be a slight tingle or a truly shocking experience. The sparking that occurs when you connect your antenna to your equipment is a probable indication that the antenna is grounded somewhere either by design or by accident. Conversely, many a technician has had his teeth loosened by a shock while working on an ungrounded antenna left connected to a receiver, transmitter, or transceiver. Incidentally, an actual ground connection is not needed to get a shock between two pieces of electronic equipment. Suppose that only one side of the power line is bypassed to the chassis in either unit (a common condition), depending on how the power plugs are inserted into the ac power sockets, one bypass capacitor may be on the "hot" side of the power line, and the other capacitor may be on the "ground" side of the line. As a result, there will be a voltage difference between the cabinets of the two units.

To solve the problem, connect all metal cabinets to a low-resistance ground with heavy flexible wire. The best ground *for this purpose* is the ground post used by the utility company in your home. In addition to the ground straps, always make certain that the equipment is completely disconnected from the power lines before connecting or disconnecting anything (including grounds) from it. Usually the easiest way to insure this is to pull the power plug from the power socket. The worst way is to depend on the power switch in the unit.

Can I change the crystal filter in my Heathkit HW-100, amateur SSB transceiver to the Heathkit SSB crystal filter? If possible, what would I gain from the exhange? The filters are interchangeable. In fact, if you purchase a new Heathkit HW-100 kit and return its crystal filter in its unopened box with $20 to the Heath Company, and order the SB-102 SSB filter – part number 404-283 – the company will ship you the new filter and a few cents change. Replacing the HW-100, 4-crystal filter in the HW-100 with the SB-102, 6-crystal, SSB filter makes the HW-100 SSB selectivity equal to the SB-102 SSB selectivity. An SB-102 filter without a trade-in costs $37, by the way.

I acquired a bargain bag of transistors, some good and some bad. How can I weed out the bad ones without a transistor tester? An ohmmeter that develops no more than 1.5V across its open test leads and allows a maximum of 1.0 milliampere to flow between the test leads when they are shorted together will identify open and shorted transistors, but higher voltage or current may damage a delicate, low-power transistor. The procedure: Measure the resistance between the transistor base and collector; then reverse the ohmmeter test leads and repeat the measurement. Note the difference between the two readings. Next, make a similar pair of measurements between the transistor base and emitter. If either pair of readings show a very low meter reading that does not vary when the ohmmeter test leads are reversed, that junction is shorted. Conversely, if the reading is high and unchanging, the junction is open. In either event, the transistor is defective. But if there is a difference between the readings in each pair, the chances are good that the transistor is usable. Some power transistors, especially germanium types, may show fairly low leakage resistances; but, as long as there is a perceptible difference in readings when the ohmmeter leads are reversed, the transistor should be usable. Do not leave the ohmmeter connected to the transistor any longer than necessary to obtain a meter reading.

My old, old shortwave receiver from the Goodwill shop brings in the stronger overseas shortwave broadcast stations, but it is not sensitive enough to bring in the weaker ones clearly. Is there any attachment I could get to bring in these weaker signals? A preamplifier between the antenna and the receiver antenna terminal should amplify weak signals three or four S-units. If you don't want to build your own preamplifier, look up the AMECO PCL-P, all-band preamp.

Your questions will be answered here to the limit of the space available. Send them to: Questions, 73 Magazine, P.O. Box 678, Gary IN 46401.

. . .W9EGQ■

Dipper Thing

Walt Pinner WB4MYL
7304 Lorenzo Ln.
Louisville KY 40228

Have you ever wished your grid dip meter were more accurate at higher frequencies or had the capability of going lower in frequency than the 3 MHz range that seems to be so popular on most units?

For some time I have been using a simple detector lead in conjunction with an rf generator for grid dip purposes. The probe is inexpensive and easy to construct and use. It utilizes an inexpensive movement which is available from most mail order houses under the title of "light meter movement." The cost is usually about a buck and a half and is typically a 45 μA (basic sensitivity) meter. The sensitivity is not critical; however, something in this range is necessary for an indication which is easily seen. A VOM or other similar indicator can also be substituted at some sacrifice in compactness and operating convenience.

In place of the standard rf generator lead, which usually incorporates a 50Ω or 75Ω terminating resistor, connect the detector lead shown below.

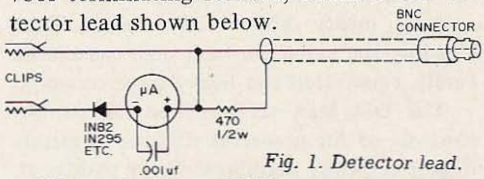


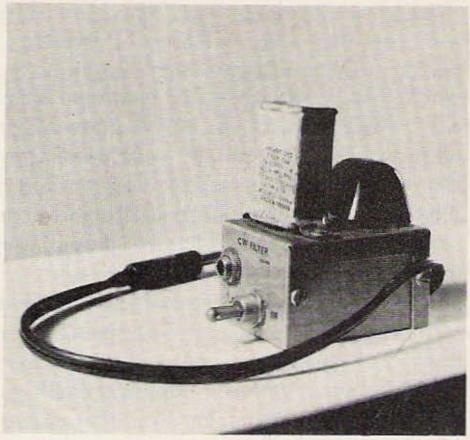
Fig. 1. Detector lead.

My probe has a BNC connector on one end and miniature alligator clips on the other. The components are mounted on the rear of the meter and this assembly is secured to the clip end of the lead with a good cement such as GE's RTV compound. Direct connections may be made to the circuit or a two-turn loop may be connected at the clips for inductive coupling to the circuits to be dipped.

You may now dip circuits whose low frequency limitation is governed by the output of the particular rf generator and the meter sensitivity. No problem has been encountered using the third harmonic of 48.3 to tune circuits in the 145 MHz range.

. . .WB4MYL■

A Filter Box for CW Ops.



Dennis J. Lazar K8TSQ
3494 Tullamore Road
University Hts. OH 44118

The kid knew, long before entering the shack, that the Old Man was working on 80 CW. Halfway down 73rd Street his transistor radio had begun to thump rhythmically. A few irate neighbors – audiophiles no doubt – could be seen glaring from windows or standing about on front porches muttering ominously as radios whined and hissed in stereo behind them.

The young Novice entered through the side door, cautiously making his way down the open wooden stairs. He descended into a dim, musty abyss. The feeble light invading the cellar through high casements barely penetrated the heavy tobacco smog.

The Old Man sat hunched before the controls of his powerful station. Dextrous fingers skillfully manipulated the paddle of an electronic keyer while the sweet music of The Code filled the basement gloom.

The kid stood watching in awed silence as dits and dahs followed fast upon each other's heels in machine gun staccato. The OM was truly a master of the ether, spanning thousands of miles with the controlled lightning at his command.

At last, with a crisp "dah dit dah," the OM "turned it over" to his distant contact. He sat back, puffing hard on his pipe, as the phones came alive. The distant station op was no slouch. His fist was crisp and clean. Moreover, there was little background noise and virtually no QRM. The signal had a clear, bell-like ring to it, quite unlike anything the kid had ever heard before. Thus, he knew instinctively that the OM had added something to his gear. But what?

He hopped up onto a high stool beside the bench and gave the equipment a quick onceover. The receiver was as he had seen it last. No preselector or Q-multiplier was in evidence.

Then his roving eyes stopped, fixed upon a tiny box placed at the end of the table. It was connected by a length of cord to the receiver's earphone output. Mounted on the box was a jack into which the OM had plugged his earphones. "What... why.. .how.. ?" The kid began, nudging the OM and pointing.

"Shhhhhh, wait a minute, George is turning it over to me." Relays clicked, transformers hummed as the big rig went on the air.

Not able to copy at 30 wpm, the kid picked up little of the ensuing conversation. He did, however, catch the 73 and the SK. The QSO was over.

"Ok, what is it?" he demanded.

"What is what?" The OM turned to face his young companion and would-be protege.

"That little box you're plugged into," the kid replied, pointing. "What is it?"

"Oh, why, that's an audio filter. For CW, you know."

"What does it do?"

"Well, let me show you." The OM

unplugged the filter from the receiver's earphone jack. He then plugged the phones directly into the receiver and tuned to the 40 meter Novice band. A bedlam of sound cascaded from the headset.

"Put on the cans and tune in a station," the OM instructed.

Obediently, the kid sat down putting the phones to his ears. He soon found a medium strength KN7 amid a multitude of stations vying for the frequency. "Okay," he said. "What now?"

"I simply insert the filter into the line like so." The OM inserted the proper plugs into the proper jacks. "Now, what do you hear?"

"Wow!" the kid exclaimed after a moment. "There's only one signal in there. All the others are much weaker."

"Ha – now watch this!" The OM flipped a toggle on the box.

The kid tuned the receiver slightly. "This is terrific. All I hear is the KN7, and nothing else!"

"Whenever you tune a CW station so that the beat note is a 750 Hz audio tone, the filter will let it through. All other tones will be blocked."

"Fantastic!" The kid eyed the tiny box. "What's inside?"

"Oh, just a couple of coils, a few capacitors, and an amplifier module."

"But what makes it tick?"

"Why, resonance, of course. It's a simple tank circuit, but resonant at an audio frequency instead of rf."

"I know a tank circuit is what you tune when adjusting a transmitter, but I don't really see the tie-in. I guess I really don't understand how a tank works."

"Okay," the OM sighed, "make yourself comfortable and let me begin at the beginning.

"Tank circuit is a term used to describe a parallel resonant circuit. These circuits are composed of two elements, an inductor (a coil) and a capacitor. Resonance in a tank circuit is possible due to certain properties of coils and capacitors."

"You mean inductance and capacitance, right?"

"Right. Now, do you know the difference between voltage and current?"

"Sure," the kid exclaimed, "I did pass the Novice exam, didn't I?"

"Okay," the OM smiled, "tell me about it."

"Well, er – current is the flow of electrons through a wire and voltage is the force pushing it. It's like water in a pipe; the amount of water in gallons running through the pipe each second would be the current and the pressure in pounds pushing it would be the voltage. . .right?"

"Fine, now we can get into explaining resonance. First, let's talk about inductance."

Inductance

When current flows through a coil of wire, it produces magnetic lines of force surrounding the coil. As long as current flows, the magnetic field remains constant. But, when input flow ceases, the field collapses. This collapsing magnetic field cuts across the windings of the coil causing a new current to flow. This induced current flows in a direction opposite to that of the input current.

When alternating current (Fig. 1) flows through a coil, a magnetic field builds and collapses with each change of polarity. When ac is initially applied, voltage and current flow in each turn of the coil. A magnetic field builds up around that turn, inducing voltage in the following turn. The induced voltage is in opposition to the input voltage. Thus, as voltage builds during the first alternation of the ac cycle (ABC) the coil tends to oppose the flow of current.

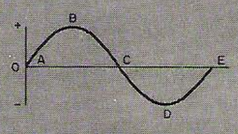


Fig. 1. Alternating current waveform.

As shown in Fig. 1, current reaches its peak at B and begins to decline. The magnetic field collapses, inducing a voltage in the coil. This voltage is in opposition to the voltage of the second alternation (CDE) and will thus resist current flow.

Resistance to change of current flow in a coil is called inductance. The effect was first described by German physicist Heinrich Lenz (1804-65). Lenz states: "Whenever a current is set up by a change of magnetic flux through a coil, the direction of the induced current will be such as to oppose the current which produced it."

Inductive reactance is the value in ohms of a coil's ability to oppose alternating current.

Capacitance

A capacitor consists of two conductors, or plates, separated by an insulator, the dielectric. Materials commonly used as plates in capacitors are metal foil and solid metal plates. Dielectric materials include air, ceramic, mica, and impregnated paper.

Capacitors function as storehouses for electricity. In Fig. 2, a battery is shown charging a capacitor through a switch. When the switch is closed, electrons flow from the negative battery terminal to capacitor plate A. At the same time, electrons flow from plate B to the positive battery terminal. As electrons gather on plate A it becomes negatively charged. The shortage of electrons on plate B causes it to become positively charged.

In the first instant following the closing of the switch, a heavy current flows, with electrons rushing to plate A and away from plate B. Little voltage is needed to force current through the circuit. Plate A soon becomes crowded with electrons and the electron supply at plate B becomes depleted. Current flow slows. More voltage now becomes necessary to keep electrons moving. With decreasing voltage drop across the capacitor due to decreasing current flow, circuit voltage increases. A point is reached at which capacitor voltage equals applied battery voltage. Current flow ceases. The capacitor now is fully charged. If the battery were removed, the capacitor would retain a portion of its charge for hours, or even days. The capacitor may be discharged by shorting across its terminals with a condcutor. Current will flow from the negative to the positive terminal until both plates have an equal electron supply.

If ac voltage were applied to a capacitor, the first alternation would charge the capacitor as shown in Fig. 2. The next alternation would discharge the capacitor, recharging it in the reverse direction.

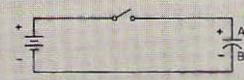


Fig. 2. Capacitor charged by battery.

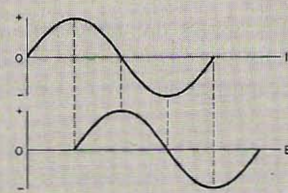


Fig. 3. Current lags voltage by 90° in an inductor.

Electron flow is to plate A and away from plate B during the first half-cycle (AB, Fig.1). The capacitor holds this charge until the second half-cycle (CD) causes electrons to flow to plate B and away from plate A.

With alternating current applied, a capacitor appears to be a closed circuit. Current flows in the circuit as if it were actually passing through the capacitor.

The amount of current that a capacitor can store is determined by its size, nature of its plate area, distance between plates, and the type of dielectric used. The capacitor thus limits or opposes current flow in a circuit. This phenomenon is called capacitive reactance and is measured in ohms.

Reactance

In a resistor, current is opposed by the material of which the resistor is composed. Power is dissipated as heat and thus is lost from the circuit.

Capacitive and inductive reactance also represent opposition to current; however, they consume no power.

Inductance of a coil is measured in *henrys*. Capacity of a capacitor is measured in *farads*. In both cases, the value of reactance (the ability to oppose the flow of alternating current) is measured in *ohms.*

Because alternating current flow in a coil causes an induced voltage which opposes current change, there is a phase difference between current and voltage, with current lagging. (Fig. 3). If the coil were pure inductance (having no resistance), current would lag voltage by 90 degrees. Resistance of the wire causes this phase difference to be smaller.

Capacitors also cause a phase difference between voltage and current. This is due to the reversal of polarity across the capacitor with reversals of the alternating current. In a capacitor, the current leads the voltage by 90 degrees. (Fig. 3). This phase angle would also be diminished by resistance.

It can be seen from Fig. 3, that while an inductance tends to oppose a change in current, a capacitance tends to oppose a change in voltage.

In any circuit containing both inductance and capacitance, the total effect on the circuit of these two influences will be the difference between their values.

Resonance

When inductive and capacitive reactance become equal in a circuit, a condition of resonance is said to exist. Resonant circuits can be designed to select or rject a certain frequency or group of frequencies.

Resonant circuits can be constructed in either of two configurations: series or parallel. A tank circuit is a parallel resonant circuit.

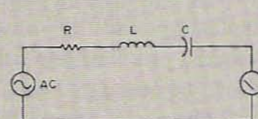


Fig. 4. Series LCR circuit

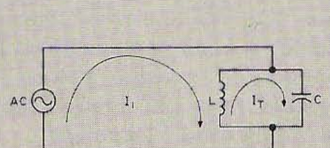


Fig. 5. Parallel LC circuit.

Series Resonance

To facilitate ease of understanding, let us look first at series resonance as shown in Fig. 4. At a given frequency, ac voltage in the circuit causes L and C each to have a reactance according to its value. If we change the input frequency, reactance values of L and C also will change. The value of R (pure resistance in the circuit) always remains constant. The difference in reactance between L and C thus represents an opposition to current flowing in the circuit. By adding this reactance value to the value of pure resistance, we arrive at the total circuit opposition to alternating current at a particular frequency. This value is called *impedance* (Z).

Assuming L and C to be some fixed value, we can find a frequency at which inductive and capacitive reactances will be equal. At this frequency the reactances, being opposite in nature, will cancel each other. Current flow in the circuit will be opposed only by R.

Looking at the circuit in Fig. 4, it can be seen that at the resonant frequency, the ammeter (I) would read a maximum current flow. At all other frequencies the reading would be lower. The circuit, in effect, allows current at one frequency to pass while impeding current of all other frequencies.

Parallel Resonance

When a capacitor and coil are wired in parallel (Fig. 5), the combination will be resonant at a frequency determined by the values of L and C. With the circuit at resonance, little signal current flows. This is because at resonance, a parallel LC circuit acts as a storage device (hence the name tank circuit). Signal energy is interchanged between capacitor and coil at a rate equal to the signal frequency. The interchange of energy, once initiated, continues nearly independent of additional signal current. The capacitor, charged by the signal, discharges into the coil. The collapsing magnetic field of the coil generates a reverse voltage which recharges the capacitor. Since the input signal established the initial charge on the capacitor, the circuit will accept little additional signal current. Thus, at resonance, signal current is very low while tank current is very high.

A parallel LC circuit at resonance, then, acts in a manner opposite to that of a series resonance circuit. At the resonant frequency, impedance for the signal current is very high, allowing little current to flow in the circuit. For all other frequencies, the impedance is very low. Thus, at resonance, a parallel LC circuit represents a large voltage drop. Current flowing through a high impedance creates a large voltage drop across that impedance. A signal current flowing in a circuit containing an LC circuit at resonance would thus result in a signal voltage appearing across the LC tank. If the signal was not at the tank's resonant frequency, little signal voltage would be dropped across the tank. In this way, a tank circuit acts as a filter, allowing a voltage output only when a signal at the resonant frequency is applied.

"So there you have it," said the Old Man. "Capacitance, inductance, reactance, resonance, the whole bit." He stretched and began to rise.

"Say, wait a minute," the kid blurted, coming out of a semi-doze, "you forgot something, didn't you? What about the box?"

"Oh yes, the filter."

"From the lecture you just gave me I assume there are coils and capacitors inside. But how did you manage to squeeze in all the components and how does the IC tie in?"

"All right," the OM sighed, "let's start by opening the box and also by looking at the schematic."

CW Audio Filter

As most hams know only too well, CW operators, especially those using the Novice band segments, are a long-suffering lot. There are QRN and foreign broadcast interference to contend with, to say nothing of adjacent-station QRM due to crowded bands. Rarely is a contact completed without at least one station issuing a strident CQ only a few cycles from the frequency in use. Many a good QSO has ended in frustration, fading away into this constant background din.

