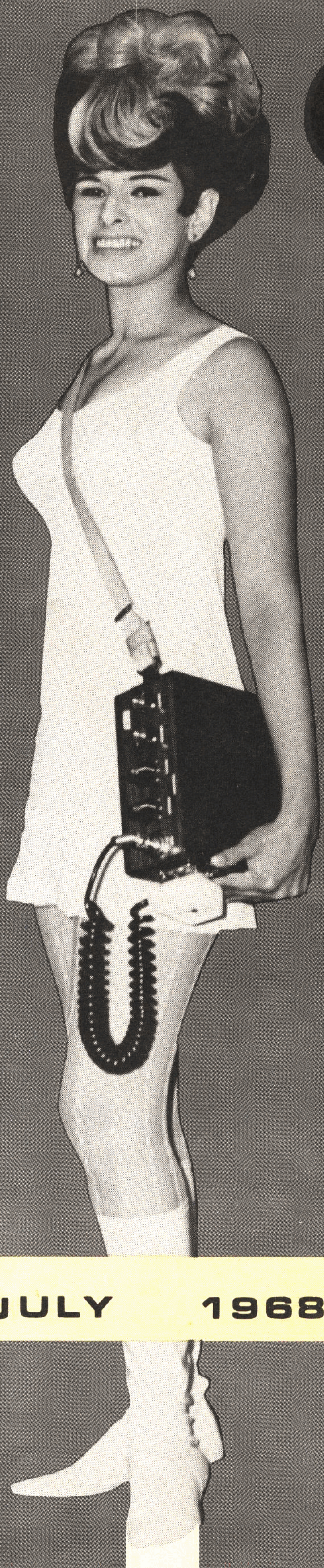
FM

volume 2, number 6



IN
THIS ISSUE

LICENSING

REMOTE PHONE

DESENSITIZATION

DIGITAL ENCODER

35c

A

STUPENDOUS

REPEATER

ISSUE

JULY 1968

SO YOU WANT CRYSTALS FASTER!

24

HOUR DELIVERY ON ALL ORDERS OF TEN CRYSTALS OR LESS

...well it will take someone with manufacturing *"know how"* to do it

But of more importance the crystal must be manufactured to Strict Specifications, have good activity and operate ***"on frequency"*** in the circuit for which it was ordered.

SENTRY can manufacture crystals for all two-way radio equipment: Commercial, Amateur, Aircraft, Military and Citizen Band. You need only to specify the model of set and channel frequency.

You don't believe it, when we say - *"Buy the Best"*?

You are satisfied with your present supplier?

You are satisfied with high prices?

You are satisfied with *"second best"*?

Until you try **SENTRY** you will never know!

Try Us! Make Us Prove It! *"Buy the Best"*

SEND FOR OUR CATALOG OF PRECISION QUARTZ CRYSTALS AND ELECTRONICS FOR THE COMMUNICATIONS INDUSTRY.
IT WILL COST YOU NOTHING!

SENTRY MANUFACTURING COMPANY

1634 Linwood Boulevard - Oklahoma City, Oklahoma 73106

PHONE: 405-232-1431

FM

PUBLISHER
M. Van Den Branden
WA8UTB

EDITOR
K. Sessions, Jr.
K6MVH

STAFF

Photographer
Bill Carpenter, WA6QZY

Cartoonist
Bill Ridenour, W3HI

Canadian Liaison
Paul Hudson, VE3CWA

Circulation Manager
Glenn Pohl, K8IYZ

Technical Consultant
Don Milbury, W6YAN

ADMINISTRATIVE OFFICE
2005 Hollywood Street
Grosse Pointe, Michigan
48236
Phone (313) 886-4115

ADVERTISING OFFICE
4861 Ramona Place
Ontario, California
91762
Phone (714) 599-2010

EDITORIAL OFFICE
1 Radio Ranch
San Dimas (8) California
91773

JULY SUPERSPECTACULAR

PUBLISHED BY VDB PUBLISHING COMPANY

Who says we're being ignored?

None of the manufacturers are interested in amateur FM! Now there's a phrase we've all heard dozens of times. But the tables are turning today as the manufacturers begin to tool up for ham FM. Now it is up to us to show them that we warrant this new interest.

One June 3, I had a lengthy conference with Bob Waters, president of Waters Manufacturing Company, and some of the key members of the corporation. The topic of discussion was the future of amateur FM. The facts and figures that I was able to provide at this conference left healthy impressions regarding the eventuality of FM becoming the key mode of UHF and VHF amateur operations.

It appears obvious, because of the advantages of repeater operation and noise-free communication, that the growth of FM is only stymied by the lack of commercially available (and specially manufactured) FM equipment designed for amateur use. Bob Waters made it clear that his company was sensitive to this need. He said, "Being a leader in the amateur field today means building what is needed for tomorrow." Bob stated that his company wants to stay ahead in the amateur field, and would welcome comments from FM readers as to the types of equipment they would like to see produced. He assured me that every effort would be made to follow up on all suggestions that held even a reasonable degree of promise.

So here's our chance! Want to see frequency synthesizers? Remotely operated relays? Decoding devices? This is the time to talk; the big boys are listening!

Another corporation with an eye to the FM market is ICE (International Communications & Electronics). Speaking for ICE, George Loos, Jr. (W5LFG), says their recently announced two-meter FM transceiver is the end resolute of a "past dream to fulfill a specific need in amateur communications." The rig itself, he says, has been built with every effort to give the amateur FM'er just what he wants for today's and tomorrow's FM activities. (See cover photo.)

Both ICE and Waters are deeply interested in us as amateur FM operators. I strongly recommend that you drop them a line; you will confirm even more their convictions about amateur FM. Here are their addresses:

Bob Waters
Waters Manufacturing, Inc.
FM Products
Boston Post Road
Wayland, Mass 01778

George Loos, Jr.
ICE, FM Products
1917 NW Military Highway
San Antonio, Texas 78213

Michael Van Den Branden
PUBLISHER

HYBRID LOOPS:
'Magic Rings' for Repeaters

They let you transmit & receive simultaneously ... with a SINGLE ANTENNA!

SPECIAL FEATURE
by
Gilbert Boelke
W2 EUP

The .34-to-.94 repeater was a big attraction at the recent Paramus FM conference, not so much because it was a repeater, but because it used a single antenna for transmitting and receiving simultaneously. To amateurs unfamiliar with some of the finer characteristics of coaxial cable sections and cavities, this might seem an impossible feat. But to those who know of the magic ring, it is merely a matter of selective coupling using the coax itself to provide the proper paths for the receive and transmit signals, and combining these annular "paths" with cavities.

As figure 1 shows, a hybrid loop is a 1-1/2 wavelength section of low-loss coaxial cable with ports at strategic places to allow access and termination of the rf signals.

At the pass frequency (f1) the cavity is series-resonant, providing an effective short-circuit at the cavity port (B). Counterclockwise-traveling rf power thus meets a short circuit after traveling one-quarter wavelength. The input end of this quarter-wave section then looks like an open circuit at this frequency.

Power flow from port A is clockwise, then, since the counterclockwise path looks like an open circuit. The characteristic impedance of the input line is continued clockwise with negligible disturbance at port A.

Assume for the moment that port C is unterminated and does not have any effect on rf power traveling clockwise past it. Clockwise-moving power from the input then continues past port C to port D. The coax from port D to B is one-quarter wavelength and shorted by the cavity at B. Therefore, an open circuit appears to the left of port D, and power flow continues out of port D to the load at f1. The power flow path from port A to port D is achieved without setting up an swr on the line at any point and, if the cavity loss is low, without appreciable attenuation.

At the reject frequency (f2) the cavity is no longer series-resonant, but it is detuned and presents a nearly pure reactance at port B. Rf power now flows past port B toward the output port. In so doing it traverses one-half wavelength of coax, with a resulting phase shift of 180 degrees.

Note that the phase difference between these two waves is 360-180, or 180 degrees. If the power contributions are equal from opposite sides of the output port, power at f2 is completely canceled.

In practice, power passing port B is disturbed by the cavity reactance. If port C is terminated in an equal reactance of the same sign as that of the off-resonance cavity at port B, the output contributions are again equalized and f2 is canceled at the output. A useful analogy is to compare the loop with a bridge circuit. Anything seen at port B must be seen at port C to balance out the output at port D.

At f1, in practice, port C is not open, but rather terminated in a reactance equal to the cavity reactance at f2. This disturbs the wave traveling to port D, setting up an swr in the coax back toward the input port. The cavity is then detuned from exact series-resonance enough to produce an equal swr in the other leg of coax to the input termination, port A. The reactances appearing on opposite sides of port A are equal and opposite, so they cancel at the input. This adjustment in turn has an effect on the balance of the loop at f2, and reactance at port C must be retrimmed.

In the adjustment procedure the output power is maximized at f1 by tuning the cavity, and the output power is minimized by adjusting the impedance at port C at f2. Alternate adjustments will eventually result in a null at f2 and a peak at f1 if the cavity Q is high enough for the frequency spacing and the coupling is adjusted properly. If the insertion loss at f1 is too high, it can be reduced by increasing the coupling in the cavity, and the adjustment procedure repeated. Too much coupling may prevent convergence of adjustment, and reduces the notch bandwidth.

The value of impedance at port C depends upon the impedance of the cavity at f2. The cavity, when coupled with an inductive, coupling loop, varies roughly as in figure 2.

A parallel-resonant point occurs at a frequency (f3), slightly below that of f1. This frequency may be varied by changing the coupling or inductance of the link. It is possible, when f2 is lower than f1, to place f3 at f1. At this point it is possible to eliminate port C entirely, since the necessary impedance is near infinity.

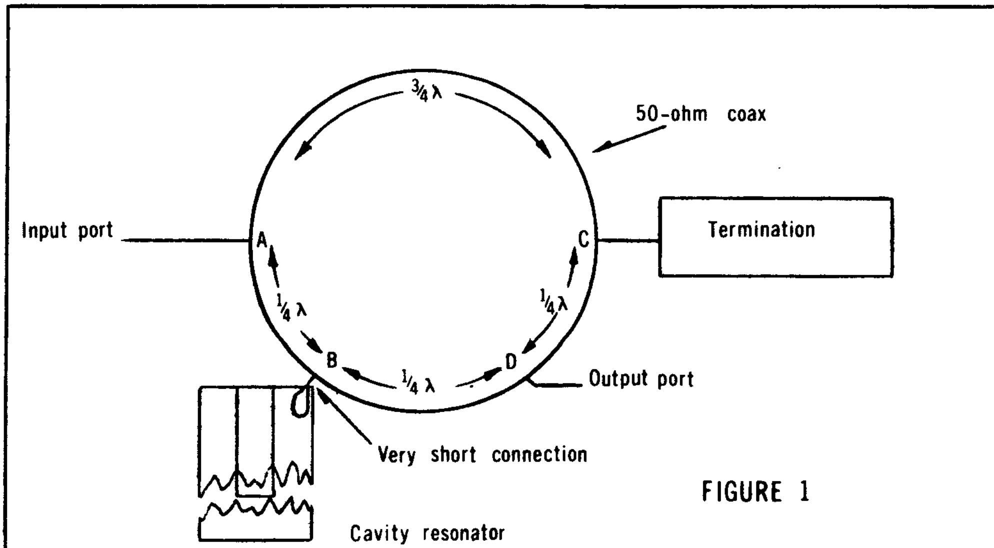


FIGURE 1

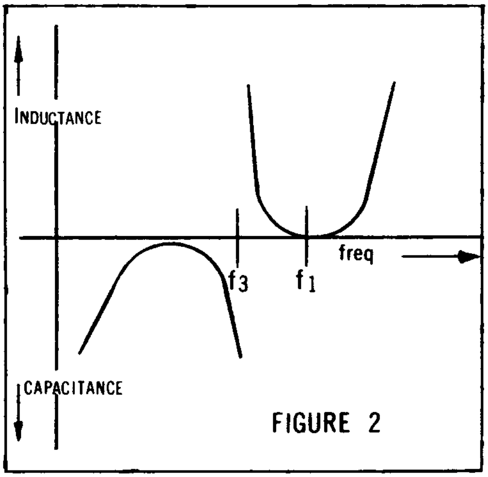


FIGURE 2

For f2 above f1, the reactance becomes inductive, and it becomes capacitive only below f3. If a parallel-resonant tank is placed at port C, one sweep of the tuning capacitor will cause a swing from inductive, through infinity, to capacitive reactance. This technique is very convenient when the required value is inductive, because it allows variation of the inductive reactance with a variable C.

In some cases it may be necessary to use some resistance at port C to achieve balance. This case occurs when there is some loss in the path past port B. A lossy cavity could cause it. With low Q cavities, poorly cut loops, or close frequency spacing, this technique allows the system to balance at f2, maintaining the full rejection of the cavity-loop combination, although compromising performance by resulting in a slightly higher insertion loss.

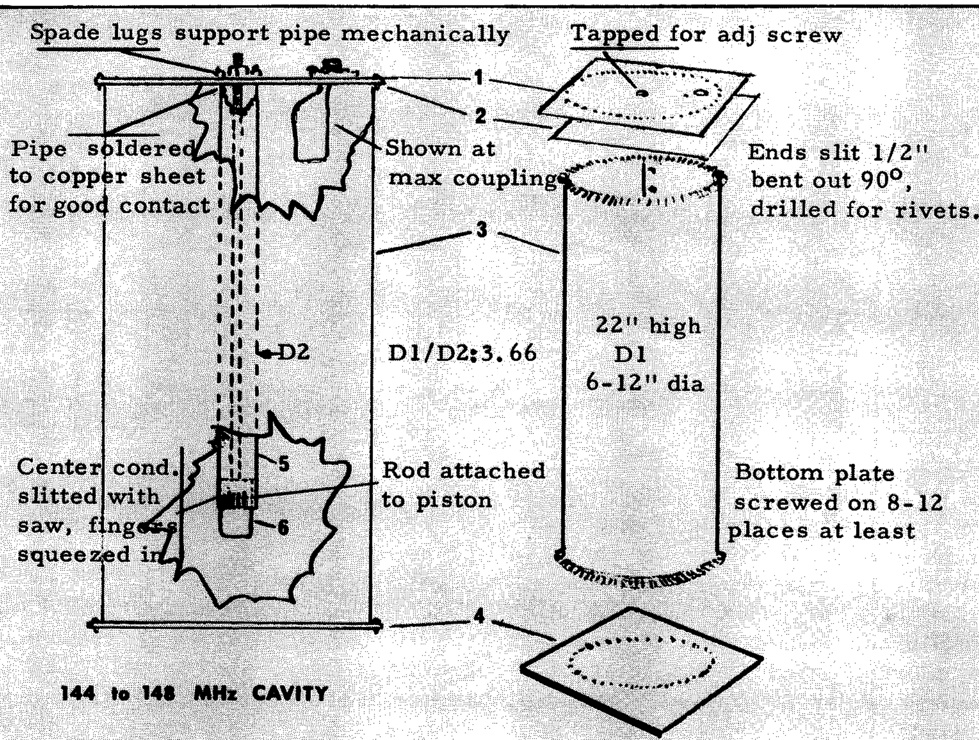
The loop itself can be checked out by leaving ports B and C open, pumping power into the loop at port A. Very little power should come out at port D if it is cut properly. Remember that "end effects" on the coax joints can have a considerable effect upon the apparent electrical length of the lines. Shorting out either port B or port C should produce full output with little loss and a low swr at the input. These checks should be made at some frequency between f1 and f2, preferably.

There should be a negligible length of coax or lead lengths at ports B and C, especially when checking the loop. Port B should be mounted right at the cavity without unnecessary lead length. Port C is not as critical in this regard to the adjustable impedance.

Two other important points: With rejections in the neighborhood of 50 to 60 dB in a cavity, lack of shielding at any point in the system can negate the effect of the cavity and loop system. Shield everything completely except the antenna itself. Also, when testing the cavity/loop the average transmitter used as a signal source may have enough spurious radiation or even ordinary transmitter noise to limit the rejection as read on an rf indicator. It may be necessary to filter the transmitter output with another cavity to make final adjustments!

Figure 3 shows construction details for a two-meter cavity with sufficient Q to be used with the hybrid rings. Four each of the cavities and rings are required to produce a system by which a single antenna can be used for both receiving and transmitting simultaneously. Figure 4 illustrates the interconnection of the elements for a .34-to-.94 repeater.

A well designed preamplifier, such as a cascode FET type, can be placed at point B without getting overloaded. This placement is desirable because it reduces the duplexer loss on the receiver side to half. Similarly, it may be possible to install a power amplifier that isn't too noisy at point A, reducing the transmitter power loss in the duplexer. Experiment will tell which, if either, alternative connection is possible for the particular system with which it is to be used.



1. 3/32" end plate - steel or over 1/8" aluminum
2. Flashing copper liner, any gage
3. Aluminum cylinder (0.032 " or thicker)
4. 3/32" steel or aluminum end plate
5. Copper pipe - dia: 1/3.66 x outside dia of cavity (not critical)
6. Tuning piston - any material with flashing copper wrapped on outside. Length to allow travel making total center conductor variable from 17" to 21".

NOTE: For piston rod screw, use 5/16 - 18 threaded rod. Secure at top with locknut.

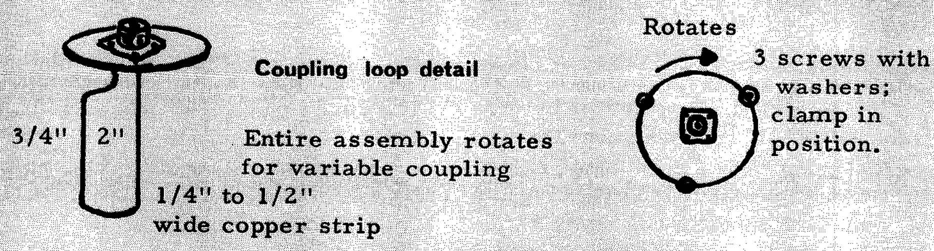


FIGURE 3. DESIGN DETAILS: 144 - 148 MHz CAVITY

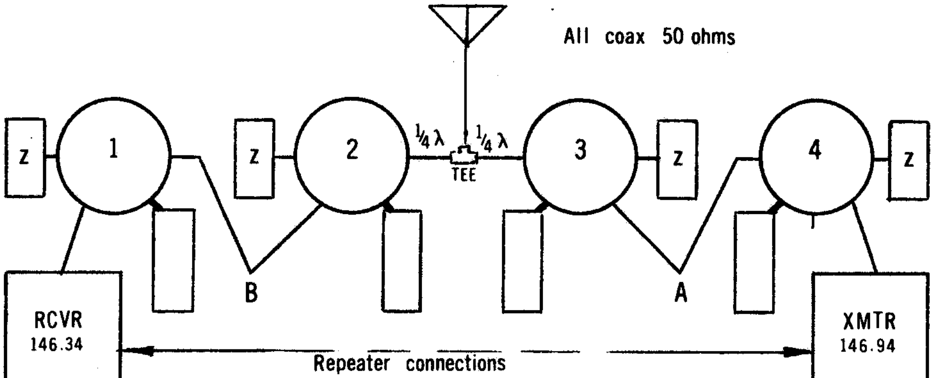


FIGURE 4

The terminations (Z) can be coax stubs or tuned circuits. I prefer the tuned circuits because they permit the attainment of a perfect null, whereas stubs produce a finite dip. Stubs should be shorted, because open stubs may radiate unless the ends are shielded. I found that a parallel-resonant circuit worked best on the transmitter cavities, and that a 3K shunt resistor across the tuned circuit produced a null in the 70 to 80 dB range. On the receive side, I found that a series-resonant circuit worked better. Again, the tuned circuit needed some loss to make a perfect null. However, an alternative method was used, which is equally applicable in either the receive or the transmit cavities.

By varying the L/C ratio of these tuned circuits, the resistive portion of the resonant circuits can be varied. Thus, instead of physically inserting a resistor, I raised the effective Q of these circuits until they produced the appropriate amount of loss. Tuning is simply a matter of dipping the capacitor (piston type for smooth accurate adjustment), noting the amount of rejection, then squeezing or spreading the coil and redipping. The inductance value is readjusted until the signal disappears in the noise. Rejection is limited only by the stability of the adjustment and the bandwidth required of the notch.

Notch bandwidth and insertion loss are the only limiting factors for frequency spacing. I was able to get 60 dB of rejection and 1 dB loss at 300 kHz separation. However, the notch width is small, and rejection degrades rapidly with deviations from the center of the notch. The 60 dB figure only represents the rejection level easy to attain in a quick adjustment. It should be emphasized that the notch depth is always unlimited except by the fact that it becomes more and more critical to adjust as it gets deeper, and obviously harder to hold there.

My insertion loss measurements are not as accurate as I would like and I hesitate to quote them, but the rejections are reasonably accurate. Here are some figures:

Pass 146.34, reject 146.94: Insertion loss less than 1 dB; rejections: At 146.940, 70 dB; at 146.928 and 146.952, 50 dB. Pass 146.94, reject 146.34: Insertion loss 0.6 dB, rejection at 146.340, over 80 dB (saw 100!); at 146.328 and 146.352; 50 dB.

Miscellaneous facts: Low cavity Q results in high insertion loss for a given

(Cont page 50)

BY POPULAR DEMAND !!

UHF AMATEUR MOBILE TELEPHONE

by

Ken W. Sessions, Jr.

K6MVH

INCLUDING COMPLETE PLANS AND INTERCONNECTION DATA FOR:

DIAL AND ENCODER

DECODER

CONTROL SYSTEM

Remote operation is getting a lot of attention these days, and an unprecedented number of amateurs are being won over to this exciting new phase of our hobby. Since last December, I have written no less than three articles on remote systems which include compatible automatic telephone interconnections. But all these articles were written with the thought that the telephone portion of the system was an add-on to a more complex setup. From the letters and phone calls I've received this year, I have come to the conclusion that most remoters are interested in the automatic patching feature as a primary function rather than a secondary one.

This fact has posed several problems because, for a single-purpose remote telephone, the circuits I've published in the past have incorporated extra relays and an unnecessary stepper switch. Finally, after a ham called me several times from Harrisburg, Pennsylvania to get additional circuit information, I decided to redesign the remote control circuitry for exclusive telephone use.

In the previous articles there has been a deficit of information surrounding the key elements of control: encoders and decoders. This lack of data was no accident; information just hadn't been available.

