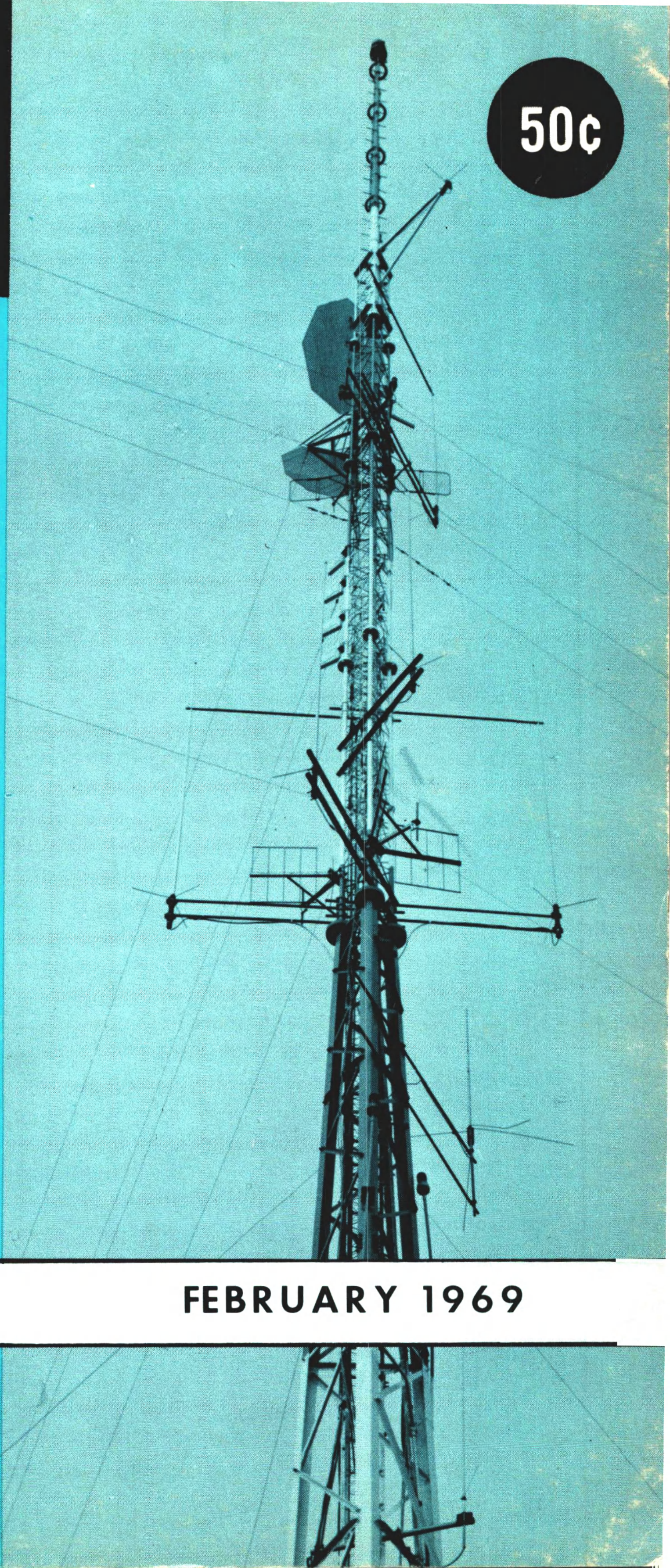
FM

volume 3 number 2

IN THIS ISSUE

CONTAINS MANY REPEATEDLY REQUESTED Out of Print FM ARTICLES



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FEBRUARY 1969

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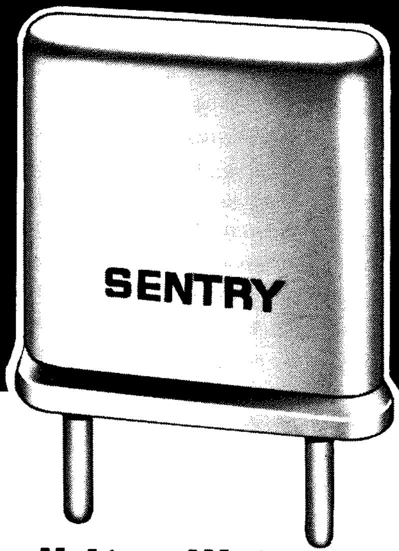

24

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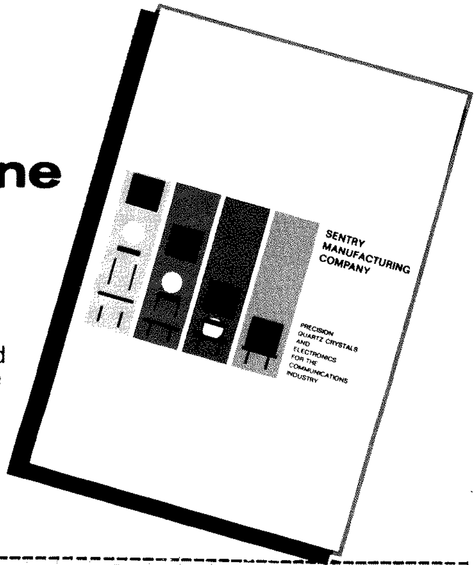

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FM

FEBRUARY 1969

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REGULAR FEATURES

Cover Photo: W1JTB Relay Point and W2GHR base station at Mt. Beacon, N.Y. Half of the antennas shown are part of the ham installation. This issue also contains many of the earlier articles that have been repeatedly requested and are out of print.

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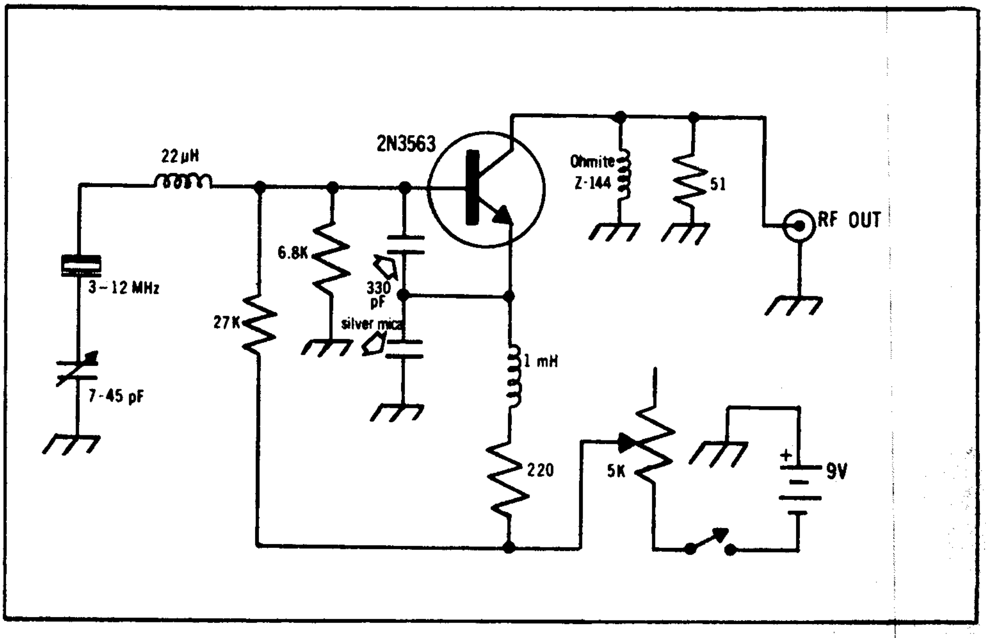
The PEAKER–TWEAKER

by P. J. Farrell,
SEATTLE, WASHINGTON

...CRYSTAL-CONTROLLED SIGNAL GENERATOR



Once upon a time, in those days before the Seattle repeater, rigs had to be kept in tip-top shape for satisfactory "direct" communications. Nuvistor and 417A preamps were the rule rather than the exception. Those whose receivers took more than 0.3 µV for 20 dB quieting were quietly pitied or openly ridiculed, or both. To keep receivers at maximum sensitivity, tuneups were performed at the drop of a hint. Because of the scarcity of "official" signal generators, a crystal-controlled one-transistor signal generator was developed. This gadget became known as a "peaker-tweaker." Seattle has a two-meter repeater now, so no one bothers much with his receiver any more, but one still remembers those good old days of superceivers and how out-of-towners with "dead receivers" took plenty of gas from the local troops.

The peaker-tweaker is shown in the sketch. As a signal generator, the device has everything going for it. It's easy to build, simple in design, and straightforward in theory; yet, it provices a clean, stable signal that can be used in tuneup of receivers on any of the VHF or UHF bands.

Here's how the peaker-tweaker works:

Inductor L_1 doubles the VXO action of C_1, allowing a single crystal to cover several adjacent channels. L_1 may be omitted entirely if the additional coverage is not desired. The rf output is a series of very fast pulses at the crystal frequency. Such a waveform is extremely rich in harmonics.

Regular transmitting crystals may be used, but any crystal in the range of 3-12 MHz works as well. The transistor specified is a VHF type which can put out up to -20 dBm into a 50-ohm load for harmonics up to 500 MHz. Oscillator pulling by the potentiometer (which controls output level) is minimal, about 1 kHz at high-band. Drift is just about nonexistent--a fact to be appreciated by those using most "regular" signal generators. To aid those with a selection of surplus crystals, a simple computer program was formulated to generate the following table of crystal frequencies (all of which have harmonics on several popular frequencies on two).

Harmonic Number	Crystal Frequencies in kHz 146.34	146.76	146.94
40	3658	3669	3673
39	3752	3763	3768
38	3851	3862	3867
37	3955	3966	3971
36	4065	4077	4082
35	4181	4193	4198
34	4304	4316	4322
33	4435	4447	4453
32	4573	4586	4592
31	4721	4734	4740
30	4878	4892	4898
29	5046	5061	5067
28	5226	5241	5248
27	5420	5436	5442
26	5628	5645	5652
25	5854	5870	5878
24	6098	6115	6122
23	6363	6381	6389
22	6652	6671	6679
21	6969*	6989	6997
20	7317	7338	7347
19	7702	7724	7734
18	8130	8153	8163
17	8608	8633	8644
16	9146	9172	9184
15	9756	9784	9796

*not often available

PAGE 7 IS MISSING FROM SOURCE

PAGE 8 IS MISSING FROM SOURCE

NEW AMPEREX UHF AMPLIFIER

promises new zip from tired old mobiles

What appears to be one of the most sensational developments of the last half-decade is a new thing being manufactured by Amperex Electronics Corporation, New York. This "thing" has the general appearance of a simple rf cavity, but what it does is imagination-staggering. For Amperex has come up with a simple and inexpensive method of upping 5 watts of rf at 450 MHz to a potent 120 watts.

The device, pictured at left in the photo of Fig. 1, is a one-piece metal cylinder that combines cavity with vacuum tube and integral circuitry to produce a high-power amplifier requiring nothing more than B-plus and filament power to turn a mini-mobile into a powerhouse. Screen voltage is provided by an internal circuit arrangement that uses the plate supply as its source.

Steve Beeferman, product manager at Amperex, told FM that the fantastic capabilities of the amplifier can be attributed to one of Amperex's recent innovations in tube design: The tube is laid out in a cylindrical configuration, and all the elements are concentric to the anode, which forms a bar traversing the center of the cylinder's longitudinal axis, as shown in Fig. 2. The cathode, as the outer circle of the device, has a large enough area to assure high current flow even at very low plate voltages. Electrons from all portions of the large-area cathode can impinge on the anode in sufficient quantity to assure high-efficiency power transfer at anode potentials below 500 volts. And the efficiency, according to Beeferman, is such that no auxiliary cooling is re-

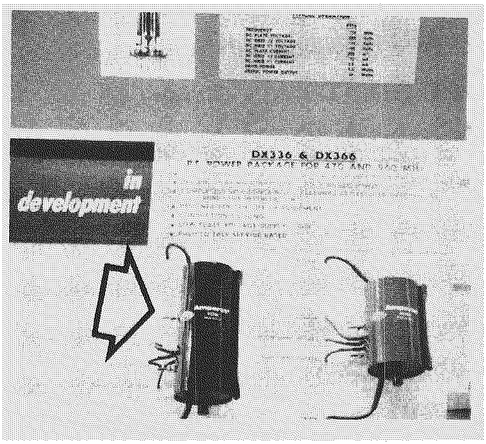


FIG. 1 IN-LINE 450 MHz RF AMPLIFIER DEVELOPED BY AMPEREX

quired. In typical mobile and base station applications, conduction-cooling, as by chassis-mounting, would more than amply remove the heat from the unique amplifier.

One of Amperex's principal criteria during design of the rf amplifier has been ruggedization, and it is this constraint that resulted in the amplifier's one-piece construction approach. Since the unit is factory-tuned prior to delivery, final tuneup can be accomplished with the two vibrationproof screwdriver adjustments on the side of the cylinder. Amperex engineers are confident the unit will be operational for long periods, too, and estimate the life to equal that of the equipment with which it is used, in spite of the fact that the tube cannot be replaced without replacement of the entire assembly.

"You won't be able to remove the tube from the assembly," stated Bill Topley, sales engineer for Amperex, "but it wouldn't make any difference anyway--the whole assembly can be purchased for no more than a typical tube of its class!" When asked what the selling price of the amplifier would be, Topley said the company was shooting for a mark in the fifty-dollar neighborhood. "And the way things are shaping up," he added, "it looks like we'll be able to hold to this figure pretty well." Topley hinted the fifty-dollar price tag might be for quantity orders, but indications do appear favorable for a low initial cost.