There is a simple and inexpensive solution to problems brought on as a result of too many stations occupying too little band space. An audio filter, selective enough to single out a discrete audio note, can make a nearly impossible snarl sound like code practice.

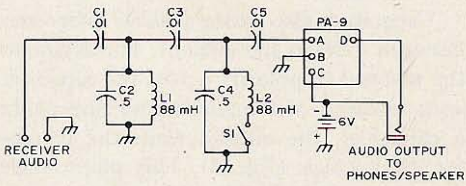


Fig. 6. Schematic of CW Audio Filter.

The Circuit

The audio filter is based upon three major components: A pair of toroidal coils which combine small size and high inductance, and a solid-state audio amplifier module.

Receiver audio, consisting of CW signals of many different audio frequencies, enters the filter through coupling capacitor C1 (Fig. 6). Capacitor C2 and coil L1 comprise a tank circuit resonant at 758 Hz. This tank will shunt to ground signals that are not at the resonant frequency. A 758 Hz signal will cause signal voltage to be developed across the tank. This signal is coupled through C3 to the top of tank circuit C4–L2. If switch S1 is closed, off-resonance signals are further attenuated. With S1 open, the second filter circuit is disabled and the signal passes directly to C5. The function of S1 is to provide two levels of selectivity for ease of tuning.

From C5, the filtered signal enters module PA-9 where it is amplified to drive headphones or speaker. Volume of the input audio from the receiver determines output volume of the amplifier.

Filter output frequency may be changed to suit the ear of the individual. Some may desire a lower tone, some a higher pitch note. By changing the value of C or L, the

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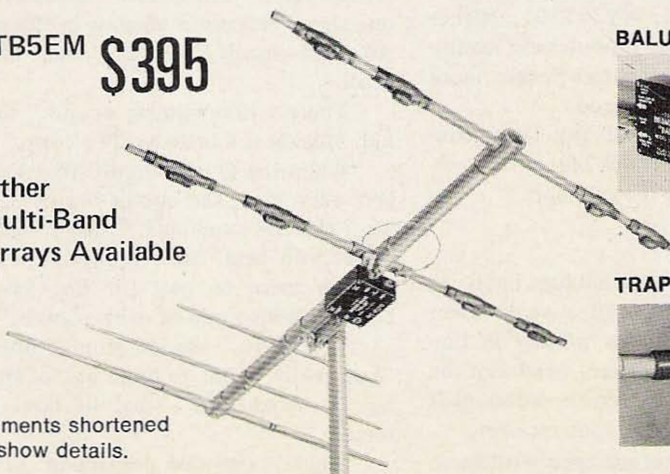

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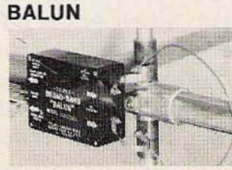

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resonant frequency of the filter may be altered.

Components

Voltage ratings of the components are not important in this circuit. Receiver audio voltage never will approach usual component ratings. Capacitors may be disk ceramic or any other type found in the junkbox or surplus electronics store. If size is no object, an economical substitute for the two 0.5μF capacitors is a surplus double oil-filled type. Most have flanges for chassis mounting.

Coils are toroids, available through many sources. You may come across them advertised for sale in the classified section of this magazine. Toroids often are used in Teletype equipment as filters to differentiate between two audio tones that carry RTTY information.

PA-9 is a "public address amplifier module" available through Lafayette Radio Electronics Corp., either locally or by mail order ($3.50). Address of the company is Box 88, Syosset, LI, NY 11791. Higher powered, higher priced modules are readily available from many sources where more audio output power is desired.

The battery may be of any type, considerations being size versus life.

Your preference is the rule here.

Construction

A minibox, a few terminal lugs or strips, a soldering iron, drill, and a screwdriver will get you through this project in fine form. The device, however, need not be built in a minibox. You can breadboard it or even build it right into your receiver.

Toroids are sold centertapped with these leads open. You must solder them together before installation. The coils may be mounted one above the other with a bolt running through the centers. You can, however, mount them in any way that will best fit the space available.

Mounting the module should present no problem even though it has absolutely no provisions for mounting. A few rubber grommets glued to the bottom of the module and then glued to the minibox will hold nicely. Leads should be covered with "spaghetti" tubing and run through a rubber grommet placed in a hole in the box under the module.

"Sounds great," said the kid. "How do you operate it?"

"Listen to this." The Old Man picked up the headphones. He switched the filter to its *out* position. With only one filter in operation, a few signals sounded in the phones. . .still nothing like the bedlam really existing on the band.

"You have to zero in on the filter's resonant frequency," he explained. "Tune the receiver's main tuning or bfo tuning control to adjust the beat note to the proper frequency."

"Wow, that signal really popped up there." The kid moved in closer, taking hold of the receiver dial. He tuned back and forth. "The strength of this one station comes through at least ten times louder when you hit the resonant frequency."

"That's right. Now let's flip in that second tank." The switch clicked and only one signal remained beeping in the phones. Adjacent signals could no longer be heard at all.

"There's that ringing sound," said the kid. "Makes it a little hard to copy."

"When the Q of a circuit (its selectivity) gets very high, the circuit begins to resonate," the OM explained. "That's the ringing effect you hear. Still, though, it's a small enough price to pay for not having to contend with a pile of other signals."

"You know," the kid grinned hopefully, "you really ought to build one of these for me. It would be a real lifesaver on 40 meters."

"What?" the OM demanded. "Do you mean to tell me that after sitting here and listening to this whole monolog, you don't think you can build one yourself?"

"Well," replied the kid, "the way I see it, if I spent all the time it would take me to build a filter, I wouldn't have time to learn the code well enough to use it."

The kid ducked as a box of screws sailed past his head.

...K8TSQ

DUALS

J. K. Bach WB2PAP
Ivy Hill Road
Walden NY 12586

Electronics is filled with dual-role phenomena All you have to do is look. . .

The electrical art in general has one very helpful feature, though this is little realized or appreciated, and that is the dual or reversible nature of many of its instruments. In mechanics, a steam engine may be driven by another engine and make a pretty good compressor. Mechanics has few of these cases, however, while electronics has several. This by no means doubles the student's knowledge without effort on his part, but it really does help. After all, if you knew one half of a Siamese twin to speak to, you could hardly avoid knowing the other half too.

Suppose you bought a new-fangled fringe-area TV antenna – which way would you point it? The way everyone else points his, of course. But the new one is different from theirs – which is the front and which is the back on the doggone thing? I couldn't tell you without seeing it, and maybe not even then. But let's examine highly directional antennas a moment:

One of the most directional, and highest gain antennas is the parabolic reflector type. These can have gains of around 40 dB (depending on frequency, size), which means that they transmit and receive 10,000 times the signal that a nondirective antenna would.

These antennas are usually called "bowls" and you often see them out in the country and on top of buildings. The bowl is actually a reflector, while the actual antenna is a little noodle of a thing in the former's focus. In Fig. 1, the transmitter T sends the signal to the antenna A, and the radio waves bounce off the bowl and are focused on the receiving bowl to the right, many miles away. Here the waves are focused on the receiving antenna A, run down the transmission line into the receiver R. Just look at a bowl and you can see without any difficulty which way it is aimed.

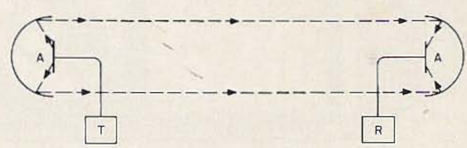

Fig. 1. The parabolic antenna concentrates virtually all the radiation into fairly tight beam.

Now consider the yagi antenna in Fig. 2. The longest element, or dipole, is at the left end and is called the reflector. The next element is the actual antenna, which is connected to the transmitter, or receiver, often switched back and forth alternately between them. In general, TV antennas are of this type. The arrow *usually* points in the direction in which the antenna transmits best – in the ideal case, toward the distant receiving antenna. At the same time, if it is used as a receiving antenna, the arrow points in the direction *from which* the best signal will arrive. You do not need to turn the antenna end-for-end when changing it from transmit to receive; this would be a clumsy expedient if it were necessary.

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Freq. Tolerance: .001% from —30°C to 60°C
Spurious Rejection: At least 60 db
Audio Power: 2 W. w/less than 10% distortion
Squelch Range: 0.2—0.8 μV
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Spurious & Harmonic Attenuation: More than 50 db below RF carrier
Deviation: Internally adjustable 0—10 KHz

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The same holds true for the rhombic and quad antennas in the same figure. In fact, it holds true for *any* directional antenna.

Now consider the vacuum tube; sometimes it has a simple function, as in a straight uncomplicated audio amplifier. But it is entirely capable of serving half a dozen functions at one and the same time. In a superheterodyne the same tube usually serves as a heterodyning oscillator and a frequency changing modulator at the same time. A simple regenerator, such as the type your grandpop used, is a regenerative detector and more often than not operated as a zero-beating oscillator at the same time – hence all the squealing you heard when they were tuned across a broadcast carrier. Not only that, but you could put an ordinary carbon microphone in the ground lead of one of these receivers and transmit your voice over it. This worked only for short distances, but it used the same tubes and antenna for both, and required no switching – it was completely automatic send and receive.

Or look at these toy-like walkie-talkies that children and fools abuse to the consternation of the FCC: They one and all rewire themselves at the touch of a thumbbutton so that the loudspeaker becomes the microphone, the first transistor becomes a transmitting element, and the audio amplifier is turned end-for-end. Dual? It surely is.

Years before the telephone was invented, kids used to play with string-and-can intercoms. They would punch a small hole in the bottom of an ordinary tin can – empty, of course–insert a string of thread and knot it, then stretch the string to a similar outfit in the next room or out in the yard. As long as the string was fairly taut and didn't rub on anything, it would

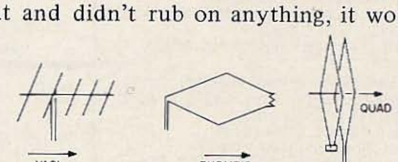


Fig. 2. Directional antennas must be pointed toward the station you're communicating with.

talk pretty good. This was acoustic duality; you had to holler into the can and poke one ear into it alternately. At the transmitting end, sound waves vibrated the string, and at the receiver, the string vibrated the diaphragm, which was the bottom of the can, making sound waves again.

To get back to aiming your TV antenna: One of the very best methods is to run a pair of wires up to your roof, with an ordinary head receiver, or pair of receivers at each end. No batteries, no amplifiers, just "Whoop and holler!" Actually, you don't have to talk all that loud; it works surprisingly well.

The theory is simple. The sound of your voice vibrates the diaphragm of the headphone (left unit in Fig. 3) which varies the air gap and consequently the magnetic flux in the headphone winding, which generates a current – you know, just like Lentz's law. Anyway, this current flows to the end of the wire and – Lentz's law again, backwards – vibrates the diaphragm and makes sound again.

Faraday himself knew that an electric current could produce motion through electromagnetism, and that the latter could generate a current by reverse action. When the electric motor was invented, it was realized at once that driving this motor with, say, a steam engine would generate current provided the field was magnetized, even slightly. A few years ago, when automobiles still had generators, the voltage regulator would occasionally fail and connect the generator directly across the battery which would instantly run the generator as a motor until the battery itself ran down. If the generator could not turn the engine over, this happened pretty quickly!

Of course, not all instruments are dual. While a telephone receiver, or loudspeaker, may transmit very clearly when sound strikes it, the current generated is weak. But send a current through a carbon microphone and the only sound you will get out of it is a sizzling, frying noise as it burns up, if you push it that far. But with normal current through it, it will transmit

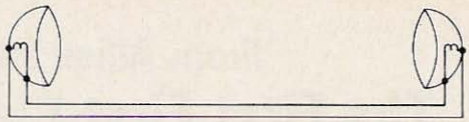


Fig. 3. Sound-powered phones are an electrical equivalent of the once-popular string and can.

very well – more efficiently than any other type. It just isn't dual. Not all motors are, either.

Technicians have a little trick for finding hidden microphones. They induce a heavy signal into the general area by methods that are kept as secret as possible, and the microphones "squeal" like tiny loudspeakers. These are not magnetic types, but crystal microphones.

Another type of crystal is the quartz oscillating crystal. These are tiny squares cut from a quartz crystal, something like minuscule soda crackers in proportion. Now quartz is one of the most elastic substances extant (no kidding, it really is!) and these tiny squares will ring like a bell, except that you can't hear them, because the frequency is millions of vibrations per second. In fact, this is the actual physical vibration that keeps the broadcast transmitter exactly on frequency. It rings better – far better than a steel tuning fork, and is more stable. But more than that, it is self-exciting.

Marie Curie's husband Pierre discovered that if you strike certain crystals, they gave off electric shocks, and if you shocked them, they were distorted out of true. The distortion was infinitesmal, but the voltage generated was considerable. A quite recent ignition system for small engines squeezes a crystal to make the ignition spark – simple and reliable. To get back to the oscillating type, when the crystal oscillator was first tuned on, the voltage twisted the crystal a tiny amount, until it went as far as it would go. Then the crystal untwisted, generating a voltage of its own, which was amplified by tube or transistor and reapplied to the crystal which distorted again. This process is much like the operation of an ordinary doorbell, and results in a very pure vibration of the crystal, of very precisely determined frequency, so long as the voltage is applied to the oscillator. But you need that twist-to-volts and volts-to-twist action to make the crystal oscillate in the first place. And these crystals have to be sliced and ground and etched from a piece of quartz crystal.

How about transformers? Take a filament transformer, for example: Put in 120V in the primary, and get 6.3V in the secondary. Or with 6.3V in the same winding, you will certainly get 120V in the other winding. The transformer doesn't know or care which way it steps, up or down, so long as you give it the right voltage and frequency. Pretty dual, I'd say.

A meter is a kind of dc motor. Will it generate electricity, too? Certainly! In fact, we can demonstrate this principle in a very useful test. Sometimes the meter is connected to the wrong points in a circuit and you wonder if it has been burned out. Or you see a nice microammeter in surplus, all dirty but apparently nearly new. Is it burned out? Or is it well worth the buck-fifty the man asks? You haven't any kind of test instrument to check it – all you have is your hands.

With the meter in your hand, see where the needle rests. (Fig. 4.) The zero adjustment may be a little off, but no matter. Suppose it is right on zero: now twist the meter to the left with a quick but not violent wrist-motion. The needle should swing 10 or 15 degrees upscale for a moment. This checks hair-spring and pivot, which must also be working okay. Now with a paper-clip, bit of wire, tie-clasp, or even a coin, short-circuit the terminals of the meter and try the twist again. This time, if the meter coil is all right, the needle should swing *much less* than before – perhaps only 5 degrees or so.

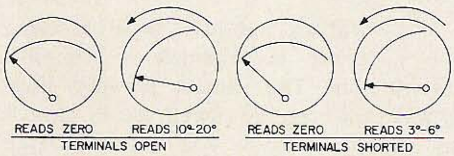


Fig. 4. A simple test can tell you a lot about a questionable meter.

When the meter terminals were open-circuited and the meter was twisted to make the needle swing, a voltage was generated by the coil moving in the magnetic field. But since no current could flow, no power was generated. But when the terminals were shorted, current *did* flow, power *was* generated, and dissipated in the winding itself, resisting the mechanical force that generated it by trying to drive the needle to the left. This is called "damping." Sensitive portable meters have a switch operated by the cover of the instrument, which shorts the meter coil when the cover is on. This prevents bending the needle due to carrying and shipping accidents, though if you drop it off a building you can kiss it goodbye.

Come to think of it, this duality business started before radio or wireless itself did. Maxwell deduced from the behavior of light that it was a kind of electromagnetic radiation, and that there should be others as yet undiscovered.

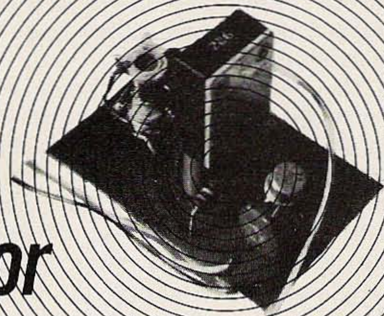
Hertz set out to find the undiscovered radiation. He used a spark coil of the same general type that Henry Ford used in his Model T ignition system. Connected to a battery, this gave a continuous series of sparks across a gap between two brass balls.

How to detect radiation from this? Sparks were disembodied electricity, so to speak; there was something magic about them. He took a brass rod about a yard long, put brass balls on the ends, and bent it into a circle or hoop, about a foot in diameter. If the gap between the balls was tiny enough, if the room was dark enough, if the loop was close enough, if the orientation was near enough, if anything like resonance was obtained, he should see a tiny spark in his loop. History tells us that he did, but you can't tell me this was accomplished all that easily. It probably took him quite a long time to try all the various positions and gaps and other variables until he hit on the one combination that would work. He had discovered hertzian waves, using a transmitter and receiver which were essentially duals of each other. More, he discovered hertzian waves with the most insensitive receiver ever built!

WB2PAP■

Clifford Klinert WB6BIH
520 Division St.
National City CA 92050

A MINIATURE Add-on Oscillator for 2m FM



In my past experiments with FM transmitters, I built up a simple crystal oscillator that is easy to reproduce and uses a minimum of components. The unit uses about 400 mW of power to an RCA 40080 NPN silicon transistor. This transistor is low in cost because of its wide usage commercially. This oscillator operates in the 6–8 MHz region with the tuned circuit described here, but should work well throughout the high-frequency spectrum.

This oscillator's first application was in an FM transmitter designed for 2 meters. The circuit layout as it is in this article was used as a crystal oscillator that was used to control the frequency of a receiver. When old AM receivers are used with VHF converters there is often a problem with frequency drift. The MARS or net operation is necessary, a drifting receiver can be a real headache. This oscillator can be built for only a few dollars, with a good junkbox. With a little study this oscillator can be used with almost any receiver to end the need for searching for the frequency each time and never being sure that no one is calling you. Of course, the oscillator can also be used as part of a transmitter, for a frequency spotter, crystal checker, an extra-frequency deck for an FM unit, or just an interesting little project to pass the afternoon.

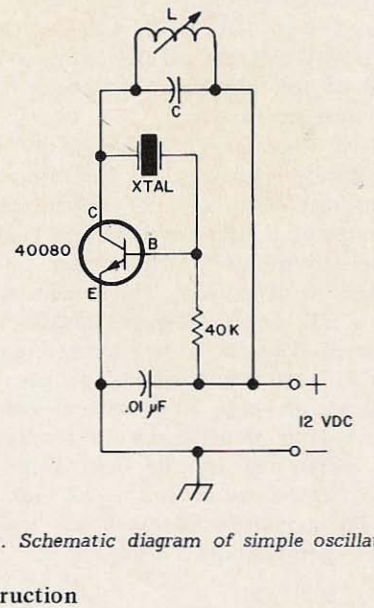


Fig. 1. Schematic diagram of simple oscillator.