One industrious amateur in the Pasadena area (Bob Mueller, K6ASK) decided to do something about it, and proceeded to design his own encoder and decoder. With a lot of ingenuity, patience, skill, trial and error, and a few of the other necessary commodities for inventiveness, he finally came up with some acceptable circuits, but his decoder was still far from perfect for telephone use.

Lee Coltin (K6VBT) adapted Bob's circuits for use is his own remote system and described them in an article for FM Bulletin in January 1968. Since that time, Bob and Lee have had the opportunity to refine the decoder by improving it's selectivity and frequency stability. They also incorporated a few significant improvements in their tone encoder.

With a good encoder and decoder, and a specially designed automatic phone patch circuit, the time seemed right for an all-encompassing article on a remotely controllable telephone system. So this is it.

SYSTEM REQUIREMENTS

There is a hard set of FCC-imposed constraints that usually determine the manner in which a remote system will take shape: Your system will probably include a UHF repeater on a hilltop or in a tall building accessed by a few mobiles and a control base station.

It is unlikely that you will use two meters to access your home telephone. Here's why: The primary requirement for a remote system of any type is that control be accomplished from 220 MHz or above. Since gear is hard to come by for 220 MHz, most amateurs use 450 MHz (where gear is both readily available and inexpensive).

Even if you could rationalize the legality of two meters, it would be unwise to use it for phone patching. There is little privacy there, so your phone's usefulness would be seriously inhibited in this regard. Also, the two-meter region is heavily populated, so you would be subject to interference -- accidental and otherwise --as well as possible phone use by unauthorized stations.

A phone system does not lend itself well to incorporation in a two-meter repeater system, either. What happens to the repeater when someone wants to use the telephone? What happens to the repeater when phone calls start pouring in? You can't just tie up the repeater so one man can make exclusive use of the telephone; it wouldn't be practical. The simple truth is that telephones belong where the activity is minimum and where control is sanctioned.

Use of 450 MHz will probably rule out installation of the control receiver and phone-access circuitry at your home; the range just wouldn't likely warrant the effort. The UHF bands are strictly line-of-sight; thus, if your system is to be successful and useful, you'll get a spot on the top of a local hill or in the highest building in town. There, you'll have your telephone, remote control repeater, and your decoder / access circuits installed.

There is no real need to go into the construction of the hilltop UHF repeater, because the subject has been covered with reasonable thoroughness in previous articles. (See "VHF Operation By Remote Control," 73 Magazine, April 1968.)

Your mobile system should be no problem, either. It should be set up for duplex operation if you want a sophisticated remote telephone system. A good system is one where the party on the other end of your phone conversation can't tell you're using a phone patch. This isn't too difficult if your access stations are all capable of full-duplex operation.

The March issue of FM Magazine includes an article for duplexing Motorola and GE Pre-Progress Line units.

The one area of control and use that does seem to have been neglected is the dial hookup. A telephone dial normally has at least two complete sets of contacts. One set is for pulsing the tone encoder; the other is used to key the push-to-talk. Figure 1 illustrates this connection scheme.

When you examine figure 1, one thing should become immediately apparent: The pulser contacts are normally closed and open only during the pulsing process. Since the encoder must generate tones only during pulsing, the dial pulser may at first seem in-

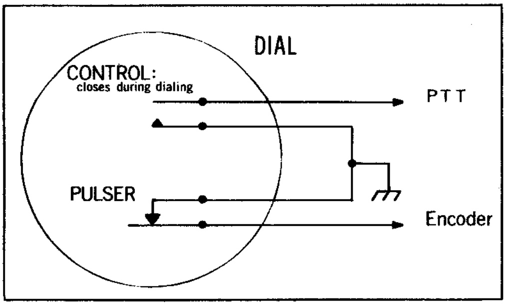


FIGURE 1. DIAL

compatible with a remote control system. It isn't. Take a look at the

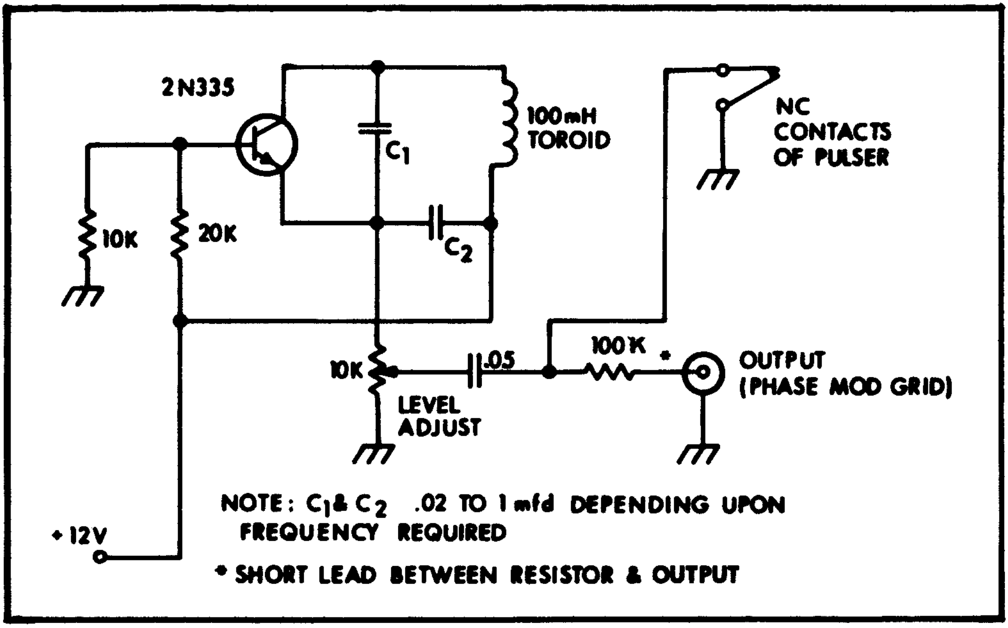


FIGURE 2. SINGLE-TONE OSCILLATOR

encoder circuit shown in figure 2. The pulser is used to keep the encoder output at ground potential until the contacts are opened. The 100K resistor between this connection and the phase modulator grid (or mike amplifier) keeps the grounded line from affecting transmitter audio level.

The tone unit itself is actually on all the time. (That is, the unit is always on when the receiver is on because the drive voltage for the encoder is presumably obtained from the receiver or transmitter filament supply.)

An important point to remember when connecting the push-to-talk to the dial contacts is to use the set that "makes" first and "breaks" last; otherwise, you may find the transmitter won't stay on the air long enough to allow the complete pulse train to be transmitted.

ENCODER

The encoder shown in figure 2 is K6ASK's improved version. It has the features of high Q for stability, a single transistor for simplicity, and tiny components for miniaturization. The circuit can be easily constructed on a circuit board or perforated phenolic sheet. The 10K potentiometer in the output allows the gain to be set to whatever level is right for your own system. It can be eliminated at the sacrifice of possible incompatibility with your existing deviation level setting.

DECODER

The function of the decoder is simply to provide a relay closure with each incoming tone signal. If a "9" is dialed at the control station, the decoder responds by closing a relay nine times at the same rate as the dialed tone pulses. The most important parameters of a good decoder are frequency stability and signal selectivity. The decoder shown in figure 3 does have these desirable characteristics. This is what K6ASK refers to as his Mod II unit. It has a variable gain control on the input for establishing the proper sensitivity of the decoder, and a dc amplifier on the out-

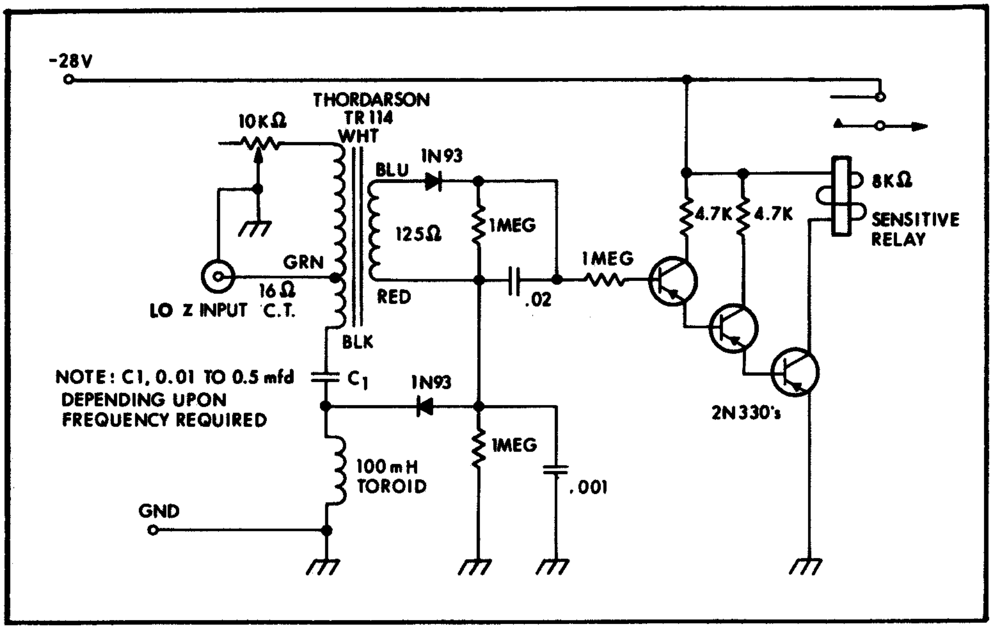


FIGURE 3. SINGLE-TONE DECODER UNIT

put for providing solid drive to the pulser relay.

The decoder is designed for a 28V power source. When properly driven, the unit will respond to pulses within a bandwidth of about 50 Hz (depending on sensitivity setting), and will reject all other tone signals.

Bob designed his decoder to accept low-impedance tone signals directly from the speaker terminals of the remotely situated receiver. Signals of the proper frequency and level are passed through the frequency-sensitive circuitry to the dc amplifier to key the 8K plate relay. This current-operated relay provides the pulses for controlling the automatic telephone.

AUTOPATCH

Figure 4 shows the schematic for the automatic patch. Here's how it works: When the telephone rings, the ac ring voltage is rectified (through isolation capacitors) to drive a sensitive plate relay (K1) that triggers the transmitter push-to-talk circuit as well as a special "ring" oscillator. (A relaxation oscillator for effecting telephone-ring indication is shown in 73 Magazine, April 1968, page 40.)

The plate relay keys the push-to-talk through a diode so the "ring" oscillator won't be triggered when the transmitter is keyed through the normal carrier-operated function.

To place a call or respond to a phone ring, the operator transmits a continuous tone for 0.5 second. This is achieved with the phone dial at the control point by bringing the digit "1" to the finger stop--which keys the mobile transmitter and causes the hilltop COR to turn on the repeater transmitter -- and turning the dial counterclockwise just far enough to open the dial's normally closed contacts. While the contacts are open, a continuous tone will be generated. At the end of the half-second period, the phone will be engaged by the timer (TD1) and the dial can be released.

When the phone comes on, the telephone enable relay (K2) is energized and latched; the phone lines are disconnected from the rectifier and fed directly into the phone patch. The decoder relay is coupled to the phone pulser relay (K3) so that additional dialing will pulse the phone line exactly as a local dial would.

As long as the user transmits a signal the telephone will stay on. Presence of his signal provides a ground signal to the timer disable relay (K4) to keep the phone patch engaged. If he drops carrier, the timer disable relay is released and the shutdown timer (TD2) is started. The shutdown timer allows the phone patch to stay on for 25 seconds without the presence of a carrier. If no carrier appears by then the timer pulls in and shuts the whole system off.

The last timer in the circuit (TD3) allows the phone to be shut down by operator command. A 1.5-second tone pulls the timer in and interrupts the latching voltage on the telephone enable relay. Thus, the system includes a positive shutdown capability.

When selecting the phone patch to incorporate into your remote system, be sure to use a hybrid type. Hybrid patches are important because they allow a very definite and positive audio null and prevent feedback.

There are many manufactured hybrid types available and a great number of circuits for their construction. From my own experience, I strongly recommend the Waters hybrid patch. Some of the others I have tried offer minor impedance mismatches which result in significant audio problems during phone use. If you're sure you have good audio transformers, go ahead and build your own. If you are not sure, you'll probably be better off buying the Waters unit. It has a built-in compressor-amplifier.

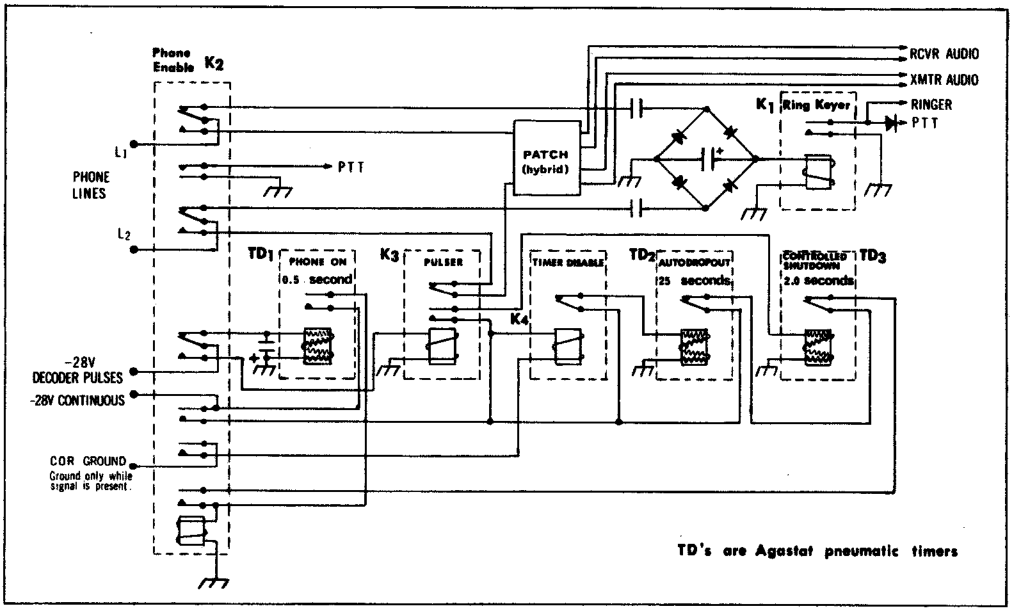
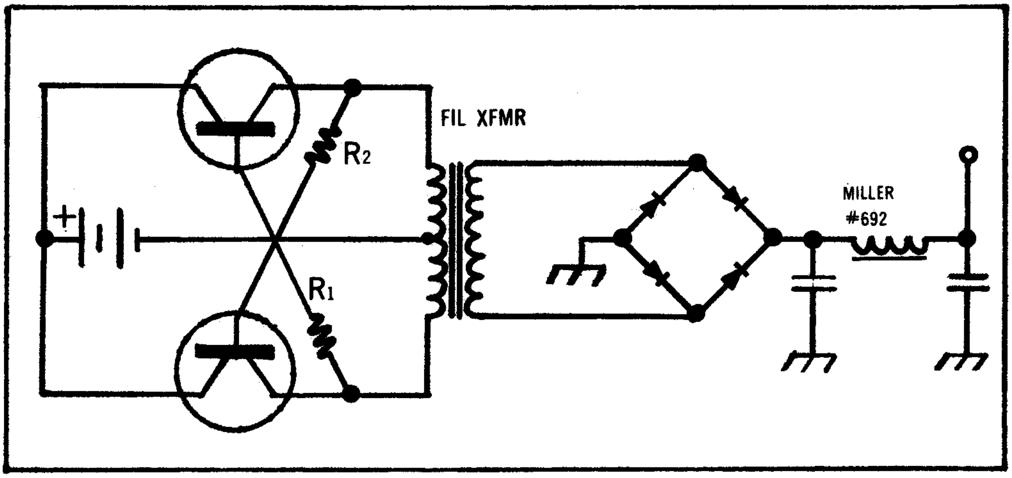


FIGURE 4. AUTOMATIC TELEPHONE-OPERATING PORTION OF REMOTE PHONE PATCH WITH FAIL-SAFE FEATURES



Quickie T-POWER with Whine Filter

by C.L.Coltin K6VBT

All you'll need is a spot on the chassis!

A while back a friend loaned me a circuit for an "easy" rec T-power supply. It looked so simple, in fact, that I merely filed it. Last week I found myself in need of a mobile receiver B+ supply, so I dug the circuit out of the file. I put it together, with junk-box parts, and was pleased to find that it REALLY DOES work.

TI can be any old filament transformer with a 12-volt centertapped wording capable of several amps. This is the good part, as transistor-type transformers are usually quite expensive ($12-$20). Be sure to use a good heat-sink for the transistors, as they will dissipate quite a bit of heat.

Values for the other circuit components are not at all critical, and should be chosen based on your available supply of parts.

The rf choke in series with the B+ lead on the output of the supply is an important part of the circuit, and can be used on any type of T-supply to minimize transformer whine. The switching frequency of the filament transformer will be somewhat less than that of a conventional specially designed transistor transformer. This factor, coupled with the fact that the transformer is probably not potted, will add to the audiofrequency noise produced by the unit. The rf choke is very effective in swamping out the whine, and the result is a virtually noise-free dc voltage.

AMATEUR RADIO

COMMUNICATION PRODUCTS

exclusive Waters Distributor nearest your QTH

The complete Waters line is always in stock at all of these exclusive Waters distributors.

AMATEUR ELECTRONIC SUPPLY
Milwaukee, Wisconsin 53216

AMRAD SUPPLY, Inc.
San Francisco, California 94121
Oakland, California 94607

ARROW ELECTRONICS, Inc.
Farmingdale, Long Island, N.Y. 11735
Norwalk, Connecticut 06850
Totowa, New Jersey 07512
Mineola, New York 11501
New York, N.Y. 10007

ELECTRONICS CENTER, Inc.
Dallas, Texas 75204

ELECTRONICS DISTRIBUTORS, Inc.
Wheaton, Maryland 20902

HARRISON RADIO CORPORATION
Jamaica, Long Island, N.Y. 11435
New York, N.Y. 10007
Farmingdale, Long Island, N.Y. 11735

HENRY RADIO, Inc.
Butler, Missouri 64730
Anaheim, California 92801
Los Angeles, Calif. 90064

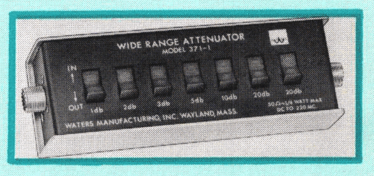
STERLING ELECTRONIC SUPPLY
New Orleans, Louisiana 70112

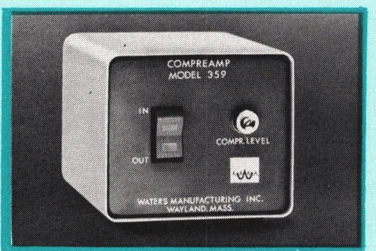
WORLD RADIO LABS, Inc.
Council Bluffs, Iowa 51501

PAYETTE RADIO Limited
Montreal 3, Canada

DUMMY LOAD/WATTMETERS
An effective means of measuring and peaking RF power into a dummy load. Four calibrated scales permit accurate readings of RF watts. Protective warning light.
MODEL 334A
1000 watts.
2 to 230 MHz ..... $135.

ATTENUATOR
Gives stepped attenuation to 225 MHz from 0 to 61 DB in 1 DB steps. 50 ohms.
MODEL 371-1
(UHF Connectors) ... $29.95

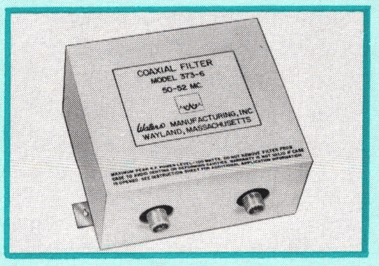




COMPREAMP
Add definite "talk power" to your signal with Compreamp! Self-powered and solid state, it is easily installed in the mike line of either fixed or mobile station. Great for the added punch when QRM and band conditions are tough.
MODEL 359 **$27.95**

COUPLER/PHONE PATCH

MODEL 3001
(Without Compreamp) $53.00
MODEL 3002
(With Compreamp) $72.50



Installed in 52 ohm antenna lines, the filter assures an outgoing signal free of spurious frequencies that cause interference problems. High level, out-of-band signals are rejected ahead of the receiver front end.

Model 373-2 (2 meters) $29.50
Model 373-6 (6 meters) $32.50

This order form may be sent direct to the factory or to your nearest Waters Distributor.

WATERS MANUFACTURING, Inc., Wayland, Mass. 01778 Dept. F
Send .... Model .... @ .... each .... $ ....
Send .... Model .... @ .... each .... $ ....
Total Order (Mass. Deliveries Include Tax) Check/Money Order Enclosed .... $ ....
NAME .... CALL ....
ADDRESS ....
CITY .... STATE .... ZIP ....

Waters

Number 5 on information card

Portable DUAL – TONE Digital Encoder

by Gary Hendrickson W3DTN

All-purpose device allows repeater control even from walkie-talkie by transmitting coded tones through mike.

Many remotely controlled systems around the country use Secode equipment for performing the various selection functions. However, it is difficult to find a large enough supply of encoders to keep up with the increasing demand. This article shows two simple solutions.

The hand-held digital encoder shown in the photo of figure 1 is small enough to be used in any control application --at the fixed station, in a mobile, or with a walkie-talkie; yet, it is simple to build and is highly reliable. The unit is unique in that its tone output is audible; the sender can be placed near any control-transmitter microphone to effect the selection of remote functions.

FIGURE 1

Hand-held Secode-type sending unit uses telephone earpiece for audible tone output.

The "speaker" on the portable sender is the receiver element from a conventional "500 series" telephone handset. I found this particular earpiece to produce the greatest output for a given input level. It will easily drive a microphone to full modulation.

The Secode system for which this encoder was designed employs the two-tone concept: as the dial is moved to the finger stop, the first tone is generated. This initial tone is decoded at the remote site to pull in the ratchet relay. The second tone is emitted as a pulse train when the dial is released. This tone causes the rotary wheel at the decoder to step to a position corresponding with the number of pulses transmitted.

As can be seen in the photo of figure 2 the unit can be built into a considerably smaller chassis then the one I used. The size, for practical purposes, is limited only by the dial, the earphone, and the battery requirements. Miniature dials are available on the surplus market, but often these are not provided with enough contacts to perform the dual functions of dialing and keying.