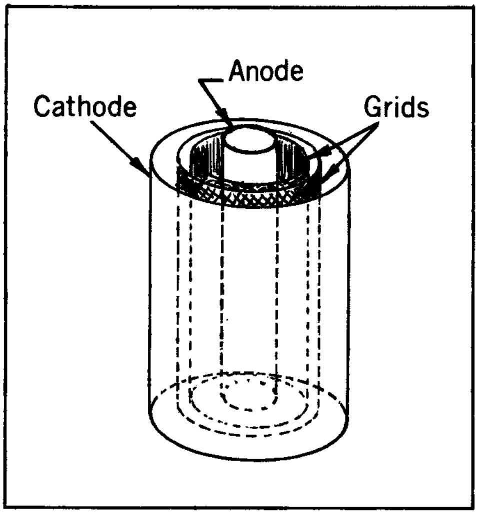


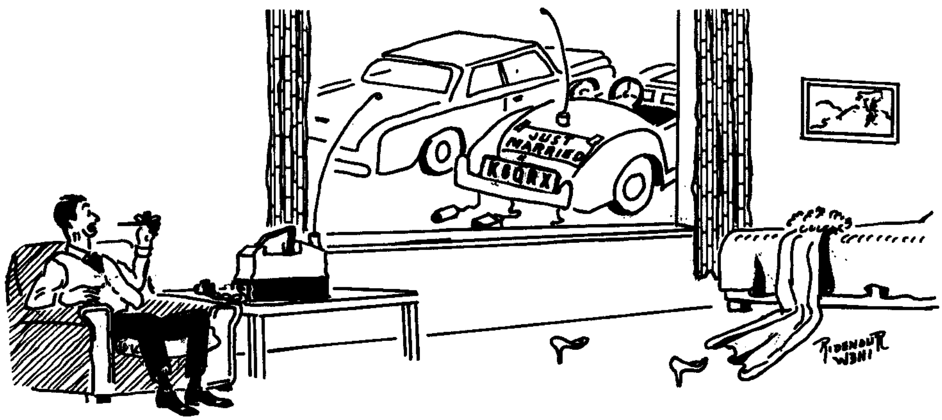
FIG. 2 LAYOUT OF NEW AMPEREX UHF AMPLIFIER TUBE.

One cost-cutting approach was Amperex's decision to market the device without coaxial connectors. Connectors can boost the price of an item considerably due to the costs involved in procurement, handling, tooling, and labor of installation and checkout. Amperex engineers feel that simple input and output coaxial leads afford a maximum of installation flexibility by allowing the user to select the connector types, and thereby saving him this as a "multiplied" manufacturing expense.

One of the key features of the power package is an instant-on capability, which means the amplifier can be energized on a push-to-talk basis with no power-consuming standby source needed. In Beeferman's words, "We've had to put some real engineering into this thing, because we'll be marketing a vacuum-tube device in the shadow of a broadening semiconductor technology. And with tubes, a major objective MUST be to stay a few years ahead of the state of the art."

Beeferman has an ideal vantage point for seeing what the state of the art is at any given moment, too. For Amperex, long renowned for their vacuum-tube technology, is also a leader in transistor development.

For more information on the 450 MHz in-line rf amplifiers, write Amperex, 230 Duffy Avenue, Hicksville, New York 11802. And don't forget to tell them you read about it in FM!



"The net will be coming on any minute now."

Putting the NINIC Pocket Receiver on Channel

Photos by Bill Carpenter

by Don Milbury

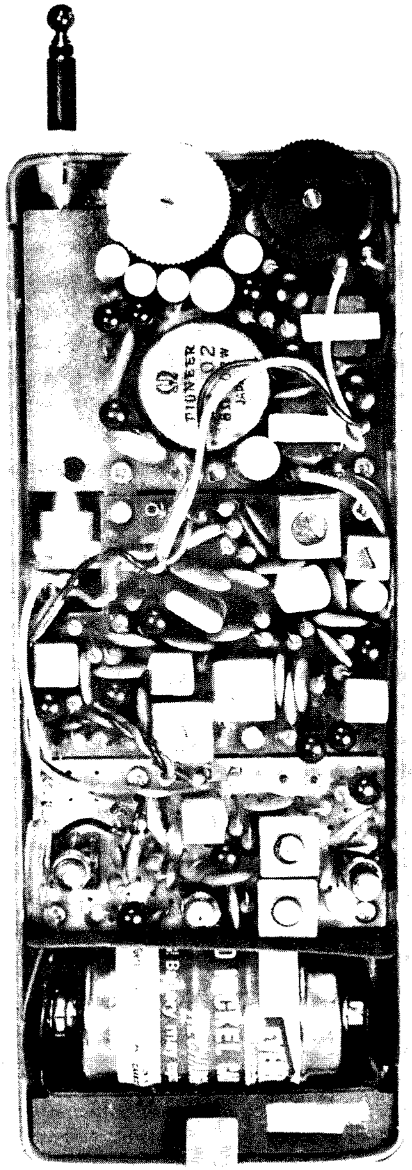


FIGURE 1. PHOTO OF OPEN UNIT SHOWS MODULAR CONSTRUCTION AND LAYOUT.

Most of us who operate repeaters or remotely controlled base stations wish for things like tiny walkie-talkies and pocket receivers from time to time. A repeater output greatly enhances the capability of any miniature communications equipment. A walkie-talkie through a repeater packs the same punch as the repeater output, and the punch usually comes from the top of a hill or mountain. To be really handy, the transceiver would have to be small enough to be carried anywhere (pocket tuckawayable), and punchy enough to develop a kicky signal from any line-of-sight range. Unfortunately, the cost for such a unit is prohibitive for us poor folk.

But there are units that do fill the bill quite nicely. GE makes one. It's transistorized and uses integrated circuitry for added miniaturization. It puts out more than a watt. It's no bigger than two packs of cigarettes. But it costs nearly a thousand dollars.

A pocket receiver is the next best thing. A good miniature FM receiver is small enough for the pocket yet sensitive enough to allow monitoring of the local repeater output from anywhere within the repeater's general range. And to be fully useful as a monitor, it must have a tunable squelch so latent band noise can be eliminated during the no-signal state. GE makes one of these, too. It's called the Message Mate. It's a highly sensitive unit made foı nigh-band paging systems. But it costs more than $200.

So it's pretty understandable that I became pretty excited when I saw

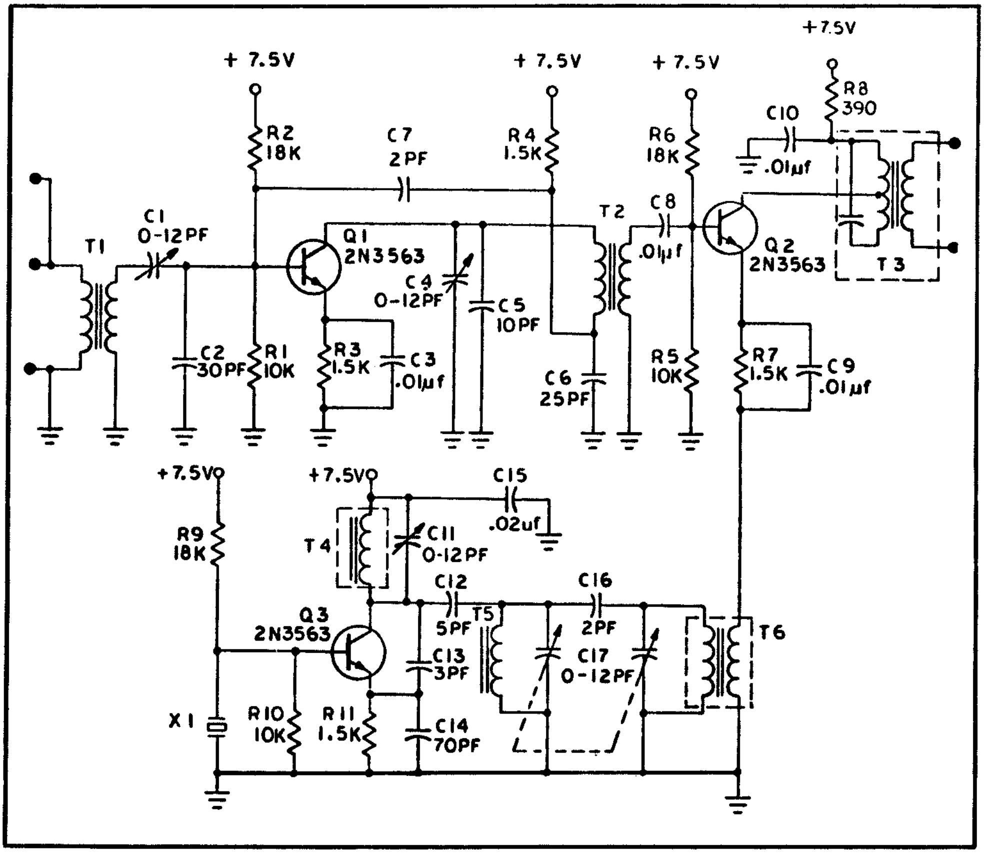


FIGURE 2. 150 MHz OSCILLATOR MODULE, NINIC POCKET RECEIVER

the Mann Communications ad in the March issue for the $74.95 Ninic pocket communications receiver. I had to have one! Here's my reasoning:

In my locality, 146.82 MHz is the primary channel. A group of us established a hilltop 146.70 MHz transmitter which is fed all the 146.82 MHz signals heard by a local receiver. If an operator were to crystal up a two-meter mobile unit to transmit on .82 and receive on .70, the mobile would be extremely valuable around town, but totally worthless out of the general repeater area. Similarly, the operator would be out of luck if the .70 transmitter were to malfunction or be forced to shut down for some reason.

An ideal solution would be one whereby FM'ers with single-channel radios could be provided with a means for copying .70 on an auxiliary or secondary receiver. Such a scheme would also prevent a repeater from causing the kind of interference mentioned by Mr. Anderson in his very controversial anti-FM Autocall column. (FMB, February 1968)

The perfect "auxiliary" receiver to complement a single-frequency mobile unit by monitoring a repeater output is a sensitive pocket receiver. And the Ninic has proved that it can do the job nicely.

A LOOK AT THE NINIC

The Ninic is a stable, crystal-controlled dual-conversion superheterodyne FM receiver with a sensitivity of about a microvolt for 20 dB of quieting. The unit is inherently noisy, and it takes a signal of greater than 10 microvolts to give complete quieting. The ad said the

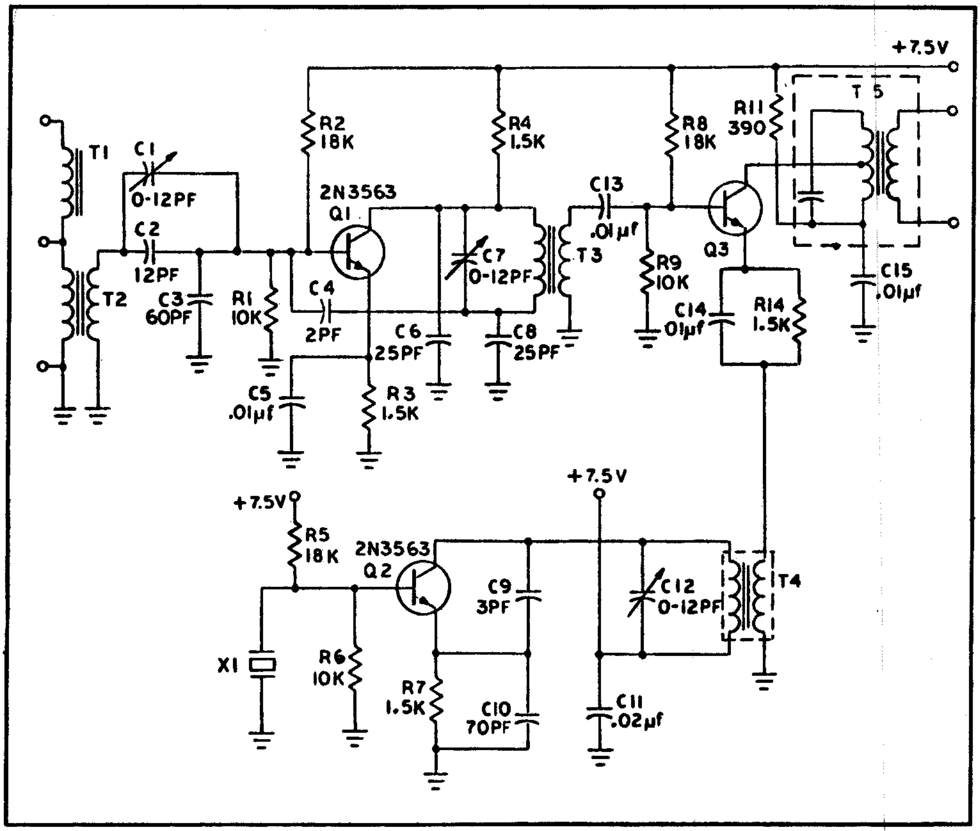


FIGURE 3. 50 MHz OSCILLATOR MODULE, NINIC POCKET RECEIVER

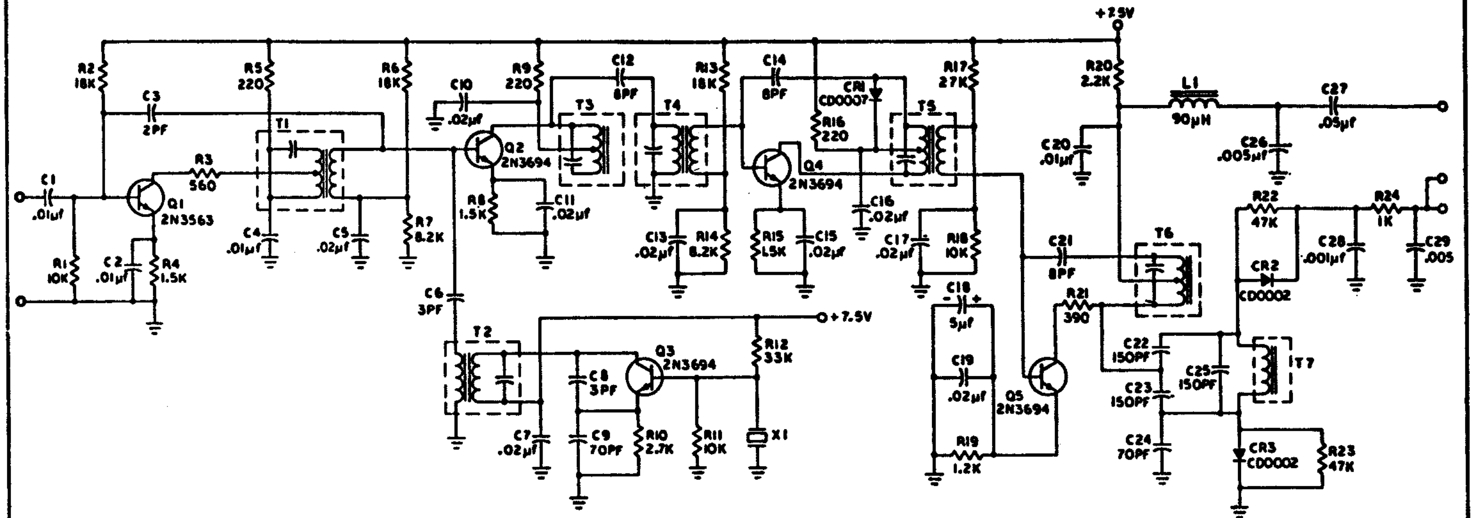
unit had a sensitivity of 0.3 microvolt. This proved to be true, but there was practically no quieting at that input level.