Construction

The oscillator was built on a PC board and a layout is provided to simplify construction. The circuit is very noncritical, and can be wired up in almost any layout, but if you build a large number of projects and buy PC materials in large quantities, you will find that it is less expensive, much easier, and neater than you think it might be. Ferric chloride is used for etching the copper and can be obtained from chemical supply houses in gallon sizes for that very purpose. PC board material can be obtained from electronics suppliers or by mail-order from dealers such as Allied in Chicago. The resist can be almost any kind of good enamel paint that is applied to the clean copper side of the board where the conductors are to remain. The board is then soaked in warm ferric chloride solution for ten minutes or so, until the desired action has taken place.

The board is cleaned, drilled, and the components soldered in place. The crystal socket used required slots instead of holes for mounting. The coil, mounted in a hole on one end of the board, is made from turns of 30-gage enamel wire on a ¼ in. diameter slug tuned form. The capacitor across the coil (C) is 275 pF, a dipped mica type. The tuned circuit should be approximately tuned to the desired frequency with a grid dip meter before applying it to the transistor. Any type of L or C can be used if it is tunable to the crystal frequency desired.

Operation

Plug a crystal into the socket after L and C have been determined with the grid dip meter. If a low-impedance power supply is to be used (batteries) a resistor should be placed in series with the power supply for safety reasons. The oscillator current will be 20–40 mA. If it is working properly, removing the crystal and tuning L and C will change the current. Tune for maximum output, not for maximum current. It will key better with a load attached. Because of the minimal circuitry, the oscillator tuning and operation may exhibit some strange characteristics, but it has never failed to give a strong clean signal. The output of the oscillator can be taken from the collector of the transistor with a small capacitor, or if more voltage is required, a secondary can be wound on L to provide higher output.

In the receiver used, power was easily taken from the cathode of the audio output tube. This will only work when a class A output stage is used. Since the tube itself limits the current obtained from the cathode bias, no resistor is needed to protect the transistor. The transistor runs slightly warm because of the power it is dissipating, and should not be placed in an extremely warm environment.

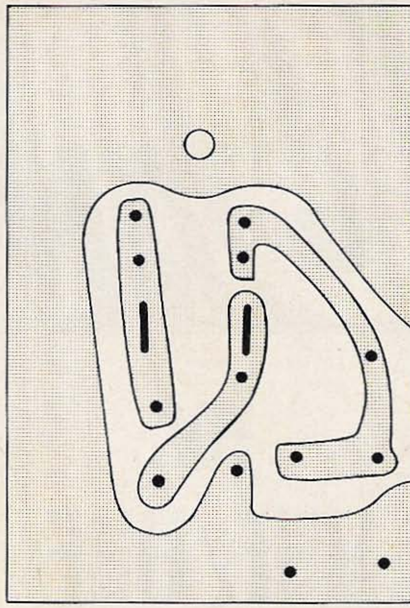


Fig. 2. 42% printed circuit layout; refer to the schematic and picture for parts placement.

The simple bias circuit used will not protect the transistor. A switch was wired into the receiver to short the grid of the receiver oscillator and turn on the crystal oscillator. The place and amount of oscillator injection must be determined by experiment. If not enough signal is available from the oscillator, it might be injected into the first rf stage of the receiver. This article assumes that the reader is familiar with how his own receiver operates, and will experiment to find best results.

Regardless of how this project is approached, it can fill a practical use or provide an afternoon's amusement at low cost.

The 40080 $1.30 is available from Circuit Specialists Co., Box 3047, Scottsdale AZ 85257. Add 15¢ for shipping.

. . .WB6BIH

GAIN ANTENNA for VHF/UHF REPEATERS

... Quadruples your repeater output power and will bring in solid those marginal mobiles in the fringe areas.

Ken W. Sessions, Jr. K6MVH

Probably the most popular antenna in the amateur repeater world is the omnidirectional collinear coaxial stack, although it is seldom called by that name. Versions of this antenna are manufactured by such companies as Prodelin, Phelps Dodge (Communications Products), and several other firms that build antennas specifically for the commercial bands.

Two of the reasons the collinear antenna is so popular are that it can be made to exhibit a great deal of omnidirectional gain at a very low angle of radiation and it takes up very little space. In its manufactured form, it resembles a long fishing pole with a pair of crossed fins at the base.

In spite of the fact that a great deal of painstaking effort is required to make the antenna and get it just right, the operation is surprisingly simple. And what makes it even more attractive to the amateur, it is remarkably inexpensive. About all you need is a good-sized hunk of 50Ω foam-dielectric coaxial cable and some polyvinyl-chloride (PVC) pipe. For 2 meters, the pipe should be between 20 and 21 ft in length; for 450 MHz, an 8 ft length will do fine. The total omnidirectional gain (as compared with a reference dipole) will be 6 dB (actually 5.8 dB, but who's counting?).

Building the Antenna

Ignoring the structural aspects, the antenna itself is nothing more than a series of precise lengths of coaxial cable soldered in an alternate phase-reversal configuration as shown in Fig. 1. A quarter-wave whip at the antenna's tip shorts the inner and outer conductors of the coax and becomes the terminal radiating element. At the lower end of the antenna, the last coax section

Invitation to transmit

Ina L. Thurmond
1040 Meadows End Drive
Calabasas CA 91302

I knew before we were married that he was a ham. He even told me. His mother used to give him books about electricity instead of letting him read comics.

I remember soon after we were married, he brought me a large paper bag. His eyes were shining, and he had the most lovable smile. I was ecstatic! He had actually gone out and bought something for our little home.

He did, but I actually didn't know quite what to say. In the bag was an aluminum box, with a few tubes and some wires.

"What is it"

"Two meters."

"Oh"

"A radio."

Suddenly, I had the overwhelming feeling that our marriage had just been invaded.

There was that one evening I sat in the livingroom alone, watching snow fall lightly outside, while he was up in the attic calling CQ, and thoroughly enjoying himself.

The time had come! I gathered all my courage, put on my winter jacket, and rehearsed my speech as I climbed those stairs. It was freezing up there! The air was drifting snow in one window and blowing dust out the other (through the cracks, of course).

It was very dark, except for the immediate area lit by the bulb dangling over his desk. He pointed to a box and motioned for me to sit down. He was holding the mike with his gloves on, and his breath fogged each time he spoke. I pulled up the wooden box close to the light bulb and sat.

When he finished talking to the other voice, I asked something that made me feel part of the action: "Why don't we set this up downstairs?"

He didn't think it was such a good idea. He didn't want to mess up the place with bits and pieces of solder. I nodded my head in agreement, since the place really wasn't ours to begin with. Well, I went downstairs, and began to read the Radio Amateur's Handbook. I figured I might as well start at the beginning of things to understand such an interest.

It has been three houses and six thousand miles later, and we still have all the stuff, and some new stuff; but at least the main antenna we have now doesn't oscillate when the wind blows, and it doesn't run down the middle of the house through the bedroom closet.

At present, we have a four-shelf bookcase pertaining to amateur radio and electronics.

Once in a great while, the pile of magazines for article cutting gets high, and he gets down on the floor with a pair of scissors and begins to leaf through all his books. It is amazing the effort and devotion one goes into.

"Hey, don't throw that out!" he shouts.

"Why not?"

"I haven't seen it."

"Woman's Day?"

"Oh."

If you are the wife of a ham, or the husband of one, don't despair. Amateur radio is a scientific hobby, and hobbies are a part of life just like golf, hunting, boating or cooking. A hobby is an interest to which one gives his spare time, that's all.

. . .Thurmond■

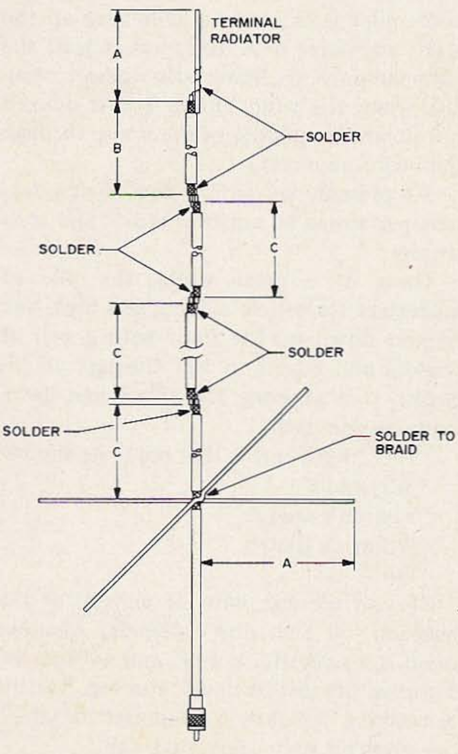


Fig. 1. The collinear gain antenna is made up of coaxial sections connected in a phase-reversal configuration. The bottom section (from the radials to the first joint) and the upper section (which joins the antenna to the shorted radiator) are half the size of all other sections.

actually becomes the feedline itself, whose length, incidentally, is not critical as long as the dimensions are followed with religious fanaticism.

A number of amateurs have managed to build antennas of this type, and diagrams have never been scarce. But few have handled the project successfully. Getting the antenna together is no big deal. The problems start to happen when it's time to turn the soldered-together pieces of coax into a structurally sound antenna. Applying wet epoxy, as in a fiber-glassing scheme, doesn't work out. I have yet to determine whether the problems are attributable to some chemical interaction between the wet epoxy and the coax dielectric (changing the dielectric constant of the line) or because the hardened epoxy doesn't allow any flexing of the coax braid. In any event, sealing the antenna with

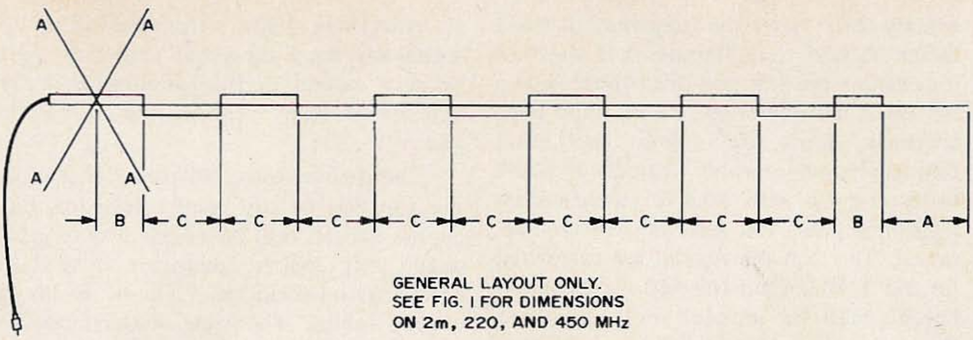


Fig. 2. Layout and dimensions of collinear gain antenna. The 2 meter dimensions are for a frequency of 147 MHz; the 450 MHz dimensions are for 442 MHz exactly. The 220 dimensions are for 220.5, just half the 450 frequency. The antenna is broadbanded enough to yield a low vswr on any frequency within a megahertz of that shown.

epoxy is ultrabad news. When the antenna is rigid and looks great, you'll measure a very disappointingly high standing wave ratio and you'll discover with much lament that your old groundplane worked better.

The commercial antenna people use fiber glass, but they do not use it to seal the antenna. Instead, they use an inert and flexible sealer, then encase the whole business within a preformed fiber-glass tubular envelope. At least one of the commercial suppliers uses beeswax as the inert sealer. Actually, there is no real need to immobilize the antenna once it has been placed inside the PVC pipe. The most important point in the construction process is to make the thing water-tight. Water drops inside a hunk of coax do bad things to antennas and feedlines; and once the water gets inside, you're better off changing antennas than trying to ignore the problems.

The dimensional details of the antenna are shown in Fig. 2. Lengths have been calculated in the decimal system to the nearest hundredth of an inch. Of course, you'll not be able to maintain this accuracy, but the system did simplify the computations. The 2 meter figures are based on an operating frequency of 147 MHz. The antenna is broadbanded enough to give an swr of close to unity regardless of the FM channel of operation. The 450 MHz frequency of operation is 441 MHz,

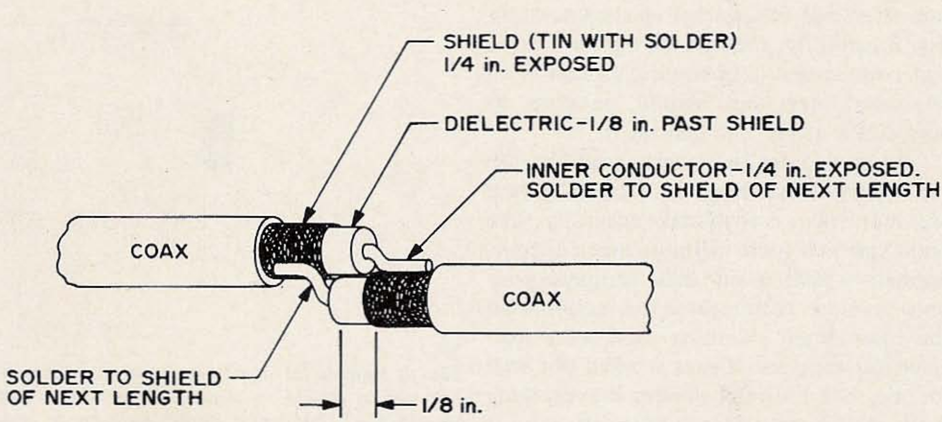


Fig. 3. The coaxial lengths should be soldered as shown. Keep the braid trimmed evenly all the way around and make sure the braid from one section doesn't make contact with the braid of the next section. If conductors are well tinned, problems will be minimized. Coax lengths are measured individually from braid end to braid end.

exactly three times the frequency of the 2 meter version. You'll note that the 450 dimensions are just one-third those shown for the 2 meter version. If you build both antennas, don't select those two exact frequencies for repeater channels or you'll likely end up with your 2 meter system triggering your 450 receiver – it *has* happened. The 220 dimensions are calculated for 220.5 MHz (half the 450 frequency). I haven't built the antenna for 220 because I've never had the occasion to use that band except when getting into W6ZJU's private repeater. But if 450 continues its trend of increasing population, there should be a general turning to 220 MHz for repeater control in the not-too-distant offing.

To begin construction, cut eight lengths of coax from the reel. Each piece should be cut about an inch oversize, then trimmed down later so that all pieces are of exactly the same length. The dimensions given are end-of-braid to end-of-braid for any given length. (See closeup detail in Fig. 3.) The braid-to-braid distance should be approximately the same as the distance between the inner and the outer conductor of the coax you're using, or approximately 1/8 in. This dimension is the only one that does not change with operating frequency or band.

When all the lengths have been cut and trimmed to the precise lengths, and you are sure they will fit together as shown, study Fig. 3 carefully, then tin all exposed braid and conductors. This tinning process is an important step and should be done as completely as you can manage it.

As you solder the lengths together, use care to avoid handling the soldered pieces any more than is absolutely necessary. The braid can pull loose without much encouragement – and when that happens your only recourse is to replace the section with the loose braid. Winding each joint with electrical tape has always worked out well for me, but I always wonder if everything is okay under that tape. Once the tape is applied, you'll just have to guess about the condition of the hidden joint. The best approach would probably be to make all joints first, then inspect the whole antenna. If everything looks shipshape, then go ahead and wrap the joints with tape. Just be very careful in the handling until the antenna is safely stuffed into its plastic pipe.

The quarter-wave radiator that goes at the top can be any good conductor, but copper is best. And the easiest way to get a good, stiff copper conductor is to buy some narrow-diameter (1/8 in. is ideal) copper tubing. The same material can be used for the radials at the base of the antenna. I *have* used type TW soft-drawn copper wire (10-gage), but it has proved too flexible for applications involving remote mounting – such as at distant repeater sites. The tubing offers a great deal better stability. If you have a heavy-wattage soldering iron or gun, you'll have excellent results soldering the tubing, too – even though you'll probably have to file or scrape the parts where solder is to be applied.

Ground Radials

There is nothing sacred about the manner in which the radials are attached to the antenna. Figure 4 shows the system I used, which worked but had a rather ugh look about it. K6VBT built one and used an arrangement of his own that looked

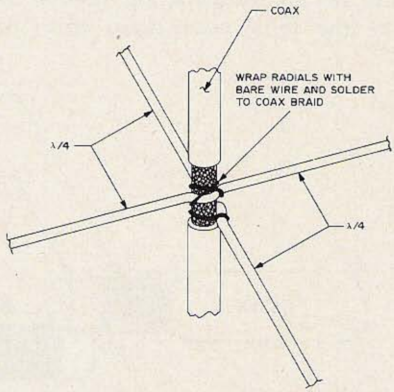
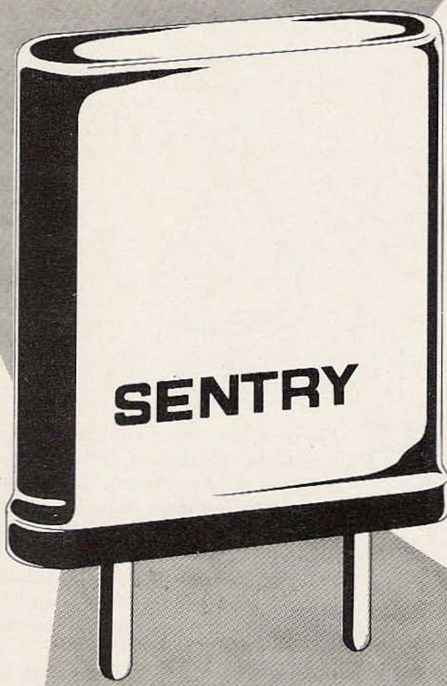


Fig. 4. Radials, of narrow-diameter copper tubing, should be cut to slightly longer than a half wavelength. The center should be bent to conform to the rounded shape of the coax braid so that on each radial a quarter-wave length extends outward from the coaxial braid. Tin the braid first. After wire-wrapping and soldering, wrap the joint well with electrical tape.

IF YOU'VE EVER USED A REPEATER,



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much more professional – but his required a lot more work and some rather precision drill work in the PVC pipe. The idea is to get four 19 in. radials extending equilaterally away from the antenna while maintaining some structural integrity. If the concept of Fig. 4 is adopted, the slot arrangement of Fig. 5 will hold things together satisfactorily.