Figure 3 shows the schematic for the portable sending unit. The single transistor is not critical; it can be any PNP type with an h_{FE} of 50 to 100. An NPN transistor can be used if all supply voltages, diodes, and other polarized components are reversed.

The 88 mH toroid is the standard telephone loading coil familiar in RTTY circles. It consists of two

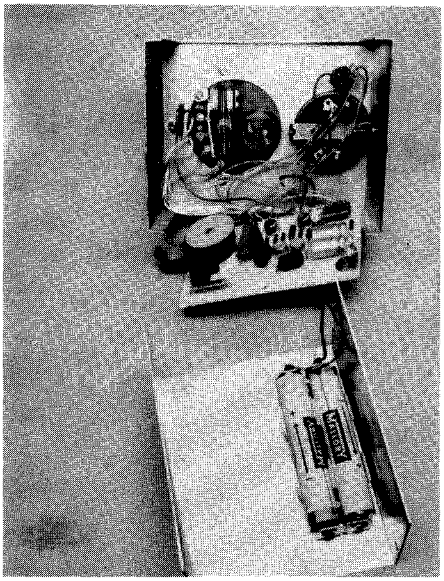
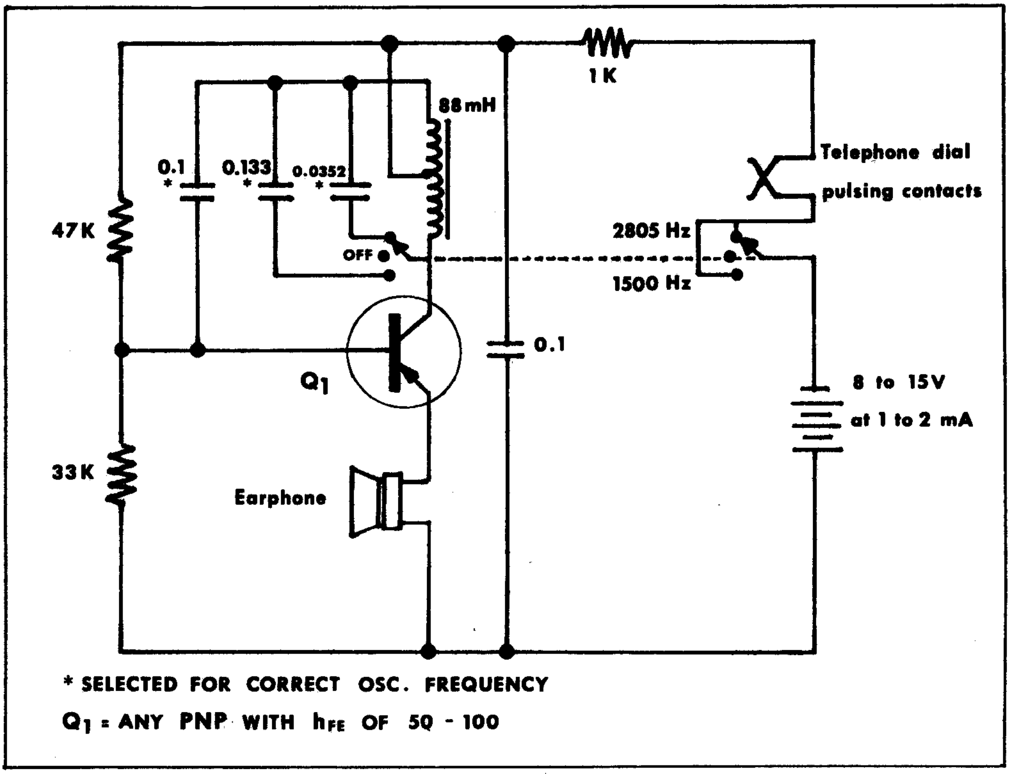


FIGURE 2
Photo shows construction of tone unit

FIGURE 3. Circuit diagram for portable Secode-type oscillator.



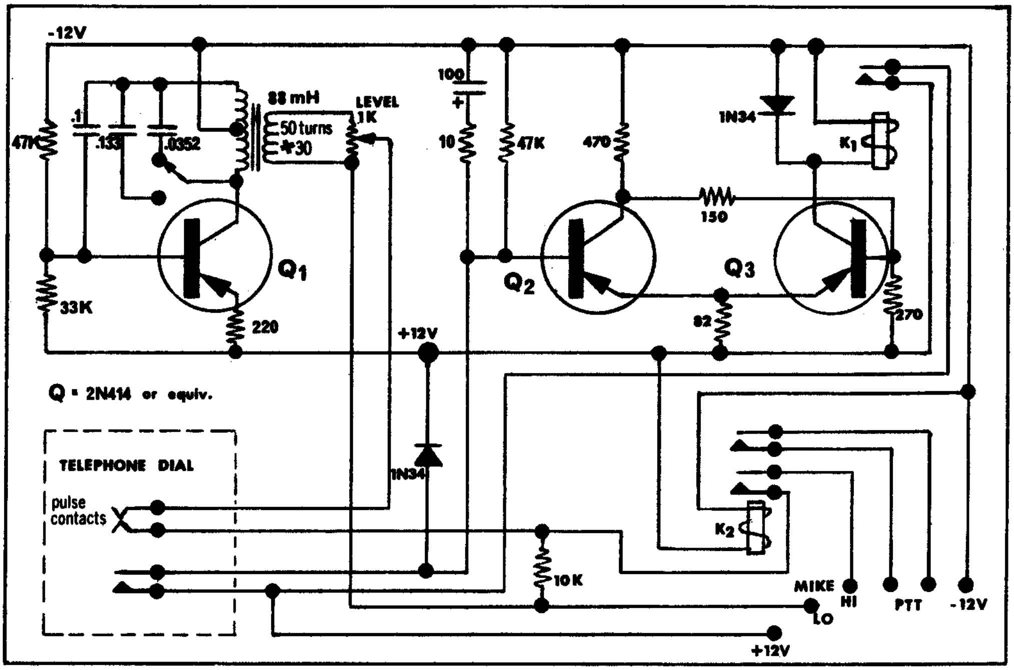


FIGURE 4. Schematic diagram for mobile Secode-type encoder unit. (This version contains a Schmitt trigger device for timing xmtr-on periods.)

windings; the adjacent ends at the center are tied together to obtain the single centertap.

The frequency-determining capacitors should be good-quality Mylar types for best temperature stability. Small values can be paralleled here as necessary to produce the exact frequency of oscillation. One capacitor and the switch itself can be omitted for single-frequency encoders. The two tone frequencies listed are standard with Secode.

Figure 4 shows a more complex configuration that is ideal for mobile use. In the mobile version, relays K1 and K2 can be a single unit if you have a relay with sufficient contacts to perform the required switching functions.

The two-transistor Schmitt trigger is an automatic-shutoff timer which can be set for just the time required to perform a dialing sequence. The purpose of this is to key the transmitter as soon as the dial is moved and to hold it on the air until the full dialing sequence is completed. In the hand-held version, this function is performed manually with the on/off switch.

The 100 mF capacitor in the mobile sender can be changed to effect variation of the period if the shutoff time is not to your liking. Two seconds is usually adequate, however. The transistors used for the Schmitt trigger can be the same type as that of the oscillator itself.

Layout is not critical, and construction can be by any convenient means, either with perforated phenolic board as I used, printed circuit, or solder terminal. Regardless of how you build it, though, you'll find it an effective means of joining the "squawk-teek-teek-teek" group.

For the crystal-conscious...

The INSIDE STORY of the $7 Gem

Plus
SPECIAL PICTORIAL:
BIRTH OF A CRYSTAL

by Eugene Kralik
SENTRY MFG COMPANY

Back in the early days of crystal making, the crystal manufacturer cut his "rocks" with little more than a protractor to determine the angle of his cuts. Today, with rigid constraints of tolerance, temperature, and size becoming increasingly important, the manufacturer must rely on a vast array of complex measuring instruments and test equipment.

In spite of all this, crystal making is still an art rather than a science. The crystal maker knows that with the right oscillator circuit he can provide a crystal slab with a "grain" angle and finish so precise that frequency tolerances to $\pm 0.00025\%$ can be held without the use of a crystal oven.

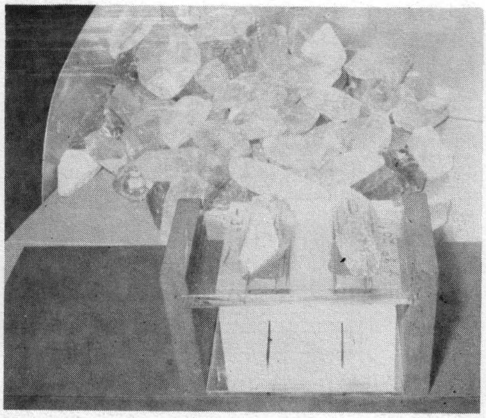
Stability

With miniaturization the order of the day, circuit space is at a premium. And on many late-model high-band radios, no provisions have been included for space-consuming crystal ovens. Instead, the radio manufacturers provide "temperature-compensating" circuitry so the burden of stability rests more than ever with the crystal rather than the oscillator. To satisfy these demanding frequency-tolerance requirements, crystal elements must be held to within one-half a minute of the intended angle of cut. This follows through all stages of lapping and polishing, where angles may shift upwards by as much as 4 minutes.

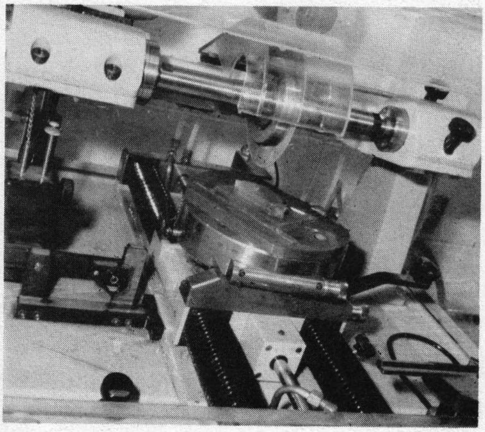
Fortunately for those of us in the crystal-making business, most FM'ers and two-way people, the heaviest crystal users, are already keenly aware of the fact that crystals are not absolute frequency-determining elements. Most of the "off frequency" complaints of other classes of crystal users could be solved if they were as knowledgeable as FM'ers about the effects of an oscillator circuit on a given crystal.

Oscillator Differences

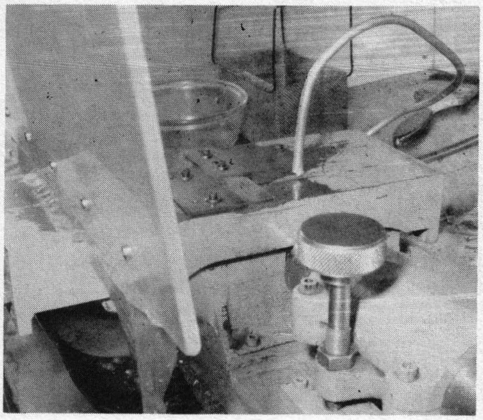
To demonstrate how the frequency of oscillation is altered when used in an "incompatible" circuit, I have selected six common oscillator types for comparison (Table I). The same precision 6 MHz crystal will oscillate in any of the three common transmitter oscillator circuits; but look at the variations in actual frequency! A similar result is experienced by inserting an 11 MHz crystal into the three listed receiver oscillator types.



The first step in a crystal's life is orientation for optic (Z) axis



Crystal hunks are then sliced into wafers (above), and diced into squares (below).



The plain truth is: most calibration "error" tolerances required for commercial two-way equipment are in the neighborhood of $\pm 0.002\%$. Thus, even though the GE transmitter would use the same frequency multiplication factor as Motorola, the GE crystal would not "zero" in the Motorola unit.

There are two basic parameters that affect a crystal's frequency of oscillation: crystal drive and oscillator load capacitance. So profoundly does load affect the oscillating frequency that virtually all commercial units are equipped with a means for effectively varying it to allow some degree of crystal "rubbering." But even "rubbering" allows only a finite amount of shift before oscillator performance begins to fall off.

From all this, one can readily see the importance of supplying the crystal maker with sufficient oscillator data when ordering a new crystal. From my own experience at Sentry, I can state, unequivocally, that you cannot "oversupply" the crystal manufacturer with information. When ordering crystals, make it a point to include:

- equipment manufacturer and model number
- equipment type and part number
- operating frequency
- crystal frequency
- information about circuit (oven or nonoven use?) (does unit have AFC?)

All is not lost, of course, if you don't have all that information. At Sentry, we can supply the proper crystal by just looking at your oscillator circuit. You can Xerox it or sketch it on a sheet and send it with all the supporting data you have about the unit in which the crystal is to be used.

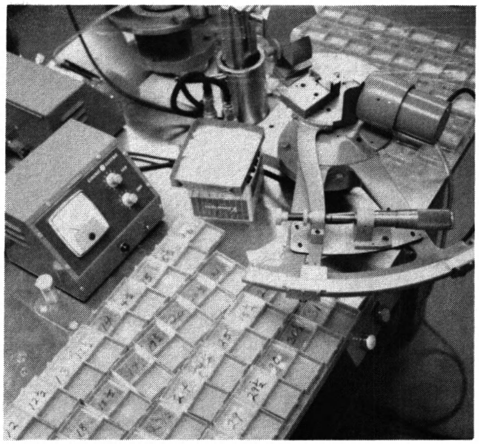
Natural vs Synthetic Quartz

The piezoelectric material that is the heart of any crystal can be obtained naturally or it can be synthesized and mass-produced. A quiet controversy has been going on for years between crystal "experts" who can't come to a complete agreement on the advantages of one type over the other.

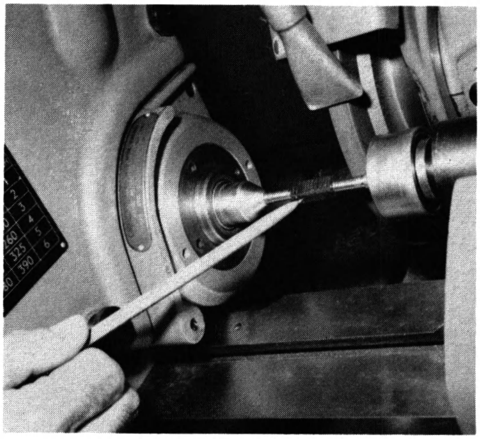
There is a very loud and powerful voice -- that of a very large number of crystal producers -- making a very convincing case for synthetics. Synthetic material is cheaper, which means a lot more crystals for a lot less money. The material is softer; it can be ground and cut and graded with unbelievable speed. With careful control, synthetics can be made to perform almost exactly like the natural stuff. The crystals -- if they are supplied from a quality-conscious manufacturer -- exhibit characteristics that are indiscernible from those of a crystal made from natural quartz. The Q of synthetic-quartz crystals is lower than that of its natural equivalent, but this should not be too meaningful if the oscillator circuit is very well designed.

But there is an indefatigable school of hard-headed artisans who just can't quite see it that way. These diehards acknowledge the fact that it takes ten times longer to produce a crystal from good natural quartz, but they say its hardness assures its stability and prevents "aging," a phenomenon they say is characteristic of the softer synthetic quartz. A high Q is important, they say, to guarantee oscillator frequency integrity: the higher the Q, the better the oscillator.

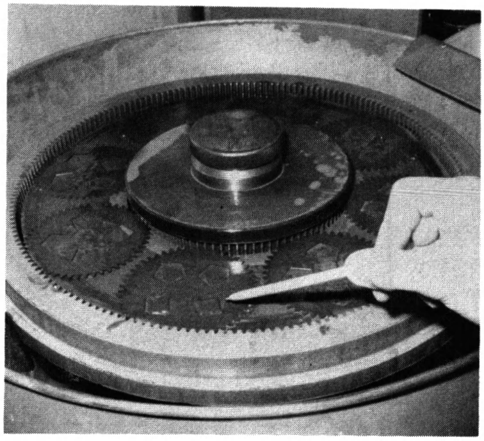
At the risk of making this article sound like an ad, I must say that Sentry was founded on the belief that use of synthetic quartz compromises product quality. And to my knowledge, it is the only company left that hasn't been

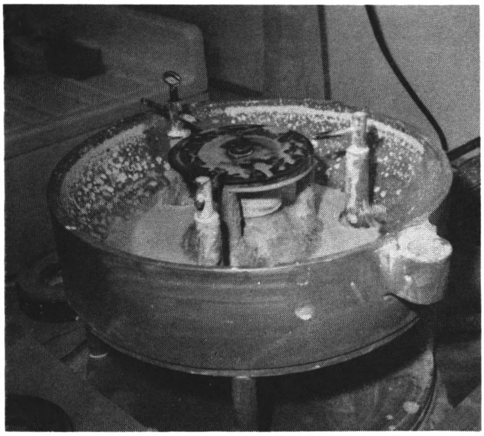


The squares are x-rayed for specific angle.

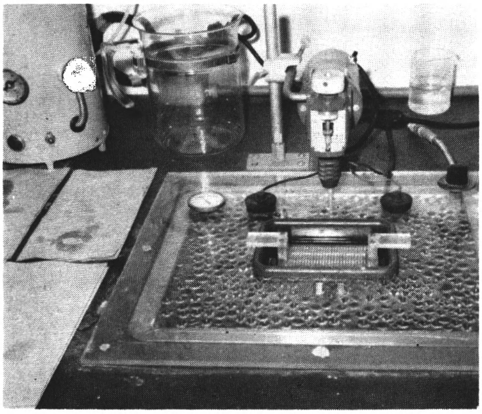


Following the x-ray, each crystal is loafed and rounded (above), then transferred to another department for lapping and calibration (below).





Some high-frequency crystals need a high-speed polish.



The etching process (above) removes all traces of particles and dirt, so the crystal can be keyed (below) with a base plating of gold, silver, or aluminum.

"won over" by the economic attraction of synthetics. No case for synthetic quartz -- however well presented -- has ever been able to convince our stubborn artists that natural quartz is a waste of money.

As a matter of fact, our boys might possibly carry this "nature" thing a bit too far in the quest for perfection: They won't use domestic quartz. With near fanaticism, they make sure that every bit of it coming into the plant is pure Grade A material fresh from Brazil.

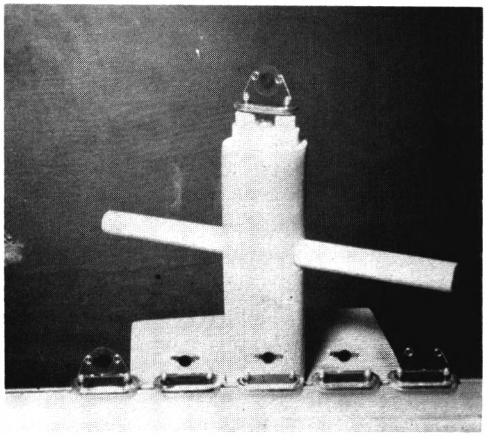
Manufacturing

The photos accompanying this article show the birth of a crystal, from the arrival of the raw Brazilian quartz to final inspection and checking of the finished crystal. At Sentry, the raw quartz is inspected soon after arrival for impurities, inclusions and cracks. During this inspection, the optic axis of the rock is determined. The optic axis is the "grain" of the crystal -- the reference point from which various axial cuts are based. The three basic angles are on the X, Y, and Z axes; Z is the optic axis. Such factors as expected temperature environment, circuit tolerances, and physical size requirements will determine the axis on which a given crystal will be cut.

After inspection, the quartz stones are cemented to a glass plate and subjected to x-ray examination, where the optimum cutting angle is determined. Electronically controlled Swiss saws cut the stone into wafers, which are in turn diced into a variety of square sizes.

Ironically, after they're squared, the wafers are rounded. And here's where tolerances really start getting tight. Diameters are held closer than plus or minus 50 millionths of an inch -- about the thickness of the fog of your breath on a sheet of glass.

After rounding, the next steps are rough, intermediate, and fine lapping to the approximate frequencies. Some units, such as those for low frequencies, must be beveled. Others, for overtone or high frequency use, are polished to an ultratransparent flat finish. After the lapping stages, the quartz blanks are etched, ultrasonically cleaned, and then baked. Next, the crystals are metal-plated under high vacuum using silver, gold, or aluminum. The metal key becomes an electrode on the quartz blank. After plating, the crystal is mounted on the proper base and cemented at both edges of the spring mount using a conductive, thermal-setting cement.



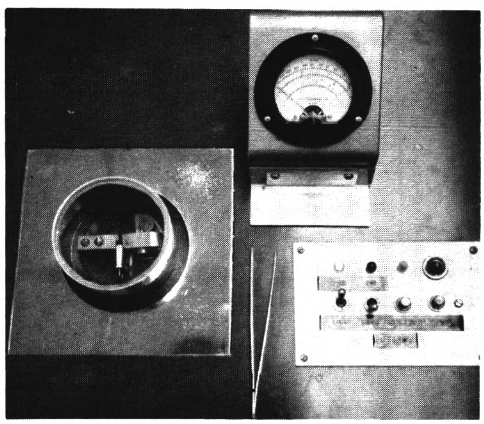
The crystal is mounted and bonded to a base fixture.

The crystals are cured, and the unit is calibrated to final frequency by plating the electrodes in a nickel solution. After baking the plated crystal, the can is attached. Finally, the entire unit is evacuated, and either sealed off under vacuum or filled with an inert gas such as nitrogen or helium.

Final calibration (above) is accomplished with a nickel solution. Then the can is evacuated and filled with some form of inert gas (below).

People often ask why all Sentry crystals are plated rather than pressure-mounted. The plated crystal has these definite advantages.

- Maximum piezoelectric coupling is attained
- Possibility of arcing between electrodes and crystals is minimized
- Frequency change due to shift of relative positions of crystal and electrodes is eliminated
- Tighter calibration and temperature tolerances can be achieved

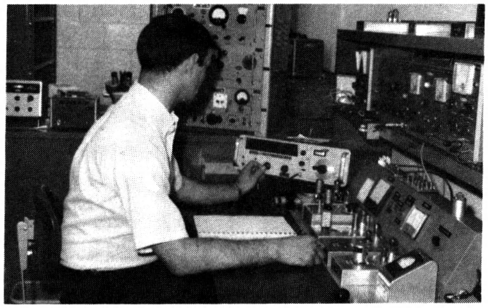


The only real disadvantage is that the plated crystal cannot dissipate as much internal heat as can the pressure-mounted unit. For this reason, plated crystals must operate at lower drive levels than pressure-mounted units of the same cut and frequency.