The Ninic comes equipped with one crystal for the converter and another for the oscillator. The oscillator crystal puts the operating frequency above 150 MHz, but the fact that it is supplied with the receiver greatly simplifies tuneup and checkout; it's always more comfortable to check out a receiver on its original frequency before attempting to set it up on a new channel. The originally supplied crystal allows individual operating characteristics to be observed so you'll know what to expect in the way of performance when the receiver is properly tuned to the new frequency.

The Ninic is comprised of three discrete modular circuit boards, as illustrated in the photo of figure 1. The smallest of the three is the oscillator module, positioned immediately above the battery.

The low-band (six-meter) receiver is identical with the high-band unit pictured with the exception of the oscillator module. The oscillator leads are connected with plug-in pins. A low-band unit can be changed to the high-band version (and vice versa) by unplugging the terminal pins, removing the hold-down screws, and inserting the appropriate oscillator module.

Figure 2 is a schematic of the high-band oscillator. While the supply voltage is shown to be 7.5 volts, the receiver works well with any supply voltage of 6 volts or more. The nickel-cadmium cell in the unit pictured provides 6.25 volts and is more than adequate to allow squelch-



NOTE:

No I-F adjustments are necessary. Adjustments of the slugs and transformers is not recommended. The I-F circuits have been factory-aligned.

FIGURE 4. CRYSTAL-CONTROLLED I-F MODULE OF NINIC POCKET RECEIVER

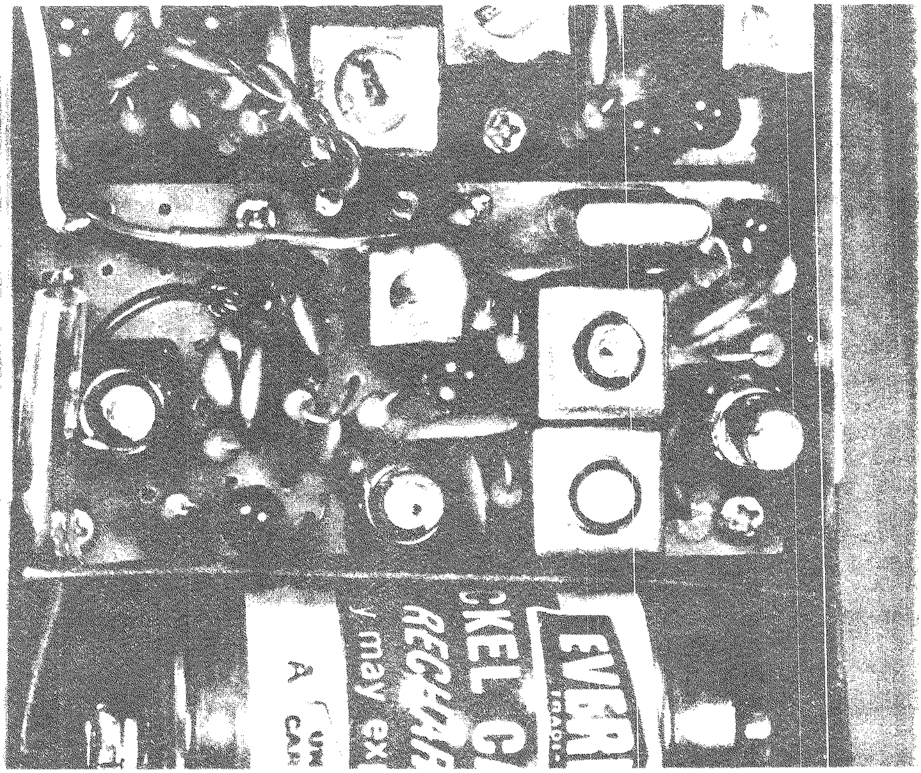


FIGURE 5. PHOTO SHOWING CLOSEUP OF OSCILLATOR MODULE (NOTE THAT VARIABLE CAPACITORS ARE ON BOTTOM SIDE.)

breaking on signals better than 0.3 microvolt. The schematic for the low-band oscillator is shown in figure 3.

Figure 4 is a schematic of the crystal-controlled IF module. This is the center circuit board in the photograph of figure 1. As noted earlier, this module is the same for high-band or low-band receivers.

TUNEUP

If you're thorough, you will by now have noticed what appears to be a discrepancy between the schematic of the oscillator and the module itself. The schematic shows a number of variable capacitors in the oscillator for tweaking the thing on its new frequency, but even the closest examination of the oscillator won't reveal even a hint of a tunable capacitor. When I saw this apparent disparity, I merely shrugged and muttered some under-the-breath comment about radios made in Japan. And I started the tuneup procedure by adjusting the wax-filled slugs in the coils and transformer cans.

The receiver had all the earmarks of a unit that could be set to any frequency in the two-meter band. I noted that most of the slugs were nearly all the way out. This seemed almost a sure indication that the frequency could be lowered a great deal without modification of the circuit. Then, when two of the slugs bottomed out, I became suspicious. The tuning range of the oscillator was nowhere nearly as broad as it looked to be.

The capacitors in the schematic simply had to be on that board somewhere. In desperation, I disconnected the test leads and interconnect pins and pulled the oscillator module out of the receiver. There they were! All the miniature tunable capacitors were protruding from the underside of the oscillator board. This layout makes the tuneup somewhat more difficult from the standpoint of convenience because the oscillator cannot be adjusted while it is mounted in the receiver. The interconnecting leads to the oscillator can be reconnected to the board after it has been removed, however. The board must be placed vertically and situated immediately adjacent to the IF module so the leads will reach. Fortunately, the oscillator is stable enough so the tuning won't change after the unit is remounted.

Before discussing the tuneup procedure, it might be wise to describe the crystal-ordering particulars. Since Sentry Manufacturing Company advertises regularly in FM -- and their crystals really are of the quality we FM'ers have come to expect -- I decided to ask them to assign a specific order number to the Ninic oscillator crystal. They did do this for the two-meter unit, but because of a lack of information at the time they could not provide correlation data for the six-meter version.

To order a two-meter crystal, give Sentry the two-meter operating frequency desired, specify crystal holder SCM-18, and mention that the receiver is the Ninic.

To order a six-meter crystal, specify crystal holder SCM-18 and refer to the crystal oscillator circuit shown in figure 3 of this article. The Sentry people subscribe to FM and can correlate the data from their copy. The first six-meter crystal order will probably take a day longer to process than subsequent orders because of the time required to correlate the data the first time through.

Here is a complete step-by-step tuneup procedure:

Frequency Adjust (Figure 5)

1. After inserting the proper amateur

Limiter/Discriminator test point is an all-purpose alignment point, and may be used to monitor limiter current as well as discriminator position. When the input signal is below saturation, use a 2V meter and peak all adjustments (maximum meter deflection). Then, with saturating signal, adjust oscillator for 0 on meter. Make sure discriminator can is adjusted for 0 with no input signal.

FIGURE 6. PHOTO OF NINIC I-F MODULE

crystal (Sentry SCM-18) remove the three hold-down screws.

2. Unplug the lead covered with transparent polyvinyl tubing (extreme left in photo of figure 5).

3. Gently lift the lower edge of the board (the end next to the battery) as if opposite edge were hinged.

NOTE

The oscillator will now be positioned perpendicular to the receiver so adjustments can be made from either side of board.

4. Carefully remove the wax from the two transformer cans located below the crystal (see photo).

5. Using a jeweler's screwdriver, turn both slugs clockwise one complete turn. (On six-meter unit, turn slugs counterclockwise one turn.)

NOTE

The slugs of all transformers are held in place by tiny one-piece rubber-band segments. If tuning is difficult or if the slug has a tendency to edge back toward the original setting, remove the slugs completely and lift out the rubber-band sections. Then replace the slugs and set as described in 5.

6. Leave the polyvinyl-jacketed lead disconnected. This lead attaches to one of the pins on the base of the receiver and allows for the connection of an external antenna.

7. Connect the output of a signal generator to the antenna lead to produce a saturating signal on the receiver. The squelch should be fully opened.

8. Turn on your base station receiver (or any receiver known to be on the same frequency that you're zeroing.

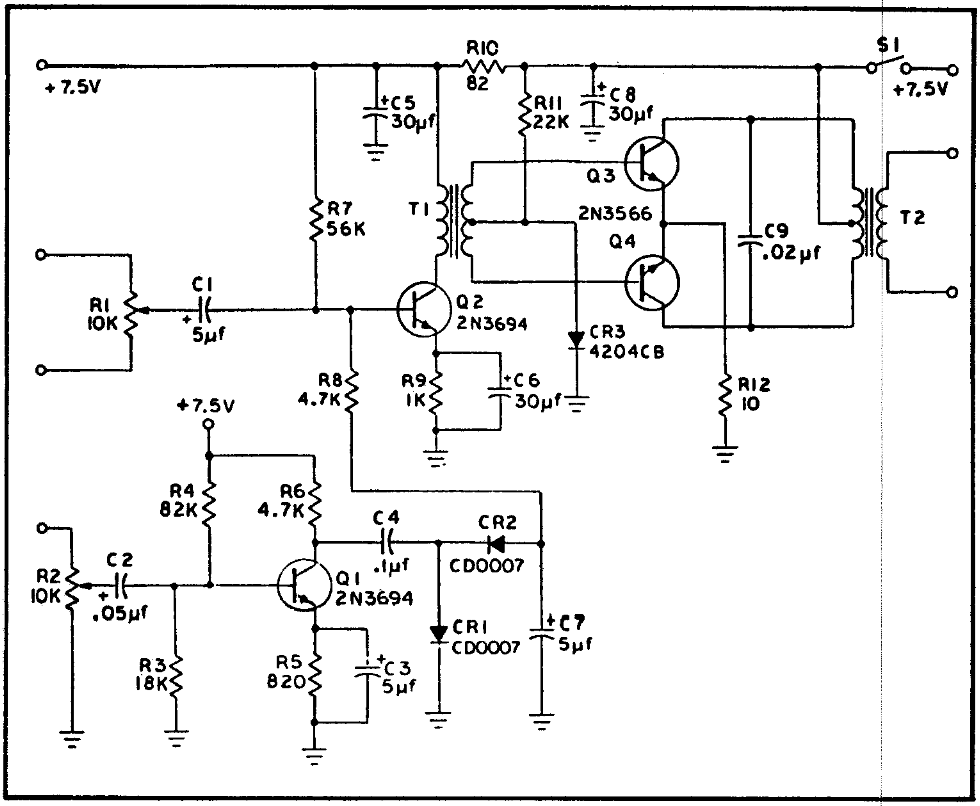


FIGURE 7. AUDIO AND SQUELCH MODULE, NINIC POCKET RECEIVER

9. Connect a discriminator meter to the base station receiver so it will be in plain view while you're making adjustments on the Ninic.

NOTE

The signal generator output must be high enough in signal strength to be copied on the base station receiver. The base station receiver audio gain should be all the way down.

10. Gradually adjust the signal generator frequency for a zero indication on the base station discriminator meter.

11. Adjust the frequency trimmer capacitor (located in corner on bottom of board below previously adjusted transformers) until presence of the saturating signal is indicated.

12. If the signal can't be brought in as described above, set capacitor to center of its range and adjust transformer slugs one additional turn. Then repeat step 11.

13. With the receiver saturated as described in step 12, decrease the signal gradually for a popping indication (about 10 dB quieting on the Ninic).

14. Adjust the antenna capacitor for maximum quieting. (This capacitor is located below the open coil at the extreme left.)

15. Reduce signal and readjust capacitor for maximum quieting. Note position of capacitor. If fully open or meshed the antenna coil must be adjusted. Continue adjustment until antenna tuning capacitor provides the best signal near the center of its range.

16. Adjust all other oscillator board capacitors for maximum quieting, but remember to reduce the input signal each time it reaches saturation.

17. Observe all capacitors. If any are fully open or closed, a readjustment of the corresponding coil is necessary.

18. When receiver has been fully tuned, reset all coils with wax. Use an ordinary birthday candle and allow the melted wax to fix the slugs in their new positions.

Final Comments

The discriminator adjustment is in the upper righthand corner of the IF module. Figure 6 illustrates this and also shows the first-limiter monitoring point. When monitoring for limiter current, set meter to either the 50-microamp scale or a 0 - 2 V dc scale (20,000 ohms per volt).

Figure 7 is a schematic of the squelch and audio circuitry. There are no adjustments to be made on this board; the circuit is included only for reference. (The Ninic does not come with schematics; the originals from which those in this article were obtained were probably the only set in existence.)

New Ears for TULSA

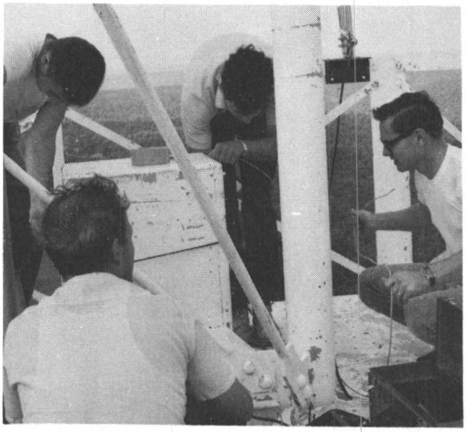
by PAT DEVLIN

The new hearing aid for WA5LVT repeater is now in full operation 500 feet up on the channel 6 television tower north of Sand Springs, Oklahoma. The new site gives excellent coverage to points west and south. Complaints of overtransmission by the repeater are now invalid as mobiles are now full quieting anywhere within hearing range of the transmitter. In addition to the tower -- including a downlink receiver, a control link receiver, and 450 sidelink transmitter. The Loud Voice of Tulsa encourages all mobiles anywhere within 150 miles of Tulsa to enjoy the repeater's extended-range relay capability. The first day the package was in operation, a mobile 45 miles west of Oklahoma was involved in a traffic accident and was able to report the full details to a rather confused highway patrol dispatcher in Tulsa via the automatic phone patch. Quieting copy 135 airline miles from mobile was recorded under nominal band conditions.