The slots (Fig. 5) are cut lengthwise into the bottom of the PVC pipe so that the radials can be held in place when the PVC is inserted into the mounting pipe (made of heavy metal). The metal pipe is notched gently to seat the radials. Before

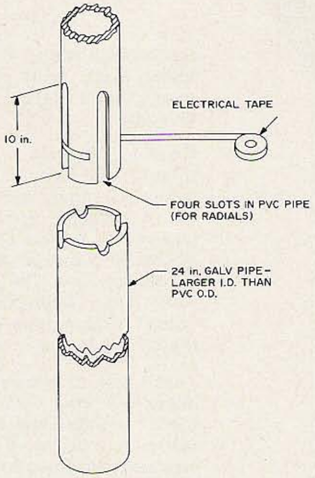

Fig. 5. Long slots in the PVC pipe will hold the radials in place with the antenna inserted. Wrap the bottom well with electrical tape after the antenna is installed in the fiber tube. Notch four matching places on a 2 ft length of galvanized pipe to seat, and try for a snug fit.

inserting the PVC into the larger pipe, the slots on the PVC should be taped up (after the antenna is installed in the PVC sheath, of course).

Building your own gain antenna *is* a lot of trouble, as you can readily see. But it looks pretty attractive when you start pricing the commercial equivalents. And there is an almost indescribable satisfaction that comes with putting out a good "commercial quality" signal from a homebrew antenna.

One Last Note

If your repeater doesn't give omnidirectional coverage, or if you'd rather have a definite preplanned radiation pattern, you can get considerably more gain than the 5.8 dB already promised by merely spacing the antenna a prescribed number of quarter wavelengths from the tower. Of course this means that your antenna will have to be side-mounted rather than top-mounted. If you space the antenna one quarter-wave from the tower, you'll get a major lobe in the same direction as the antenna is from the tower mass, as shown in Fig. 6A. Each additional quarter-wave essentially adds a lobe that exceeds the 5.8 dB omnidirectional reference point.

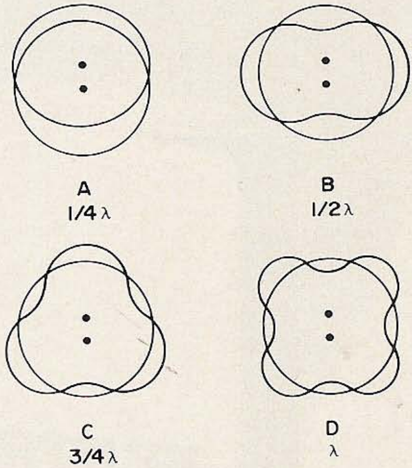

Fig. 6. By spacing the antenna the proper number of quarter wavelenghs, some interesting radiation patterns can be obtained. In the patterns shown, the circles represent the 5.8 dB omnidirectional gain achieved by top-mounting. The asymmetrical overlays represent the patterns obtained by side-mounting. Note that even though signal loss occurs in some directions, significant gain improvement is realized in other areas.

Playing around with antenna-to-tower spacing can help you spend a jolly afternoon at your repeater site – which can be great fun when compared with painting the fence or fixing the wife's vacuum cleaner. So grab yourself a hunk of coax or two and get started on the antenna. Then take a good look at a map of your area and see if you can't improve your repeater's efficiency by some selective mounting techniques.

...K6MVH■

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301 Broadway **(53)**
Riviera Beach FL 33404

Erickson Electronics
4657 N. Ravenswood Ave.
Chicago IL 60640

Galaxy Electronics
10 South 34th St.
Council Bluffs IA 51501

Newsome Electronics
19675 Allen Road
Trenton MI 48183

Scientific Radio Systems
401 Lyell Ave.
Rochester NY 14606

Varitronics Inc. (54-55)
4109 No. 39th St.
Phoenix AZ 85018

SCANNERS

Aerotron Inc. (36)
P.O. Box 6527
Raleigh NC 27608

Electra Corp.(61)
Cumberland IN 46229

Gonset, A Div. of Aerotron Inc.
P.O. Box 6527
Raleigh NC 27608

George D. Griffin
322 W. State St.
Ithaca NY 14850

Kris, Inc.
1026 B S. Washington Ave.
Cedarburg WI 53012

Regency Electronics, Inc. (47)
7900 Radio Row
Indianapolis IN 46226

Unimetrics Inc.
23 West Mall
Plainview NY 11803

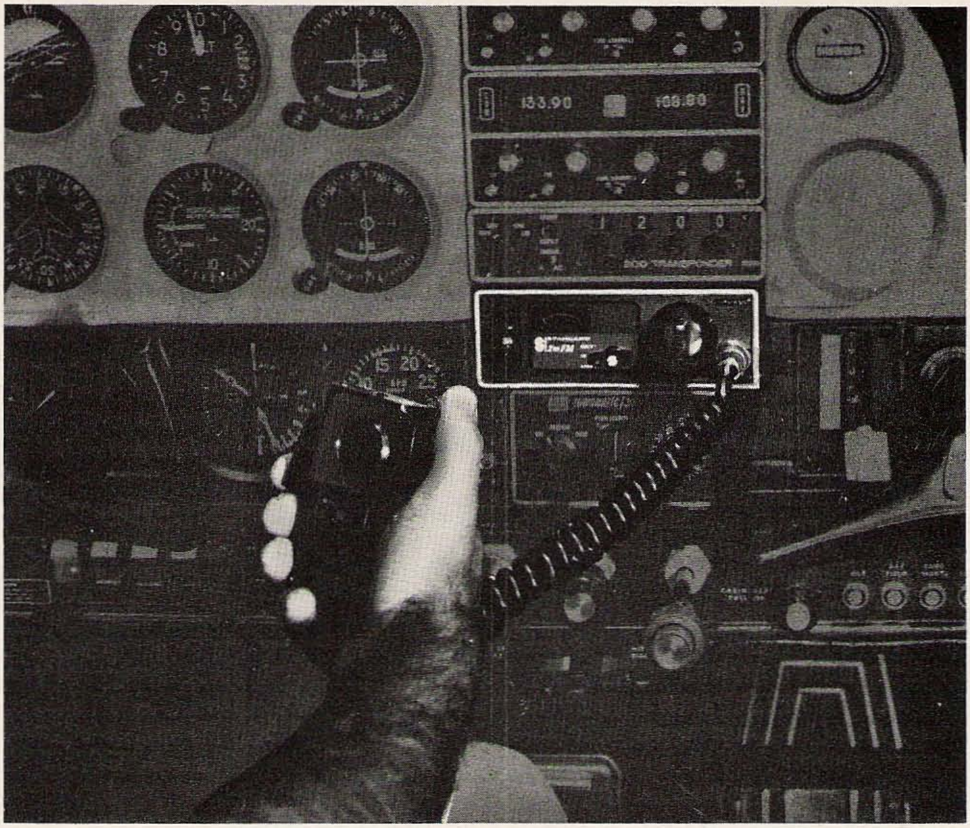
SURPLUS

C & A Enterprises
2529 East Carson St.
Long Beach CA 90810

DuPage FM
Box 1
Lombard IL 60148

FM Ham Sales
Box 1574
Fort Worth TX 76101

Fair Radio Sales (92)
Box 105
Lima OH 45802



Gregory Electronics Corp.
249 Route 46
Saddle Brook NJ 07662
Mann Communications (57)
18669 Ventura Blvd.
Tarzana CA 91356
Newsome Electronics
19675 Allen Road
Trenton MI 48183
Spectronics Inc.
1009 Garfield St.
Oak Park IL 60304

TEST EQUIPMENT

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Manchester NH 03103
Gertsch (The Singer Co.)
3211 So. La Cienega Blvd.
Los Angeles CA 90016
Heath Company (79)
Benton Harbor MI 49022
Hewlett-Packard
Lampkin Laboratories, Inc.
8400 Ninth Ave, N.W.
Bradenton FL 33505
Measurements
Motorola Inc. (Cover III)
Semiconductor Prod.Div.
P.O. Box 10924
Phoenix AZ 85001
Pathcom Inc.
24049 S. Frampton Ave.
Harbor City CA 90710
Perfection Elect. Products
404 E. Harrison
Royal Oak MI 48067

TONE ENCODERS/DECODERS

Alpha Electronic Serv. (62)
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Stanton CA 90680
Communication Specialists
P.O. Box 293
Brea CA 92621
Digitone (81)
Box 116
Portsmouth OH 45662
Federal Sign & Signal Corp.
136th & Western Ave.
Blue Island IL 60406
Mann Communications (Silent Sentry) (57)
18669 Ventura Blvd.
Tarzana CA 91356
Riggins Electronic Sales
2331 San Anseline
Long Beach CA 90815
Ross & White Co.
50 West Dundee Road
Wheeling IL 60090

TRANSCEIVERS

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Raleigh NC 27608
Canadian Marconi Co.
Marine & Land Com. Div.
2442 Trenton Ave.
Montreal 16 P.Q. Canada
E. T. Clegg Associates, Inc. (69)
Littell Road
E. Hanover NJ 07936
Communication Company, Inc.
P.O. Box 520
Coral Gables FL 33134
R. L. Drake Co. (Cover IV)
540 Richard St.
Miamisburg OH 45342
Dumont Communications
78 Hammarlund Drive
Mars Hill NC 28754
Galaxy Electronics
10 South 34th St.
Council Bluffs IA 51501
Henry Radio (Tempo) (19)
11240 W. Olympic Blvd.
Box 64398
Los Angeles CA 90064
931 No. Euclid
Anaheim CA 92801
Butler MO 64730
New York area: J. Richardt W2WIY
Houston area: J. Carman W5SBX
E. E. Johnson Co.
Waseca MN 56093
Kaar Electronics Corp.
2250 Charleston Road
Mountain View CA 94040
Radio Corp. of America
Mobile Com. Prod.
Front & Cooper St., Bldg 2–3
Camden NJ 08102
Regency Electronics, Inc. (47)
7900 Radio Row
Indianapolis IN 46226
Sideband Engineers
Simpson Electronics
2293 N.W. 14th St.
Miami FL 33125
Sonar Radio (35)
73 Wertman Ave.
Brooklyn NY 11207
Standard Communications (51)
640 E. 219 St.
Torrance CA 90502
Swan Electronics Corp.
305 Airport Road
Oceanside CA 92054
Telecomm Electronics (33)
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Cupertino CA 95014
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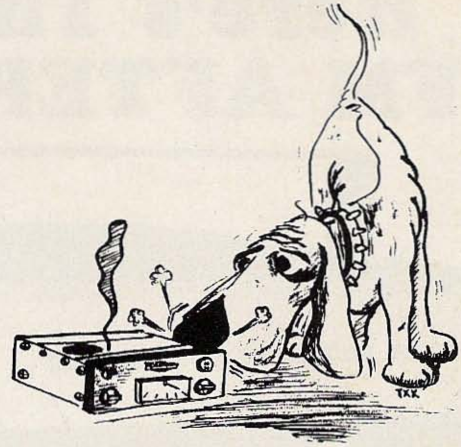
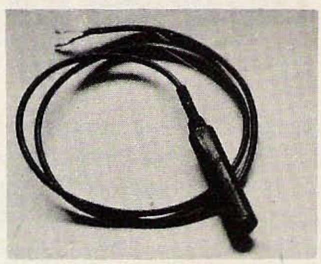


Dycomm offers the most useful trouble shooting tool since the SIMPSON 260; The Dycomm RF "SNIFF-IT". "If you can smell RF you got it licked."

This item enables anyone to follow the <u>RF PATH</u> in a multiplier chain or other RF source.

Just plug it into your present multimeter and trace RF from BC to UHF. The SNIFF-IT will display relative RF (from 1 mW to 250 W) output on your VOM, in volts.



Use it to trace RF in:

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Have you ever wanted to peak up your 1.8 through 450 MHz transmitter without a wattmeter:

The Dycomm "SNIFF-IT" enables you to "DO-IT". Just place the "SNIFF-IT" near the RF source and where it stops is where the trouble is. When tuning for maximum power into a load just tune for max reading on your VOM.

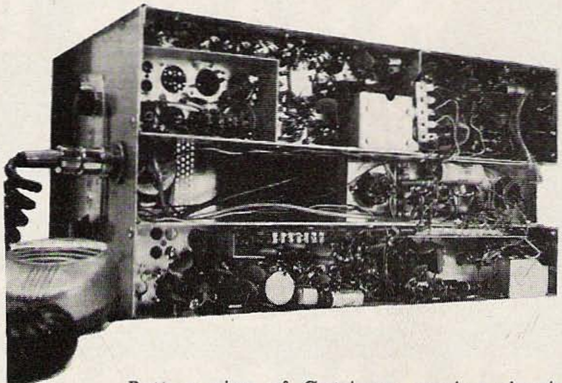
The "SNIFF-IT" does not appreciably load the circuit even if placed in a tuned circuit.

Price only $5.00 cash, check or money order.

Same day order in – shipment out. Guaranteed to work or your money back.

DYCOMM *PO BOX 10116 RIVIERA BEACH FLA.*

DESKTOP BASE STATION from MOTOROLA G STRIPS



Bottom view of G-stripper, receiver chassis at the top, conversion chassis in the middle, transmitter chassis at the bottom. Note the compactness of the unit; it makes a neat 15 x 7¾ x 5¼ in. station.

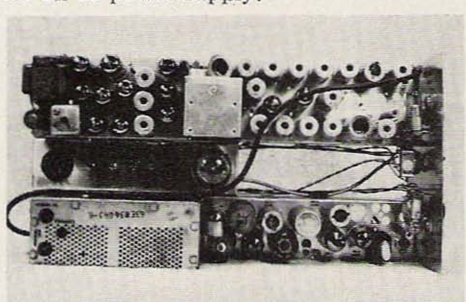
Chuck Klawitter W9VZR
4627 North Bartlett Ave.
Milwaukee WI 53211

There have been a large number of manufacturers making equipment for the 2 meter FM enthusiast; but a lot of interest has also been generated on 6 meters and 10 meters. Yet, there is no newly manufactured equipment specifically designed for these frequencies. The only logical route for amateur radio operators is commercial surplus low-band equipment. (Low-band FM gear generally covers 25–50 MHz.)

After having tried several different types of equipment and methods of conversion, I will report to you my results with constructing 6- and 10-meter base stations. My concern for this equipment was compact size so that it would be compatible with my present SSB exciter and would fit comfortably on my desk. And the equipment had to be attractive enough so that my wife wouldn't try to get rid of it every time I left the house.

Receiver sensitivity and transmitter output should be compatible with present-day standards. The units should be flexible enough in design to allow multifrequency operation, remote control, and tone operation. Finally, it must be inexpensive.

How was this vast list of specifications finally filled? With "G" strips – those compact units which made possible such units as Motorola's T41GGV or U51GGT. These units are only 15 in. long and around 3 in. wide. They have become available separately, as strips rather than mobile units, through Mann Communications* at a combined price of $28. Considering that surplus base stations using these strips are not available for less than $150, this seems to make these strips a good deal for the amateur with a little time and an old TV power transformer for an ac power supply.



Top view of G-stripper; receiver chassis is at the top. Note the placement of components on the conversion chassis– from left to right, octal power plug, speaker jack, and voltage regulator for the transmitter oscillator.

*Mann Communications, 18669 Ventura Blvd., Tarzana CA 91356.

NEW! 120 WATTS FM MOBILE

AS-IS IN ORIGINAL FACTORY CARTON
120 WATTS OUTPUT 148-174 MHz
CAPABLE OF UP TO 6 FREQ OPERATION
FULLY SOLID STATE EXCEPT 8624 FINAL
STANDBY BATTERY DRAIN 0.25 AMPS.
FULLY NARROW BANDED

These units are KAAR Model DT 76 and are sold as-is less crystal and crystal oven. Manuals will be included. No factory warranty.

This mobile unit is a must for the power conscious amateur who wants a brand new 2 meter rig. All units are sold on a first-come-first-served basis. Don't be shut out; order now while they last.

Kaar Model DT 76 complete with accessories $349
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We also handle clean used equipment. Write for free catalog.

Mann Guarantee

Money refunded without question if equipment is returned within seven days from shipment, undamaged, freight prepaid.

Conditions of Sale

Unless otherwise specified, equipment is used, and is sold as-is. All items shipped FOB Tarzana, California. Crystals, ovens, antennas not included unless specifically stated in catalog. All equipment is sold on a first-come, first-served basis.

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(602) 955-4570

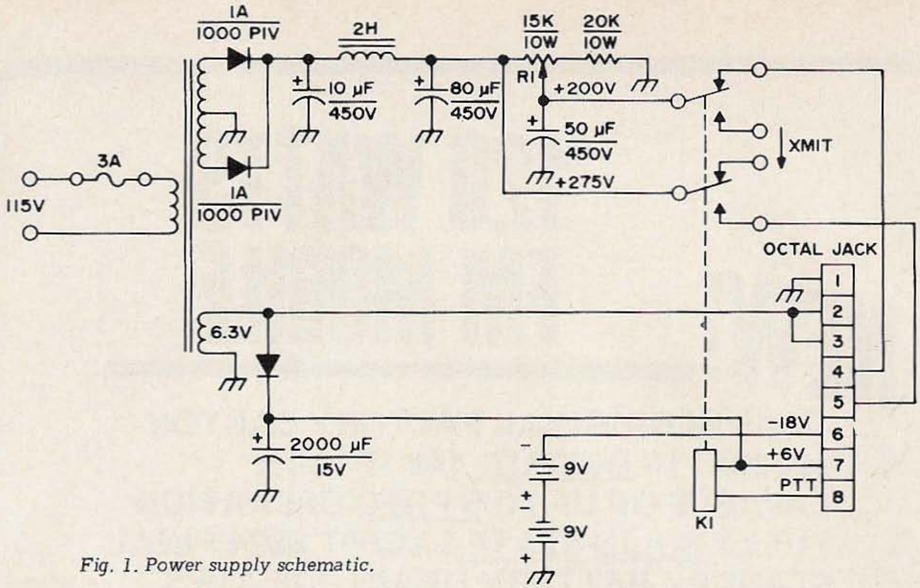


Fig. 1. Power supply schematic.

The power supply (Fig. 1) can be constructed on a separate 2½ x 5 x 13 in. aluminum chassis so it can be placed remotely. This helps keep the desktop package compact and eliminates a lot of unnecessary heat in the transceiver cabinet. The power supply contains the TV power transformer, high-voltage rectifying and filtering components, bias supply, filament supply, transmit-receive relay, and control voltages. Layout of this chassis is not difficult; work for best mechanical design and easy wiring.