All Sentry crystals are checked at final inspection for resistance to vibration and shock; absence of moisture, cracks, or inclusions in the base and seal; resistance/activity; unwanted modes; and excessive pin-to-pin capacitance. Crystals are subjected to a number of checks which may include testing under a variety of temperature conditions and in oscillators which are exact electrical duplicates of those in which the crystal is to be used. Final frequency determination is done with an electronic counter to be sure the crystal operates within the specified tolerance.

When you stop to consider all the processing a high-quality crystal must undergo before it reaches your oscillator, the 5- to 7-dollar price tag doesn't seem very steep at all, does it?

Crystals for special high-precision use get the Coldweld treatment (above) before final inspection (below)



Converting the 41V

a "HOW TO" from Donald L. Milbury W6YAN

Setting up the 4IV to operate on two meters is too simple to warrant a complete article on the subject. After a few preliminary value adjustments, the tuneup procedure is perfectly straightforward. This article deals primarily with changing a 6V unit to 12V; but, in the interest of completeness, here is the frequency conversion information:

1. Add 2-5 pF from pin 1 to pin 3 on L1, L2, L3, L4, and L5 of receiver.
2. Add 4 or 5 pF from pin 1 to pin 3 on L7, L7A, and L8 of receiver.

Crystal data:

Transmit — Motorola Type R03, 85°C oven. Specify operating frequency; Sentry will correlate.

Receive — Motorola Type R21, 85°C oven. Specify operating frequency; Sentry will correlate.

Sentry address is: 1634 Linwood Blvd, Oklahoma City, Ok 73106.

6 TO 12V CONVERSION, TRANSMITTER

a. Double-Driver (V106)

(1) Disconnect and remove the jumper between pins 7 and 8.

(2) Disconnect the brown-white lead from pin 2 and connect it to pin 7. This connects tubes V106 and V107 in series.

b. Tube V105: 3rd Doubler (25-50 MC) 2nd Doubler (152-174 MC)

(1) Disconnect and remove the ground lead from pin 3.

(2) Disconnect and remove the jumper between pins 2 and 3.

(3) Connect a jumper between pin 2 and the center shield (gnd).

(4) Disconnect the brown-white to pin 3. This connects tubes V101 and V105 in series.

c. Audio Amplifier (V108)

(1) Disconnect and remove the ground lead from pin 9.

(2) Remove the jumper between pin 9 and the center shield.

(3) Connect a jumper between the center shield and ground.

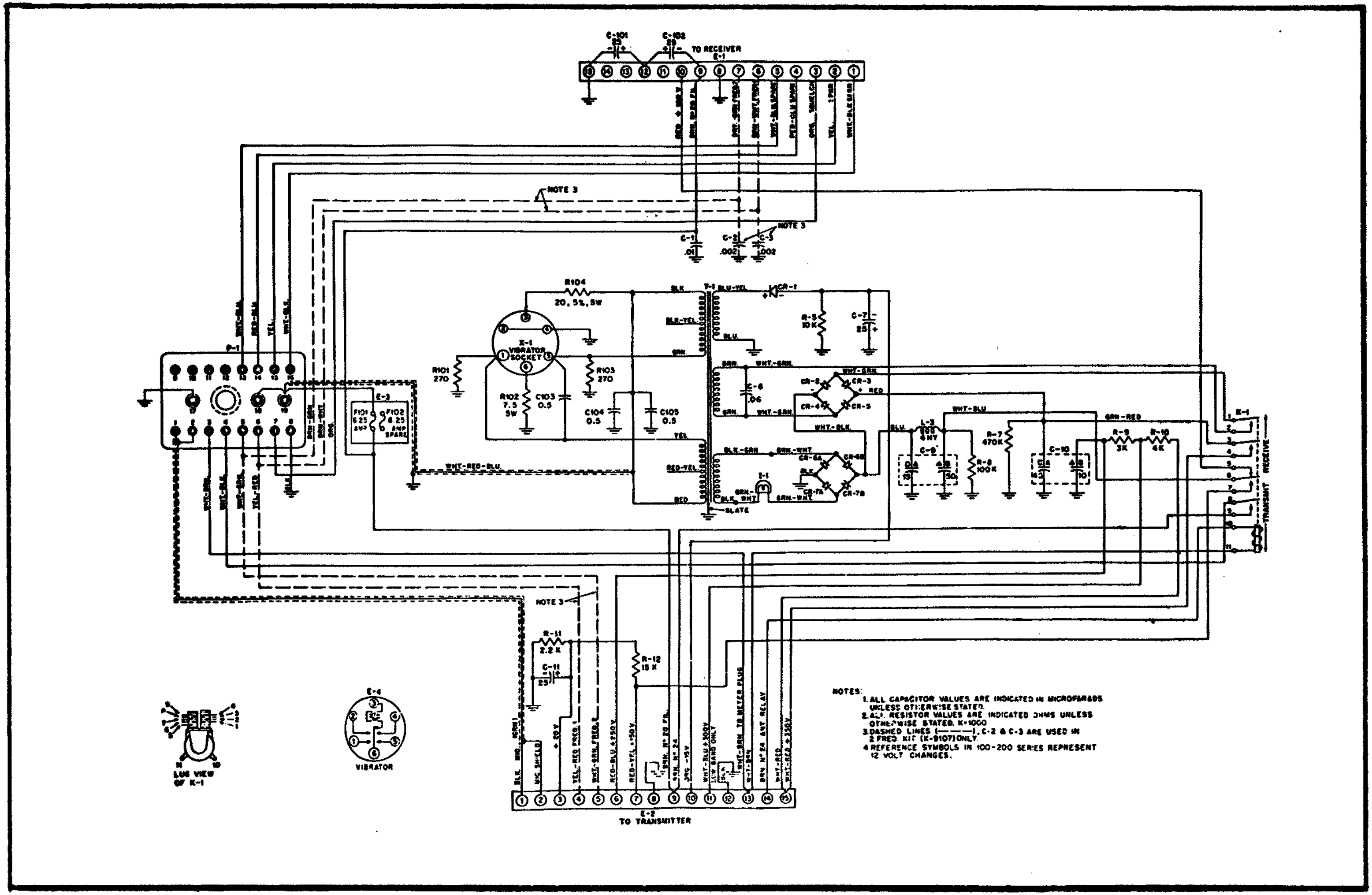
(4) At the V108 tube socket, disconnect the brown lead (running from tube V109) from pin 4 or pin 5, depending upon which is used, and connect it to pin 9. This connects tubes V108 and V109 in series.

d. Tubes V102 (Modular), V103 Buffer and 1st Doubler), and V104 (2nd Doubler - 25 to 50 MC and Tripler - 152 to 174 MC)

Replace the three type 6AU6 tubes (V102, V103, and V104) with type 12AU6 tubes.

e. Antenna Relay

(1) Remove the three screws that hold the antenna relay cover to the chassis. Unsolder the



41V POWER SUPPLY AFTER MODIFICATION TO 12 VOLTS relay cover from the shield around the rf section.

(2) Remove the solid bus which connects the relay coil to ground.

(3) Connect the brown-white lead between the relay coil lug, from which the ground bus was just removed, and pin 2 of tube V106.

(4) Replace the antenna relay assembly on the chassis by means of the three screws. Resolder the relay cover to the rf shield. This connects the relay in series with the transmit-receive relay on the power supply chassis.

f. Crystal Socket (Single-Frequency Models Only)

(1) Use items 4 through 8 and mount the two 15-ohm resistors near the crystal socket by using existing holes in the chassis. Place one lockwasher, one eyelet, and one fiber washer at each end of the resistor. Connect the resistors in parallel.

(2) Disconnect and remove the ground connection from the crystal socket.

(3) Connect one end of the paralleled 15-ohm resistors to the crystal socket terminal from which the ground connection was just removed.

(4) Connect the other end of the paralleled resistors to ground.

g. No. 2 Oscillator V201 (Two-Frequency Models Only)

(1) Disconnect and remove the jumper between pins 2 and 3 of the V201 tube socket.

(2) Connect the 39-ohm resistor between pin 3 of tube V201 and the grounded lug on the crystal socket (X202). This connects the filament of tube V201 in series with the 39-ohm resistor across the 12V source.

h. Crystal Assemblies (Two-Frequency Models Only)

(1) Make a note of the frequency of each crystal and remove the two crystal assemblies from their sockets. The crystals must be removed from each 6V assembly and inserted in the new heater and base assembly as outlined in the following steps. Use care so that 6 and 12V assemblies are not mixed.

(2) Remove the housing cover by releasing the ring clamp.

(3) Remove crystal from the 6V base assembly and install in 12V base assembly.

NOTE

The letters A and B are stamped on the bottom of the base assembly. Plug the crystal into the socket on the A side.

(4) Place the spacer plate between the crystal and the heater element and replace the cover. Make sure that the polarity of the cover and base agree.

(5) Insert the crystal assembly in the proper socket.

6 TO 12V CONVERSION POWER SUPPLY

a. Vibrator Connections

(1) Disconnect the shielded lead from the two 2.9 h choke coils located near the center of the chassis (figure 1).

(2) Disconnect the other ends of the two chokes from the two 0.5 mF capacitors (C4 and C5). These two choke coils are not used in the 12V circuit.

(3) Disconnect the black-yellow transformer lead from capacitor C4 (0.5) and disconnect the red-yellow transformer lead from capacitor C5 (0.5). Tape each lead separately and dress it out of the way.

(4) Disconnect the sleeve-covered lead from pin 3 of the vibrator socket. Use this lead to connect capacitors C4 and C5 in parallel. Do not solder the connections to C4 and C5 until completing step 15.

(5) Disconnect the black, yellow, and red leads from pins 1, 2, and 4 of the vibrator socket.

(6) Remove the lead between vibrator socket pin 6 and ground.

(7) Remove the 100-ohm resistors connected between vibrator socket pins 1, 2, 4, and 5 and ground.

(8) Connect the red and black leads to the ungrounded terminal of C4 or C5 (changed to C104 and C105 on schematic).

(9) Connect pins 2 and 4 of the vibrator socket and then ground pin 4 at the ground lance near pin 5.

(10) Connect a 270-ohm resistor from vibrator socket pin 1 to ground.

(11) Connect a 270-ohm resistor from vibrator socket pin 5 to ground.

(12) Connect a 7.5-ohm resistor from vibrator socket pin 6 to ground.

(13) Connect the yellow transformer lead to vibrator socket pin 1.

(14) Connect a 20-ohm resistor from vibrator socket pin 3 to the ungrounded terminal of capacitor C4.

(15) Connect the shielded lead, which was disconnected from the 2.9 H choke coil in step 1, to the ungrounded terminal of capacitor C5.

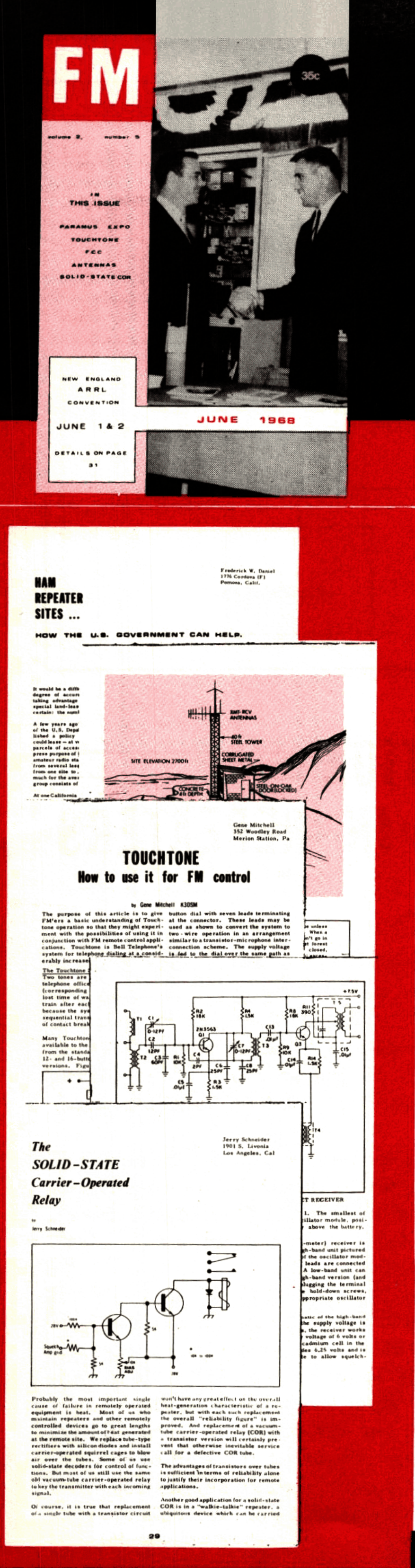
b. Push-to-Talk Relay Modifications

(1) Remove the white-black lead connected between terminal 8 of relay K1 and terminal 14 of transmitter terminal strip E2.

(2) Remove the white-black lead which connects between terminal 14 of terminal strip E2 and pin 4 of power plug P1.

(3) Connect a black-white lead from terminal 8 of relay K1

(Cont. page 58)



for the

PROFESSIONAL AMATEUR

FM...

THE MONTHLY specialty ham magazine that made it. -BIG.

THE source for authoritative articles on

- REPEATERS
- THEORY
- CONTROL
- TECHNIQUES
- MOBILE
- FM HINTS

THE source for news on

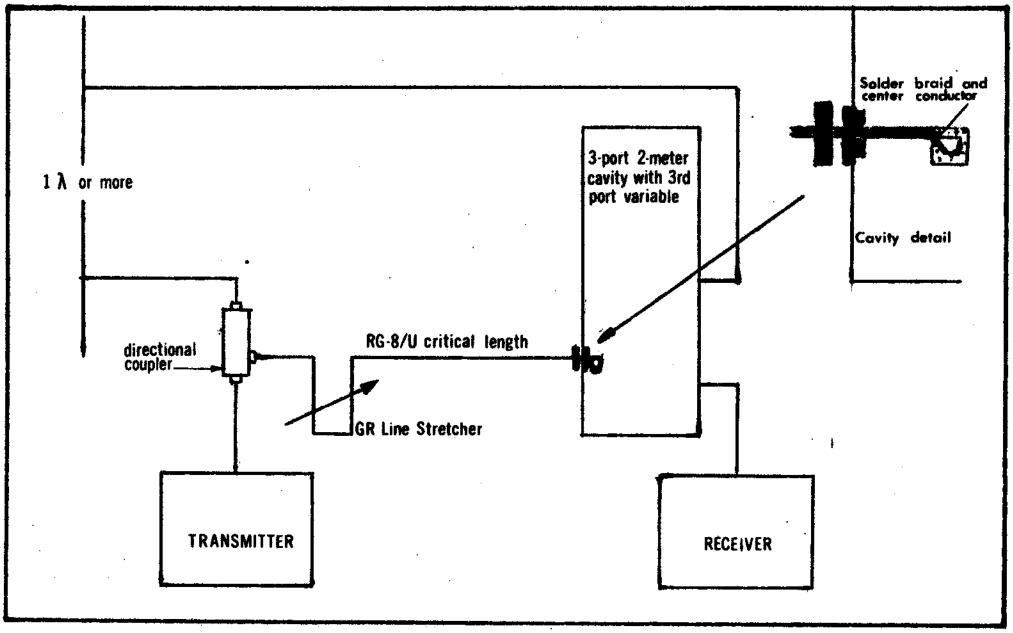
- FCC REPEATER RULEMAKING
- ARRL INVOLVEMENT WITH FM
- TECHNICAL ADVANCES IN FM

FM editor is **Ken Sessions, K6MVH;** FM contributors are top-ranking specialists; FM readers are serious amateurs who want something more from radio than a simple exchange of signal reports.

ARE YOU AN FM READER? SHOULDN'T YOU BE?

The price? $3 a year... $5 for two

FM: 2005 Hollywood Street GROSSE POINTE, MI 48236



DEFEATING DESENSITIZATION IN REPEATERS

by Van R. FIELDS, W2OQI

In a typical repeater situation, the transmitted signal causes the limiter current on the receiver to increase (thus affecting receiver sensitivity at the time when sensitivity is needed most). It appears that the rf and mixer stages are biased class C and the mixer must generate noise that the limiter "sees."

In the above diagram, the transmitted signal is transmitted from the lower antenna and introduced into the upper receiving antenna. The idea behind this scheme is to introduce the same signal back 180° out of phase and at the same amplitude. This is achieved by sampling the transmitted signal with a directional coupler, adjusting the phase with the line stretcher, and adjusting the critical length to the cavity.

The cavity has a small loop that is variable so the attenuation may be adjusted with no phase shift. Ordinary attenuators also introduce varying amounts of phase shift, thus giving two variables to be adjusted at once.

Motorola normally puts in three large cavities with small loops to get the high skirt selectivity (and high losses). They usually shun spacings this close in frequency.

To adjust, watch first-limiter current on a sensitive meter and turn adjustable cavity loop to about 45°. Next, adjust the line stretcher. A dip should be noted on the meter at some point. If the dip comes at the end of the adjustment (and it always seems to), add a small section of coaxial cable.

(continued page 56)

The FCC Speaks Out ...*on repeaters*

Part 97, Amateur Radio Service rules, does not provide for the unattended operation of an amateur (repeater) station used to automatically receive and retransmit signals from other amateur stations. Operation with a properly licensed operator in attendance at the so-called repeater station, or at an authorized remote control point, is permissible provided the requirements of applicable rules, including Section 97.43, are met. Control of any remotely controlled transmitter(s) must be exercised by the licensee by wire line or radio link (220-225 MHz or higher amateur band) from a fixed remote control point. Radio control links for RACES operation must be in the 220-225 MHz band since higher frequency amateur bands are not authorized for RACES operation.

Section 97.43(b)(6) specified the requirements for the operation of an amateur (repeater) station by radio remote control. Such operation must be specifically authorized, and the remote control point where the operator is located must be designated in the license. Provision must be made at the remote control point to disable the repeater transmitter, if its operation should deviate from the requirements of applicable rules, by means of control signals transmitted in the 220-225 MHz band or higher frequency amateur bands. Provision should also be made for disabling the repeater station in the event the control receiver fails or is captured by an undesired signal. A timer may be used as a "fail-safe" device to automatically limit transmission to a period of not more than three minutes, in the event of failure of the radio control link or capture of the control receiver by an undesired signal.

Control of an amateur (repeater) station is the responsibility of, and must at all times be maintained by, the licensee of that station from the remote control point specified on the license. However, the repeater licensee may limit access by other amateur stations (mobile, fixed, or portable) by the installation of appropriate circuitry such as that which may be actuated by subaudible tones. However, this does not relieve the station licensee of his responsibility to be present and maintaining control of the repeater station when it is in operation.

Identification and logging of the repeater station must comply with Sections 97.87 and 97.103. Automatic identification by means of taped voice or code wheel is permissible. Such identification should be made at least every three minutes while the repeater is being used. Tape recordings may be used for logging purposes.

Applications for remote control operation of amateur (repeater) stations must satisfy the minimum requirements indicated. These basics have been found necessary for adequate control and monitoring of operations in the amateur radio service where the use of frequencies is on a shared basis by all amateurs and the probability of interference is significant.

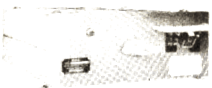
A GREGORY EXTRA!
FOR FM READERS

We are offering free, with any purchase of our low, money saving specials, a free copy of the "F.M. Schematic Digest"...a $4.50 value... while they last!
Mention our special offer when ordering and we will include your free Schematic Digest. Only one free copy per order.

6 METERS F.M.
MOTOROLA X-51GGS SPECIALS VERY CLEAN!
3 frequency dual front end receiver
2 frequency transmitter
Receiver has a transistorized power supply
Transmitter uses a dynamotor.
12 volts 50 watts wide band
in 15" cases
Units complete with cables, multi-freq. control head, speaker, microphone, control relay and fuse block $128.

---

450 MHz USERS



Gregory Electronics offers you a large selection of Motorola T-44 Series U.H.F. equipment. Complete with cables, control head, speaker, microphone, control relay and fuse block.
All units are 15-18 watts in 15" cases

T-44 A	6 or 12 volts	vibrator supply	$48.
T-44A6	6/12 volt	vibrator supply	$58.
T-44A6A	6/12 volt	vibrator supply	$68.
T-44AAV	6/12 volt	vibrator supply	$88.

With the conversion data in the schematic digest seen above, you can be on 432 MHz in no time!