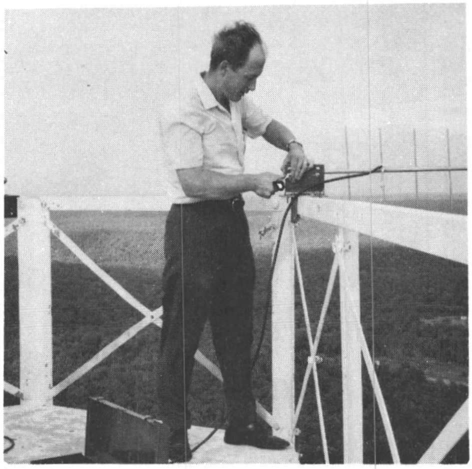
There was a rather fantastic band opening on October 7. Southern Texas stations were talking to an Ohio station and every repeater within 300 to 1,000 miles was activated. Of course WA5LVT was right in the middle of the dogpile.

The Tulsa Repeater Story, 4th Edition, is now complete and has already been booked well into December. The story, an 80 slide documentary with audio tape, explains repeater development in Tulsa and across the nation and gives tips on licensing, equipment and practices. The show runs about 45 minutes with the last 10 minutes devoted to an actual recorded QSO through the WA5LVT repeater. The story may be reserved for club meetings, hamfests, new repeater groups, or by any interested group by contacting Pat Devlin, WA5BPS, at 3345 South Harvard, Tulsa, Oklahoma 74135 at least a month in advance. There is no charge for the presentation; however, the borrowing group agrees to be responsible for the slides and tape and their safe return to the lender.

Transient mobiles are invited to stop in for a personal visit with the "vocal chords" of the Loud Voice of Tulsa. A tour of the repeater facilities can usually be arranged if the traveler is in town for overnight.



MERLE SUMNER (W5HXD), WARREN COX (WA5QMZ), DOUG CARTER (WA5QGN), AND KEITH MORRISON (WA5SEQ) INSTALL THE 450 MHz EQUIPMENT PACKAGE 250 FEET UP ON TV TOWER NEAR SAND SPRINGS, OKLAHOMA. THE 146.34 INPUT RECEIVER IS 250 FEET HIGHER ON THE TOWER.



WARREN COX MOUNTS A 450 MHz BEAM FOR THE CONTROL RECEIVER AT THE 250 FOOT LEVEL OF SAND SPRINGS TV TOWER.

CHICAGO'S CFMC

... a community repeater

by Ernest Simon HIGHLAND PARK, ILL.

Little has been published in the past concerning repeater operation in the Chicago metropolitan area. It is therefore the purpose of this article to familiarize FM'ers with the most active repeater in Chicago which is available to amateurs of all classes.

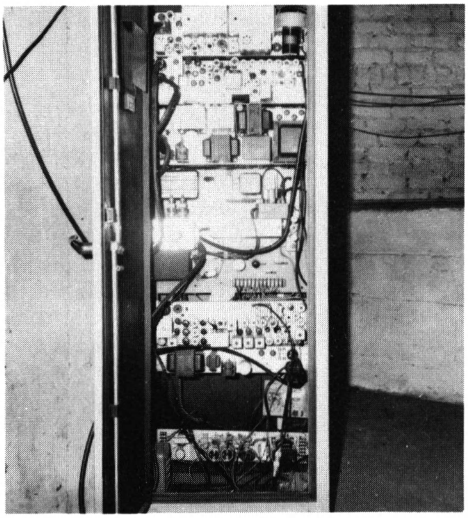
The Chicago FM Club (CFMC) has been in operation since 1964 and presently utilizes 146.34 MHz input with output on 146.76 MHz. The transmitter site is a 400 foot office building in Chicago's downtown Loop. Power output is 60 watts to a 5.8 dB Andrews 150-11 antenna fed with Heliax.

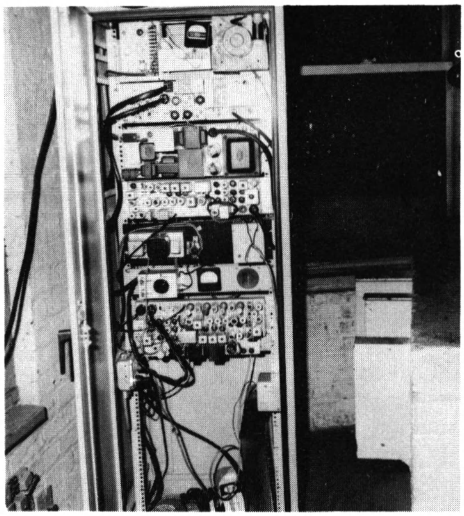
The repeater utilizes two receiver locations, extending coverage of the system from LaPorte, Indiana on the south, to north of the Illinois-Wisconsin state line, east to Benton Harbor, Michigan and west to Joliet, Illinois.

The north receiver is 7 miles north of the Loop on a 350 foot building where a Motorola G receiver with preamp is fed by an Andrews 151-11 7.5 dB cardioid gain antenna.

The south receiver is atop a 275 foot building 7 miles south of the downtown Loop, using a unity-gain folded coaxial type antenna. A Motorola G receiver is used here also.

Experiments have shown that use of "off-site" receivers is necessary in Chicago due to the extreme rf fields found in the downtown area. Of course, the system could be located completely outside this rf "hotbed," but the highest buildings are to be found in the Loop. This necessitates the use of two satellite receivers removed from the transmitter for maximum coverage.





Motorola T44-type 450 MHz Link transmitters and receivers are used for relay and control purposes with point-to-point beams and corner reflectors for the antenna systems. Much of the control system is solid state, and work is under way for a solid-state receiver voting system. Presently, tone input is used for receiver selection and repeater access. An automatic code wheel identifies each individual 450 MHz transmitter. This is done because each remote receiver location is licensed as a separate repeater. The 450 MHz i.d. is filtered out before it gets to the main output.

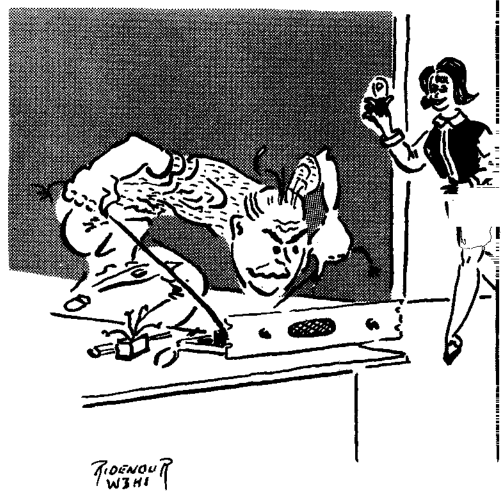
Installation is now in progress to provide additional 6 meter output on 52.525 MHz with repeater input on 52.76 MHz. Although initial output will be on 52.525 MHz, It is expected that this will be changed soon, since it is anticipated that 52.525 MHz local interest will pick up with the repeater operation. There is a lack of activity on 6 meters in the Chicago area due to Channel 2 TV.

CFMC has over 60 active members, of whom 20 use, in addition to their mobiles and fixed bases, portable Handie-Talkies which are battery powered. The repeater is operational 24 hours a day and averages over 100 hours each month of actual "on the air" time.

The repeater club holds regular monthly meetings at which projects relating to repeater operations are discussed. The membership votes on proposals concerning improvements and modifications of the repeater system.

The CFMC repeater is an open repeater available for use by any visitor to the Chicago area. To actuate the system an 1800 Hz tone for the north receiver or 2000 Hz for the south receiver is required. This can be easily whistled.

Officers if the club are: William S. Knopp WA9ERC, President; George M. Hunt WA9EWT, Vice President; John F. Pawlowski W9FUL, Secretary; and Vincent M. Lynn, Jr., WA9KUK, Treasurer.



"Could this be the trouble? Mother borrowed it yesterday to darn some socks."

"Naw! The family don't bug me anymore about home chores. F'rinstance I remote control everything with this dial."

Jim Mann
Mann Communications
18669 Ventura Blvd
Tarzana, California

DUPLEXING YOUR 450 MHZ MOBILE

Duplex operation is a near necessity for the 450 MHz repeater user. Without it, the operator has no indication as to when he's "making it" or when his signals are marginal in the repeater. A 450 MHz mobile as an access to a two- or six-meter remote base station loses much of its effectiveness when the control operator can't hear his own "talkback" signals as he is transmitting.

The duplex capability is the final finishing touch on the 450 MHz repeater system which includes an automatic telephone patching device as an operational function. Without duplex in this service, the radio operator finds himself explaining the principles of his operation with nearly every telephone call so his party won't speak at the wrong time -- thus going unheard.

What is duplexing? In the strictest sense duplex operation is transmitting on one frequency and receiving on another. What this article is about, however, is simultaneous duplex, or receiving on one frequency the repeated signals that are being transmitted on another at the same time. A completely duplexed unit allows "telephone" type operation, whereby each person can hear what the other transmits at any time. With repeaters, this does not allow telephone operation between repeater users, but it does allow it between any of the mobiles and the repeater base station. And between any of the users and the base telephone when an automatic phone patch is incorporated into the system.

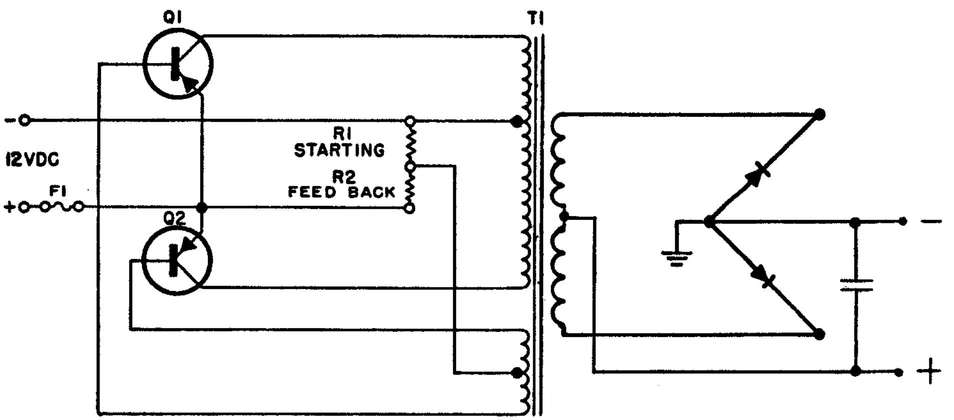
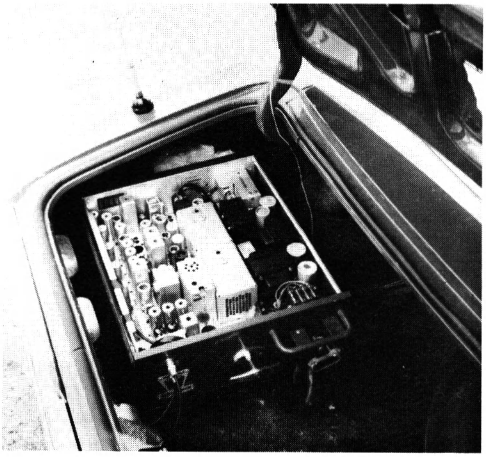


FIGURE 1

How do you duplex a 450 MHz FM mobile? Since the integral vibrator supply of the stock unit is inevitably unable to handle the added load of the receiver during transmit, the only logical course of action is to build up a transistor supply to power the receiver on a continuous basis.

When the added supply has been incorporated, there remains but one stock lead to reroute (if the 450 MHz unit is a Motorola T44 or a GE Pre-Progress Line MC306).

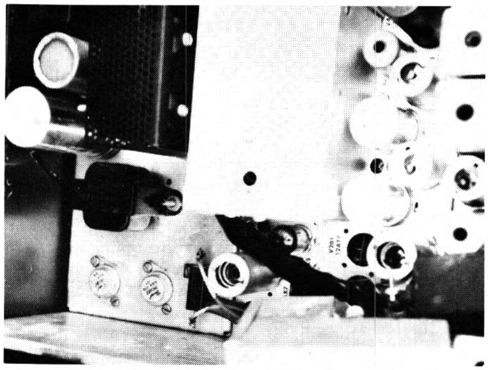
Another feature of these units is the fact that sufficient room exists on the power supply chassis of both to readily accommodate the T-supply.



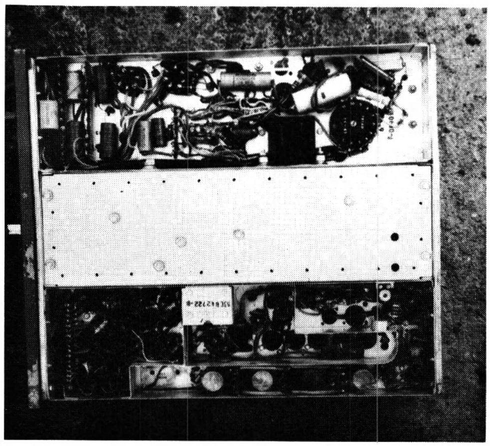
Obtaining a good circuit should be no problem, regardless of the transistor types your junkbox is stocked with. There is little difference between circuits except for the values of the starting and feedback resistors. Figure 1 is a typical circuit using a Triad TY82 toroidal-core transformer. In this circuit, the output is more than adequate to power any FM mobile communications receiver. Additionally, all Triad TY-series transformers come packaged with at least two basic supply circuits and a wide list of usable transistor types.

Figure 2 is a photograph showing a naked Motorola T44 trunk-mounting mobile unit. The T-supply is installed on the power supply chassis immediately below the tone encoder unit (shown as a projection from the back wall of the mobile unit).

As shown in the closeup photo of figure 3, only the transistors need be mounted above the chassis. The chassis surface itself serves as an excellent heat dissipator for the transistors. And the installation is not esthetically displeasing. Even the most conservative FM'er shouldn't balk at this modification.



When the flat Triad TY82 is used, there will be plenty of room on the underside of the chassis for mounting this as well as the other circuit components. Figure 4 shows the guts of the supply in the chassis of a T44. Silicon diodes are used for rectification to keep the size down and allow ample leeway for choice in component placement.