The conversion chassis (Fig. 2) is placed between the receiver and transmitter. It replaces the old mobile power supply. This chassis contains tie points for connecting various receiver and transmitter functions, a standard phone jack for the speaker, voltage regulator tube, octal power plug, and accompanying components. Four groups of 6-32 hardware

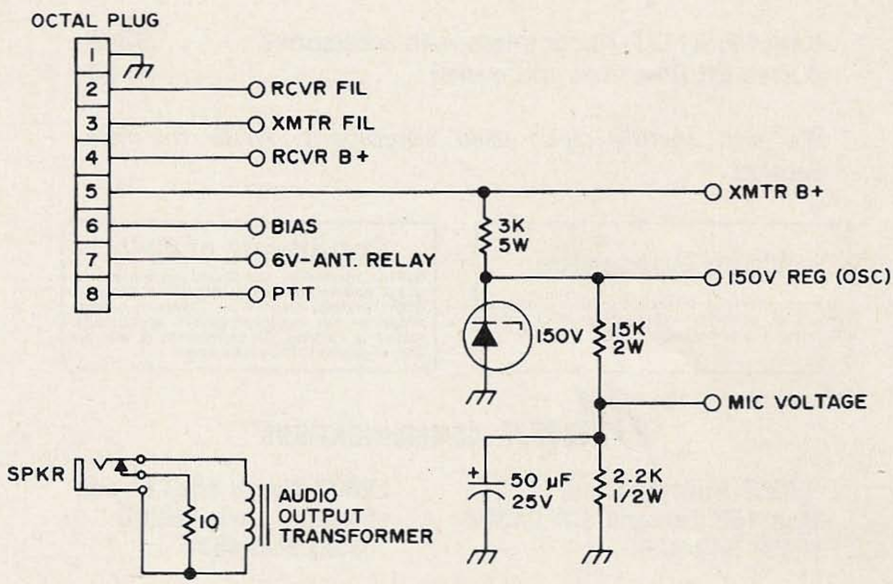


Fig. 2. Conversion chassis schematic

are used to hold the three chassis together. The conversion chassis was made of scrap aluminum about 1/16 in. thick. The mechanical layout for this chassis is shown in Fig. 3.

The front panel is also constructed from scrap aluminum. The front panel layout is shown in Fig. 4. An escutcheon from a Motorola control head will dress up the unit considerably and the components from the control head can be used in the front panel. The front panel is easily mounted because the fronts of the strips are drilled and tapped for 6-32 hardware. Four 6-32 binder head screws will securely attach the front panel to both the transmitter and receiver strips also adding a great deal of mechanical stability. The schematic for the panel elements is shown in Fig. 5.

Electrical Considerations

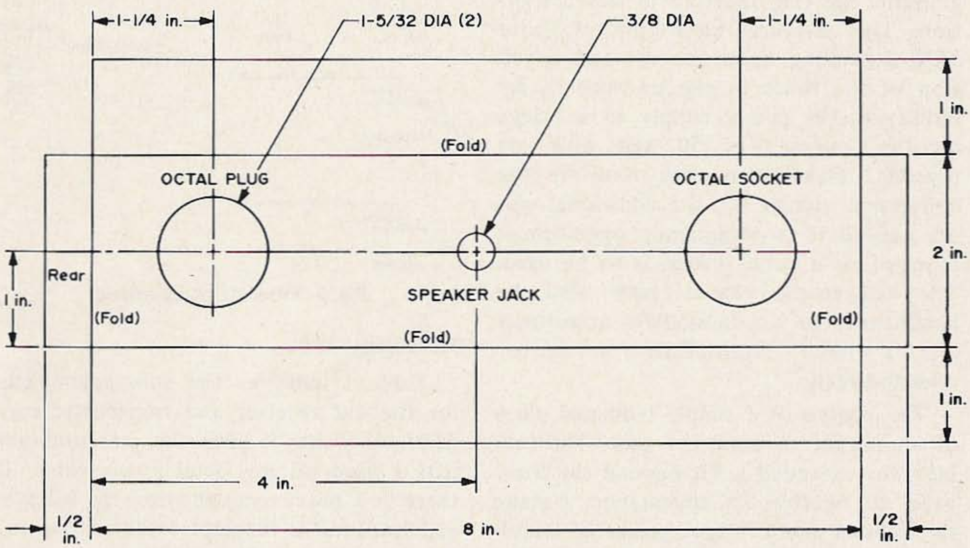
Fortunately, schematic diagrams are easily available for these units. The *FM Schematic Digest** not only contains the schematics for this equipment, but other helpful information for servicing, alignment, and ordering the proper crystals.

The power supply is built around an old TV power transformer which has been a fine choice in that the price is right and

Simple U-shaped cabinet is made of scrap aluminum. The speaker is mounted behind the perforated part of the cabinet at the top front of the cabinet. Choose your own color combinations, and refinish mike to match unit.

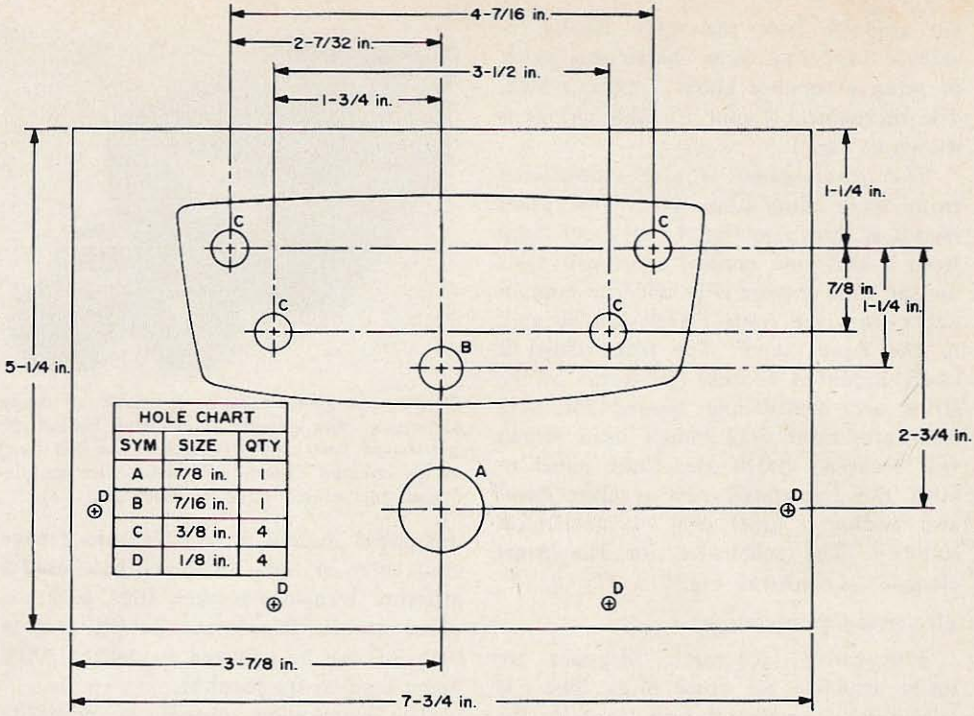
the power supply is very flexible. I have built three of these units and have used a different transformer each time with excellent results. In reference to Fig. 1, note that R1 can be adjusted to deliver 200V under load to the receiver.

The conversion chassis is primarily needed because when these strips were in their original mobile unit, the receiver and transmitter were not connected by plugs, but were wired together in manufacture. The conversion chassis serves as a place to connect the cut ends of the strips and a



*Sherman Wolf, Two-Way Radio Engineers, 1100 Tremont St., Boston MA 02120.

Fig. 3. Conversion chassis flat pattern layout.



NOTE: POSITION OF "D" HOLES MAY VARY WITH DIFFERENT STRIPS.

Fig. 4. Front panel layout.

place for the power plug and speaker jack. The screen and plate of the final amplifier are tied together in this conversion. This produces an output of about 15W depending upon the age and condition of the tubes in the transmitter. By modifying the power supply to a bridge rectifier, outputs of 50 and 60W are possible. There is enough room in the conversion chassis for the additional wiring needed if two-frequency operation is required or a tone system is to be used. The conversion chassis may also be lengthened to accommodate accessories like a mike preamplifier or carrier-operated relay.

The cabinet is a simple U-shaped piece of aluminum covering the unit. The cabinet was extended a bit beyond the front panel to improve its appearance. I made the cabinet out of three pieces of aluminum bolted together. I used solid pieces for the sides and a perforated piece for the top.

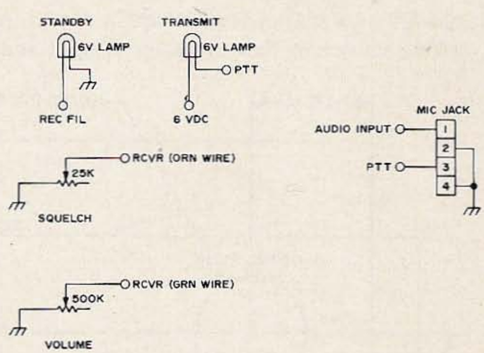


Fig. 5. Front panel schematic.

Miscellany

Table I indicates the wire color code for the cut receiver and transmitter connections. Table II gives the pin functions that I used on my octal power cable. If there is a heavy enough wire, the receiver and transmitter filament leads can be tied together. This will give you an extra connection for an additional function. An 11-pin socket can be used for more

flexibility and control of power functions.

Table I - Lead Identification Connections

Function	Color Code
6.3V ac Filament	Brown
Rcvr fil return-ground	Green with yellow stripe
Rcvr + 200V	Red
Rcvr audio control	Green
Squelch control	Orange
Xmtr audio and shield	Green shielded cable
Mike dc	Green with white stripe
Xmtr 150V dc	Red with black stripe
Xmtr 275V dc	Red with yellow stripe
PA screen	Orange
PA plate	Red with blue stripe
Bias	Green with red stripe
Xmtr fil return-ground	Brown with yellow stripe

Table II - Power Cord Connections

Pin Number	Function
1	Common-Chassis ground
2	Receiver Filament
3	Transmitter Filament
4	Receiver B+
5	Transmitter B+
6	Bias
7	6 or 12V dc
8	Control-push to talk

Some of the strips I have worked with have a disease called "hardening of the insulation." In case this should cause you any problems, it will be helpful to replace the wiring from the transmitter and receiver tie strips to their respective tie points in the conversion chassis. Carefully check wires in the strips that run tight against the chassis for shorts. . . .W9VZR■

Jack Taylor W4CWB
2400 N. Quantico St.
Arlington VA

CAMOUFLAGE EXTRACLASS

This article is dedicated to K9AZG* and all hams who desire to improve the state of the art but must cope with XYL-itis in erecting beam antennas. The plans that follow are foolproof and allow you to assume control. However, the author assumes no responsibility for their success because his XYL won't let him.

Plan I.

Jack threw the big switch. Between the QRN from an impending storm and the impotent signal generated by his attic antenna it had been a most frustrating evening.

"I just can't get out," he mused.

The lone QSL card from W2NSD/1, obtained "eyeball" at the '58 ARRL Convention, some samples from printers, and an SWL card from a boy scout on the next block bore mute testimony of the fact.

"Damned females and their sense of esthetics, if only I could put up a beam," and as an afterthought, "and still keep peace with the XYL."

A rumble of distant thunder heralded the arrival of the storm. Quickly he made a phone call, yawned most audibly and to the XYL upstairs he called, "Nancy, let's turn in, I'm bushed."

The storm broke – successive flashes of light penetrated the shuttered darkness of the bedroom. Each flash being followed by a sharp clap of thunder that rattled and reverberated throughout the house.

"A thousand and one, a thousand and . . . "

"Jack, stop that," cried Nancy, "I'm scared enough as it is." "Did you turn off that dumb radio?" "Yeah, yeah," responded Jack, giving her a reassuring hug, "now try to get some sleep."

Jack awoke the next morning to streamers of sunlight stealing through the blinds, the aroma of breakfast coffee and a loud resounding knock on the front door. Nancy answered it. A man with a charred brick in his outstretched hand framed the entrance way.

**See article by K9AZG entitled "Camouflage" October 1970 issue of 73*

"Good morning, m'am, some storm we had last night," he said in way of introduction. "I've been surveying the neighborhood for storm damage – it's my business, you know – lightning protection. You folks had a narrow escape, only lost a brick from your chimney – lucky! Could have been worse."

Jack had heard enough. He stormed toward the door shouting, "I don't believe it – I've heard about you fellows faking damage." He turned to Nancy and said, "I'm going up on the roof and see if a brick really is missing. However, when I get down, I suspect our caller will be the only thing missing."

Nancy appeared embarrassed. The caller appeared hurt but replied, "I'll wait." Ten minutes later a somber Jack faced Nancy.

"The man's right, Honey, a brick is missing!"

To the man: "Come in, Sir, and tell us what we need in the way of lightning protection!"

The man stayed about fifteen minutes – time for his sales pitch, a signed contract and a cup of coffee. After he had gone, they both sighed in nervous relief.

"To think," said Nancy, "we almost lost our house to lightning, when full protection can be had by a decorative flagpole lightning arrestor in the back yard!"

"I feel guilty too, Honey," said Jack, "now that I know my attic antenna contributed to the danger – I'll take it down." He lowered his head. The XYL was responsive, "Don't feel badly, Dear, remember the man said you could put an antenna on the flagpole and it would even increase our protection," she paused – "if you don't mind."

Some weeks later Jack was in QSO:

"K4SGO, this is W4CWB, how copy Marv?"

"W4CWB, this is K4SGO, Q5 S9+20, but cheapskate, when are you going to return the brick I used from my patio fireplace?"

Plan II

Plan II is tailored for a certain breed of impatient hams that will rush to the corner drug store to buy a tube on Sunday night rather than honorably scrounging same, or who can't wait for the proper climatic conditions to execute plan I. Fortunately, this plan is also foolproof and the XYL can be conned as easily as with the flagpole routine.

Seriously, have you ever seen an XYL that wouldn't like to have a better picture on the "boob tube." Of course you haven't!

And what is the average TV antenna installation? One driven element, fed with cheap 2¢-a-foot transmission line (and one parasitic element). Point out its ugly appearance on the roof! Exercise pride.

Take down this eyesore. Restore the graceful and clean architecture of your home. In extreme cases you can even cut the grass to impress on the XYL your sincerity for the "house beautiful."

Now that this blemish has been removed, buy the largest TV antenna you can find. Some of them are really massive. Be sure to assemble it in the living room, where it must remain (under any pretext) for at least 24 hours. This is important because you are psychologically conditioning the XYL to size. Be sure that the carton identifying the monstrosity as a TV antenna remains there, too.

Next, install the antenna on a tower that will later also support your beam. Be sure to mount the TV antenna at suitable height for good reception (but reserve the top spot for you-know-what!); then feed the antenna with high grade transmission line. The XYL will be both amazed and proud of her improved TV picture. Your image will improve too. She may even tell her mother that maybe her marriage wasn't a mistake after all.

Now for the ultimate camouflage! On the chosen day encourage the XYL to go on a little shopping spree. Now do your thing! Upon her return she will voice little or no opposition to your beam which incidentally will appear smaller (than hers) on top of the tower!

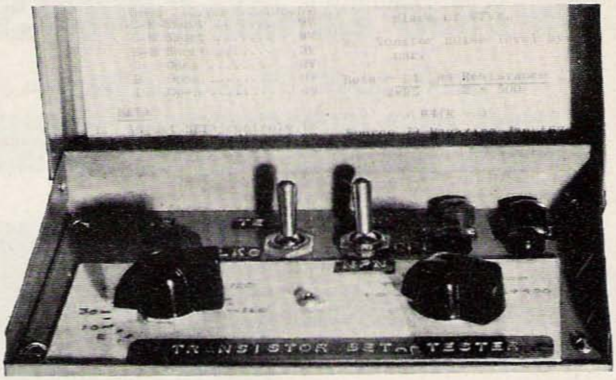
Plan III

Truly, this is for desperate cases, so upon request we will mail in plain brown wrapper . . . ...W4CWB■

Samuel C. Milbourne WB4ITN
4624 Daugette Drive N.W.
Huntsville AL 33805

FILE BOX

Transistor Beta Tester



Previous articles described two test units in a line of "file box" test equipment, so called because they all are housed in metal file boxes sold to hold 4 x 6 in. file cards.

This month, we have a convenient *transistor beta tester*. As Thorp[1] describes it, the main tests required to determine the adequacy of a transistor are:

1. Determine if NPN or PNP type.
2. Check for short between collector and emitter, collector and base, or base and emitter.
3. Look for open collector, base, or emitter.
4. Check the relative leakage of the transistor.
5. Determine the transistor beta (current gain).
6. Monitor the relative noise level by ear.

Previous design allowed testing of beta to 150. However, higher scale readings were noted and a range switch of plus 100, 200, 300, and 400 was added. By using this equation a fairly accurate tester will result (Fig. 1).

$$\beta = \frac{R4}{2 \times R5}$$

$$R4 = 150\ k\Omega$$

$$R5 = 500\ \Omega$$

Let us assume that we will vary R4 until the dc voltage V_e equals 2V. The resulting

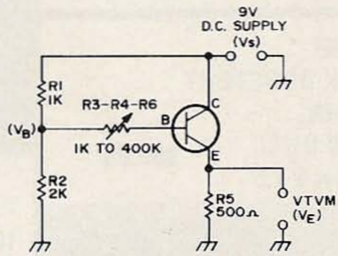


Fig. 1. Simplified Beta Test Circuit

resistance of R4 when divided by 1 kΩ (2 x R5) will result in the transistor current gain (in kilohms).

For example, after setting V_e at 2V for a specific transistor, by adjusting R4, you may have a total of 130 kΩ across R4. This is the direct equivalent of a beta of 130. You will be surprised how much several transistors of the same type will vary in beta. Now, you can determine which are the "hot" ones in a handful of transistors, all of the same type.

Look at **Fig. 1** again. This is a simplified circuit. It is a common-emitter type. The two resistors (R1 and R2) form a voltage divider across the 9V power supply. The point V_b will measure 6V to ground. Thus, with the variable resistance set at minimum, the transistor base-to-ground voltage will be 6V. There will be a drop of 0.3V (germanium) to 0.7V (silicon) across from base to emitter of the transistor. The remainder of the 6V will appear across

[1]**Thorpe, Darrel, *73*, Jan. 1967, p. 38.**

emitter resistor R5 (approximately 5.5V). By adding the 5.5 and 0.5V we get 6V, or 3V from base to collector.

If we change the variable resistor, we can change the ratio of resistance between the base and emitter resistors. By arbitrarily pegging R5 at 500Ω the beta will conform to the formula above. In practice, the variable resistor will be calibrated, with an accurate ohmmeter, to show beta.