G-E Schematic
Outline and
Interconnection
DIAGRAMS
for G-E 2-way
FM RADIOS
VOL. 1
Pre-Progress Line
(1949-55)
25-50 MHz
72-76 MHz
VOL. 2
Pre-Progress Line
(1949-55)
150-174 MHz
405-425 MHz
450-470 MHz
$4.50
each volume

General Electric
4ES14A
6/12V. 450-470MC
12-15 Watts
less accessories
$38
in lots
of 10 . . . $30

GREGORY ELECTRONICS CORP. 249 Route 46, Saddle Brook, N. J. 07662
Phone (201) 489 9000

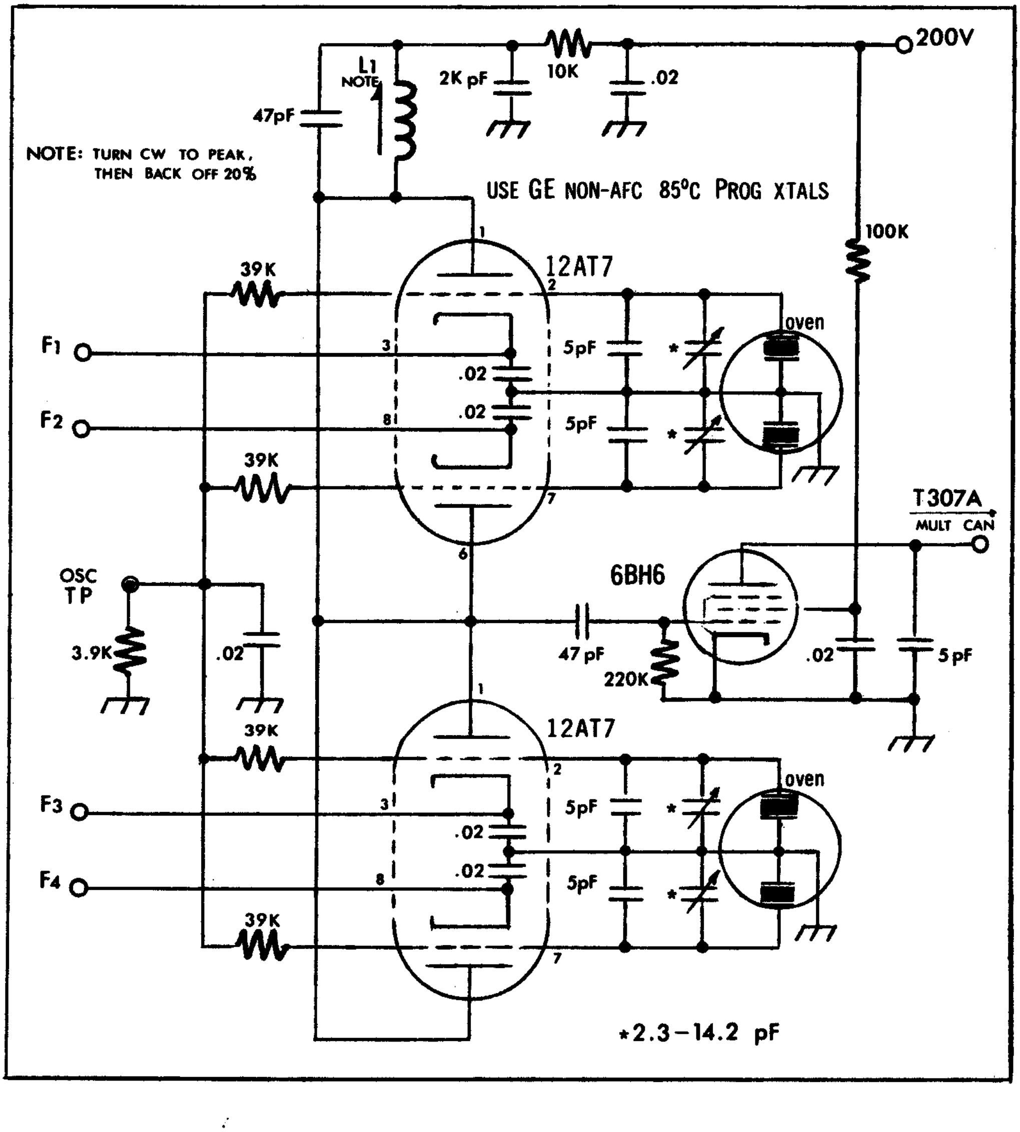
Number 6 on information card

4-frequency conversion for the 450 pre-prog

by

James J. Lev K6DGX-W6FHF

The GE Pre-Progress Line 450 MHz mobile unit is the most versatile piece of equipment available to the FM amateur today. Unlike its nearest rival, the Motorola T44, it is blessed with a fair amount of open chassis space that may be used to great advantage. (The T44 has some open underchassis space,



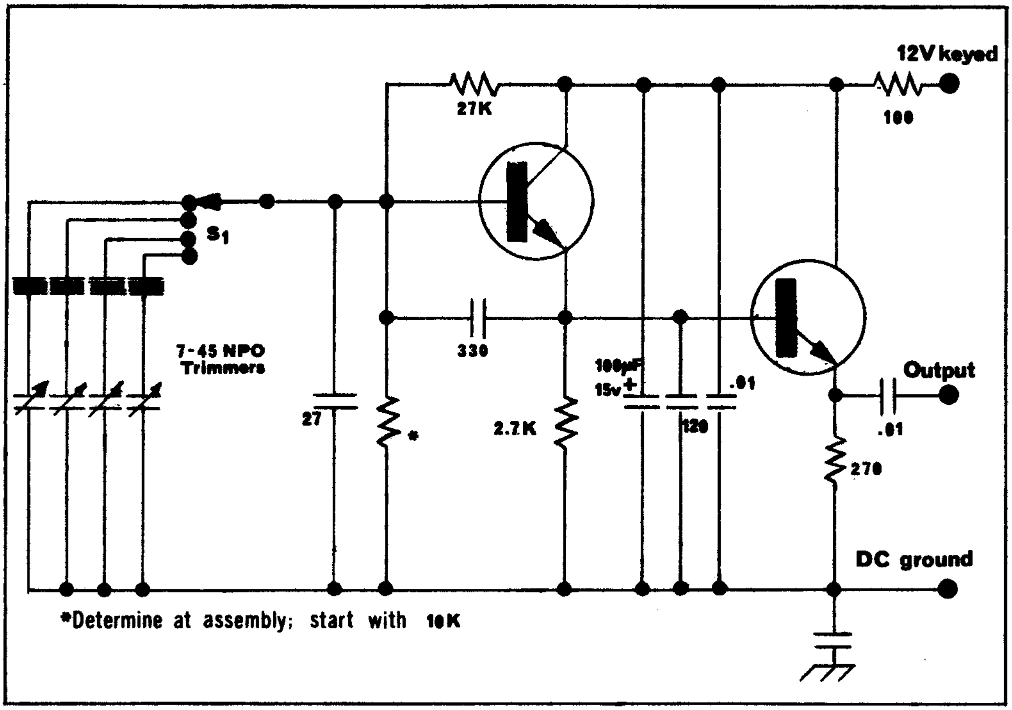
but only on the power supply strip.) The four-frequency circuit diagram illustrated here is a composite of existing GE circuitry that has been modified to permit use in the Pre-Prog receiver.

In addition to the four-frequency receive capability, there is also a decided advantage to be realized by eliminating the existing AFC oscillator platter due to its tendency to excessive frequency drift. (For those interested in a single-frequency "Progress Line" oscillator conversion to Pre-Prog units, refer to "450 MHz Mobile Units for Remote Radio Control," FM Bulletin, September 1967.)

To begin the conversion remove the existing AFC first-oscillator platter from the receiver. Remove the three adjacent blank oscillator platters, then remove the AFC feedline (black shielded cable running towards rear of receiver strip). A metal plate should now be cut to fit into this opening; a little metalwork with a nibbler tool is in order to make sure cross pieces obstructing this opening are cleared away. Coil L1 in the schematic is the same coil that is on the AFC-type oscillator platter; it must be carefully removed and remounted on the new plate; examine the coil slug carefully to be sure it has not been "diked"; this is a favorite stunt of some commercial technicians that is sometimes used to "stretch" receiver frequency without having to buy a new crystal; remove the present capacitor across L1 and solder a 47 pF in its place.

It will of course be necessary to employ dual crystal ovens; for best results it is suggested that either GE, ITT, or RCA 12-volt types be used. These are available at $3 each from Mann Communications, 18669 Ventura Blvd, Tarzana, California.

Your present AFC-type oscillator crystal may not be used as the correlation is different; it will be necessary to buy new crystals of the GE "Progress Line" type that are available from Sentry Manufacturing Co. When ordering, specify that the crystals are to be used in a GE Progress Line Model #4ER26 NON-AFC receiver; holder type F-605 with an oven temperature of 85°C.



REMOTE CRYSTAL OSCILLATOR

by Sam Craig W2ACM

If your VHF/FM gear is of Pre-Progress vintage and you have been wondering how to add multifrequency capability, here is your answer. This article describes a remote crystal oscillator with switch selection of up to four crystals. Since the original unit was intended for the transmitter of an ES-1B two-meter FM unit, 3 MHz crystals were used.

The circuit should work equally well with crystals of other frequencies (up to 15 MHz or so), and it can be applied to receiver local oscillators as well as transmitters. It is not designed to work with overtone crystals, however.

The circuit consists of a transistorized Pierce oscillator coupled to an emitter follower for isolation and low output impedance.

The oscillator unit may be mounted in any convenient location and coupled to the transmitter by a length of ordinary shielded cable. Neither the type of cable nor its length appears to be critical. In the original installation, a four-conductor shielded cable having a length of about six feet was used. The output impedance of the circuit is low enough to tolerate the shunt capacitance of 15 feet of shielded cable or coax, without any drastic reduction in output voltage. Impedance matching is not necessary since optimum power is not a requirement.

The rf output from the remote oscillator is fed directly into the grid of the former oscillator tube in the transmitter, so that this stage now becomes a buffer. The cathode of this tube (and screen, if a pentode) should be bypassed to ground for rf if not already done in the existing circuit. In my installation, the grid current in this stage was not as high with the remote oscillator as it was originally, but the drive level in the subsequent stages was unaffected.

The output frequency is not affected by the load, and changes only a few hertz when the supply is varied between 5 and 15V. Although the output voltage increases as the supply voltage is increased, the use of more than 15V is not recommended.

The following two pages show the complete plans for the oscillator. Once the etched circuit boards are made, assembly of the unit is quite simple. After soldering the components to the main circuit board, attach the output, power, and ground leads and mount the board in the Minibox. Be sure that leads and solder do not protrude more than 1/16 inch on the foil side of the board. Then attach and wire the connector (J1). Next, the rotary switch (S1) should be put in place and connected to the main board.

The remaining two circuit boards with the crystal sockets and trimmers are fastened together and mounted last in the box. The front of this assembly is supported by the leads from the boards to the switch, so 20 or 18 AWG solid wire should be used for mechanical stability. Use care when inserting or removing the crystals so as not to crack the circuit boards. Glass-epoxy board material is worth using, if available, because of its greater strength.

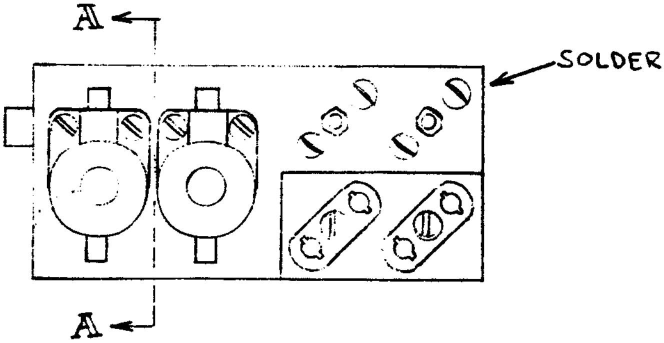
When adjusting the trimmers for exact frequency, remember that placing the cover on the box will lower the frequency slightly (10 to 20 Hz with 3 MHz crystals) due to the added capacitance. To avoid this problem, holes can be drilled in the cover for access to the trimmers. Because of its small size, the oscillator can easily be taken to a counter or other measuring equipment for accurate frequency adjustment.

Measurements of thermal stability have not been taken yet, but experience has shown that in the usual mobile environment the frequency does not change enough to be evident at the receiving end.

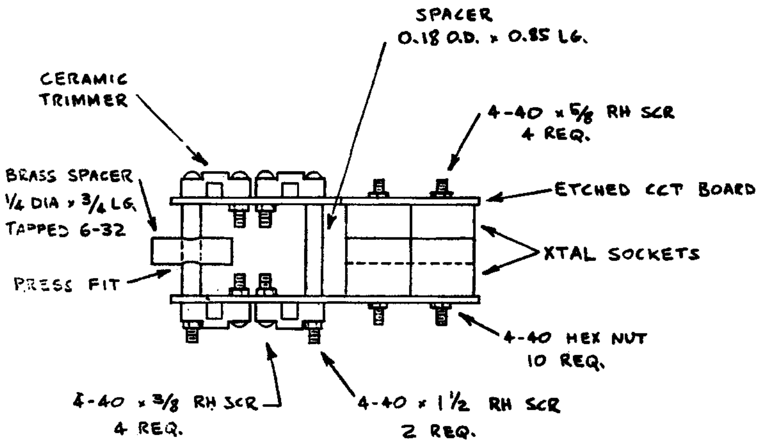
If you have any trouble making the remote oscillator work, please get in touch with the author.

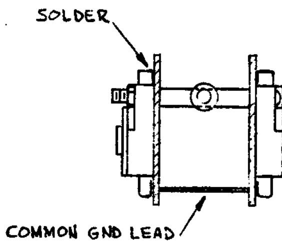
Acknowledgment:

The author is indebted to N. V. Friend, who furnished the idea for this device.

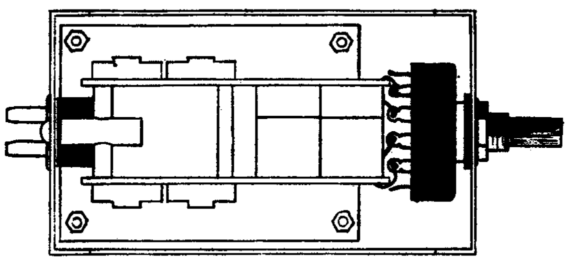


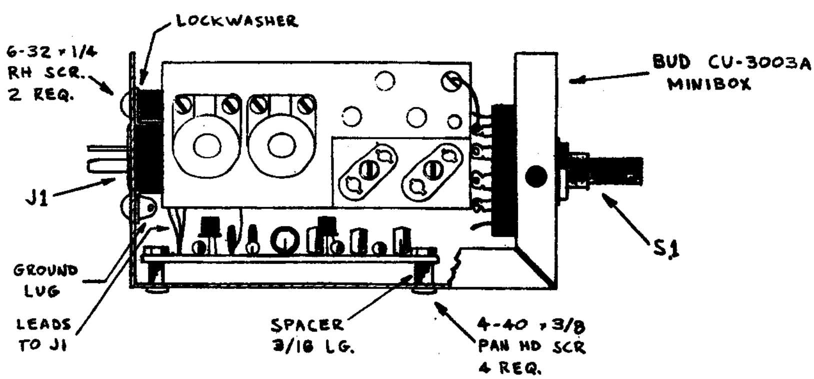
MOUNT TRIMMERS ON FOIL SIDE
XTAL SOCKETS ON OPPOSITE SIDE

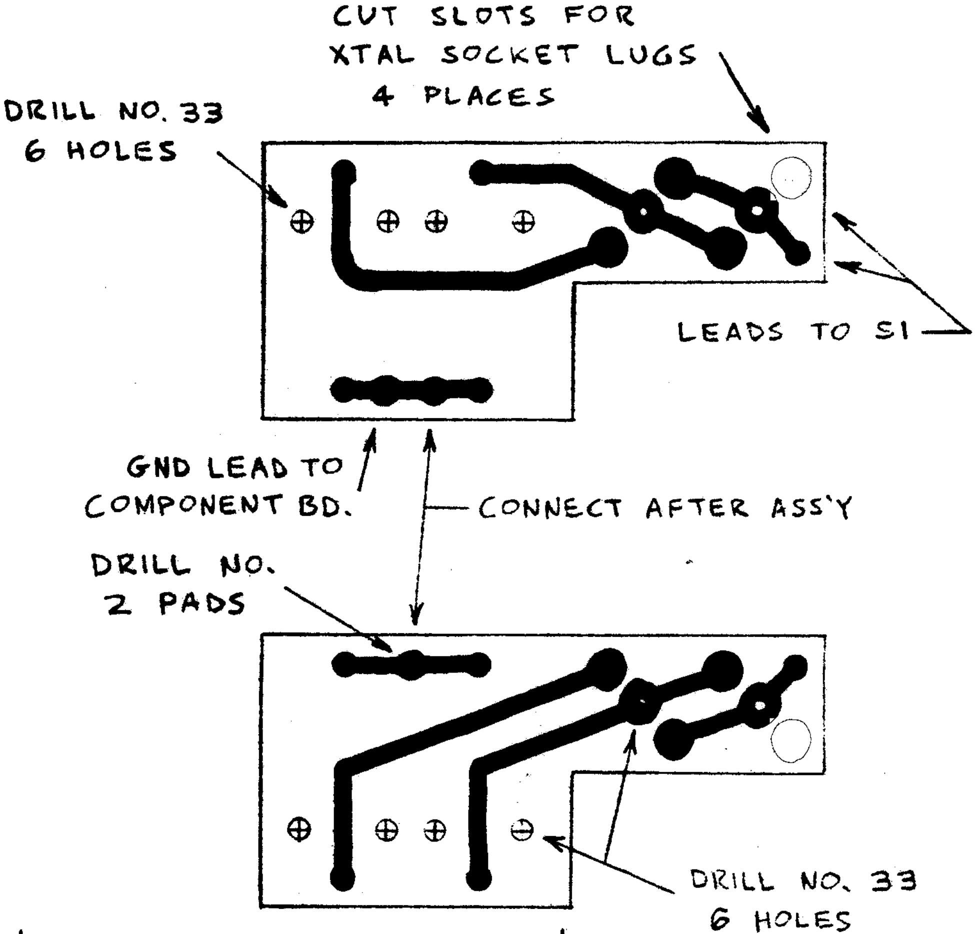

SPACER
0.18 O.D. × 0.85 LG.
CERAMIC
TRIMMER
4-40 × 5/8 RH SCR
4 REQ.
BRASS SPACER
1/4 DIA × 3/4 LG.
TAPPED 6-32
ETCHED CCT BOARD
XTAL SOCKETS
PRESS FIT
4-40 HEX NUT
10 REQ.
4-40 × 3/8 RH SCR
4 REQ.
4-40 × 1 1/2 RH SCR
2 REQ.

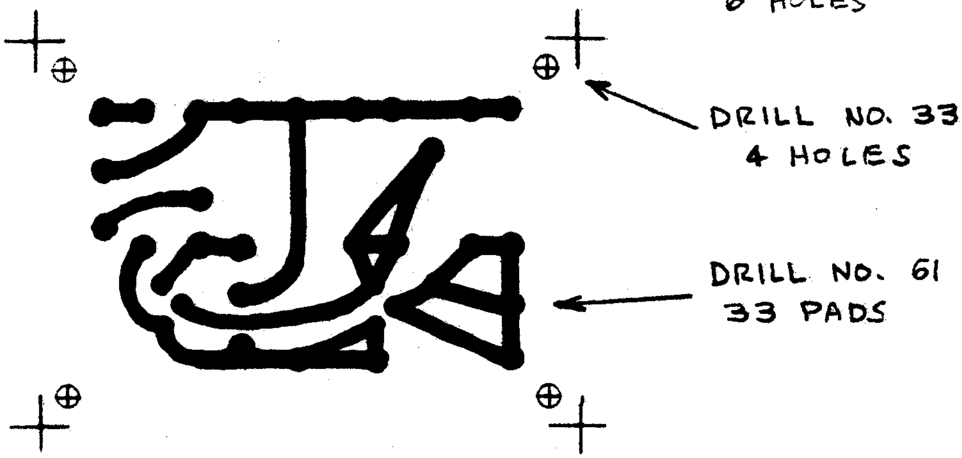

SOLDER
COMMON GND LEAD

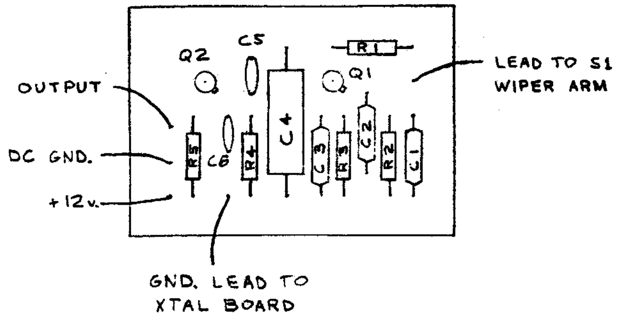
SECTION A-A




LOCKWASHER
6-32 × 1/4
RH SCR.
2 REQ.
BUD CU-3003A
MINIBOX
J1
S1
GROUND
LUG
LEADS
TO J1
SPACER
3/16 LG.
4-40 × 3/8
PAN HD SCR
4 REQ.


CUT SLOTS FOR
XTAL SOCKET LUGS
4 PLACES
DRILL NO. 33
6 HOLES
LEADS TO S1
GND LEAD TO
COMPONENT BD.
CONNECT AFTER ASS'Y
DRILL NO.
2 PADS
DRILL NO. 33
6 HOLES


DRILL NO. 33
4 HOLES
DRILL NO. 61
33 PADS


OUTPUT
DC GND.
+12v.
Q2
C5
R1
Q1
C4
R5
C6
R4
C3
R3
C2
R2
C1
LEAD TO S1
WIPER ARM
GND. LEAD TO
XTAL BOARD

REPEATER LICENSING
—HOW TO BEAT THE HASSLE

by Gary Hendrickson W3DTN

So you want to build and license a repeater? Well, we went through the hassle of licensing the Baltimore area repeater, WA3DZD, and maybe through our experience we can help other aspirants of a similar nature.

The important thing to keep in mind is that the boys at the FCC office don't have time to read through a ream of paperwork. Keep it simple! DON'T send schematics or instruction manuals for the equipment you intend to use. Send pictures! They like pictures! A block diagram similar to that shown, and a very brief explanation of how it works will be less likely to wind up at the bottom of a big pile on somebody's desk.

Of course the first item on the list is the old faithful FCC form 610, "Application for Station License."

Part I.

Subparts 1 through 7 are self-explanatory.

Subpart 8. If you want a special callsign as a memorial to a deceased amateur, there must be a valid reason, not merely just a friend. He must have been a past member of your club, or something equally valid. Otherwise a new callsign will be issued.

Subpart 9. The remote station location must be pinpointed as accurately as possible. Under certain circumstances in Subpart 11, the geographical latitude and longitude must be given.

Subpart 10A. If more than one control point is needed, additional points should be listed on a separate page, by name, call, and address.

The address shown on Subpart 10A form 610 should be that of the trustee. When the license is issued, that is the address that will be shown, but an additional sheet with the list of additional control points will accompany it, and this must be posted along with the license at all control points. Our license has 7 additional control points licensed, and the New England repeater system has over 15, in 5 states!

Subpart 10B. If remote control will be by radio, several requirements must be met, and stated:

a. The remotely controlled transmitter must be located at a point readily accessible, and on premises controlled by the licensee. If it is on someone else's property, the licensee must have ready access to it.

b. The transmitter will be in a locked cabinet and only accessible by duly authorized persons. A guarantee that local electrical regulations regarding safety and good engineering practice would be advisable.

c. A copy of the station license must be displayed on the exterior of the transmitter cabinet, and the original must be displayed at the control point.

d. A receiver tuned to the operating frequency of the remotely controlled transmitter must be in continuous operation at the remote control point for monitoring the emission of the remote transmitter.

e. Some means to deactive the remote transmitter from the control point in the event of any deviation from the terms of the license must be provided. A simple statement of how this is accomplished is all that is required.

f. The controlling transmitter at the remote control point will operate in the bands of 220 MHz or above. Specific frequencies need not be specified -- just the bands involved.