Selection of Transistors

Many so-called "experts" say there is no need to match the two transistors used in a switching circuit. They're just plain wrong! While the parameters of a given transistor type need not be matched, it is not a good policy to use two different transistor types. The operation can result in

(Continued on page 47)

Bill Strack
11052 Wickford Drive
Santa Ana, California

touchtone as a STANDARDIZED control approach

by Bill Strack

Bell's dialing system provides the means by which a flexible yet standard set of conventions for amateur remote control can be established.

Many FM'ers, in examining the various methods of tone control currently in use, have come across a new name. No doubt most of us have heard of the Touchtone telephone signaling system developed by the Bell Telephone Laboratory, already in use in many areas of the United States.

The Touchtone article by K3DSM in the April issue of FM cited a few of the key characteristics as well as some original applications. This article is intended to augment K3DSM's material by providing more detailed data on the Touchtone system and describing additional control applications.

Touchtone consists of eight discrete tone frequencies arranged in two groups of four tones each (a high group and a low group). Sixteen digits can then be represented by the combination of one tone from the high group with one tone from the low group. The individual frequencies and various combinations are illustrated graphically in the K3DSM article.

In standard telephone use, only ten of the possible sixteen digits are used. The remaining six are used for special-purpose applications. In order for the FM'er to decode the ten standard digits, seven individual tones will have to be processed. With only slight modification to the digit-formation logic in the decoder, the two other functions will also be picked up. That is, the four low tones and three of the high tones will allow for the selection of twelve separate functions, a sufficient number for most remote control applications.

By this time, it has probably become pretty clear that Touchtone is a relatively complicated approach in comparison to other techniques in vogue. For example, the signals require more circuitry for decoding than do those of the AFSK dial pulse or the single-tone pulse-train systems enjoying current popularity in amateur remote control applications.

So why go to a complex method when so many simpler systems are available that will provide the same results? Completely ignoring the advanced technology of Touchtone, the system is highly versatile and is unique in that it has the lone potential of becoming a truly universal control scheme.

Of prime importance is the Touchtone encoder (or "pad"). The Automatic Electric pad that a W2 in New York buys and puts into service with his facility will be the exact equivalent of the Western Electric pad in use by the W6 in Los Angeles. The tones will be within a few hertz of each other even over a very wide temperature range. These two FM'ers could drive from state to state using any system setup for these tones, as long as they had the capability of operating on the correct radio frequency in each case.

Let's look at the functional requirements of your system. If you need less than seven functions, you have no need to bother decoding the dual frequencies. If two adjacent buttons on the pad are pressed simultaneously, only a single tone will be produced. Making a slight modification to the pad so that the 941 Hz tone can be sent independently, you will have seven individual tones that can be decoded in standard fashion.

With a little bit of help from our national FM journal, certain frequency/function standards can be established and used consistently across the country. For those of you who like the compatibility angle but don't want every Tom, Dick, and Harry to have the same control tones you use on a restricted control frequency, the solution to your dilemma rests in use of a small vibrating reed and associated parts: compatibility without universal accessibility.

The superiority of Touchtone in marginal-strength areas over any sort of dial pulse approach is clear. It is safe to say that regardless of the type of tone system you are now using (or contemplate using), going to Touchtone or standardized single tones will provide you with a versatile and technologically up-to-date control system that has the potential of being used in a multiple-user, statewide, or perhaps -- eventually -- nationwide repeater or remote base system. Even if you have no desire to become part of a large complex of remote systems, the inherent advantages of Touchtone over the other control techniques tends to justify its use.

What are the problems involved in sending and decoding Touchtone signals? The first basic premise is one that pertains to both sending and decoding: Whenever the two-tone combination needs to be limited, watch out! If hard limiting -- as in the clipper of the transmitter -- occurs, exit Touchtone! One of the characteristics of extreme instantaneous limiters or clippers is to accentuate any differences in level that were already a part of the tone combination. Make certain that the transmitted tone amplitude is such that no clipping occurs when the transmitter is set for correct deviation on voice.

Due to the fact that amplitude differences are naturally quite low as a result of encoder design, and all the tone components are within the flat frequency response area of most FM equipment, there will be no difficulty if limiting does not occur.

The process of decoding the Touchtone signal after it arrives at the receiver is an area where there are a number of successful methods in current use. The most sophisticated -- and probably the most complicated -- is that which was originally proposed by Bell and is used in Bell equipment. It consists of separating the two-tone combination (via band elimination filters) into groups consisting of all applied frequencies except the high-group or low-group sequence that is to be eliminated. This is done so each tone component can be regulated separately, hard limiting successfully applied, and each group treated discretely after this point in decoding.

After group limiting, selective filters separate the individual tones. Each filter has a corresponding detector and output circuit as well as an output timer and checking circuitry. The active elements are solid-state components of standard design.

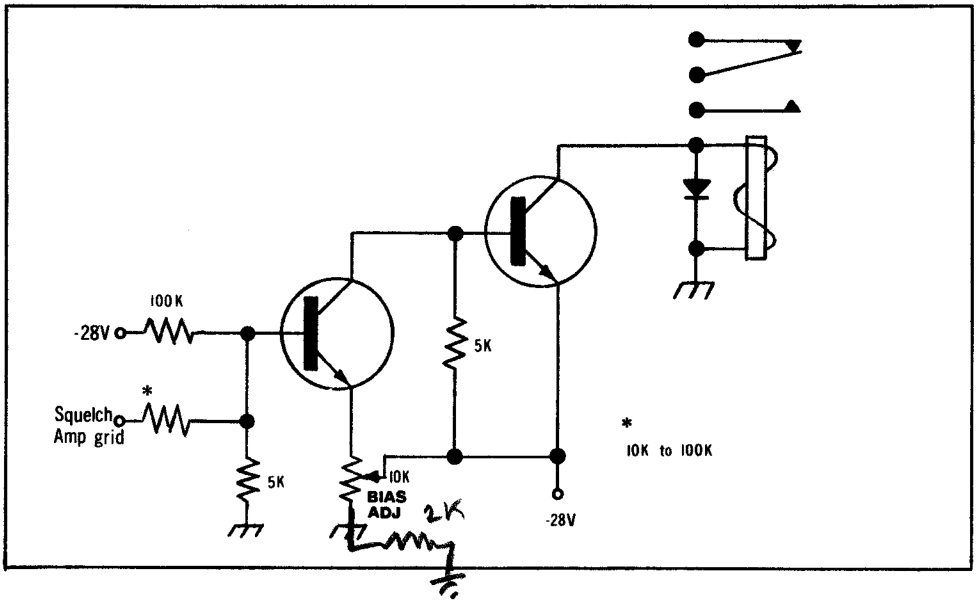
As might be expected, this decoder represents an "optimum" design approach. The time required for the decoder to recognize a valid digit combination is a quick 40 milliseconds. The number of false indications due to voice energy or noise tripping is next to none.

For those of us who refuse to look at anything less than the absolute ultimate, this is THE decoder, already neatly designed and optimized. The only hangup is the fact that Bell is somewhat reticent about making available various critical parts used in the design. Fortunately, there are ways by which the amateur can circumvent this problem.

The SOLID-STATE Carrier-Operated Relay

Jerry Schneider
1901 S. Livonia
Los Angeles, Cal

by
Jerry Schneider



Probably the most important single cause of failure in remotely operated equipment is heat. Most of us who maintain repeaters and other remotely controlled devices go to great lengths to minimize the amount of heat generated at the remote site. We replace tube-type rectifiers with silicon diodes and install carrier-operated squirrel cages to blow air over the tubes. Some of us use solid-state decoders for control of functions. But most of us still use the same old vacuum-tube carrier-operated relay to key the transmitter with each incoming signal.

Of course, it is true that replacement of a single tube with a transistor circuit won't have any great effect on the overall heat-generation characteristic of a repeater, but with each such replacement the overall "reliability figure" is improved. And replacement of a vacuum-tube carrier-operated relay (COR) with a transistor version will certainly prevent that otherwise inevitable service call for a defective COR tube.

The advantages of transistors over tubes is sufficient in terms of reliability alone to justify their incorporation for remote applications.

Another good application for a solid-state COR is in a "walkie-talkie" repeater, a ubiquitous device which can be carried anywhere and mounted on such unlikely stanchions as tree trunks or telephone poles.

A pole-mounted transistorized repeater may sound a trifle far-fetched, but the idea does have merit. Such an approach allows installation of a low-power repeater at locations where no commercial power is available. At least one California amateur (Paul Signorelli, K6CHR) has reportedly been using a portable two-meter transistor repeater for years to successfully provide coverage in the San Fernando Valley and throughout the Los Angeles Basin. His site is high enough to provide excellent coverage, but far enough away from commercial ac lines to preclude their use as a power source.

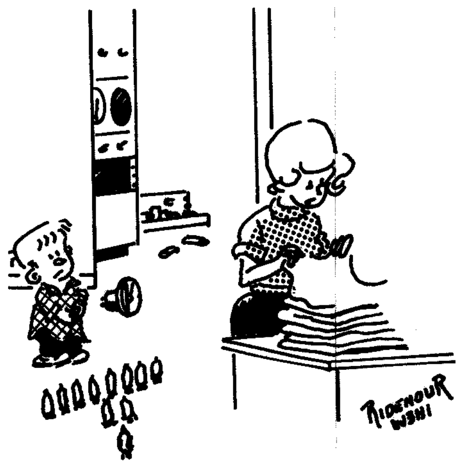
A low-power repeater of all-transistor construction can be successfully deployed using an automobile battery as a dc source. The unit can then be kept operational by the simple expedient of exchanging batteries once a month.

Although the basic operating principles are the same for both vacuum-tube and transistor receivers, the COR shown in this circuit was designed for compatibility with a tube-type squelch amplifier, such as Motorola's conventional 12AX7 or 12AT7 variety. It can be used "as is" for most GE and Motorola receivers, but some modifications would be required to adapt it to a solid-state squelch amplifier.

The 24 - 28 volts required for power should prove no problem at all. A standard transmitter bias supply is an excellent source. If you have a control system, you're probably using a 28-volt dc source to drive a stepper or operate transistor circuits, anyway. If not, a small external battery will do the job nicely.

There are no critical components in the solid-state COR. The transistors can be any NPN types capable of switching at a collector current of greater than 50 mA. The mechanical relay can be any low-current device that will pull in with less than 24 volts applied.

"Go ahead - See if the relay out of the dishwasher will fit."



Yes - Your soldiers look very nice. Now put the repeater back together before daddy calls in.

SPLIT-REED VIBRATORS
for simplified 6- to 12-volt conversions

by Bill Harris LAFAYETTE, INDIANA

Some of the more common and newer pieces of two-way gear lend themselves readily to 12 volt conversion; some by restrapping the cable plug, other types simply by plug-in jumper arrangements. Much of the older equipment, however, was designed as strictly 6 volt, with conversion to 12 generally necessitating the procurement of a new dynamotor as well as a new vibrator transformer and vibrator.

Obtaining a 12V dynamotor is seldom a problem for the average FM operator because many types are available surplus* and some are being retired in order to change to transistor power. Therefore, we will not delve into the dynamotor aspect at this time, but will concentrate on the vibrator supply.

Studying the average 6V mobile unit to be converted, the first item of note is that the existing vibrator transformer is usually in clean condition and does match the chassis space and construction fairly closely. To maintain this ethnic symmetry one would normally want to replace the transformer with one having the same physical characteristics but with the exception of a 12V primary winding instead of a 6. The first thing that comes to mind here is the price of such item. Since it is an item that doesn't generally wear out, it's a pity to callously throw it away.

The vibrator, however, can generally be considered well on the road to being in need of replacement, since it is an item that DOES wear out. In addition, some of the original equipment 6V vibrators are getting increasingly scarce and expensive. So if we're going to replace it anyway, why not spend the money on one that will: (1) allow the use of the old transformer, (2) last nearly forever, (3) be easily obtainable for replacement. There is one vibrator that fulfills all these criteria: the Mallory No. 1701 (or Motorola 48B800145). This unit is of split-reed design; that is, it is essentially two vibrators in one, which allows us to use the 6V transformer in a 12V circuit. It is of heavy enough design and it is used to power 50W transmitters; hence the longevity. It uses a common 7-pin base, which makes obtaining sockets easier; and it is one of the more common communications replacement vibrators, so it can be found in almost any two-way radio shop or radio parts catalog. The price runs about $7 or $8 which is indeed reasonable considering the above factors.

In case you have heard that split-reed vibrator supplies are noisier than their simple counterparts, don't accept that as gospel. The only causes of excessive noise in a vibrator supply are: poor design or layout, inadequate shielding, lack of bypassing, or a worn-out vibrator. I've never experienced noticeable noise from a split-reed conversion, and I suspect it's because a new vibrator is almost always employed.

If you are ready to convert, here's how:

1. Carefully strip out old vibrator socket from chassis. Save ground cup, buffer capacitors, wire leads and any bus-wire jumpers and "spaghetti."
2. Install new socket (Amphenol No. 77-MIP-7) in hole vacated by previous socket; it may be necessary

to file hole out a few thousandths.

3. Ground pin 7 to chassis with a short, heavy bus wire.

4. Connect 12V "hot" lead (or hash choke) to pin 3.

5. Using heavy bus wire and spaghetti, jumper pins 1 to 5, and 2 to 6 of socket.

6. Carefully wire an 0.01 uF Discap from chassis ground to each of pins 1, 2, 3, and 4. Use more than one ground if necessary, but keep cap leads short.

7. Connect a 39-ohm, 2-watt resistor from pin 3 (A hot) to pin 4 of socket.

8. Connect one each (total of two) 330-ohm, 1-watt carbon resistor from ground to pin 5 and ground to pin 6 of socket.

9. Connect transformer primary OUTSIDE leads to pins 5 and 6 of socket. LEAVE CENTERTAP LEAD DISCONNECTED AND TAPE OFF SECURELY! The primary voltage is now applied at the vibrator socket and not at the transformer.

10. Install whatever type of tie-lug terminal strip(s) you can find that will fit in the vicinity of the transformer secondary leads.