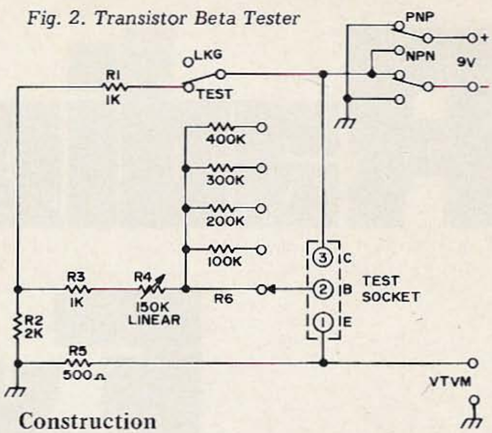
Figure 2 shows the actual transistor beta tester. You will see that either a collector-to-base, or a collector-to-emitter short will show a full power supply (9V) reading.

A base-to-emitter short will read 2V if the variable resistor is at minimum. Under this condition, R1 and R5 will then be a voltage divider across 6V, with 4V across R1 and 2V across R5. An open collector will produce the same reading. If either the base or the emitter is open, no voltage will result across R5.

A leakage test is performed by opening the supply voltage at R1. There will always be a small leakage which will result in no reading or a small reading. The lower the leakage, the lower the reading.

Whether the transistor under test is a PNP or an NPN type is easily determined by throwing the toggle switch to the position which results in a forward reading of the VTVM.

Fig. 2. Transistor Beta Tester



Construction

The first thing to do is to collect the necessary parts, as follows:

File box:

(1) File Box 4 x 6 x 4 1/2 in. Ohio Art Co. or equivalent.

(2) pcs. 1/2 x 1/2 x 1/16 x 4 in. of aluminum angle bracket. (Reynolds Aluminum #2406, old number #161, or equivalent.)

(4) Rubber feet with 6-32 mounting screws and nuts.

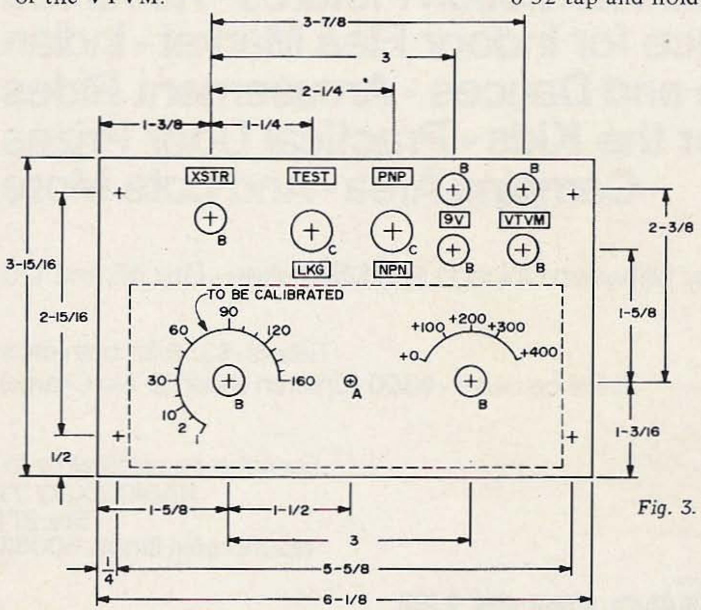
(1) Panel, aluminum, 6 1/8 x 3 15/16 x .030 in.

(8) Machine screws 6-32 x 1/4 in.

Miscellaneous tools and materials:

Twist drills (#25 and #35).

6-32 tap and holder.



HOLE CHART		
LTR	SIZE	QTY
A	NO. 25	1
B	3/8	6
C	1/2	2

Fig. 3. Front panel dimensions and markings.

Fine steel wool.
Alcohol (for panel cleaning, not internal comfort).
Zinc-chromate spray
Lacquer spray, RCA 222627
Tape embosser and tape.

Transistor Beta Tester:

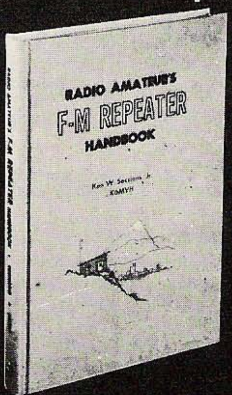
(1) Switch, 1 Pole, 5 position
(1) Potentiometer, 150 kΩ
(2) Knobs
(1) Switch, spdt
(1) Switch,dpdt
(2) Resistors, 1 kΩ
(1 each) Resistors, 500Ω, 2 kΩ, 100 kΩ, 200 kΩ, 300 kΩ, and 400 kΩ
(1) Socket, transistor
(1) Banana jack, red, with panel insulator
(3) Banana jack, black, with panel insulator
(1) Standoff, insulated lug

Assemble the file box by mounting feet 1/2 in. in from each corner. Mount the angles inside the box. Position them just below the top edge of the box and at each end. Detailed instructions on this and other construction can be obtained from the previous articles. The holes for the screws in the sides are 2 in. apart and centered. The tapped screw holes for the panel are positioned 3 in. apart and centered. The holes in the side are made with a #25 drill. Those in the bracket tops are made with a #35 drill and then tapped using a 6-32 tap. The panel is laid out and drilled or punched as shown in Fig. 3. Note that the 9V battery is shown as external to the unit. It can be mounted internally, but unless test units are to be used regularly, it is better to keep the battery external. You may also note that the picture showing the finished unit does not indicate the use of a transistor socket. The original idea was to provide several sockets in another case, but this proved cumbersome.

Before drilling or punching, always check your own parts to see that the required holes agree with those given here.

After drilling the panel, prepare it for painting and spray it as recommended in previous articles. Prepare the tapes as indicated by the picture and Fig. 3, and affix them as shown in Fig. 3. Take an index card cut to 2 3/8 x 4 1/4 in. and layout as

Want to know more about Repeaters?



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shown in Fig. 3. Use india ink or press-on numbers. The left-hand control will have to be calibrated by placing the card on the panel, attaching the pot and knob, and then, with an ohmmeter, mark out the kilohms.

Mount all the parts on the panel, including the insulated lug. Wire the unit, swinging the resistors between points as required. Before the tester is finalized, the white card on the panel may be sprayed with clear acrylic. Draw up the schematic and mount it under the unit on the box bottom. Use tape with adhesive on both sides or glue.

Finally, type or cut out the following and paste onto a 4 x 6 card and install it in the file-box top.

QUALITY

1. Set PNP-NPN switch to proper position.
2. Set *BETA* controls to zero.
3. Set *LKG-TEST* switch to TEST
4. Approx. VTVM Readings:

Good	5.5 v.
C-E Short	9.0 v
C-B Short	9.0 v.
B-E Short	2.0 v.
C Open	2.0 v.
B Open	0 v.
E Open	0 v.

BETA

1. Adjust *BETA* controls to a VTVM reading of 2.0 v.
2. Read beta directly by adding calibrated and switch control reading.

LEAKAGE

1. Reset *BETA* controls to zero.
2. Set *LKG-TEST* switch to *LKG*.
3. Observe VTVM reading.

NOISE CHECK

1. Connect headphones in place of VTVM.
2. Monitor noise level by ear.

$$\text{Beta} = \frac{R4}{2 \times R5} = \frac{R4}{2 \times 500} = R4 \text{ in Kilohms}$$

. . . WB4ITN■

Mark Hurwich WA2ITE
48 Manetto Hill Road
Plainview NY 11803

Call Sign Plaque

During my own rather short amateur career, I have met very few other hams who were not proud of being a radio amateur. To show the world their hard won prize, many invest a fair amount of money in some device which displays their call sign. Call sign plaques can often be expensive, but they need not be. You can make your own with very little effort and for a cost of only $2.50 (or even less).

To start, I purchased six "house letters" (the letters printed on a gold-anodized aluminum sheet, with an adhesive backing). These were 25¢ each, for the largest size (3½ in. high). A piece of ¼ in. plywood with a walnut veneer was obtained from the local lumber yard for 75¢, about 6 in. wide and 2 ft long. To leave a 1¾ in. border, slightly longer on the ends, it was then cut to 20 in. The corners were rounded, edges sanded, and finally the face was *gently* sanded (use fine paper – the veneer's only 1/32 in. thick!).

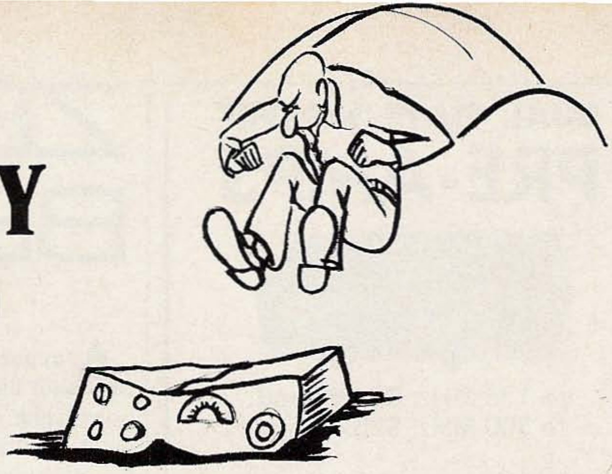
I chose to finish the surface "antique oil" (wax or shellac could do just as fine). The surface is waxed, shined, and then left to harden. A finish such as *Minwax Antique Oil Finish* is then applied over the wax, to be wiped off two hours later and buffed. This results in a beautiful soft finish, which completely dries in 24 hours.

The edges are next dyed the color of the veneer using (brown) shoe polish. The last step is merely to draw a centering line and mount the letters.

By the way, the same finish on a "hunk" of walnut makes a fantastic key base!

. . .WA2ITE■

PAGE SEVENTY THREE ACTION COUPON



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Your evaluation____

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Servicing problems? ____

Your recommendation: High☐ Okay☐ Poor☐ Very Bad☐ Or?_______

ZERO BEAT

Wm. Bruce Cameron
324 So. Riverhills Dr.
Temple Terrace FL 33617

Anyone who has ever operated in a net has complained about other stations being off frequency. Crystal control by itself does not help, both because of fine differences in crystals and gross differences in rigs. When you suggest adding padders to the rig some guys rebel for fear of hurting resale value, and others because there is just not enough room.

The easiest answer I have found is to attach a small ceramic padder directly to a FT 243 case, using a longer screw through one of the upper holes in the body and cover plate, as shown in the drawing. If you are issuing crystals to a net, you can prefabricate these little assemblies so all the operator needs to do is apply a screwdriver. If he is a genuine appliance operator you may also have to supply the screwdriver. When the crystal is changed to another rig, it can be readjusted to suit.

This method works so well I have also used it on one of my 2 meter FM rigs, which has socket provisions for only one crystal but which I like to operate on several frequencies. I removed the padder which was on the chassis and have a separate one mounted on each crystal. To the modern pushbutton set this may seem pretty strange, but for us old boys who used plug-in coils both in transmitters and receivers it seems merely a bit nostalgic.

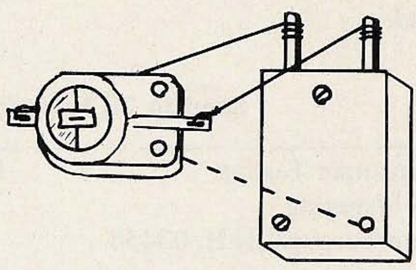
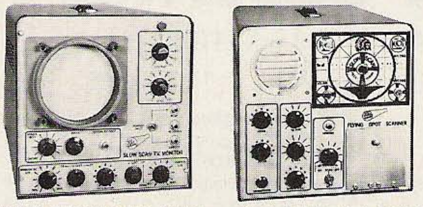


Fig. 1. Zero beat.

. . .WA4UZM■

SLOW SCAN TV



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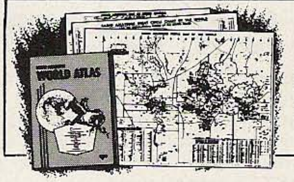

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The first amateur kilowatt transmitter I ever saw was 6 ft tall and weighed over a quarter of a ton. The SB-220 is 8 in. high and weighs less than 50 lb. The first kilowatt rig I ever built, around 1947, was 5 ft across and took four of us to lift onto the operating table. The SB-220 is only 15 in. wide and can be carried under one arm. We've gone a long way, guys, to get where we are today.

In the last few years, I've looked over all the popular linear amplifiers on the market and have wished many times that one was sitting on my desk. Until recently they were all out of reach; shoes and food for my five have first priority. I even made plans to build my own, but getting parts and finding time to build crossed that idea off my list. Then I saw the Heathkit linear and couldn't resist.

It took the truck lines over two weeks to get the SB-220 kit from Michigan to my location out here in the Mojave Desert in California. All this time they did their best to bust up the two cartons. They didn't get the job done, due to good Heath packing.

It sure was a happy day when my kit arrived. I canceled all plans for the weekend and spent the evening checking the parts list.

The electrical design follows what has almost become an amateur standard: broadband input, grounded grid, and pi-tuned output. You can get all the specifications and other good information from the Heathkit advertisements.

The mechanical design of this kit has been well planned. To get the power supply (which takes up one-third of the space) and the rf section in one little cabinet took a lot of careful planning. But they did it.

The assembly manual lives up to the Heathkit reputation of being the best in the business. One section in the manual that is very helpful consists of chassis photographs. I only wish a person could get real glossy prints so the details could be seen much clearer.

Safety is not left out. This high voltage could prove fatal. Not only do they provide a warning decal, but they designed an automatic discharge interlock that operates when the inside top panel is removed.

Bands: 80, 40, 20, 10m
Driving power: 100W
Duty cycle: Continuous
3rd order distortion: -30 dB
Output impedance: 50-75Ω unbal.
Power required: 120V at 20A or
240V at 10A, 50–60Hz
Cabinet size: 14 7/8 x 8 1/4 x 14 1/2 in.
Net weight: 47 lbs.
Heath Model Number: SB-220

Basic specifications

Construction was started on a folding card table and was all the space needed. Three muffin pans and a couple of cigar boxes, plus the packing boxes the kit came in held all the parts for easy accessibility. All the chassis photographs were removed from the manual and hung up for easy and quick reference. This helps in understanding the layout and detail drawings. No special tools are needed; I did use a pencil-type soldering iron with a small and large tip.

Carefully following the step-by-step assembly section of the manual, it took just under 20 hours to complete. Along with coffee and rest breaks, the weekend went by very fast. The "test and final assembly" section took another three hours. I ran into a few problems and made a list of things I would do differently next time. I had a chance to use this list when a doctor friend of mine asked me to put his together. It sure helped. I gave this list to a retired friend, and it saved him time and trouble the first time. (The list is available on receipt of SASE.)

Now came the problem that many of us have, and one of the reasons many amateurs feel a linear of this size is out of the question: ac power. The SB-220 will work on 120V, but requires a maximum of 20A. This is the most a 12-gage wired circuit can handle. What could be done is to operate the linear on one house circuit and bring an extension cord in from another house circuit to run the rest of the station. I live in a rented house, and this is what I did at first. I later ran a special extension cord to the clothes dryer outlet in the kitchen and picked up my 240V from there. We don't use a dryer here in the desert, so this made a good source of power. Keeping the cord out of the way required a few holes in the walls. Maybe an article on ac house wiring for amateurs would be a good thing to write about next.

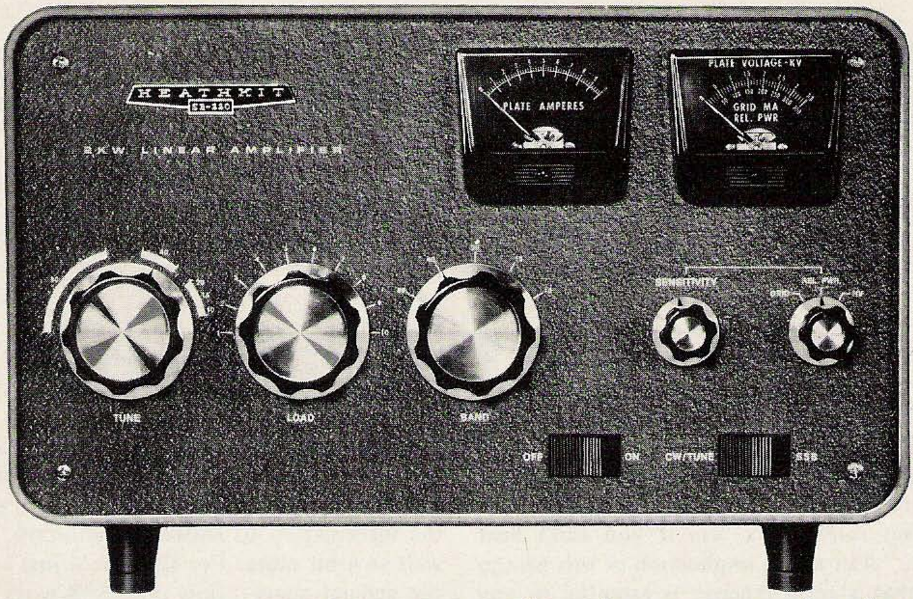
We moved to a new house since constructing the SB-220, and this time we had to wire in a new 240V line to the operating position. That cost over 40 bucks just in materials. The SB-220 runs best on 240V, and you fellows that have it in your shack or can have it wired in have no problem. If you wire it yourself, make sure the local electrical code is followed to the letter, for your own protection. My 80 and 40 meter inverted-V antennas worked fine on low power; but for this high power, I added insulators at the ends where the high voltage could cause trouble. This proved to be a good move, and it didn't change the loading a bit. The loading control knob on the SB-220 seems to be very broad, no matter which antenna is being used. Guess I'll have to get a Heath scope to make my tuning more precise. The only real trouble I've had in using the linear has been of my own making. I sometimes forget to change the bandswitch when I go from band to band. This hasn't hurt the linear, but it sure makes the output meter pointer swing wild.

I enjoy working barefoot, but there come times during net operations or running a phone patch that a linear makes operating pure pleasure. I don't go looking for DX, but when a distant station answers the first time, man that's living! I've had no trouble running it on reduced power for RTTY 15–20 minutes at a time – this beats their specs by 100%.

The only dislikes that I have are purely personal. To ship the SB-220, it must be packed in a special shipping box. The other is the size; in this area, it doesn't match the other SB pieces of equipment.

All in all, this unit is a wonderful buy, at 17½ cents a watt! Heath sells many of these kits. Buy yours now, before the price of materials make the kit price go up. I like my SB-220 – I'm sure you'll like yours.