In our application we stated that all equipment used in the system is of the type that is type-approved for commercial use and is listed on the FCC radio equipment list, that all transmitters and receivers will be crystal-controlled, and that antennas will be installed in compliance with good engineering practice. The above items should all be stated on one page.

If the system includes more than one remotely controlled point, such as satellite receiver points, or control-relay points, a block diagram should be submitted for each site, as well as a block diagram for the overall system.

Subpart 11. If the antenna does not exceed local FAA tower height limits, vote NO. If it is your own tower, use FCC form 401-A, as instructed. If you are borrowing space on an already existing commercial tower, file FCC form 714. The licenses for the existing commercial radio equipment on the tower will have FCC file numbers listed on them, which can be referred to for notification to FAA. The exact latitude and longitude must be listed. In the event the commercial user of the tower discontinues use thereof, you must assume full responsibility for tower maintenance, such as painting and lighting, or be prepared to surrender the station license for cancellation. This should be clearly spelled out.

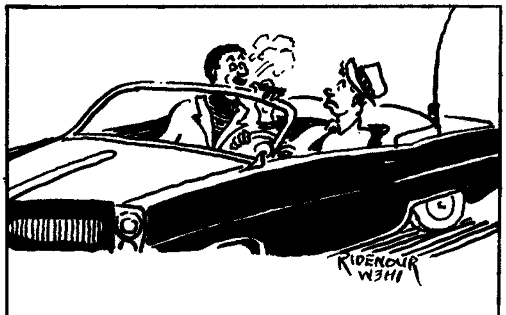
Subpart 12. In addition to filling in the blank, you should submit a letter of authorization to use the premises where the remotely controlled station is to be located, signed by some official in direct charge of the premises. In our case this was the chief dispatcher of the county policy and fire radio systems, whose tower we are using.

Subpart 13. If this is to be a club station, send a copy of the constitution and bylaws. If an incorporated club, include a copy of the articles of incorporation filed with the state.

Last but far from least is that little check for the appropriate filing fee.

The whole package should be sent to the Gettysburg, Pa. office, from which it will be forwarded on to Washington, D. C. for technical evaluation.

That's all there is to it! Don't bother the men at your local FCC office. Many of them don't even know what a repeater is and would tell you it's illegal. Bear in mind to make it complete, but simple. The boys at the FCC headquarters office have been very cooperative with us and we hope that this information will help you and them to do the job as quickly and easily as possible.



"OK - so your repeater works. Now let's try dialing the destruct code."

CHRONICLES OF SEVEN-SIX

By Ken Sessions

VIII. REPEATER CHEATERS

Everything was copacetic. Or so we thought. Fred and I had a complete 450 mc repeating system that let us have unhampered communications between ourselves. And if we wanted more activity, it was merely a matter of calling home through our "private repeater" and having my wife dial the tie-in number. When she'd dial the proper 5-digit number, our 2 meter receiver on the hill would feed all signals into our 450 transmitter. When our 450 receiver heard signals, it would feed them into the 2-meter transmitter, keying it automatically. In this way, we could work 2 meters or "secret channel" at will.

And everything worked beautifully. The remote 2 meter transceiver on the hill would allow us fantastic range, while mobile almost anywhere within a 100-mile radius. The 100 watts on the hill was far better than the kilowatt at home. And the kilowatt, used on rare occasions, made us virtually jamproof. Then one night I dialed on and got into a ragchew. Then--without warning--I heard the "dial off" signal, and I was off the air. I dialed on again, but only to be again turned off. Someone was playing tricks. (Not an unusual occurrence among seven-sixers.) The ratfink had found my secret channel, tape-recorded the function selection tones, then played them back through my system. The scary part was that the hijacker's signals completely captured mine, although I was within 15 miles of the remote transmitter and directly line-of-sight. My 25-watt control signal had seemed adequate at first, but it began to look pretty puny as the buttinski's signals clobbered me out.

On the very first day I heard the intruder, I shut down the system at the earliest opportunity, and began work on a highly-directional multielement yagi. It only took a few hours to construct the antenna. I used a wooden broom handle for the boom, and copper brass welding rod for the elements. A few minor adjustments after checkout with an SWR meter brought the match up to what it should be.

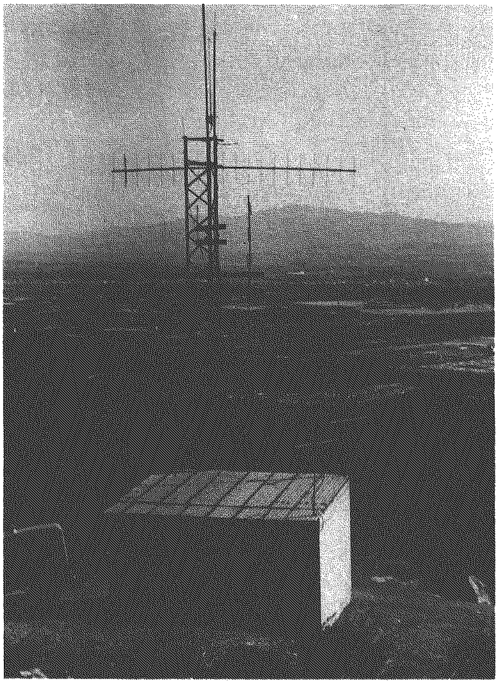
I installed the beam, and carefully aimed it at the remote site, which I could almost see. Then I went into the house and started yakking, with the hope that my nemesis would try to capture me out again. I was really ready for him this time, and said so. But before I could finish my transmission, I was dialed off.

I secretly declared war.

It was war, all right. The mystery repeater cheater struck again and again; each time causing more embarrassment than the last. We increased the power of our control transmitter and optimized the efficiency of the control beam. Eventually, after replacing our RG-8/U coax with extremely low-loss Heliax, and raising the control yagi to 65 feet, we were able to keep control of the remote base station under any circumstances. When our friend would try to use our system, I would simply come on channel and capture him out. He soon tired of fruitless jamming, and disappeared.

But not for long! It was apparently obvious to the "cheater" that another jamming means must be adopted. And Fred and I were unaware that while we were finally enjoying uninhibited use of our facilities, our nemesis was engaged in diabolical reasearch.

When three weeks had elapsed without interruption on our secret input frequency, we became lax. I would leave the system turned on when I went out for the evening. (When the system is "turned on", the 2 meter FM frequency, as received on the hill, is automatically retransmitted on our 450 mc frequency when a 2 meter carrier appears on channel.) On one particular evening, I decided to visit a friend for an evening of chess. Fred had decided to go into Los Angeles, and Helen, my wife, retired early.



For Fred, one drink led to another, prolonging his LA visit. For me, one game led to another. It was nearly 2 AM when I got into my car to go home. As is the custom, I turned on my mobile control rig. A very suspicious gurgling sound was all I could get from the remote. I turned on my 2 meter mobile rig. The gurgling sound was there too. I realized, with sudden horror, that my 2 meter hilltop kilowatt was being keyed, and modulated with strange noises. I found out later that it had been transmitting for nearly four hours. It was a relatively simple matter to shut it off, and I did. Some of the subsequent comments, while noteworthy, couldn't bear repeating.

Inhabitants of the channel were pretty upset. People found that they couldn't communicate with each other for more than a half-mile, even though they were 30 or 40 miles from my transmitter. Needless to say, I was shamed. It was several daus before I could make another appearance on the Preferred Frequency. (The episode hasn't been forgotten even to this day.)

Our nemesis was back! He had discovered an effective way of locking our transmitter on. It was only after a calculated, well organized research program that Fred and I realized how our nasty adversary had accomplished his evil purpose.

After considerable experimentation, we found that while our 450 mc transmitter is on, the 450 mc receiver is desensitized. The repeater cheater had produced an attenuated 450 mc signal just strong enough to key the hilltop transmitters. When the transmitters (one on 2 meters, and one on the 450 mc band about 6 mc from the input) are keyed, the 450 mc receiver loses sensitivity, and the carrier disappears. When the carrier disappears the transmitters shut off, and the cycle repeats. Indefinitely.

For the time being, our only course of action was to disconnect the 2 meter remote facility from our 450 mc repeater. Jamming would then only interfere with those of us operating on the 450 mc system. When the two were disconnected, the jammer lost interest, and abandoned--momentarily--his project.

Meanwhile, Fred and I had to come up with an unjammable system. We considered a number of selective control systems, similar to those used commercially on crowded industrial channels. The single-tone system was ruled out right away. It's very effective for commercial use, but presents no serious challenge to a devoted jammer. With single-tone, carriers are only repeated when accompanied by an initial short burst of tone. A good whistler masters the act of simulating these signals in short order.

Private line was a possibility. With PL, a continuous tone of a specific frequency must accompany a carrier before it can be repeated. But here again, any good jammer has an audio oscillator at his disposal, and finding the right tone frequency is no great feat. Besides, who wants to put up with a background hum on every transmission? There had to be a better way.

Fred's first defensive act was to reduce the control receiver's input bandwidth. The GE pre-Progress line of FM receivers uses a superwide AFC system. Any station with a reasonable signal operating within 75 kc from the crystal frequency will pull in. So Fred got a couple of diodes and placed them across the discriminator so as to reduce the bandwidth to 15 kc.

While Fred was engaged in this project, I worked to develop the fruits of a brainstorm of my own. Part of our problem stemmed from the fact that the system was just plain accessible. The input 450 mc antenna was omnidirectional, on a mountaintop, and on a 60-foot tower. Anyone anywhere could plop a 100-milliwatt signal on the 450 mc input frequency -- once I'd turned on the system -- and be repeated onto 146.76 mc. We had never seriously considered installation of a directional receive antenna because of the limitations it would naturally impose on our mobile operations.

But we had a pretty capable control system, and the capacity to include additional control functions. Suppose a directional antenna were employed normally, then changed to omnidirectional only during mobile use?

This was the answer! I connected a coaxial relay so that in the normal state the receive antenna was a highly directional multielement beam aimed toward my house. By dailing a certain digit at home, the relay was energized, and the receiver was switched over to the omnidirectional groundplane.

Loss of control, momentary loss of power, or shutdown of the system would automatically cause the receiver to revert back to the directional antenna.

While I worked on the antenna system, Fred scrounged up a 3-minute electrical timer, and wired it in. Any 2 meter transmission (from our transmitter) in excess of 3 minutes would disengage the 2 meter station from our 450 mc repeater system, and necessitate redialing the 5-digit number to reconnect.

All this preparation kept the Bad Guys out of OUR system for awhile, but elsewhere, others were having problems of their own!

In keeping with the trend toward private repeater operation, a generally widespread effort to "sophisticate and modernize" manifested itself on the Preferred Frequency. It goes without saying that seven-six does not represent the upper-income bracket of hamdom, hence only a handful of seven-sixers were equipped financially or materially to establish remote transmitting facilities. A few others spent impressive amounts on late-model equipment and the like, but the majority were left to their own limited devices. And of this majority, a number of operators displayed a degree of ingenuity and resourcefulness that might well be envied by even the most extravagant of hobbyists. For individual systems began to appear that couldn't be duplicated regardless of cost.

One of the most interesting specimens of this elaborate gimcrackery was a special radio land-line network designed and built by Steve Childress, WB6CSZ, at a ridiculously modest cash outlay. His system was a masterpiece of amateur imagineering.

Steve linked his 2 meter FM station with a private telephone line in such a way that he could dial his own unlisted number from any other telephone and be automatically patched into seven-six. (Such operation is not blessed by the telephone company, but absence of a direct tie-in precludes the legalities of intervention.) Steve was planning to expand the system still further by installing a tone system and dialing mechanism in his car so that he would be able to initiate telephone calls from his mobile transmitter. Unfortunately, however, he hadn't reckoned on the characteristic system busting tactics of seven-sixers - and eventually had to abandon his entire project.

When Steve's telephone/seven-six system became a matter of general knowledge on the channel, some of the sneakier rascals began to devise dastardly plots whereby they might use his device to their own personal advantage. Steve caught on fast and kept all significant information a deep secret. He was impregnable to inquisition from friend and foe alike, and jealously guarded even trifling bits of data which he thought might help some seven-sixer to learn his secret number.

The more secretive Steve became, however, the more curious were his associates, and the more determined were the Bad Guys to break into his system. Time passed, but the interest didn't subside. The Bad Guys didn't show any real progress, and those big talkers among them began to lose their cherished notoriety for system busting.

All this especially perplexed Paul Signorelli, K6CHR, who took great pride in his official title of "Supernasty." Paul had a reputation to uphold, and became obsessed with the idea of learning the magic number that would allow to operate Steve's radio from any telephone. So intense was Paul's drive in this quest that he spent an entire day at the local telephone company making friends and establishing relationships in a concentrated effort to glean what scraps of vital information he could -- anything that might help him to learn Steve's private number. And his time was not ill spent! Paul didn't get Steve's number (in spite of pleading, deceit, and offered bribes), but he did learn an extremely important and very useful fact:

If a person in Steve's telephone exchange area were to dial the numerals 951, an automatic computer device in the telephone office would cause immediate verbal playback of the number of the telephone being dialed! If Paul could just use Steve's telephone, he could dial the three-digit number and learn the supersecret key to the system.

As it happens, Paul was not on the best of terms with Steve, so obviously he could not use Steve's telephone to dial the computer. He must delegate the task to a mutual acquaintance of dubious character willing to commit such a treacherous act. Naturally, I qualified.

But in my own defense I must say that this was not in itself an agreeable assignment. My consent was based on Paul's promise not to make public certain secret communications I had been having with the FCC.

At any rate, I was to visit Steve and, at the first opportunity, surreptitiously dial 951, then memorize the automatic playback. I would report this to Paul at a clandestine meeting later in the evening.

It went off remarkably well. When I arrived at Steve's, he had other visitors, W6NQS and WB6DEJ. Both his visitors were trying to pry the secret telephone number from him, and Steve was enjoying the attention enormously. Before I even got in the door I told the fellows that I knew the number and would mention it on the air for all to hear. Steve eyed me with suspicious disbelief and challenged me to repeat the number. Of course I could not, so I declined on the grounds that it would not be morally right, etc., etc.

The instant that the center of attention was diverted to another part of the house, I dashed to the telephone and dialed. Almost without hesitation the number came back -- and I committed it to memory and replaced the receiver on the hook.

Someone suggested we all go to a nearby hamburger joint to continue our idle chatter, so Steve ushered all of us to the door and locked his apartment, confident that his secret was safe. And actually, it would have been. I had already decided to forget the number and give Paul a false report. But it was too late for that.

We were two blocks from Steve's apartment when we heard K6CHR's voice coming in uncommonly strong on Steve's mobile rig. It wasn't until the voice said. "Thanks, Ken, you did a fine job of sleuthing," that the full impact of what was happening struck home.

Steve was slightly puzzled. I was embarrassed; doublecrossed; hoist, as it were, by my own petard!

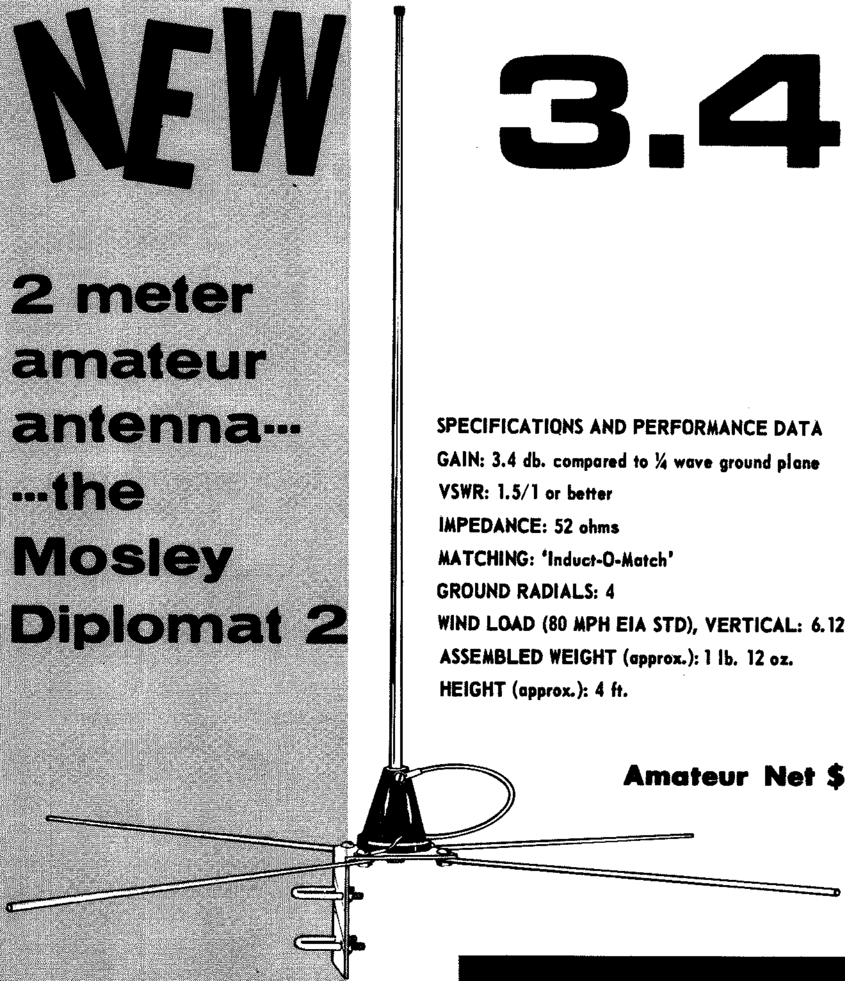
"Boy, your telephone system sure works great, Steve," Paul's voice gloated. The fink was ratting on me in first-class seven-six tradition.

(Cont. on page 50)

NEW

3.4 DB

2 meter amateur antenna... ...the Mosley Diplomat 2



SPECIFICATIONS AND PERFORMANCE DATA

GAIN: 3.4 db. compared to ¼ wave ground plane

VSWR: 1.5/1 or better

IMPEDANCE: 52 ohms

MATCHING: 'Induct-O-Match'

GROUND RADIALS: 4

WIND LOAD (80 MPH EIA STD), VERTICAL: 6.12 lbs.

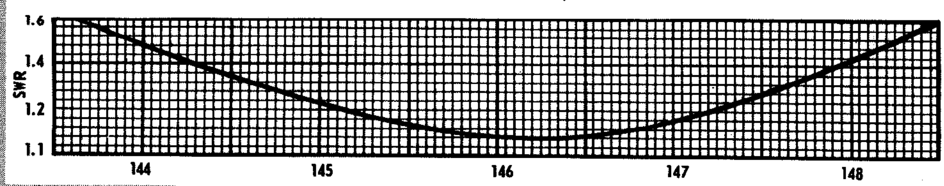
ASSEMBLED WEIGHT (approx.): 1 lb. 12 oz.

HEIGHT (approx.): 4 ft.

Amateur Net $8.10*

VHF ASSOCIATES
P. O. BOX 3321
JEFFERSON STATION
DETROIT, MICHIGAN 48214

* we pay the postage - mich. res. add 4% s.tax



Number 8 on information card

Hey fellas!

Let's put up a repeater!

by

P. L. Cohen (WB4DZH)

That's just about how it started. A number of two-meter FM addicts around the Miami, Florida area decided to "improve the state of the art," and so the WB4HAA repeater was born.

With this thought in mind, the word was quickly passed around on .94 that there would be a meeting at the home of Bun Freedman (K4EBG) for the express purpose of forming an organization to get a repeater going. The meeting was well attended by a fairly representative group operating two-meter FM equipment in the area.

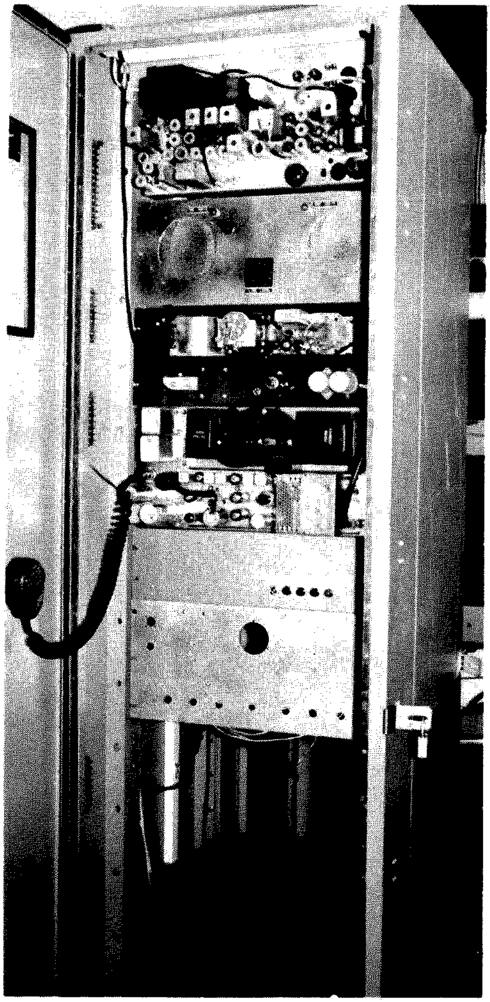
A guest was present -- a man who was down visiting from Michigan and knew quite a bit about the various repeaters already in operation in that area and other locations along the eastern seaboard. This gentleman had recently started a small publication for FM'ers aptly titled "FM Bulletin." If Mike can remember that occasion he'll remember the labor pains that accompanied the birth of the South Florida FM Association, the election of temporary officers, and the first steps toward our goal of an operational repeater.

At this point the road branches off in two directions, but meets again further on in this tale of trial and tribulation. One path was the procurement of the license, while the other concerned the technical aspect of the repeater itself. A great deal of time was consumed in the pursuit of both these elusive specters.

A technical committee was formed whose sole purpose was to set up the design of the repeater system. Another committee (with the usual duplication in membership) was formed to draft the license application and to determine a site for the repeater when (no question of "if") the license was obtained. Let's have a look at these hardworking committees and see what they accomplished, and how they did it.