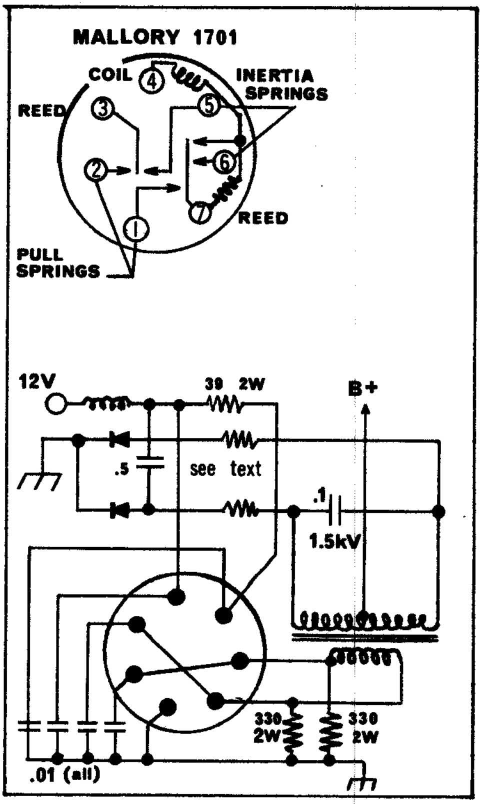
11. Build up a bridge or full-wave bank using a minimum of two 400 PIV or higher silicons per leg for each 200 volts expected on the secondary. Use small value carbon resistors (10 to 100 ohms) in series with each secondary lead. DON'T OMIT THESE PROTECTIVE RESISTORS. Use spaghetti where necessary to insulate diodes and resistors from chassis and other wiring.

12. Recheck all wiring before applying power. Make sure buffer capacitor(s) have been replaced with the proper values.

One caution: Do not operate any split-reed supply without a proper load! Secondary voltage will go sky-high and vibrator will very likely incur damage!

When conversion is complete, replace all shield covers, install vibrator and connect a dc voltmeter of the proper range to the B+ line of the set. Turn on set and observe meter: If voltage is somewhat high, recheck after tubes warm up (10 to 15 seconds). If voltage falls to normal, leave set running and check for excessive vibrator or transformer heat in 5 to 10 minutes. The vibrator should never get so warm it cannot be unplugged with the bare hand; the transformer may run somewhat warmer than the vibrator, though no hotter than it operated on 6 volts.

*Two common types of surplus "dynos" are the Signal Corps DM-35, 12-14V input at 28 to 32 amps; 625V at 225 mA output, good for 829-B and Pr.-807 rigs; and the Eicor D-401 (Collins TCS Eqpt), 12-14V input at 18-22 amps, 420V out at 200-240 mA for Pr.-2E26 rigs, etc.



the DISCOVERY of wideband FM

by GENE MITCHELL, DEVON, PA

There is a growing interest in wideband FM on the VHF bands. This mode of operation is far different from that on the lower frequencies. Interest is not in DX or the latest ham appliances. These operators find a quiet intercom, free from QRM and the howls of dozens of lids.

The biggest advantage of FM is crystal-controlled receivers and transmitters. This eliminates tuning and missed calls. There is no drift. Receivers become more sensitive since they do not have to be broad-banded to cover the entire band. FM has a better quieting factor than AM. The volume level is constant, regardless of how strong or weak a signal may be.

QSO's sound like dispatches from commercial service. They are short and ragchewing is kept to a minimum. Sometimes the commercial "10 code" is used to shorten transmissions. Since these frequencies are monitored most of the time for emergency calls for calls to other stations, long transmissions are frowned upon. FM has a great potential for emergency communications, since operation is simplified and performance is commercial quality. Rarely is a CQ heard. All that need be said is K3DSM 10-8. 10-8 means monitoring on the frequency, 10-7 means closing station, 10-6 means standby, 10-4 means roger or OK, 10-20 means location.

Radio clubs find FM perfect for a club frequency to monitor. It is easy to remote FM radios throughout a house so that the frequency can be monitored without being in the hamshack. Mobiles equipped with FM turn on with the ignition key and are ready to monitor or call without tuning. The mobile equipment usually mounts in the trunk with a control head under the dash. Typical power is 25 - 30 watts output for a mobile and 30 - 60 watts output for a base station. Range is usually reliable to 30 miles or more for base to mobile, and 30-50 miles between base stations. Skip appears on 6 meters occasionally, but not like on the lower frequencies.

Since the equipment used operates only on crystal - control operation as mentioned, channels were established many years ago with the idea that activity might grow to a nationwide operation. It did. On the commercial low-band, 30-50 mc, channel separation was 40 kc before a recent change in FCC rules.

This change made the gear available to amateurs since it was impractical to modify most of it for narrower channel spacing. The fact that transistor gear was available attracted the commercial users to the newer equipment. The 40 kc spacing carried over to the 6 meter band. 52.525 mc became the first and remained the national calling frequency. Since this was an odd frequency, the channels started at 52.60 mc and ended at 53.96 mc. 52.60 mc is the national RTTY FM channel and 52.64 mc is the secondary talk channel. On the high-band, 152-172 mc, commercial channels were spaced every 60 kc. Similar practice brought this spacing to 2 meters, starting at 146.22 mc and continuing to 147.84 mc. 146.94 mc is the main calling channel and 146.7 mc is the national RTTY FM channel. Secondary channels vary widely in many parts of the country. On the commercial UHF band, the spacing was 50 and 100 kc. This carried over to the 3/4 meter band. Most of the 6 meter activity is at the lower channels since it is closer to where the radios were originally tuned in commercial service. Wideband FM is only permitted above 52.0 mc. On 2 meters, the high end was chosen for similar reasons, also considering Novice and Technician privileges. The 450 mc band also bears the same reasoning. Only in large areas such as Chicago or New York area are the channels covered from one end of the band to the other. In most areas, only 146.94 mc and 52.525 mc are found to be the centers of activity. National repeater frequencies were also established: 6 meters - 52.80 mc input, 52.72 mc output; 2 meters - 146.34 mc input, 146.76 output. In some areas, however, repeater outputs are found on the main channels.

FM equipment is available from several commercial communications equipment dealers at reasonable prices averaging $40 to $70. Compared to the new price of between $200 and $600, you couldn't beat the deal for any other type of gear. Sometimes the equipment can be obtained directly from the commercial user, such as police, fire, taxi, etc., in quantities for $10 to $25 per unit. Motorola, GE, and RCA are among the most popular with other makes sometimes available. Conversion books and schematics are available from several sources.

Conversion for ham use requires purchasing commercial standard crystals and retuning the various stages. Some 6 meter gear requires other modification, and some 2 meter gear requires padding the front end of the receiver. UHF equipment generally needs no modification except crystals and retuning.

Antennas for 6 meters are usually 4 1/2 feet long, in the form of whips or groundplanes. Sometimes 5/8 wavelength gain antennas are used. The 3 dB gain is the most popular since the prices are reasonable and the effective radiated power is doubled. Two meter antennas are about 18 inches long in the form of whips, groundplanes, and coax verticals. Gain antennas are very popular on this band.

Repeater stations have become quite popular recently and are springing up all around the country. These automatic relay stations receive on one frequency and retransmit on another frequency at the same time. This gives mobile stations the advantage of higher power and higher antennas. Mobile to mobile operation is extended many times through a repeater. Some repeaters repeat 6 to 2 meters and 2 to 6 meters, and some repeat within the same band. The latter is the most popular. It is possible to travel across the country and work through one repeater in one area and work through another repeater as you approach that area. That is why standard repeater frequencies are helpful. Hams interested in repeater operation should form or join a radio club for that purpose. Individual repeaters, as proven in the past, cannot operate without many problems.

The Main Line VHF Association in the Philadelphia area has recently installed a repeater on the 2 meter band, repeating 146.34 mc to 146.94 mc. Since an FM receiver responds only to FM signals, AM stations are not compatible with the repeater. The repeater mainly consists of a Motorola Sensicon receiver on 146.34 mc and Motorola Research 30 watt transmitter on 146.94 mc. A carrier-operated relay (COR) keys the transmitter whenever an FM signal appears at the receiver. A timer prevents the transmitter from locking up or remaining on for more than 3 minutes. A code wheel identifies the repeater at least every 3 minutes when in use by sending "RPT DE WA3BKO." A recorder records all transmissions going through the repeater for logging purposes. A tone receiver on the 146.34 mc receiver allows any user to shut the repeater off, should anything go wrong. The FCC requires a second and primary control on another frequency above 220 mc. An RCA 450 mc receiver strip is connected to another tone receiver which can turn the repeater on or off. Eleven stations are listed on the two-page license as control stations permitted to use the 449 mc control. One of these stations must monitor the repeater at all times to ensure proper operation. Future ruling by the FCC to change this unnecessary burden is being sought by thousands of FM repeater users. This hampers the usefulness of having the repeater available for emergency use, 24 hours a day.

LA's
FM Welcome Mat

as observed by Jan O'Brien K6HHD

How it feels to be a stranger in the FM capital of the world

It all started on a Tuesday afternoon about 4:30, the last week in August. We were on the down stretch into the San Fernando Valley, headed for Anaheim and Disneyland. Since leaving Sacramento earlier in the day, we had heard only one station on two meters FM; that was in Fresno on .94 (he happened to be home sick that day).

Now as we made our way through the mountains we began to hear snatches of conversation on .76 and .94, but copy was still in and out. Jay (W6GDO) keyed the .34 transmitter -- we still haven't decided if it was coincidental or if he caused the next barrage -- it was bits and pieces of conversation, but the phrase "unauthorized keying of private repeaters" came through loud and clear. Then signals started to hold in; we were nearly through the mountains now. But what we heard was frankly quite unbelievable. Jay again keyed .34, curious to see what would happen, and each time he merely keyed the transmitter we would hear "CAPTURE, CAPTURE." Somebody was having a great time blocking "unauthorized transmissions" through the .34-.94 repeater.

As we proceeded down Interstate 5 toward our destination, the activity picked up; it was that time of day when most people are headed home from the daily grind. We mostly listened. A couple of times when .76 was quiet, Jay's announcements of "W6GDO mobile six, anyone around?" were met with deafening silence, although there were obviously people around. We had much better luck on .94. One or two people actually acknowledged we were there and were even quite friendly. Most attitudes, however, were noticeably cool.

Later in the evening a most miraculous thing happened: Jay's call was recognized and we managed to establish contact with a friend. This friend was a person known to others in the area and as soon as it was clear that he knew Jay, the tide suddenly turned and people started talking to us! After that we had very little difficulty in establishing contacts as we mobiled through Los Angeles.

This episode may sound exaggerated ...I wish I could tell you that it is, but I cannot. These are the observations of visitors to the so-called FM capital. We have been told that we just happened to hit it at a bad time and it really isn't always that way. I truly hope that is so. Never before have we encountered such a closed fraternity among amateur radio operators.

I hope that it was due to something other than the way it appeared to us--perhaps end-of-summer blues or whatever, who knows--but it sure leaves a bad taste, and an inclination to warn others headed that way to beware or even forget attempting to communicate on amateur FM at all in the Los Angeles area.

EDITOR'S NOTE:

Seven-six in Los Angeles is exactly as described in "Chronicles of Seven-Six." But it's not all bad: The FM channel as an outlet for their crudities keeps them off the street.

THE Fine Art OF RECEIVER ALIGNMENT

If it's a sick GE you can HEAL IT ...if you do it RIGHT!

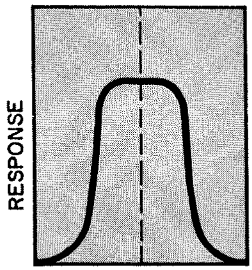
Donald L. Milbury
16421 East Burtree Street
Valinda, California 91744

Aligning an FM receiver is a great deal more complex than getting the oscillator on frequency and peaking the various stages to an on-channel signal. Yet this is precisely what many amateurs -- and, unfortunately, many commercial service technicians -- actually do.

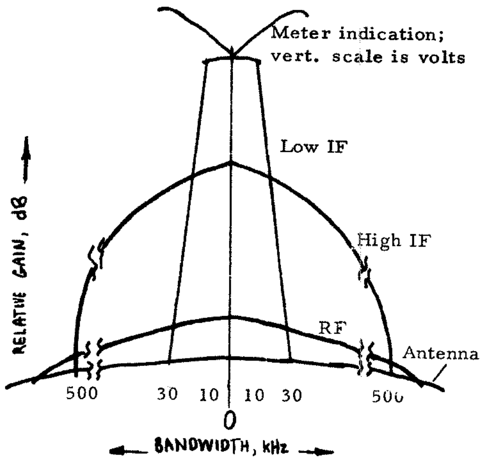
When an FM receiver is tuned up using this procedure -- we'll call it the "tweak" method -- the technician is making a number of raw assumptions which may or may not be valid. First, he's assuming that the low i-f's and the discriminator are correctly aligned to their respective frequencies. Second, he's assuming that the sealed bandpass filter is properly tuned to its design frequency. The latter can generally be a safe assumption, even though it is not uncommon for these filters to change or shift a bit in frequency as a result of excessive vibration or shock or other abuse.

What happens when the tweak method is used for tuneup? It is, admittedly, a quick-and-dirty process by which a receiver can be made to operate. The brutal truth, however, is that the primary receiver qualities of selectivity, sensitivity, and stability are interrelated. The tweak method is an optimum compromise of the three based on the initial setting of the second converter and the low i-f circuits.

Selectivity (and gain, of course) is broadly determined by the number and state of the tuned circuits in the receiver chain, from the antenna, itself, to the discriminator. Each frequency-sensitive element adds somewhat to the selectivity and affords at least some degree of gain. An important point is that each of these elements must be centered on the frequency of operation. To assure proper tuneup of a receiver, the selective circuits (rf, high i-f, and low i-f) must be aligned so that desired signals can pass through the center of each selectivity curve. Equally important, the configurations of the various curves must conform to their design shapes. The proper combination of these shapes will yield an overall response curve that looks like this:



The sketch below shows how the ideal composite selectivity curve is obtained. In the



(Continued next page)

sketch, the center line represents an incoming on-channel signal. The flowing V at the top is the discriminator slot. The low i-f passband is the steep-sided peak with the broad plateau across the operating frequency. The broader curve with the sharper arc in the frequency range of interest is the selectivity curve of the high i-f. The rf amplifier and antenna are shown as low broad arcs. The curves are plotted as bandwidth (horizontal) versus gain (vertical).

At this point, it would be wise to say that i-f alignment usually isn't necessary unless:

- A component has been replaced in an i-f filter;
- The circuits have been subjected to tweaking without proper test equipment.