. . .W6BMK■



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STUDY GUIDE GENERAL CLASS LICENSE

Part X: The Listening Post

One of the oldest sayings in radio (attributed by some to Signor G. Marconi in the years preceding 1900) is, "You can't work 'em if you can't hear 'em." The direct implication of this maxim is that a good receiver is essential to any ham station.

Not only is a good receiver essential, but the FCC requires that any aspirant for the General class license have some knowledge of what goes on inside that receiver. While only three questions on the official study list of questions to help in preparation for the license exam involve receivers, those three between them manage to require a fairly complete knowledge of receiver theory.

In this chapter we're going to tackle those receiver questions, and while we're at it we'll take up SSB (single sideband). This isn't as farfetched as it might sound, because the generation of an SSB signal is mighty like the reception of just about any kind of signal.

The FCC study list questions we will deal with are:

40. List the basic stages of a conventional superheterodyne receiver and tell what function each stage performs.

44. What are the basic stages of a single sideband (SSB) receiver and transmitter and what purpose does each serve?

46. What are "images" in a receiver?

For a start, how about "What kinds of receivers exist?" The answers to this will help put the requirements of the FCC questions into perspective, as well as providing groundwork for several parts of the detailed discussion later. Then we can look at "What makes up a superhet?" and get the information to answer question 40, as well as a bit more. For SSB, we'll just ask the general query "How does SSB work?" and get the required block diagrams of transmitters and receivers along with a view of how SSB fits into the general communications picture. Finally, we'll try to determine "How is receiver performance rated?" This question might easily be considered first, but the ratings make more sense when the attributes being rated have some meaning.

We're biting off quite a mouthful for this chapter, so let's get right to chewing it up. If you're ready, let's go.

What Kinds of Receivers Exist?

The earliest kind of radio receiver on record was a device which today would startle almost anyone involved with electronics. It was "a circle which could be rotated within itself . . . made of copper wire 1 mm thick, and had a diameter of only 7.5 cm. One end of the wire carried a polished brass sphere a few millimeters in diameter; the other end was pointed and could be brought up, by means of a fine screw insulated from the wire, to within an exceedingly short distance from the brass sphere."

This receiver was used in 1888 by 31-year-old Heinrich Rudolph Hertz (the man for whom the unit of frequency is named) to demonstrate the existence of "distinct rays of electric force" carried without wires, through space. The quotations are from his own description of the experiments, published in December 1888. The copper-wire loop was the complete receiver; the accompanying transmitter was a sparkgap arrangement, and the maximum distance between transmitter and receiver was limited to about 5 ft (when everything was working perfectly, amazing DX of 6 ft could be achieved).

After Hertz' experiments demonstrated the existence of radio waves, Marconi developed a communication system around them. The Marconi system used a "coherer" as the main part of the receiver; this was much more sensitive than Hertz' loop-and-sparkgap, but still nothing compared to today's apparatus.

By the time amateur radio began to become popular, the coherer was on its way out, having been replaced by the much-more-sensitive galena crystal. This was a first cousin to today's semiconductor crystal diodes, and operated in essentially the same fashion (but for more than 20 years no one suspected as much). Finally, during World War I, the vacuum tube came into use for radio reception, and a young Signal Corps major named E. H. Armstrong invented, in order, the regenerative receiver, the superregenerative receiver, and finally the superheterodyne circuit. The superhet is still the standard receiver circuit, although transistors and integrated-circuit chips are replacing the vacuum tubes Armstrong knew.

Despite the almost universal use of the superhet for serious communications today, the diode, regenerative, and superregen circuits are still very much with us. The popular "Twoer" and "Sixer" transceivers from Heath use superregen receivers, and most superhets include at their core at least one diode detector which is a direct descendant of the ancient "crystal set." Regenerative circuits are popular for beginners' construction projects and can deliver amazing performance with a minimum of components.

All these receiver types so far are for AM reception. For CW, the regenerative and superhet circuits work nicely. The diode circuit and the superregen do not produce easily audible output from CW signals; the crystal set worked on the CW of its day only because the output of a sparkgap transmitter was not a clean CW signal, but instead was a raucous buzz (or smooth whine if the gap was driven by an alternator or used a rotary gap arrangement, as some of the large commercial installations did).

Almost all FM receivers are of the superhet variety, although a superregen will operate nicely on FM and even a diode circuit can perform creditably.

The modern standard, as we said, is the superhet. These come in several types, and we'll find out more about them in the next section.

What Makes Up a Superhet?

Before we can get very far in finding out what goes into a superhet circuit, we must look at receiver circuits in general. This, in turn, is going to take us back in places to the subject matter of our previous chapter, modulation.

For now, incidentally, we'll only be examining receivers for AM signals. Once we have them down cold we can proceed to the features required for other types of modulation.

The simplest practical receiver for today's signals is the diode detector, shown stripped to its basics in Fig. 1. It will work just this way, too, if you care to try it. Incoming rf picked up by the antenna must pass through the diode and the capacitor (the inductance of the headphones acts as a choke) to reach ground. The diode, how-

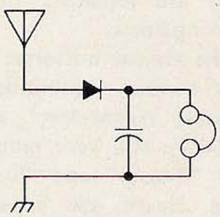

Fig. 1. Simplest radio receiver consists only of antenna, ground, diode, capactior, and earphone connected as shown.

ever, permits current flow in only one direction and blocks any reverse current flow. This results in production of a charge across the capacitor which follows the *peak* values of the radio-signal envelope waveform. The headphones are operated by this voltage. Fig. 2 shows the waveforms and brings out how the rectifying action of the diode causes the modulation envelope to be reproduced across the capacitor.

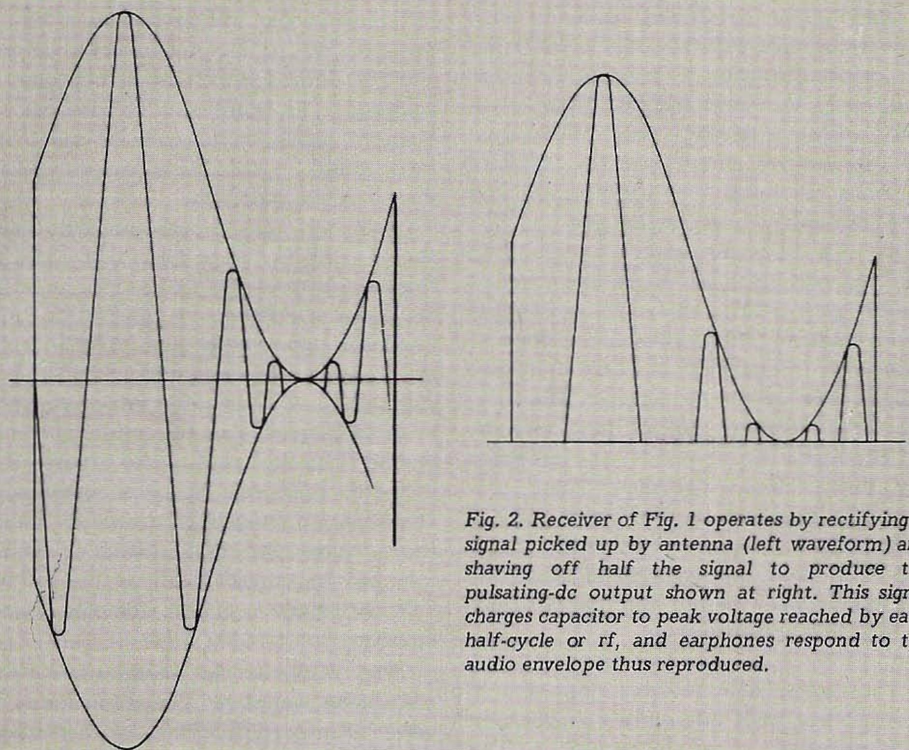

Fig. 2. Receiver of Fig. 1 operates by rectifying rf signal picked up by antenna (left waveform) and shaving off half the signal to produce the pulsating-dc output shown at right. This signal charges capacitor to peak voltage reached by each half-cycle or rf, and earphones respond to the audio envelope thus reproduced.

Such a receiver as this will have little or no selectivity. That is, it will receive *all* radio signals which reach it. Most will not produce enough power across the capacitor to operate the phones, so if you try it you probably will get only the strongest broadcast station in your area (and if you live more than 15 to 20 miles from the transmitter, you may not get even that). Some degree of tuning is provided by the antenna, but that's the only control over what you get.

Obviously, this simple circuit suffers from three major problems. It is not very sensitive (cannot pick up weak signals), has poor selectivity (cannot separate a single signal from all the rest), and has low output (earphones only, and no control of volume).

Selectivity was improved in crystal-set days by adding tuning circuits between antenna and detector. As many as three or four separate tuned circuits were found in the fancier sets, and they helped to shave reception down to the desired signal. However, they could not produce enough selectivity to separate two signals only a few kHz apart – and they did nothing for sensitivity or output.

It took the vacuum tube to do much for receiver performance in the areas of sensitivity and output volume. The amplification made possible by the tube could be used at either radio frequency, to provide added sensitivity by producing a stronger signal to the detector than the antenna alone could produce, or audio frequency following the detector, to provide louder output. Normally it was used both places – and still is.

Early vacuum tubes were expensive, and experiments were hard-pressed to obtain more than one at a time. Ingenious circuits were devised to permit this one tube to amplify the signal at rf, then detect it, and amplify the resulting audio some more, all in the same stage.

Then Major Armstrong came up with the regenerative detector, which made use of positive feedback to produce both exceptionally high gain and very sharp selectivity within a one-tube stage. For years, the regenerative circuit was the standard for both amateurs who could afford the tube, and commercial installations.

By this time researchers had realized that the particular set of problems represented by a radio receiver had no simple direct solution. Radio communications require high frequencies, but amplifiers give greatest gain at low frequencies. Similarly, selectivity requires sharp tuned circuits, but the higher the frequency the less sharp any tuned circuit becomes. These problems, as much as anything else, limited early radio to frequencies below the upper end of today's broadcast band. Available receivers simply would not operate properly at higher frequencies.

The regenerative receiver amounted to an oscillator with not quite enough feedback provided to sustain oscillation. This gave extreme gain and excellent selectivity. By this time, CW transmitters were replacing the noisy sparkgaps, and the regenerative receiver also turned out to be excellent for receiving CW signals (which the diode detector simply could not detect). All that was necessary was to push the receiver just over the line into oscillation; the oscillating receiver was then tuned to a frequency just a few hundred cycles off from that of the transmitter. The receiver's own rf mixed with the incoming rf from the transmitter to give a "beat note" or "heterodyne" signal equal to the difference between receiver and transmitter frequencies, and this pure tone was easy copy. This technique was known as "heterodyne reception".

While serving overseas during World War I, Major Armstrong had what was probably his most important of many new ideas. He saw how to eliminate all the problems of reception by applying the heterodyne principle in a new way. Rather than offsetting local and received frequencies by an amount in the audio range as was done for heterodyne reception, why not make the difference come out in the lower end of the rf range, at a point where good gain and the desired selectivity could easily be achieved. The resulting "intermediate frequency" signal could then be redetected into audio, after being amplified and shaved down as desired.

That was the "superheterodyne" idea, and it's still in use in essentially the same form its inventor first conceived. A superhet today will have, as a minimum, a local oscillator to provide the offsetting frequency, a mixer stage to combine the local and signal frequencies into the intermediate frequency or i-f, an i-f amplifier, a second detector, and audio stages. Most will also have one or more stages of rf amplification preceding the mixer (sometimes called the first detector), and if intended for communications use, will provide heterodyne action for the second detector.

Fig. 3 shows the stages of a single-conversion superhet communications receiver. The purpose served by each stage is described in the following paragraphs.

The rf amplifier's primary purpose in superhets operating below the VHF range is to isolate the local oscillator from the antenna and thus prevent interference by the receiver to other receivers. At VHF, the rf amplifier serves primarily to boost the signal strength and thus help overcome noise problems, but at HF and lower frequencies ample gain is available in later stages.

The local oscillator provides the "offset frequency" signal and thus controls the receiver's tuning. The receiver will pick up only signals which are separated from the local-oscillator frequency by the amount of the i-f frequency, and so changing the frequency of the local oscillator changes

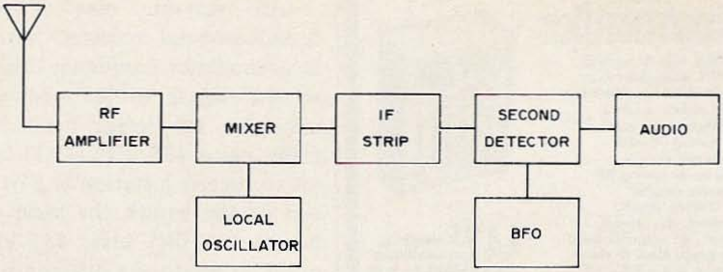

Fig. 3. Basic stages of a conventional superheterodyne receiver are shown here and described in text. Rf amplifier and bfo are not normally included in non-communications superhets for entertainment use, but are considered essential in quality communications receivers.

the frequency to which the receiver is tuned. The local oscillator must be stable; that is, its frequency must remain constant once set. Otherwise the receiver will "drift" off frequency and will require frequent retuning.

The mixer or "first detector" operates in the same manner as the amplitude modulator we examined in the last chapter, combining two input signals at different frequencies to produce four output signals which are at the two original frequencies, their sum, and their difference. Most often only the difference frequency is of interest. The mixer actually gets many more signals in, and produces many more out, because all the signals which make it through the rf amplifier stage are acted upon by the mixer. The relative frequency difference between different signals is much greater at the output than at the input, however, because the mixer essentially subtracts a constant (the local oscillator frequency) from each of its input signals.

The i-f strip is the heart of the superhet receiver. This block consists of one or more stages of rf amplification, operating at a fixed and relatively low frequency. For many purposes, the standard intermediate frequency is 455 kHz. At this low frequency, very sharp selectivity may be attained, yet good gain is still possible. The i-f amplifiers are set to one frequency and left there (a process called "alignment"), and thus the receiver's gain and selectivity are the same at any frequency within its tuning range. Because of its selectivity, the i-f strip accepts only one of the many signals appearing at the mixer output; all the rest are eliminated, but the one signal accepted goes on through and is amplified to respectable strength before reaching the second detector.

The second detector is essentially the same as the simple diode detector of Fig. 1; since both sensitivity and selectivity have been provided by the preceding stages, the only function of this stage is to convert the i-f signal into audio.

For reception of CW and SSB signals, a beat frequency oscillator (bfo) may be provided. This oscillator produces a signal offset from the i-f by a difference within the audio range; normally, it includes a "pitch control" which adjusts its output frequency to fall either side of the i-f. The bfo output is fed to the second detector along with the i-f when heterodyne reception is desired. In more recent designs, the bfo is sometimes included as part of a separate "product detector" circuit which is switched in to replace the second detector for heterodyne reception. We'll look at this more closely in the next section.

Once the incoming signal is converted to audio by the second detector or its equivalent, the audio is then amplified to drive a loudspeaker (if desired) by the audio section.

Everything has a price, and the performance of the superhet is no exception. Since the basic principle is that of converting an incoming signal to an intermediate frequency by mixing action, which produces both a sum and a difference signal, it's possible to receive two different signals simultaneously with a superhet. Such action is called "image" reception.

An example may make it clearer. Broadcast-band receivers usually have the local-oscillator frequency higher than that of the signal to be received (partly to minimize the image problem), and normally use a 455 kHz i-f. Thus when one is set to receive a station at 610 kHz (the low end of the band), the local oscillator will be set to 1065 kHz, 455 kHz higher, in order to produce a difference frequency of 455 kHz.

Unfortunately, with the oscillator at 1065 kHz, any incoming signal at 1520 kHz which happens to reach the mixer stage will also produce a 455 kHz output (1520 – 1065), which the i-f stage will not be able to distinguish from the desired signal. Thus the 1520 kHz signal can and will interfere with the desired one at 610 kHz.

The characteristic of image reception is that the undesired signal is always separated from the desired one by twice the i-f, and is on the other side of the local-oscillator frequency.

Another aspect of the image problem, which shows up on many inexpensive ham receivers, is the possibility of tuning the same signal in at two places on the dial. To reverse our previous example, you could tune in the 1520 kHz station either at its true frequency of 1520 kHz, or at the image point 910 kHz lower, 610.

As the signal frequency gets higher, with a constant i-f, the separation between true and image points becomes proportionately smaller. In the 40 meter band, for instance, 8 MHz commercial signals show up on top of 7 MHz ham signals, and the ham signals themselves can also be tuned in around 6 MHz if you like. By the time you get to the 10 meter region, ham signals at 29.5 MHz can be causing interference with other ham signals around 28.59 MHz.

Since the separation between true and image points is always twice the i-f, one solution to the image problem is simply to use a higher i-f. If the i-f is raised to 1600 kHz, for instance, the true and image points will be separated by 3.2 MHz, and then a single rf stage ahead of the mixer normally will reduce the image response to the point that it is not objectionable.

Unfortunately, the higher the i-f, the poorer the sensitivity and selectivity of the receiver.

One of the more ingenious solutions to this problem was the invention of the "double superhet" or "double conversion" system. This is essentially two superhets end to end, with the mixer of the second taking the place of the second detector of the first as shown in Fig. 4.

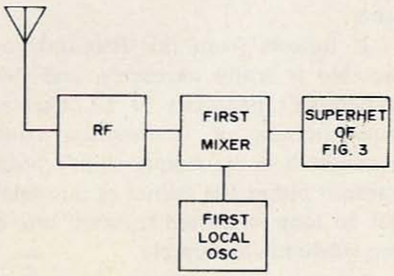

Fig. 4. Double-conversion superhet duplicates "front-end" circuitry of single-conversion superhet, then uses entire single-conversion superhet at output of first-mixer. Resulting composite circuit has two local oscillators, two mixers, and two i-f strips (rf stage of single-conversion receiver becomes first i-f of double-conversion circuit). Advantage is improved image rejection because first i-f can be relatively high frequency, while maintaining selectivity and gain with low-frequency second i-f.

The first i-f is picked for best image rejection, while the second is chosen for gain and selectivity. One popular receiver using the double-conversion principle used 1825 kHz as the first i-f, and converted this down to 85 kHz for the second to achieve high selectivity.

When double conversion is used, either the first or the second conversion oscillators may be tuned. Use of a VHF converter ahead of a tunable communications receiver is an example of double conversion with the second oscillator being tuned; the converter produces an i-f between 14 and 18 MHz, for instance, and the receiver then tunes over this band. Many high-performance receivers now make use of double conversion with tunable second oscillators in order to achieve high stability in frequency, and to get the same tuning rate on each band covered (since the tuning is always the same).