The technical committee first drew up a rough draft of what the repeater configuration should look like. Control systems were determined and block diagrams made up so that nothing was left to chance. The members of the association had decided to use an input frequency of 146.34 MHz, which was standard. After some lengthy discussion, an output frequency of 146.70 MHz was selected to eliminate the interference that would have been caused by having an output on 146.94 MHz. Research into the question also turned up the information that the frequencies we chose were considered by many to be the national repeater frequencies for two-meter FM.

Once the technical paperwork was completed, the committee finally set about the actual construction of the repeater. A site had been obtained for the transmitter at the location of the University of Miami Radio Club (K4HYE) on the top floor of the engineering building, while the receiver would be located another building on the university campus. Assignments were handed out and various members of the committee undertook to construct the various components of the repeater system, while the entire project was straw-bossed by our able technical director, Don Hayman (WA4JBI).



Components for the repeater were obtained through three primary channels (no, not beg, borrow, and steal, although this may have been simpler). Some equipment was donated by members of the association, some was purchased outright from the GE bargain corner through the assistance of association prexy Norm Ginsberg (W4YFD), while our third source of supply was the ingenuity and ability of our members. For example, our timer panel was designed and constructed by the association's vice president Aubrey Hutchison (K4ANV); a cw identification code wheel and tone oscillator was the project of Jay Smith (W4TQH); the audio input system was put together by secretary Ted Holdahl (K4ANW); while a surplus tape recorder was modified and hooked up for logging purposes by Cal Barfield (K4GSN). This does not mean to imply that these were the only workers on the project; all members of the association cooperated fully whenever a working part was required. After all, it was "our" repeater, and we were responsible for giving birth to it.

While the technical work was going on, efforts were being made to obtain a license for the repeater, and this is where we began to run into a few stumbling blocks. Inquiries at the local FCC office really didn't shed much light on what was really required to license a repeater for legal operation, so a decision was made to submit an application requesting waivers on just about anything we could think of. Waivers were requested on logging, control and identification, and a few other aspects. We were shortly greeted with the nicest rejection slip you ever did see. But, along with the rejection, in plain words, was just what the FCC required to license a repeater for legal operation. So back went our revised application, complete and to the very letter of the requirements.

Five association members were set up as trustees on the application, and these five have control over the repeater via UHF link and Secode. There is at least one trustee control station on the air whenever the repeater is operational. There is a three-minute "time out" which will drop out the transmitter unless it is reset by transmitter drop-off. Reset takes place when the COR is dropped out. If timeout occurs and the transmitter drops out, someone is left talking to himself. Another three-minute timer controls the code wheel, triggering it after three minutes if the transmitter is being keyed. For the first ten seconds of each transmission the tape recorder comes on for logging purposes, so a reel of take designed to last for 24 hours actually lasts us almost six weeks. All of this information was included in our revised application -- now all we had to do was wait.

One day the good news came and elation came to the SFFMA. A license had just been received for the remote operation of a transmitter with the call letters of WB4HAA. There was still the final twisting and tweaking yet to do, so it took another week or so of concentrated effort on the part of the association members, but on the evening of April Fool's Day WA4JBI and WB4DZH had the collective honor of making the first official mobile-to-mobile contact via the WB4HAA repeater.

Technically, the WB4HAA repeater has a lineup as follows: The VHF transmitter and receiver are GE Progress Line; both transmit and receive antennas are Mosley DB-2 Diplomats; and the UHF receiver is Motorola.

Yes, we had our problems, and every once in a while there's a gremlin that must be worked out, but right now the WB4HAA repeater is working just fine. And you can bet that there are some mighty proud hams on the frequency knowing that the repeater they're using is "their baby." So if you're ever ragchewing on .94 and somebody pipes up with the remark, "Hey fellas, let's put up a repeater," just remember that it CAN be done -- and you can have one helluva good time doing it, too.

WOULD YOU LIKE TO GET A FREE CRYSTAL? SEE PAGE 67 FOR THE DETAILS!

Hybrid Loops (Cont)

notch bandwidth. Rejection notch still unlimited theoretically; depends upon stability and accuracy of adjustment. Use low-loss coax for loop. Tried small Teflon coax and got very poor results. Solid shield better in system. Need double-shielded coax at receiver output and transmitter input lines. Double-shielded cables also make good loops.

Clamp loops down to prevent movement. Cavity coupling loops must be wide straps, not wire.

For test purposes, a receiver makes the best rf indicator, with a good calibrated attenuator-type signal generator. Theoretically, the swr at the input of these cavity-loops at the frequency to which it is tuned is unity for a resistive load. In practice, it might be desirable to add a variable matching network to the system on each side because a cavity/loop tuned for best rejection may not exhibit a good swr at the pass frequency.

With careful design and construction it is possible to combine all the best attributes, so that a single high-gain antenna and a lone run of low-loss coax will give results comparable to two such installations spaced a great distance apart.

CONTINUED FROM P. 46

Steve pulled the car to the side of the road and vented his wrath, singeing my ears and pride. Naturally, I told him the whole story. I hadn't counted on Paul ever really learning the number, but now everyone knew it! When I dialed from Steve's house, his transmitter had come on. And when the operator repeated the number, all who listened on seven-six could hear it. Paul knew what to listen for and misused the information immediatly and without mercy.

NEXT MONTH (The last chapter)
IX - THE ELEMENTS

FM'ERS WATCH

James F. Weaver, WA8COA

Membership in the Cincinnati, Ohio, Community Radio Watch was conferred upon the Queen City Emergency Net (W8VND/W8VVL) at ceremonies at the Cincinnati Police Headquarters. Cincinnati Chief of Police Col. Jacob Schott (W8DZ / W8FGX) officiated with Chiefs of Police of Silverton, Ohio, and Fort Thomas, Kentucky, participating as representatives of the Hamilton County (Ohio) and the Northern Kentucky Police Chiefs Associations. Earl Nichols (W4PII) and James Weaver (WA 8COA/WA9FEW), QCEN President and Communications Manager, respectively, represented the amateur group.

QCEN is the first independent, volunteer group to join CRW in Cincinnati, and is believed to be the first amateur radio organization to join in any of the 382 CRW cities in the U. S. QCEN mobiles operating on the Net's 53.05 MHz, FM, intercom frequency report traffic accidents, fires and other emergencies to law officials through members assigned as monitoring stations. Emergencies reported are those observed during normal business or pleasure driving.

DETROIT PREPARES FOR A REPEATER

Glenn Pohl, K8IYZ

The sixth largest city in the country prepares itself for the introduction of a new 2 meter FM repeater. Detroiters will experience the convenience of mobile operations over long distances such as they have been reading about in past issues of FM Magazine.

Essentially the repeater consists of a General Electric 50 watt base station, controlled by a 450 MHz link to Detroit. Equipment will be located near Clarkston, Mich. about 25 miles N.W. of Detroit. Anticipated coverage will be three counties and portions of Ontario, Canada.

The Great Lakes Repeater will have a 146.340 input and an output on 146.760 MHz. This leaves 146.940 MHz open as a calling and base to base frequency.

COORDINATING COMMITTEE MEETS

A group has been organized, called the Midwest FM Repeater Coordinating Committee, to contact repeater groups operating on inputs of 146.340 and 146.460 MHz and using the 146.760 MHz channel as their output frequency.

Those who would be interested in more information about the group and their ideas and reasons for use of 146.760 MHz as the output frequency should contact: Ernest M. Simon, W9JCE the President of the group, at 370 Aspen Lane, in Highland Park, Illinois. 60035

Send your Hot!!! News items to FM News, c/o FM Magazine 4861 Ramona Place, Ontario, California 91762

PA. REPEATER GOES NARROW

The State College, Pa. repeater is undergoing a modification from wide to narrow band operation. Scott Kostenbauder, W3WLF the trustee of the repeater explained the change was necessitated by the recent availability of 58 late model transistorized mobile units. Besides this area the only other narrow band repeaters are in Miami and Tampa, Florida. All of these are on 146.34 to 146.760 MHz.

MAN oh Mann!

6 METERS 4 FREQ

PERFECT FOR REPEATERS!

MOTOROLA T51 GGD
4 freq xmtr 2 freq rcvr
50 watts out

$95

PRICE INCLUDES:
CONTROL HEAD, SPEAKER, CABLES
MICROPHONE, 6/12V

450 MHz GE Pre-Prog 4ES14A1

$65

trunk-mount
complete w/accessories

without accessories

$45

MORE OF THOSE
HOT ONES
FROM MANN

6 meters 35W

VIBRATOR POWERED

MOTOROLA T41G or GGV
For dash or trunk 10" mount
SPECIFY 6 or 12V
SPECIAL LOW PRICE **$104.99**

INCLUDES: control head, mike, speaker, & cables

silent sentry

CONTINUOUS TONE SQUELCH
Compatible with
PL • Channel Guard • Quiet Channel

$65

mounting bracket: $2.95

SPECIFY type of equipment in which unit is to be used. List frequency desired. Allow 30 days for delivery.

Mann COMMUNICATIONS
18669 VENTURA BLVD TARZANA, CALIF 91356
Phone (213) 342-8297

SEND FOR FREE CATALOG

Number 9 on information card

CANADA'S D.O.T. DROPS BIG BOMB ON VE'S

Paul Hudson VE3CWA
Canadian Liaison

Repeater operation in Canada could be in trouble. The Department of Transport (Canadian FCC equivalent) has recently issued directives to its field offices that may seriously affect us northerners. Although they have thus far exerted no real pressure, the DOT radio inspectors have been instructed to insure that the directives are indeed enforced. Two points of particular concern:

- Repeaters may not be used for base-to-base communications.
- Repeaters must not be interconnected or linked together.

This comes as quite a blow. Not too long ago (April), we were shocked with a 400% increase in our license fees (from $2.50 to $10 per year). And now this! Many of us are wondering what the reasons for the anti-amateur actions are. The DOT seems to have answers ready for some of our questions, however.

Recent correspondence from Ottawa states that the Radio Act was amended by "Order-in-Council PC 1968-558, dated 2 March 1968, to prescribe changes in radio station license and radio operator examination fees."

The letter continues "...This action has been taken because of the continued increase in overall costs related to the licensing and regulation ... and because, with few exceptions, there has been no upward revision of radio license fees for thirty years or more... With these points in mind we feel that the fee increase is justified." There are a number of amateurs who just don't see it that way.

Until now, Canadian repeaters have been reasonably free from regulations. Most groups have self-imposed restrictions on the use of their repeaters and in most cases this has been adequate. We can only assume that the DOT has been displeased with us.

Radio inspectors have told us that we have been provided with spectrum in the 3 - 30 MHz band which we should use for longer-haul communications (a task we are trying to achieve now with VHF repeaters). They use the same argument against base station operation on repeaters and add that the intent of VHF repeaters is to "extend mobile coverage."

Although we have received no written confirmation, we have been advised that these repeater directives also apply to remotely controlled base stations where the remote function is accomplished via a radio link.

The remote station would thus become a repeater. This seems to be carrying the thing a little too far.

The DOT has indicated it is looking for guidance in the establishment of firm regulations. It has issued directives, but will not enforce them for a while so we can have the opportunity to speak out.

And speak out we will! The Toronto FM Communications Association is preparing a petition to establish FM repeater rules that will be mutually acceptable to the amateurs and the DOT. This group would like to hear from groups across Canada in order to prepare the best possible document. With enough support, these present rules <u>can</u> be changed.

LONG ISLAND PETITIONER DISCLAIMS INTENT
...States Signers Were Used to Satisfy Personal Grudge

As one of the signers of the petition addressed to the Poughkeepsie Radio Club (reprinted in the June issue of FM), let me commend the editor for his accurate and thought-provoking summation and analysis of the entire situation. (See Civil Strife, FM, June 1968.)

Speaking individually -- but I am confident of similar thoughts on the part of the large majority of those who also were involved -- I wish to proffer my apologies not only to the Poughkeepsie radio group, but to the entire FM fraternity.

At the time the petition was being circulated for signatures by Long Island FM'ers, there was no mention of it being directed to anyone other than the Poughkeepsie Radio Club, and in exactly the context which is evidenced in its text.

Unfortunately, however, the prime mover and author of the petition has used (or, more accurately, misused) both it and its signers to further his personal cause in a feud of long-standing with one or more of the amateurs who are responsible for the construction and operation of the Mt. Beacon repeater now licensed under W2CVT, but operated for some years as W2GHR.

I wholeheartedly concur that we should "effectively and with maturity cope with our own internal conflicts," and I can assure all readers that this was specifically the "pitch" presented at the time the missive was circulated for signatures.

Let it be clearly understood that Pat (Patricia) Veraldo, WB2CRY, who is described as "acting secretary for the plaintiffs," is in no way to blame for the fact that copies of the letter were sent to ARRL, FCÇ, and the major amateur publications. I am glad that at least the sole <u>intended</u> recipient, the Poughkeepsie Radio Club, was at least remembered on the mailing list.

In retrospect, it becomes quite apparent that Pat's able services as a stenographer and secretary were not solicited primarily therefor, but rather as a "drop" for any return correspondence, and as a "front" for the real pot-stirrer whose own address and/or name would in all likelihood have resulted in immediate discounting of the validity of the entire petition.

The severe interference problem which existed for over 100 Long Island stations on 146.94 MHz, as well as no less than three active repeater groups in that area, resulted from W2CVT experimentally employing a unidirectional input antenna and an omnidirectional output array. As I understand it, the group was "feeling out" the capabilities of the site shortly after its having been turned over to the club.

Within 36 hours after receipt of the petition, and following a perfectly amicable on-the-air discussion, the antenna arrangements were altered. The problem has been corrected for all but a few Long Islanders on the north shore.

Had the petition been employed as originally intended by the signers as a whole group, and the circulation been limited accordingly, it might well stand as a classic example of amateurs in general and FM'ers in particular to "settle our differences peaceably among ourselves."

As it developed out of proportion, we have surely not shown that "we do not need nor do we desire policing and supervision from any official body." In closing, once again, thanks to Poughkeepsie for a gentlemanly approach to (the problem and) an equitable solution.

Signed: Richard C. Lapham WA2QBB
Bayport, Long Island, New York

FM COMPARES 450 MHz MOBILE GAIN ANTENNAS

by DONALD L. MILBURY W6YAN

STAFF TECHNICAL CONSULTANT

Checking and comparing antennas is a lot more difficult a task than it might seem. I had the opportunity to install and use three different types of gain antennas for 450 MHz manufactured by two antenna makers: Communications Products, and Antenna Specialists (ASP). The ASP models were rated at 3 and 4 dB gain, respectively. The ComProd was rated at 3.5 dB (I'm not sure what the reference was for determining the gain). Then I saw an ad in Communications Magazine for a 5 dB gain antenna made by Larsen. In response to my query, Larsen sent me a 450 MHz 5 dB gain mobile antenna for evaluation.

I tried to make measurement and comparisons with the ComProd and the Larsen gain antennas, but my signal source was too unstable, so I drew the conclusion (perhaps unfairly) that both the ComProd and the Larsen exhibited substantially the same gain characteristics.

But there are other factors than gain to consider. The ComProd won't tune down to below 450 MHz without replacing the upper section with a whip that is about 2 to 2.5 inches longer than the original one. The ASP antennas will give reasonable performance below 450, but the whip sections must be extended so far from their sockets that the setscrews grasp only the tips; the result is an unsatisfactory mechanical electrical connection. The Larsen antenna showed no measurable reflected power at 442.12 MHz when a 20 watt signal was put into it. (No effort was made to increase the length of either the lower or the upper whip sections prior to this measurement.)

The Larsen antenna comes ready to mount into any existing installation. The one sent to me was designed to fit into a standard "eightball" mounting assembly (GE).

The antenna installed on the ball mount would never win a contest for appearance. For one thing, the ball of the original mount is a black hemisphere that protrudes almost two inches above the surface of the car. The bottom portion of the Larsen antenna is a slender gray cylinder about 3/4 inch high and perhaps an inch in diameter. Either the ball or the cylinder alone would make a passable installation, but the gray cylinder atop the black ball is a monstrosity. The same Larsen mount would make a beautiful addition to the new low-profile antenna mount made by Motorola, however.

The Larsen whips (upper and lower) are silver-plated and coated with clear epoxy. This probably adds little or nothing to the performance of the 450 MHz model, but the same technique applied to a two-meter whip would probably do a great deal to minimize noise. I intend to make comparative readings on the two-meter gain antennas in the future and will remember to check this particular aspect of performance.

The 3 dB ASP mobile and antenna has no spring. Neither does the 5 dB Larsen antenna. The 3.5 dB ComProd and 4 dB ASP both have springs as integral parts of their lower whips.

The springs are more attractive than functional, and characteristically exhibit losses because of the braid that interconnects the top of the spring with the bottom. I would consider a spring to be important if a driver intends to subject his antenna to a great deal of punishment from low-hanging branches and other such obstructions, but he should be prepared to sacrifice performance as a necessary tradeoff.

A lot can be said about construction, and I discuss this aspect at the risk of losing prospective antenna advertisers. In my opinion, the ASP models (the 3 dB as well as the 4 dB version) are cheaply constructed. All gain antennas for 450 have one feature in common: They have a small collinear "loop" section that is encapsulated. This device fits between the upper and lower whip sections with setscrews. On the ASP antennas, the fit (on the two antennas I tried) was sloppy on the top and bottom. As a result, when the setscrews were tightened, the whip sections were no longer parallel with each other, and had to be bent to give the appearance of continuity from the base to the end of the whip. Also, the setscrews in the ASP antennas were hex recessed (Allen), and the adjusting tool provided fit loosely into the recessed head. Needless to say, I stripped one of the setscrews during the first tightening process.

The ComProd offered an improvement in this category by using a bristol wrench rather than the conventional Allen arrangement. The fit was perfect (tool-to-setscrew) and chances of stripping are minimal. Unfortunately, since the ComProd wouldn't tune below 450 MHz, I had to replace the upper section with a conventional two-meter whip, then trim it to size. The whip I used was smaller in diameter than the original upper section, and I was stuck with another sloppy fit (upper section into collinear loop).

The Larsen antenna uses Allen setscrews, but the tool supplied fit all screws perfectly. The fit (whip sections into collinear segment) was better on Larsen than on any of the others, so inferior performance from bad electrical connections is extremely unlikely.

The worst thing I can say about ComProd's gain antenna is that it cannot be used satisfactorily below 450 MHz without replacing at least the top whip section with a longer piece. The worst thing about ASP is the fit between the whip sections and the collinear segment and between the setscrews and the tool. Larsen's only apparent fault is the ugly mating to the eightball mount.

DEFEATING DESENSITIZATION
(Continued from page 32)

It pays to have several short random lengths of coax available (or you can cut each one a nanosecond longer than the last).

Once you have a dip, adjust the cavity loop for minimum limiter current.

Once it is operating, the line stretcher can be replaced with a piece of coax of the proper length. Trimming can be accomplished by adding connectors or adapters.

It is necessary to keep the two antennas rigid so they won't move with the breezes characteristic of the locale. But more importantly, the system must be moisture-proof. If the vswr shifts on a damp night, the phasing is out and so is the repeater. Ideally, one antenna with a ferrite isolator would be used, but as yet no isolator has been obtained for 146 MHz.

There's always one other solution to the problem of desensitization: Build up the cavity / hybrid loop array described by Gil Boelke (this issue).

LETTERS FROM FM READERS

Your FM magazine is GREAT! I don't see how you do it -- and in your spare time! I only wish that the wealth of technical info, such as K3DSM's article on Touchtone repeater control, had been available when I started building repeaters.

Waghan and I control a full-Touchtone, automatic phone repeater on 450 MHz. This repeater was designed and built by the two of us for our own use, and stands unique among just about all other phone repeaters. The unique feature is that the audio tones produced by the Touchtone instruments in our mobiles go direct to the central office telephone equipment via our remote-control repeater. We use no digital conversion whatsoever at our repeater. We believe our telephone repeater is the first of its kind anywhere on the West Coast. Dialing reliability is fantastic! Our previous digital format phone system stands as a crude joke when compared to our present system.

I would like very much to hear from anyone who uses a Touchtone phone repeater similar to ours, possibly on the East Coast. Your technical articles would have been a great help if they had been available a couple of years ago.

As to WA8UIT's letter regarding the overabundance of articles from California contributors: Can California help it if we have an edge over the rest of the nation in highly qualified operators? This fact is to be observed by the vast majority of repeaters listed in California in your U. S. Repeater Directory.

As to his comment that Ken Sessions writes too many articles: Which would your readers rather have, a few articles from someone who really doesn't know much about FM, or a lot of articles from someone who knows FM inside out? I think the choice is obvious. Since WA8UIT says his feelings won't be hurt, I suggest you dispense with his letter in the manner he mentions. I'm for more technical articles whether they come from Butte, Montana or from California, as long as the author knows his subject.

Keep up the fine work.

Dennis Nichols, WB6GVV
1460 So. Crest Drive
Los Angeles, California 90035

WA3BKO is now on the air, licensed as a repeater from the Berwyn Roller Rink in Berwyn, Pa, which is a suburb of Phila, west on the Main Line. The repeater was changed from the 2-piece unit as originally described in FM. The elevation is 540 feet above sea level with the rink and mast adding an additional 100 feet. Our license was approved as submitted to the FCC.

The club regrets to announce the passing of one of its members, Gary Shapiro, K1YDW/3. Gary was very active on FM and will be sorely missed by the Phila gang.

Gene Mitchell, K3DSM
352 Woodley Rd
Merion Station, Pennsylvania 19066

(41V CONVERSION CONTINUATION)

to terminal 4 of the power plug.

(4) At terminal board E1, disconnect the No. 24 brown lead (running from the relay coil lug) from terminal 9. Reconnect this end of the lead to terminal 14 of terminal board E2.

d. Fuses

(1) Remove the two 15-ampere fuses from the fuseholder.

(2) Paint out or use tape to mask over the markings on the fuseholder. It is recommended that 6.25 amp now be marked on the fuseholder to insure that oversize fuses are not used.

(3) Place two 6.25-ampere fuses in the fuseholder.

e. Terminal Strip E1 Modifications

(1) Connect a 25 mF capacitor from terminal 9 to terminal 12 of receiver terminal strip. Connect the negative side of the capacitor to terminal 9.

(2) Connect a 25 mF capacitor from terminal 12 to terminal 15 of the receiver terminal strip. Connect the negative side of the capacitor to terminal 15.