Unfortunately, the latter is more usually the case with amateur FM equipment. No amateur should ever try to tune up an FM receiver unless he has a schematic diagram of his equipment so he will know where NOT to tweak. Even in commercial service, the most common source of i-f misalignment is unnecessary tweaking on the part of an incompetent or inexperienced serviceman.

Realignment is usually required if the i-f passbands are not centered on the incoming signal of interest, if the passbands are asymmetrical (not the same on both skirts), or if the bandpass is too narrow. The presence of high impulse noise on weak signals is one symptom of an off-frequency passband. This is due to the fact that the ringing frequency of the filters is not coinciding with the discriminator center frequency. An even more apparent indication of this type of misalignment is "chopping out" of signals or undue distortion of signals which are being deviated at a near-maximum level. The chopping-out effect is the sudden vanishing of a strong signal with each voice peak.

Off-frequency filters also usually produce a high discriminator "idle" reading. If an inexperienced tweaker has been at work, though, he has probably already compensated for this condition by changing the discriminator to get a zero indication -- and thereby throwing the receiver even further out of alignment.

So, what do you do when you're certain your receiver needs alignment? The first thing is to be <u>doubly</u> sure. If you've no doubts, then get a signal generator and start warming up the receiver. If your receiver is equipped with AFC, disable it. Set up the signal generator to produce a stable signal on the operating frequency, and keep it well below the limiter saturation point.

For units which use double-coil i-f transformers (such as GE and DuMont), the resistor loading method is perhaps the most effective means for obtaining a good receiver alignment. This procedure is a bit complicated but not too difficult. Remember to keep the input signal dead on frequency and below saturation. Tune each stage to the exact peak as described below, then repeat the entire sequence.

The response of an i-f transformer changes with the loaded Q of its resonant circuits. By loading one of the coils with a resistor, its response is lowered to a nonresonant point. The undercoupled coil can then be tuned for maximum deflection of a meter on the first limiter. If the coil is coupled to other coils immediately adjacent to it, both adjacent coils must be similarly loaded.

The value of the resistor must be low enough to produce a sharp peak during tuning, but not so low as to make precise tuning difficult. (The lower the resistance, the broader the peak.) Keep the resistor leads short enough to prevent the introduction of stray capacitance into the circuit; and peak one coil at a time.

There are other methods for alignment, but the above procedure is probably the most satisfactory for the amateur, where the preponderance of such test equipment items as oscilloscopes and sawtooth generators are the exception rather than the rule.

If the discriminator needs adjustment and you are set up with a crystal-controlled i-f generator of some kind, you're in business again. (The generator must be capable of holding a test signal to within 100 Hz of the low i-f frequency.) The procedure described here is not applicable to all discriminator circuits, but is ideal for receivers using Foster-Seeley discriminators (GE and DuMont again).

First, monitor the discriminator current with the proper test meter (0-50 uA for DuMont, and 0-2.5V for GE). If possible, disable the second oscillator to prevent receiver "garbage" from causing erroneous readings. Apply a low i-f signal to the first-limiter input and adjust the signal level to saturate the second limiter. Then tune the secondary of the discriminator transformer for a near-zero meter reading, and repeak the primary.

Move the test signal 10 kHz above the low i-f and note the reading; then move it the exact same amount below the i-f. If the readings don't deflect the meter the same each side of zero, adjust the primary until equalization occurs. You'll have to rezero the secondary

(Continued on page 47)

SPECIAL FEATURE

THE TRANSISTORIZED POWER SUPPLY

If someone were to ask you to name the chief advantage of a transistor pack over a vibrator power supply for mobile use, how would you answer? If you were to cite efficiency as a prime advantage, you'd be wrong! The little-known fact is, a transistor supply is typically no more efficient than a well designed vibrator supply of the same overall rating.

The conversion efficiencies of both standard supply types are generally in the vicinity of 70%. Conversion efficiency percentages in the high nineties can be attained with transistors, of course, but such supplies are not generally available because of their inherent extra cost. They require employment of more than one transformer in the switching circuit.

The transistor supply is still superior, however, for a number of very sound reasons. To name but a few: simplicity of design, miniaturization of circuit, longevity of components, availability and economy of transformers, inherent circuit protection, and enhanced reliability under the most adverse of environmental conditions.

Design Simplicity

The average transistor power supply (referred to industrially and commercially as a dc-to-dc converter) employs a very simple switching circuit which comprises nothing more than two inexpensive transistors, a couple of resistors, and a special transformer with an added feedback winding.

Since there are no moving parts, very high switching speeds can be attained; the higher the speed, the less filtering is required. Switching frequencies of 5 kHz are by no means uncommon. Motorola's MOTRAC series of commercial FM units uses power supplies with a 5 kHz switching frequency.

Miniaturization

The components of a medium-power dc-to-dc converter are usually small enough to allow mounting on an already existing chassis. (See "Duplexing Your 450 MHz Mobile," by Jim Mann, this issue.) This is a particularly attractive feature when the mobile equipment is a trunk-mounting unit. There is usually ample space on the power supply chassis of a trunk-mount rig to accommodate at least an add-on receiver supply, even without modification of the unit's built-in vibrator power source. The existing chassis normally provides an excellent means for dissipating the excess heat generated by the power transistors because of the large surface mass. If a special chassis is required, it can be made quite small. It must be borne in mind, however, that power transistors <u>must</u> have adequate heat protection. Thus, a small chassis usually means that an external heatsink must be employed.

Miniaturization is also enhanced by the increased switching speed. As the ac supply frequency increases, the transformer size requirements diminish. At a switching frequency of 5 kHz, the size of a medium- to high-power transformer is impressively tiny indeed. A transformer capable of delivering 200 watts will fit nicely in the palm of your hand and will easily weigh less than a pound!

Since filtering requirements are also reduced, capacitors on the secondary can be made smaller. In most cases, filter chokes and other reactor devices can be dispensed with entirely.

Longevity

The prime disadvantage of a vibrator as a switching source is that it is a mechanical device. A vibrator reed may operate without significant degradation for several million cycles; eventually, invariably, inevitably, however --- it fails. The constant make/break under load causes unavoidable pitting and arcing, and the contacts simply wear out.

The transistor is infinitely superior in this respect: it has no moving parts. Transistors cause switching by alternate electrical conduction, so they are, in theory, able to last indefinitely.

Not being magic, of course, transistors are subject to failure just like any other circuit component, but failure of a transistor in a well designed circuit is almost always indicative of a serious problem elsewhere.

Availability/Economy of Transformers

There is less mass to a transistor transformer than to a comparable vibrator transformer. The reduction in core mass is made possible by the increased operating frequency. It goes without saying that a ten-ounce transformer will be less costly than a two-pound equivalent. Mass production of high-frequency transformers has resulted in lower costs; and increased competition among the manufacturers is likely to keep them down for a long time to come.

Circuit Protection

A direct short circuit in an unfused vibrator supply would very likely cause irreparable damage to the vibrator and perhaps the transformer. The transistor supply, on the other hand, has the unique capability of "sensing" a short circuit. When a dead short occurs in the secondary of a transistor power supply, the semiconductors in the primary simply cease to oscillate; and without oscillation there is no switching. When the short is removed, normal oscillation resumes.

It is true, of course, that transistors can be destroyed under some circuit conditions. A partial short, for instance, which causes excessively high current drains for short periods, can cause junction breakthrough on the transistor. If such a problem is suspected, however, transistor destruction can frequently be averted by carefully studying the transistors during operation. With medium-power converters, indications of abnormal operation are: (1) The heatsink temperature rises to the point where it cannot be touched for more than a few seconds at a time, and (2) the "singing" frequency of the transformer shifts or decreases appreciably with no external changes in input voltage or output load.

Reliability

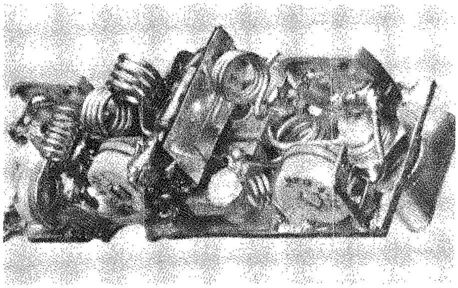
Much of the preceding discussion has included facts which bear out the inherent reliability advantage of a transistor supply. But there is yet another area of reliability which should not be overlooked: the ability of transistors to withstand virtually every climatic and vibration environment likely to be encountered in mobile service.

Winter and summer are without meaning to the sturdy transistor, which requires only an adequate sink to keep its own junction temperature to a comfortable level. Because of today's advanced technology, the transistor is likewise impervious to physical shock. An impact that would render a vibrator totally useless wouldn't be likely to even cause the average transistor to so much as skip a beat.

Application

The numerous advantages notwithstanding, a transistor supply doesn't usually offer enough of an edge to warrant modification of an existing piece of equipment to incorporate it in the unit. There are occasions, however, where addition of a transistor supply is the only logical solution to an existing problem. Jim Mann's article in this issue is a case in point.

ADD TWO WATTS TO YOUR H/T

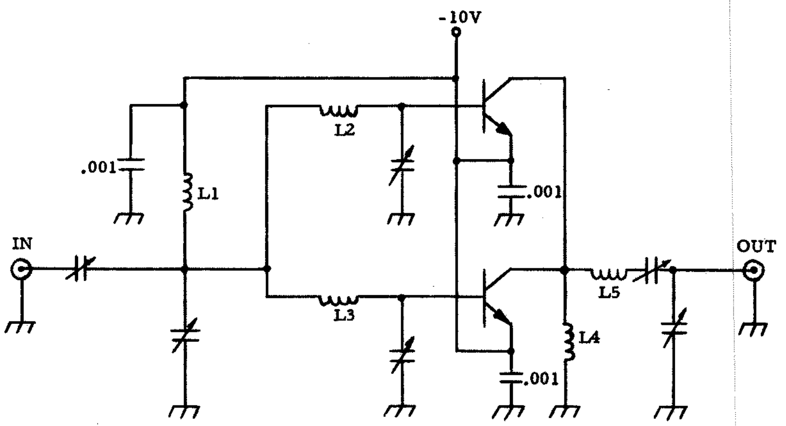


by Dan Harger

The add-on amplifier shown here is capable of two watts output with a battery input of 10V. This is a 9 dB increase over the 250 mW of the barefoot transmitter described in the December issue of the FM Bulletin. When the battery voltage drops a volt or so, the final output may go down to about 1.5 watts.

The transistors are RCA 40405, silicon epitaxial NPN's, each of which is capable of delivering 700 mW at frequencies as high as 500 MHz. These transistors, by the way, are exceptionally good as multipliers -- so good, in fact, that I intend to use them almost exclusively for multiplication and buffering on future transmitters. The RCA 40405 is in the right price range, too. The $1.25 price tag keeps the cost of transistors for this final to only $2.50.

The transistors are manufactured in standard TO52 cases and are only about an eighth of an inch in diameter. Of course, they must be mounted to an appropriate heatsink for protection and adequate heat dissipation. A good makeshift heatsink is a small rectangular sheet of 3/16-inch aluminum panel (0.5 x 1.25 inches).



Notes:
All coils use tinned bare copper wire
All variable capacitors are 8 - 60 pF, type not critical.

L1 - 7 turns #20, 1/8" I.D., 1/2" long
L2, L3 - 4 turns #16, 1/4" I.D., 1/4" long
L4 - 3 turns #20, 1/8" I.D., 1/8" long
L5 - 3 turns #16. 1/4" I.D., 1/4" long

Four holes are drilled in the heatsink: two #14 drill-size holes for the transistors (force-fit) and two holes for passing 6-32 nylon mounting bolts. Two #14 holes should be placed in the center of the heatsink, and spaced about equidistant from each other and the ends of the heatsink. The mounting holes are drilled just close enough to the transistor holes so that the head of the mounting screw will hold the flange of the transistor in its hole without touching the leads. The collector and the case of the transistor are common to each other, so if the screw happens to be metal it won't matter if it is close enough to the collector lead to actually touch.

I was able to obtain some nylon 6-32 bolts and some 1/16-inch washers to space the block off the chassis. I would strongly advise against using thin mica as an insulator between the block and the chassis, as the capacitance added to the collectors might make it difficult or impossible to tune without additional modifications.

The final itself is mounted on a 3.5 x 1.25-inch copper-clad board. It fits nicely beside the batteries and leaves a reserve of space in the box.

The six variable capacitors in the final circuit allows tuning of any driver and any antenna to the final; also, it provides a means for balancing the two transistors for optimum output. (Tuned slugs could be used for this purpose if extra miniaturization is a requirement, but the variable capacitors proved the easiest way out for me.)

A shield is mounted between the input components and the output components (including the heatsink). It was possible to obtain more output with the shield than without; this was apparently due to some out-of-phase feedback without the shield. Overall stability -- with the shield -- is extremely good.

Construction is not really critical at all. The important thing to remember is to keep the leads short (ordinary good engineering practice) and the amplifier in a "straight line" configuration.

Checkout

When the amplifier is completed, apply 250 mW or so of drive without any voltage, using an indicating device of some kind on the output. You should be able to see drive "leakthrough" -- a phenomenon common to rf transistors. Tune all stages for maximum output (without voltage, remember) to get the final "in the ballpark." Following this procedure, apply approximately 6V and tune for maximum output again. You should be able to produce around 700 mW. Then, with 10V on the final and 250 mW of drive, the output should increase to somewhere near a full two watts. For my own tests, I used a Bird Thruline wattmeter with a 3W plug to measure output power.

Results

The efficiency of the amplifier is quite surprising! With 2W of power from the battery (0.2A at 10V), the rf output is negligible less than 2W. The total battery drain from the entire 250 mW transmitter and 2W final is 300 mA at 10V. To verify these figures, I have used two other wattmeters; all readings tally closely! Incidentally, I blew out the #49 pilot lamp used in Motorola's 250 mW load, so I installed a #47 in its place. The resultant vswr is not as impressive, but its life is greater -- and it gives a good indication that the final is still operating. Its color is a dim orange-yellow with a 1.5W signal; the color turns more yellow as power increases.

Now for the striking results! From inside a metal structure, I could not be heard when I transmitted on the 250 mW unit. The increase to 2W, however, brought the signal up to a quieting level. Attesting to the overall communications capability is this fact: If a signal can be heard full-quieting on the Roll-Your-Own receiver, it can be worked with the 2W final. This was not always true with the straight-through 250 mW unit; the receiver has a tendency to outperform the basic transmitter.