How Does SSB Work?

In the preceding chapter we made the acquaintance of "sidebands" and found that sidebands are necessary in any kind of modulated signal – in fact, that sidebands carry the information which composes the "modulation" of that signal.

We also saw that any modulated signal has two sidebands, one on either side of the carrier, which are mirror images of each other.

It follows from this that only one of the two is really necessary, and that the carrier isn't necessary at all. That is, the same amount of information could be transmitted if we simply didn't bother to transmit either the carrier or one sideband, just so long as we did transmit one of the two sidebands accurately.

Since with AM modulation the limit of 100% modulation is reached (with sinewave signals) when the modulating signal has half as much power as the carrier wave, and since this modulating signal's energy is split between the two sidebands, that means that ¾ of the power transmitted from an AM station is useless; all of the information can be recovered properly from one sideband, which represents only 250W of the power transmitted from a 1 kW transmitter.

That's what SSB is all about – the technique of taking advantage of these facts, to achieve that 4-to-1 power advantage by concentrating all the transmitted power in the only meaningful part of the signal, and simultaneously to conserve space in the rf spectrum by holding the bandwidth of the signal down to half that of a conventional AM transmission.

Unfortunately, doing so is not so simple as we may have just implied. Getting rid of the carrier and one sideband requires special circuitry in the transmitter, and in addition SSB signals cannot be received as simply as can those from ordinary AM stations. The missing carrier must be put back into the signal at the receiver in order to recover the audio, and that's a bit of a job.

SSB has been in use since 1927, but until 1948 was applied only to commercial telephone communications. The first ham station to use SSB was apparently W6YT, the Stanford University club station, but within a matter of weeks after W6YT appeared with SSB a number of other stations followed suit. Today, SSB is rapidly approaching the state of being the "standard" means of voice communication on HF ham bands.

A number of factors combined to produce the 21-year delay between first use of SSB and hams' acceptance of the technique. Most of them boiled down to the fact that at first, it was simply not simple enough to be practical for the vast majority of hams. Costly installations and special equipment were required. The advances in radio technique during World War II changed this situation and made it practical for hams to take up SSB operation.

Still, SSB is nowhere near as simple as ordinary AM, either to generate for transmission, or to receive. In addition to all the functions of a normal AM transmitter, the SBB transmitter must include facilities for removing the carrier and unwanted sideband from the signal. These normally operate properly only at low signal levels, and once the signal is converted into SSB it cannot be amplified by normal rf power amplifiers (which would introduce distortion). This introduces the requirement for linear amplifiers, which are more difficult and critical to adjust than are ordinary class C stages.

Once the signal is generated and transmitted, it must be received. Frequency stability is necessary in an SSB receiver, because a drift in receiver tuning of as little as 20 Hz is noticeable, and a 100 Hz drift renders the signal unreadable in most cases. The receiver must, in addition to having high stability, include provisions for putting the carrier back into the signal for detection, and this means that heterodyne reception is necessary.

Let's look at the requirements for both generation and reception of SSB signals, now that we have a general idea of how they differ from conventional AM techniques. We'll take the transmitter first.

Figure 5 shows a block diagram of a

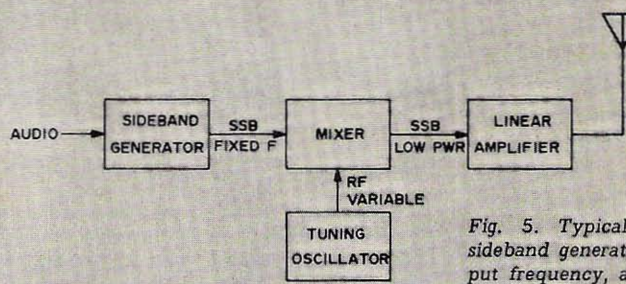

Fig. 5. Typical SSB transmitter consists of sideband generator, provisions for changing output frequency, and linear amplifiers. See Figs. 6 and 7 for details of sideband generators.

typical SSB transmitter, contrasted with that of a typical AM transmitter. The difference in complexity is obvious.

In the SBB transmitter, the audio is applied to a sideband generator stage where it is converted to an rf signal which reproduces the audio at some radio frequency. This is done by a variation of the normal AM process, but the carrier and unwanted sideband are removed before the signal gets out of the sideband generator. Output of the sideband generator is an SSB signal, but is not necessarily at the desired signal frequency because it turns out to be much simpler to always generate the SSB signal at the same frequency, and then translate it by a mixing operation to the desired frequency for transmission.

Sideband generator output, therefore, is applied to a mixer stage, and an output-frequency tuning signal is applied to the mixer's other input. This output tuning signal may be obtained either from a fixed-frequency oscillator such as a crystal circuit, or from a stable vfo. The mixer's output includes an SSB signal at the desired output frequency, which is selected and amplified to the output power level by means of linear amplifiers.

The sideband generator stage is the heart of the SSB transmitter, and warrants additional examination. At least three different techniques for sideband generation are known, but only two of these are used in practice. They are known as the "filter method" and the "phasing method."

Both the filter and phasing methods make use of "balanced modulator" circuits, which are special types of mixers which eliminate one of the two input signals from their outposts. These balanced mixers are usually set up to eliminate the carrier signal, because the audio signal (at a far different frequency) can easily be rejected by tuned circuits. Output of an SSB balanced modulator, then, usually consists only of the two mirror-imaged sidebands which result from the mixing process.

Figure 6 shows a block diagram of a filter-method sideband generator. Incoming audio and the rf carrier signal are applied

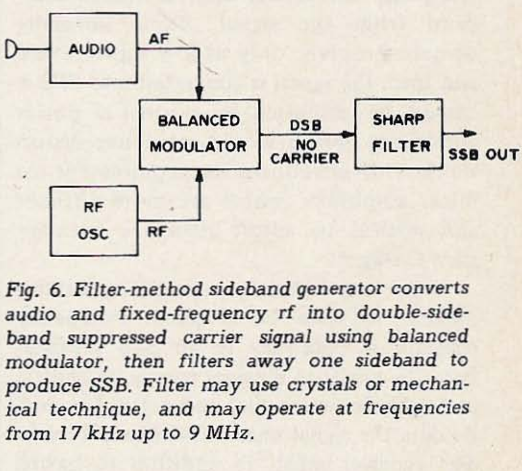

Fig. 6. Filter-method sideband generator converts audio and fixed-frequency rf into double-sideband suppressed carrier signal using balanced modulator, then filters away one sideband to produce SSB. Filter may use crystals or mechanical technique, and may operate at frequencies from 17 kHz up to 9 MHz.

to a balanced modulator, where the original signals disappear. Output of the balanced modulator is a double-sideband (DSB) signal with both carrier and audio suppressed. This DSB signal is then passed through an extremely sharp filter, which shaves off one of the two sidebands, and passes the other relatively unaffected. Output of the filter, therefore, is the desired single sideband signal.

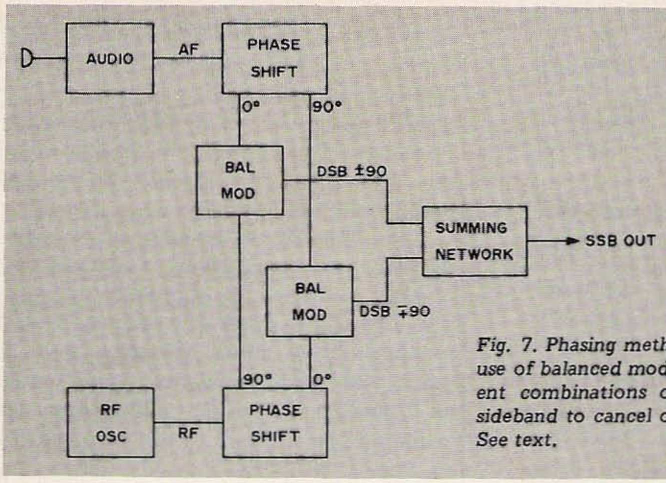

Fig. 7. Phasing method of SSB generation makes use of balanced modulators operating with different combinations of input signals forcing one sideband to cancel out in the summing network. See text.

The phasing method (Fig. 7) is more complex, but eliminates the need for the sharp (and costly) filter. Incoming signals, both audio and rf, are applied to phase-shifting networks. The phase shift networks produce pairs of outputs, which are identical except that they differ from each other in phase by 90 degrees.

One audio-rf pair is applied to once balanced modulator, and the other pair goes to a second balanced modulator. Outputs of these two balanced modulators are double sideband signals.

The balanced-modulator outputs differ from each other in phase, however. Because of the phase shift introduced into the signals before mixing, one sideband (either the upper or the lower one) will have the same phase in both modulator outputs, while the other sideband will have a 180-degree phase difference between one modulator output and the other.

The two outputs are combined in a summing network, where the sideband with no phase difference survives while the one with 180-degree phase difference cancels itself out. The output of the summing network is, therefore, the desired single sideband signal.

Both the filter method and the phasing method have advantages and disadvantages. The filter is simpler in concept, but requires components which are usually more costly. On the other hand, phasing is less expensive but requires more critical adjustments. Either technique is capable of producing outstanding results – or garbage, depending upon the skill and care of the operator.

Once the sideband generator produces an SSB signal, regardless of the method used to obtain it, the mixer (Fig. 5) translates it to desired output frequency and its power level is determined by linear amplifiers.

Now that we understand how SSB is generated and transmitted, let's look at how it is received:

Almost any receiver capable of copying CW signals *can* be used for SSB reception, but for generally satisfactory results an SSB receiver should have high frequency stability, a slow tuning rate, and sharp selectivity. We've already seen why stability is required. The tuning rate goes right along with it; when a 20 Hz error causes distortion, you want to be able to make fine tuning adjustments slowly.

The selectivity is required in order to take maximum advantage of SBB's narrower bandwidth. Best use is made of a signal if the receiver bandwidth exactly matches that of the signal, because if the receiver covers a wider band than the signal occupies, the leftover space will contribute noise to the receiver's input and thus degrade total performance.

The receiver must be capable of heterodyne reception to recover the audio from the SSB signal. Detection, like modulation, is actually a mixing process. In a conventional AM detector, the sidebands are mixed with the carrier, and the difference frequency (which is the audio involved) is taken as output. Since the SSB signal has no carrier to mix against, an external carrier must be supplied.

SSB forced recognition of the basic identity of modulation, detection, and mixing – and led to improved techniques for detection when the principles long established for mixer operation were applied. The resulting circuits are now known as "product detectors" and provide outstanding performance forboth CW and SSB signals.

A good agc system is convenient to have in an SSB receiver, because the signal strength varies widely and rapidly. This creates some problems, because conventional AM receivers drive their agc (sometimes called avc) systems with a signal derived from the carrier strength (the same signal drives the S-meter), and SSB has no carrier. The problems have been solved in many different ways, and again CW operators as well as SSB users have benefited.

The block diagram of a typical single-conversion selectable sideband receiver intended for AM/SSB/CW operation is shown in Fig. 8. The circuit may be compared with Fig. 3, which shows the conventional version of a similar receiver. You can see that the sideband receiver contains all the functions required for ordinary reception, and merely adds a few new ones to handle SSB.

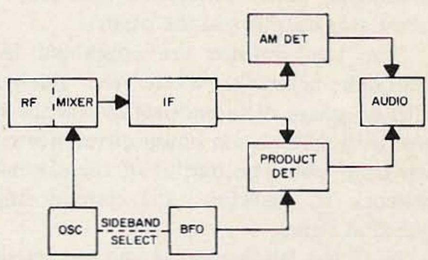

Fig. 8. Selectable sideband receiver shows great similarity to ordinary receiver (Fig. 3), but with added extras to facilitate SSB reception. Actually, any receiver capable of receiving CW can tune in SSB, but extra features shown here are needed for extended use.

The purposes served by these added functions have been indicated in the preceding paragraphs. Naturally, many more functions *could* be added. For instance, most selectable sideband receivers involve double-conversion techniques to achieve sideband selection. For this, add the features of Fig. 4.

How Is Receiver Performance Rated?

Now that we know all that we need to at this stage about both receivers and SSB operation, let's look at the factors by which various receivers are rated and compared with each other.

We've been using some of these factors all the way through without bothering to specifically define them. This is the point at which we will rememdy that situation and provide definitions.

The three major performance points involved in rating receivers are (1) sensitivity, (2) selectivity, and (3) stability.

Sensitivity is a measure of how weak a signal can be received, or to put it another way, of how strong a signal must be in order for the receiver to pick it up. Different techniques for measuring sensitivity are used in different parts of the frequency spectrum. In the normal ham bands, a measurement of signal level in microvolts (μV) is about as frequently encountered as is any other rating. The smaller the rating, the more sensitive the receiver. That is, a receiver rated at 1 μV sensitivity is ten times as sensitive as one rated at 10 μV, all other conditions remaining equal.

It's necessary to be cautious in comparing receiver sensitivity ratings, though, because the "microvolt" rating is meaningful only when the impedance across which this voltage is to be measured is specified. For instance, a receiver rated at 10 μV across 300Ω does *not* have the same sensitivity as one rated at 10 μV across 75Ω. The first receiver is four times as sensitive as the second, because when impedance is stepped down so is the voltage, and 10 μV at 300Ω is equivalent to 2.5 μV at 75Ω.

Selectivity measures the receiver's ability to separate signals which are close to each other in the spectrum. Again, there are many different ways to rate this ability. The normal way is to specify a bandwidth, or two bandwidths, together with a rejection level. If only a bandwidth is given, the rejection level is normally understood to be 3 dB or 70% voltage (half power).

Thus a 10 kHz bandwidth rating for selectivity does not mean that a signal 11 kHz away will be totally rejected. It means only that signals 10 kHz from the frequency to which the receiver is tuned will be reduced in strength to 70% voltage or half power.

If 6 dB bandwidth is rated at 6 kHz and 60 dB bandwidth is rated at 12 kHz, though, excellent selectivity is indicated. This says that signals 6 kHz away from center frequency will be cut to half voltage, and those just twice that far away will be trimmed to 1/1,000,000 their voltage level. This amounts to complete rejection, in most cases.

Another facet of selectivity has to do with "image rejection." This is a quality unique to superhet circuits, which we met earlier. Image rejection is usually rated in dB, and refers to the amount of rejection of the unwanted or "image" frequency which is achieved. Anything better than 60 dB is excellent; many good receivers do not exceed 35 dB image rejection.

Stability, the final major performance point, refers to the receiver's ability to stay tuned to one spot over a period of time as the equipment heats up during use. Stability is often rated in terms of frequency drift, which in turn is usually quoted as so many cycles per unit of time. For instance, some receivers are rated for frequency stability "better than 20 Hz per hour," which says that this receiver will remain within 20 Hz of the spot to which it is tuned for at least an hour without readjustment of the tuning controls.

Less major performance points, but still important rating factors, include such items as the frequency coverage of the receiver, its power requirements, nature and level of audio outputs, etc.

Communications receivers usually come in one of four main categories with respect to frequency coverage. Commercial users often employ fixed-frequency receivers, which are permanently tuned to a single frequency. These find little use in ham work except for the VHF FM nets operating on a basis similar to police or taxicab radio dispatch networks.

In addition to the fixed-frequency group, receivers may be "general-coverage," "continous coverage," or "ham band only." Inexpensive receivers are often general-coverage types, enabling reception of SW bands other than ham bands. The ham-band-only receiver, being designed to cover a smaller frequency range, often gives more performance per dollar since the design need make fewer compromises. Price is usually higher, however, because of limited demand for these units in comparison to the market for general entertainment receivers. Continuous coverage receivers are seldom seen; they provide complete coverage of their portions of the rf spectrum with no omitted regions. Normally these are laboratory instruments. Some military receivers, however, are of the continuous coverage type, and occasionally appear in surplus and so reach the ham market.

Rating for power requirements and audio output is self-explanatory. These ratings must be compatible with your desires, or the receiver won't do you much good. It's worth noting that most better receivers do not provide a loudspeaker as standard equipment; it's an extra-cost option, because for many communications uses the speaker is unnecessary – and when it is, its characteristics may vary from job to job. . . .Staff■

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INDIA	14	14	7B	7B	7B	7B	14	14	14	14	14	14
JAPAN	14	14	7A	7	7	7	7	14	14	14	14	14
MEXICO	14	14	14	7A	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	7A	7B	7B	7B	7B	7B	14	14	14	14
PUERTO RICO	14	14	7	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7B	7B	7	7	7B	14	14	14	14A	14A	14	14
U. S. S. R.	14	7	7	7	7B	14	14	14	14A	14A	14	14
WEST COAST	14	14	14	7	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7A	7	7	7	7	7A	14	14	14
ARGENTINA	21	14	14	14	7	7	14	14	14	21	21	21
AUSTRALIA	14	14A	14	14	7B	7B	7	7	7	7B	14	14
CANAL ZONE	21	14	14	14	7	7	14	14	14	14	21	21
ENGLAND	14	7A	7	7	7	7	7A	14	14	14	14	14
HAWAII	14A	14A	14	14	7A	7	7	7	14	14	14	14
INDIA	14	14	14	7B	7B	7B	7B	7B	14	14	14	14
JAPAN	14	14	14	7A	7	7	7	7	14	14	14	14
MEXICO	14	14	7A	7	7	7	7	7A	14	14	14	14
PHILIPPINES	14	14	14	7B	7B	7B	7B	7B	14	14	14	14
PUERTO RICO	14	14	14	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7B	7B	7	7	7B	7B	14	14	14	14	14	14
U. S. S. R.	14	7B	7	7	7	7	7A	14	14	14	14	14

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7	7A	14	14	14
ARGENTINA	21	14	14	14	7	7	7	14	14	14	21	21
AUSTRALIA	21	21	21	14	14	14	7	7	7	7B	14	21
CANAL ZONE	14	14	14	14	7	7	7	14	14	14	14A	14A
ENGLAND	14	7A	7	7	7	7	7	7A	14	14	14	14
HAWAII	21	21	21	14	14	14	7	7	14	14	14	14A
INDIA	14	14	14	14	7B	7B	7B	7B	14	14	14	14
JAPAN	14	14	14	14	14	7A	7	7	14	14	14	14
MEXICO	14	14	14	7A	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	14	14	7A	7B	7B	14	14	14	14
PUERTO RICO	14	14	14	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7B	7B	7	7	7B	7B	7B	14	14	14	14	14
U. S. S. R.	14	7B	7B	7	7	7	7	7B	14	14	14	14
EAST COAST	14	14	14	7	7	7	7	14	14	14	14	14

A = Next higher frequency may be useful also.
B = Difficult circuit this period.