We are at the almost stage with our repeater. We have had it on the air with operators on duty for a couple of months, but the real test -- radio link control -- will come in about 2 weeks. Meanwhile, it's my job to coordinate the activities of about six amateurs who work under the direction of a "chief engineer" with procurement and licensing. (We believe everyone involved should have a job!)

Our chief engineer, Leo Moreau, keeps asking, "Why does the blame thing have to log itself??? Especially when everyone using it must log it too???" The MCS identifier was tricky and the tone dialing almost illogical, but this recording business is downright foolish. It is easy enough to accomplish, but the prospect of storing 365 days of mylar tape appalls.

I stopped in at ARRL headquarters last Tuesday and met a lad there (on the staff) who had met you in New Jersey early in May. Somehow it came out that maybe the FCC would license a repeater that does not log itself. What do you think the chances would be if I sent a request to the FCC for permission to operate a remote station that does not log? Sure would like to know your views on the matter. Perhaps the next issue will tell all, but we are closer than that to forwarding our paperwork to the Commission.

Robert S. Katson
Pres, Conn Amateur FM, Inc.

I believe that the FM magazine is the best amateur radio journal on the market! The past three months have seen a remarkable change in the journal -- I shared my last issues with other amateurs and find that it is quite popular with them too. You will no doubt notice an increase in your subscription list.

I have been an amateur and commercial radioman since the "wireless operator" days. The last couple of years I had become rather inactive, with my interest fading, for several reasons. The main reason was that the enthusiasm for research and experiment once enjoyed by hams seemed to have gone, along with the courtesy once extended on the bands. Since being introduced to this new group of FM enthusiasts, I have renewed my interest in ham radio, and I am quite happy that I have found a group that is comparable to the radiomen of the "good old days."

With reference to the "business of uniting" (Vol II No 4), this is a wonderful idea. Put my name down as a charter member. I also vote for the FM Magazine to be the official journal of the NLFMA. I would like to recommend a "Mr. FM," but I'm afraid Dave Goodman, WA8UIT, wouldn't agree with my recommendation. See "Letters," same issue.

Ken W Sessions, Sr
K6MQB

THANKS, DAD.

I am a present subscriber of your fine magazine, and let me compliment you on your material. Do you still have some back issues and perhaps all since day one? Also, do you have any articles on Motorola "Dispatcher" D33AAT or perhaps you can refer me to some other publications which would help me with converting power supply and tuning, etc. Thanking you in advance for your time and trouble.

Richard H Arthur
5 Eastwood Drive, Apt L
Newport News, Virginia 23602

THERE ARE NO MORE BACK ISSUES AVAILABLE.

I would like to know if you are interested in a poorly written blurb on the New Mexico repeater system, including methods of linkage? I am quite familiar with our system, having built and am now operating the third of our three mountain top repeaters (all interlinked). W5YFN in Roswell owns the first (Capitan Summit), and WA5KUI of Alamogordo owns the second (Alamo Lookout). Mine is at Capilla Peak, near Albuquerque. We are also very very familiar with the licensing requirements and have worked out a good (and acceptable!) description of control(s) and the repeater(s) to be attached to form 610.

I'll be glad to try to write a blurb if you want.

Philip H Dater, M.D. (WA5JDZ)
9006 Crestwood, N.E.
Albuquerque, New Mexico 87112

I suggested that ARRL subscribe to FM so that I could keep abreast of the latest trends in this growing field. The first issue, May 1968, has reached my desk and I am delighted to see the clean, informative format that is being used. Further, it was pleasant to note the lack of politically inspired editorialism. Keep up the good work!

I think that the best source of any worthwhile information comes from the so-called "horse's mouth." In keeping with this thought, I am interested in getting something into the ARRL Handbook which deals with VHF and UHF FM, and also some data concerning repeater operation. In this instance it would seem that you, and your magazine, represent that horse's mouth I mentioned.

The mention of FM and repeaters in the handbook must at this time be scaled to the available page space for specialized communication techniques. I want to outline the standards for present-day ham FM (deviations, national frequencies, typical power levels being used, sources of popular two-way gear, block diagrams of repeaters, etc.) plus write a bibliography of articles on the subject. There will be typical circuits of FM receiving channels, plus examples of FM exciters. Any recommendations that you would care to make would be most welcome. I don't know your feelings about the ARRL, but we'd be happy to work with you in the promotion of ham FM. I think it deserves better treatment in the Handbook than we've given it and want to take this first step toward rectifying the situation. I need someone who is well versed in the modern trends to give me the outline required. Certainly this would assure better accuracy than might result were I to glean this information on a piecemeal basis.

If you are interested in a cooperative program along the lines I have mentioned, I'd be happy to hear from you in the very near future.

Doug DeMaw, W1CER/W8HHS
Asst Tech Editor
Editor, ARRL Handbook

I was referred to you for information by one of your local subscribers who recommended you very highly.

Would you please tell me where I can find conversion instructions or even a circuit for a Link Radio Corporation (New York) transmitter, type 1906 ED Za, Serial 69996, 152-172 mc FM Rig.

James R Copeland, W3ECF
821 Libby Street
Easton, Pennsylvania 18042

CAN ANYONE HELP JIM?

I noticed in the listing of repeaters the only one in Tennessee is in Chattanooga. This is not true. I'm not too familiar with them, but I know they exist. There is one in Nashville -- 146.34 to 146.94 -- and it also works 146.94 to, I believe, 147.20. There is one in Shelbyville, Tenn -- 146.34 to 146.94 -- which is owned by W4IWV Timothy R. March, 912 Shelbyview Drive, Shelbyville, Tenn 37160. I don't know him, but when we were running a test off the mountain, one of the fellows talked to him. Also, when we were running the test, we talked to Nashville, Shelbyville, and Huntsville, Alabama, so we should have no trouble talking to them. We have one fellow in Knoxville who should make it o.k., and we have the fellows in Atlanta anxiously waiting to try. You might write Mr. March -- I think he is in the know of all the operations west of Chattanooga. The reason we in Chattanooga never knew of the operations west of us is that the mountains block us talking in that direction. The repeater should solve this problem -- hope hope hope.

The FCC sent me a few comments when they sent my license back. I am sending you a copy. I don't know if you have seen this, but it is the first time I have seen the FCC make comments on repeaters. (SEE "FCC SPEAKS OUT," THIS ISSUE.)

I have spread the word around of your fine magazine, and also have passed subscription leaflets around. I hope some of the fellows have subscribed.

Milton S Ridgeway, K4EPM
4604 Crestview Circle
Chattanooga, Tennessee 37415

The concern that Mel Dzialak voices in his June letter about our repeater operation in the Kalamazoo, Michigan area on 146.94 MHz reflects the feeling we all have -- particularly when we read about repeaters with scores of users dumping overwhelming signals into frequencies of nonusers.

We are sure others will wonder about our intentions after reading Mel's letter, and feel we should clarity the situation. We are sure Mel meant it only as helpful advice, but his fear is greatly exaggerated and without basis in fact.

LESS THAN TEN stations in the Kalamazoo area (60 mile diameter) have 2 meter FM equipment. The amount of time these stations use the repeater can be recorded on less than 2 hours of take a WEEK.

With the capability Mel suggests, we would not only bother "South Bend, Chicago, and points west," but Detroit, Lansing, Grand Rapids -- and so on, to include all the other cities within the range. THIS INTERFERENCE HAS NEVER OCCURRED. Surveys of the surrounding areas during the two weeks of operation prove this.

If we ever could build this fantastic system to increase our range to the point suggested, which would make it possible for hundreds of stations to communicate, it would take more than the single channel suggested by Mel. (Rest assured we are in no way inclined to do this. The problems created would be far greater than any benefit we might derive.)

We are fully aware of our obligation to others who use the frequency, but at present the use of .94 as an output frequency for the repeater in this IN-ACTIVE area can only improve FM as a whole.

We welcome reports from any of you that HEAR our repeater, and will give them serious consideration if interference ever occurs. Our address is:

Oshtemo Amateur Radio Club, K8TIW
FM Repeater Group
4429 Grand Prairie Road
Kalamazoo, Michigan 49007
Robert W. Miller, Wa8KGE

We are going to install a 6-meter repeater on a mountaintop some 5 miles east of Bishop, at an elevation of 10,847 feet and want to use 52.525 as the transmitting frequency. Would like to make it a mobile relay as well as a remote base station and listen on 52.525 as well as some other frequency for the mobile relay. We are thinking of 52.925 as the rec freq. Will be using a 450 link for control as well as simplex. Can anyone advise the use of these freqs for a repeater on 6? I think that the thing will have fantastic coverage as it is a straight shot to the east and we experience a lot of knife-edge refraction over the Sierra-Nevadas to the west. Expect to use power out of 250 watts.

By the way, we are hearing several repeaters on 2 from the San Francisco area. One is WB6OQS, and we are interested in seeing if we can hook up a link with additional receivers to tie the two repeaters together. It's quite a distance, as these signals from the SF area are over 200 miles away.

Terry Downey, W6PZN/K7BDS
151 South Main
Bishop, California 93514

We have a large amount of FM activity here in the area of Butte and Anaconda, Montana. At the present time we are using 146.76 mc for mobile-to-mobile communications. The Butte Amateur Radio Club has formed a repeater committee with Orvil W7DB as the chairman. Any information you might have on the subject will be greatly appreciated.

Joseph A D'Arcy, W7TYN
ARRL SCM
Anaconda, Montana

According to Bob Dreste, K7VOR, the Arizona Repeater Association's repeater is now operational with the call WA7CEM. The input is 146.34 and it outputs on 146.94 MHz. From the site atop a TV tower on South Mountain, a class A coverage is a 100 mile radius, with a class B signal, to Tucson, Flagstaff, Yuma, and others. The interpretation of class B coverage would amount to "possible coverage" to stations with gain antennas and a receiver sensitivity of greater than .50V.

Arizona

I've enjoyed every article in FM when I've been able to scrounge them from those who have subscriptions, but I'm going to cease with the scrounging routine and take advantage of the low price before the offer expires, so enclosed please find my $2 for one year's subscription. Since I'm moving to Ken Sessionsville, I'll give you that address, and please begin the subscription with the July issue, so I'll be sure to be there when the first issue arrives.

I would also like to comment on a remark you made in reply to a letter submitted by Earl Lagergren, K7OEP. You stated that "to our knowledge there is no formal narrowband activity on any amateur VHF band." I would like to take exception with that statement and remind you that we in South Florida -- for that matter in all of Florida and also seemingly in all the Southeastern United States, are running 5 to 7 kHz deviation. I do know for certain that almost all members of the SFFMA are running narrowband on 146.94 MHz as well on our repeater frequencies of 146.34 in and 146.76 out. Are we really that much the bunch of oddballs?

Perry L Cohen, WB4DZH/6
5524 Corteen Place
North Hollywood, California 91607

Re: repeater output on .94.

The following comments probably won't do much good, because once an operating mode has been originated, it is very difficult to change frequencies because this means spending money on new crystals.

For several years I operated mobile on 145.26 MHz which was the standard frequency for 2 FM in Cleveland, Ohio. A repeater was put on the air with its output on that frequency. After several years of trying (unsuccessfully) to compete with the damned repeater, I gave up and sold the mobile unit. It is poor to try to have a simplex QSO and have someone who isn't monitoring the frequency (or can't, because of his location) come on with the repeater and wipe you out! (The reason for using 145.26 MHz in the first place is a long story, but the parallel applies to .94.) It is possible that others may give up operation on .94 simply because they can't compete with a repeater.

I had understood that until about a year ago all repeaters were operating .34/.76 with .94 reserved for calling and for simplex operation. There were (and are) many valid reasons for this use of frequencies. At one time, the group at the Tri State ARC, W9BF, did a great service for amateur FM by strongly recommending certain "standard" frequencies both on 6 and 2. Apparently they are no longer active, and unfortunately their inactivity coincided with the rapid growth of repeaters. They were strong advocates of .34/.76 for repeaters as recently as 3 years ago!

What can be done? Probably the only thing possible at this late date is for someone who is respected and who is "widely read" to start a campaign to get all new repeaters operating on some output frequency other than .94. Since .76 is second in popularity to .94, .76 would be a logical choice for the output frequency (subject to prior use of .76 in a given location). The best input frequency seems to be .34.

The problems with "converting" to .76 probably are these: (1) Prior use by some other group. This could be a blessing in disguise depending upon the present use. (2) Cheapskates who won't pay $4 or $6 or whatever it takes for one new receive xtal. (3) The lazy ones who don't want to bother to plug in a new receive xtal and realign the front end of the RX, or who are too lazy to 2-freq the RX. There are probably many other "reasons" for not switching, but the second one is probably the real reason in most cases.

Ron Guentzler, W8BBB
Route 1 - Box 30
Ada, Ohio 45810

I am interested in obtaining further information regarding encoder and decoder units designed by Robert Mueller, K6ASK, and discussed in an article entitled "Stable Tone Units for Remote Radio Control," FM Bulletin, January 1968, by Larry Coltin, K6VBT.

Henry C Woodrum, K6MTA
Civil Defense Coordinator
200 Wilshire Drive
Redding, California

DIODES WERE REVERSED IN SCHEMATIC. SEE K6ASK'S IMPROVED VERSION, "UHF AMATEUR MOBILE TELEPHONE," THIS ISSUE.

THE FOLLOWING IS A LIST OF AMATEUR SUPPLY STORES AT WHICH FM MAGAZINE IS SOLD

IS YOUR STORE ON THIS LIST?

CALIF.

C & A Electronic Enterprises
2529 E. Carson St.
Long Beach

Dow Radio-Milo
1759 E. Colorado
Pasadena

Henry Radio
931 E. Euclid
Anaheim

Henry Radio
11240 W. Olympic
Los Angeles

Radio Products Sales, Inc.
1501 S. Hill St.
Los Angeles

Mann Communications
18669 Ventura Blvd.
Tarzana

FLA.

Amateur Radio Center
2805 N.E. Second Ave.
Miami,

IND.

Graham Electronics
122 S. Senate Ave.
Indianapolis

MICH.

Radio Supply & Engineering
90 Seldon Ave.
Detroit

Heathkit Electronic Center
18645 W. 8 Mile Rd.
Detroit

N.J.

Gregory Electronics Corp.
249 Route 46
Saddle Brook

N.Y.

Adirondack Electronics, Inc
2469 Albany St.
Schenectady

Stellar Industries
10 Graham Rd. W.
Ithaca

TEXAS

Electronics Center, Inc.
2929 N. Haskell
Dallas

CANADA

Payette Radio Limitee
730 Rue St-Jacques
Montreal

"It's in perfect condition, of course, it needs, tubes, resistors, sockets, coils capacitors and a few little odds and ends."

The FM'er and THE LAW

A K6MVH EDITORIAL

Not long ago, I received a letter from a fellow ham in Ohio. This fellow was distressed -- after reading some of my articles in the various ham magazines -- because he was left with the impression that California amateurs were being treated differently from some of the amateurs in Ohio. The W8 was interested in installing a repeater, but he knew he could not live up to the rules in every detail, so he was convinced that he would be refused a license to operate a repeater.

Since a great many of the remote stations in Southern California are ostensibly controlled from mobiles, it would seem that either all of the operators are operating illegally or that California has been given a special dispensation by the FCC. In truth, neither is the case.

The explanation for the apparent disparity between the operation and the rules is simple: After various amateurs got together to analyze the FCC requirements for remote operation, the void became very noticeable; there was simply a gap in the rules where remote operation was concerned. And there was no mention in the rules about many common forms of repeater use. So prospective users and control operators began to interpret the rules that DID exist in a way that would be most advantageous to them. Then, as they submitted their applications to the FCC for remote control authorization, they would explain their own interpretations of the questionable rules by proposing certain methods of operation that went against the grain of the more conservative amateur. When the licenses weren't refused, it was implied sanction of the operator's interpretation, and the questionable mode of operation became a generally accepted concept.

Here's a specific example: The FCC rules state that a remote station must be controlled from a fixed site. To many, this automatically precludes the possibility of setting up a control scheme in the mobile unit. But close observation of Part 97.43 shows that no prohibition of mobile control is included. My interpretation (subjective, I'll admit) is that control can be accomplished from anywhere, as long as fixed control is maintained. The information on the reverse side of a remote license bears this out when it says the remote control point may be operated mobile, portable, or fixed. (Take a look at the back of your license and see for yourself; it pays to read the small print.)

The Ohio amateur was probably most concerned with my overpublicized telephone system that operates through my 450 MHz remote facility. To him, operation through a telephone is illegal because the transmitter on the hill goes on when the phone rings. But the fact is that this only happens when the control operator allows it to happen by command. The caller is just as passive as any party on a phone patch.

So look again at the laws, but look with a broader eye. Don't call your local FCC field office and ask for interpretation of a rule. He's no better at reading than you are, and you can bet that the answer he gives will be one that makes his own position the safest. Interpret the law the way you see it, but honestly. It is unlikely you'll get in trouble then.

CLASSIFIED ADVERTISING

WANT ADS are free to subscribers and copy should be mailed to: FM Magazine, Want Ads, 2005 Hollywood, Grosse Pointe, MI 48236.

WANTED.......T44 A6A instruction manual, (Motorola number 68-P836-000). Also wanted- Motorola test set meter for T44 A6A. What is your best price? Please contact: Robert Young, W3EDH, 319 Wyatt Rd. Harrisburg, PA. 17104

FOR TRADE OR SALE....G.E. 2M Voice Director; G.E. Message Mate 2M.; G.E. TPL with all cables; G.E. 12V. transistor pwr. sup. 2M 30 watts; G.E. 2M Voice Commander. Contact: Thomas F. Kelsey, WA4UXD P.O. Box 119, Ivy, VA. 22945 (phone: (703) 293-1456)

FOR SALE...UHF Motorola T44 AAV 6/12v complete w/accessories, extra clean $70. VHF GE TPL Progress Line (T-pwr), 60w, 12v, complete w/ accessories, in best condition $150. Channel Guard only $25 extra. VHF GE Pacer, Progress Line (T-pwr), 15w, 12v, single unit underdash, beautiful, only $100. VHF Motorola FHTRU-1 Handie-Talkie, on freq. (146.94), dry pack (inc. bat.), only $35. Contact: T. Pap Pan (WA8ZTY) PO Box 147, Corunna, MI 48817 (No phone)

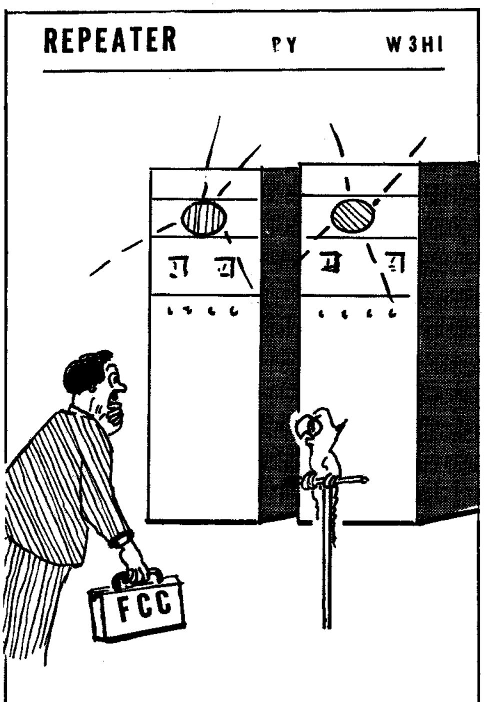
WANTED....Remote control like the T-1200. Contact: J. Thomsen, W9YVP 8280 S. Tennessee, Claredon Hills, Ill. 60514

WANTED....either 2 or 6 meter FM Base or Mobile unit. Wish to trade for a Gonset 2 meter sideband w/AC and DC prw sup. or a Lafeyette HA460 Contact: Jerome F. Musialowski at 1214 Walden Ave., Buffalo, NY 14211

WANTED...Motorola H21DCN-2 freq. (low band); GE VO-38, or GE KO-39 Power Mate. Contact: Thomas F. Kelsey, W4UXD, P.O. Box 119 in Ivy, VA. 22945 (703) 293-1456

FOR SALE.....GE Progress Line, model- E-33, with Western Electric Selector, Four Freq deck w/ Sentry crystals for .94 to .94, .34 to .94, .34 to .76 and .82 to .82. Also have control head and cables. In perfect condition. $175 Contact: Michael Van Den Branden, WA8UTB at FM Magazine office.

NOTICE....Angola FM Picnic will be held at the same location as always at the 4H park on Crooked Lake in Angola, Indiana on August 18th. More details next issue.



"I keep the repeater log. F'rinstance, Joe is working Pete right now."

[P]rogress Line Units

ME-42	450 MHz	$219.50
	15 watts	199.50
MA/E-16	Low band 50 w	189.50
MA/E-33	High band 30 w	200.00
MA/E-36	High band 60 w	224.95

ALL WITH ACCESSORIES ! LOOK !

gertsch

FM-3 $276 • FM-4 $449

AM-1 with 100 kHz standard

hp 524A counter $575

STORE HOURS

WEEKDAYS: 9 AM to 9 PM

SATURDAY: 9 AM to 5 PM

C & A ELECTRONIC ENTERPRISES

2529 East Carson St • Long Beach, Calif. 90810 • (213) 834-5868

FREEWAY-CLOSE TO LOS ANGELES

20 MINUTES FROM AIRPORT

RADIO SPECIALTIES

SPECIAL LOW PRICES

MINIPAK 1160-24-1 PORTABLE $16.95

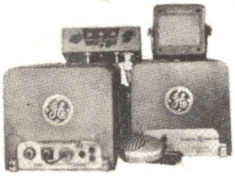
PACKSET 1144-62-1 $24.50

LOW BAND

ET-6, ER-6, 50 watts

12 v

w/acces. only $46.00



HIGH BAND

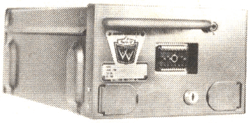
T43 GGV-20

with P.L. & accessories

$198.50

w.o. access.

$172.95



LOW BAND

T41 GGV-1

with accessories

$134.50

w.o. access.

$108.77

Note — Accessories consist of power and control cables control head, speaker, mike (as applicable)

EQUIPMENT SOLD AS IS • FOB LONG BEACH

MOTRAC !

LOW BAND

U41HHT 3400

with Expander & Private Line

Write or call for quote

HIGH BAND

U43HHT 3100

with Private Line

Number 16 on information card