A plus feature of the final is that it is compatible with any transmitter in the quarter-watt class. The only difficulty in such an application is that of providing a 10V power source and a means for antenna changeover. Individual ingenuity should solve both these problems with ease, however.

One last note: The amplifier oscillated when I had the wrong coils inserted. This can be avoided by applying drive without voltage (as mentioned earlier) and adjusting the variable capacitors to see if they all tune effectively. At one time, the aluminum block got too hot to touch (when the final had the wrong coils), and was oscillating with a current drain of 400 mA. Fortunately, my heatsink performed well, and the transistors lived through the ordeal. I eventually did blow the transistors, however, by shorting some of the transistor leads to ground with no drive applied. Foolishly, I was adjusting the final without cutting off the supply voltage. The proper power supply with overload protection would have prevented this.

One learns to anticipate the unexpected. A famous man once said, "Moments of despair are the lot of men with vision." Likewise, unforeseen incidents are the lot of the experimenter. But don't let them dampen your spirit. Keep trying. The results will be most rewarding!

In closing, I wish to thank all the people who have assisted me in getting this project completed: Harry Taylor (WA8TCD) for his photography, and Wedemeyer and Fulton for their successful aggressiveness in obtaining parts for the handie-talkie.

...... W8BCI

DIALS & SWITCHES and things like that

by Don Milbury

Although it is true there is but little to say about a simple telephone dial, it is an extremely important part of most remote control systems, and virtually indispensable with remotely operated telephones. (Remember, it may be a telephone dial to you, but to the repeater owner, it's a digital formatter.) So, what is to be said should be said, and it seems appropriate to say it first.

A dial is a circuit interrupter (and NOT a contactor as many believe). When the finger plate is released after being turned from its normal position, it interrupts the line circuit in quick succession a number of times corresponding to the digit dialed.

Thus, if a dial is to be used in a circuit that requires a series of "makes" for pulsing, the dial will have to be used to drive a normally closed relay by holding it "off-normal" until pulsed.

Dials typically have several sets of contacts that make while the dial is in motion and break as it comes to rest. These contacts are usually employed for keying the push-to-talk of the transmitter in remote applications. This function is hardly important enough to be mentioned, except for the fact that wiring of the wrong contacts could result in automatic dropping of the final pulse each time the dial is used. Just remember to use the set of contacts that stay in contact until after the pulse sequence has been transmitted.

In most amateur radio control schemes, the dial at the control point pulses a tone encoder so that a series of beeps is transmitted. (The system cited in reference 1 is an example.) The beeps are decoded at the remotely situated receiver to yield a series of relay closures. (See also article cited in reference 2.) The relay closures are typically used to drive a rotary stepper switch of one kind or another.

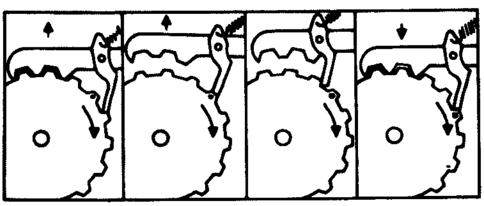


FIGURE 1

And this brings us to the next point of discussion. The rotary stepper switch is the basis of much of today's automatic telephone switching. The switch is of the ratchet type, consisting essentially of one or more wiping springs fixed on a shaft which is moved by a pawl-and-ratchet mechanism (figure 1). This mechanism is actuated by an electromagnet, which responds to momentary surges of current from the pulsed decoder. At each pulse, the pawl engages the ratchet, moving the wipers one step forward over a bank of contacts. Figure 2 is a diagram of a spring-driven rotary stepper switch.

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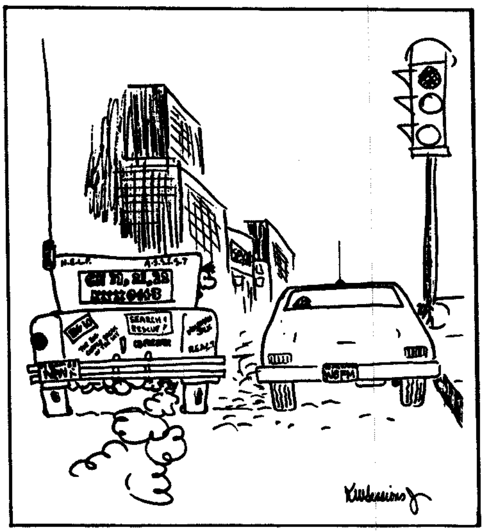

WHAT CHANNEL YOU ON, BROTHER?

DIALS, SWITCHES, ETC.
(Continued from preceding page)

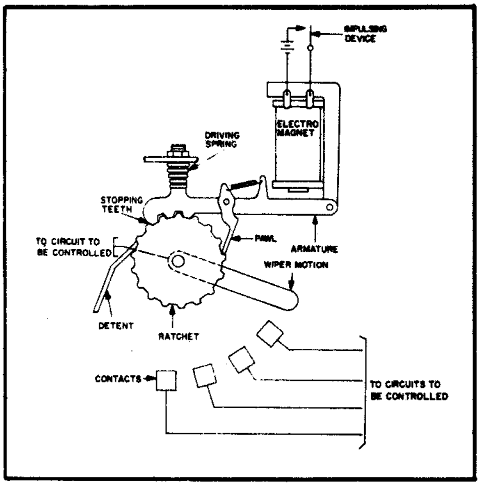

FIGURE 2

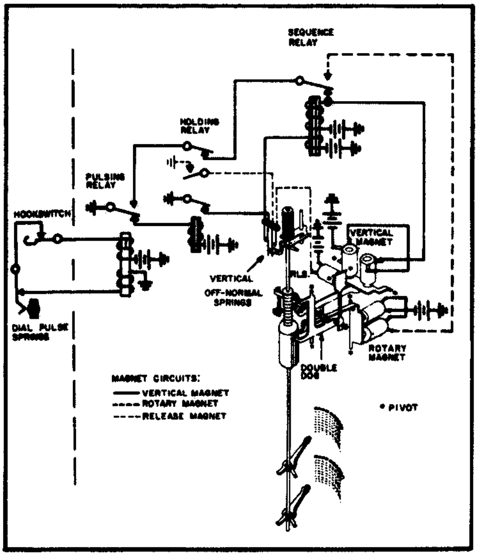

FIGURE 3

There are two types of driving mechanisms associated with rotary steppers: indirect (spring-driven) and direct.

- Spring-Driven Stepper. Operation of the stepping magnet moves the driving pawl out of the ratchet and drops it over the succeeding tooth, but does not move the wiper assembly; when the magnet is deenergized, the wiper is driven forward by a spring. The switching operation is not complete until the magnet circuit is opened.

- Direct-Driven Stepper. Operation of the stepping magnet moves the pawl into the ratchet and moves the wiper assembly; a detent holds the wipers in place when the stepping magnet is deenergized and the driving pawl is returned to normal by a spring. The switching operation is complete the moment the magnet operates.

Probably the most universally functional of the steppers is the Strowger (after inventor A. B. Strowger). In commercial telephone service, the Strowger type of switching device (figure 3) is the principal mechanism used in establishing automatic connections. This switch selects one out of 100 possible contacts. A contact bank consists of ten levels with ten contact points at each level. The wiper moves in two axes by being driven vertically on the first pulsing sequence, then horizontally on the next. The first digital sequence drives the wiper to the proper deck; the second selects the proper contact of that deck.

How does the Strowger know when to step up and when to step across? The partial schematic of figure 3 shows the typical use of fast and slow relays to channel dial pulses to the proper stepping magnet. In telephone use, when the caller lifts his handset, the hookswitch closes the line circuit and operates the pulsing relay. The pulsing relay operates the holding relay, which in turn operates the sequence relay. In amateur use, the hookswitch function is generally accomplished by the contacts of a carrier-operated relay.

REFERENCES

1. Sessions, K. W. K6MVH, "Telephone Operation by Remote Control," FM Bulletin, Dec 1967

2. Coltin, Lee K6VBT, "Stable Tone Units for Remote Radio Control," FM Bulletin, Jan 1968

Stable Tone Units for Remote Radio Control

by Lee Coltin K6VBT

The hottest fad in the west right now is the design, construction, and operation of remotely controlled FM stations. FM'ers gobble up 450 MHz mobiles and base stations as quickly as they appear on the market. And such commercial control equipment as encoders, decoders, and Strowger switches are becoming increasingly more scarce.

Fortunately, however, the lack of availability of components provides the necessary impetus for design initiative. And the result is a variety of ingeniously developed circuits for devices most amateurs wouldn't even dream of building under normal circumstances. The trend serves to prove again that necessity is indeed the mother of invention.

Two cases in point are the tone encoder and decoder circuits shown in figures 1 and 2. Bob Mueller (K6ASK) needed a tone encoder for a remote system a small group of us are building. We tried the local supply houses and made inquiries on the popular FM channels to no avail. It finally became obvious that if we were ever to get a decoder, one of us would have to build it. So Bob did just that.

Bob noted that there was no great shortage of frequency-to-dc converter circuits, many of which could be adapted to our application. But, since he was doing the design work form the ground up, so to speak, he decided to set certain operating standards as criteria:

- The selectivity would have to be sharp enough to preclude the possibility of off-frequency signals triggering the system, yet broad enough to allow decoding under a variety of signal coditions.
- The stability must be tight under even the most extreme of temperatures to assure positive control at all times.
- The reliability must be assured to the extent that the unit would provide continuous, repeatable, trouble-free service.

Bob felt that semiconductors would be the surest way to provide all these features. So he went to work. He experimented with one circuit after another, continuously changing, modifying, improving. After what seemed like endless hours of trial and error, his breadboard began to perform the way he wanted it to.

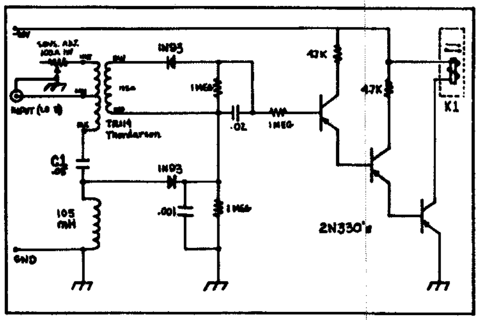

FIGURE 1. SINGLE-TONE DECODER

In line with space-age thinking (he's employed as a solar power technician at JPL), Bob subjected his model to environmental tests consisting of humidity (water from an atomizer) and temperature-shock (oven and refrigerator) checks.

When used in conjunction with the encoder circuit of figure 2, the decoder fulfilled all Bob's operational expectations. The best part of all, Bob says, is the cost. It runs between 10 and 12 dollars for all the nonjunkbox parts.

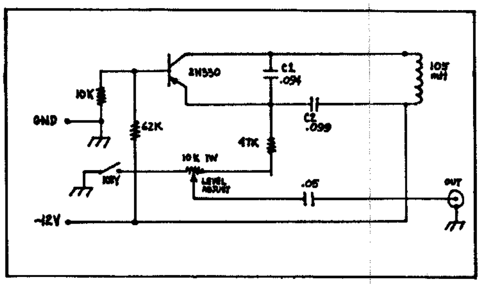

FIGURE 2. SINGLE-TONE ENCODER

SPECIAL NOTES

In both schematics, all transistors are 2N330's.

The relay shown in figure 1 (K1) is a standard sensitive plate relay with a coil resistance of 8 to 10 K ohms.

The frequency is set for 2300 Hz for both units; it may be varied on the decoder by changing the value of C1. On the encoder the tone frequency may be shifted by changing the values of C1 and C2.

......K6VBT

GE & MOTOROLA UNITS FOR 450 MHz AMATEUR USE

A salty FM'er doesn't need to be told that GE and Motorola are THE standards when it comes to amateur FM equipment. And the quality of the two manufacturers' units has always been comparable -- for frequencies up to 450 MHz. However, for FM units operating in the commercial band of 450-470 MHz, the picture begins to change. There were a number of design deficiencies in the early and middle 1950's that are now the legacy of amateurs converting them for use in the 420-450 MHz amateur region.

Oddly, GE's chief problem is its MC-306 receiver; Motorola's problem is the T44 (A7 version) transmitter. The GE is curable; the Motorola is not. In the Motorola unit, the final plate tank circuit is difficult to keep in resonance because of the poor design of the driver and tuning mechanisms. Both the final and driver are built into special cavity sections with removable covers. Tuning is accomplished by varying the capacitance from the cavity cover to the plate of the tube (2C39). Since the cover must be removed periodically to change tubes, in time the cover-to-case fit becomes sloppy; the holes for the cover hold-down screws get widened and the threads strip. Inevitably, the cover-to-case resistance gets erratic and the internal capacitance begins to shift, causing the driver and the final to stray from their positions of resonance.

An even more serious problem is the locking system. The tunable screw-type capacitor is secured by tightening a lever that binds the capacitor shaft. As the shaft is secured, it is forced to move slightly from its resonant position. Plate current goes up and output power drops just enough to shorten tube life and impair efficiency of the transmitter output stages.

GE's answer to the T44 was the MC-306, known by amateurs across the country as the "Preprog" (for Pre-Progress Line). The GE Preprog transmitter has never been plagued with the T44's problems because some bright engineer designed the capacitance tuning into the sides of the cavities, rather than into the covers. And knurled knobs were incorporated for easy hand-adjusting. But the design engineers apparently were so engrossed in the transmitter that they were blinded to the problems which were developing in the receiver.

The Preprog 450 MHz receiver is typically very broad and highly unstable. The oscillator is characteristically low in output -- it peaks about 0.75 volt when measured at the test point (J306) with a dc voltmeter. Temperature extremes turn the oscillator into a vagabond; it may wander as much as 150 kHz between dawn and midday.

The built-in AFC allows the oscillator to be pulled by any signal within 60 kHz of its design frequency. But the drifting problem is often so severe that even the AFC doesn't help.

These problems are annoying and frustrating when the receiver is being used in repeater service. Transmitters must be tweaked and crystals "bent" to chase the receiver across the spectrum. But in a mobile application, the situation can get downright intolerable.

Since the Preprog is the most common single piece of equipment in use by California amateurs for the 420-450 MHz band, a number of amateurs have made changes to improve the receiver's performance. These changes vary in complexity, from reducing the AFC's pull-in range with diodes to completely redesigning the oscillator circuit.

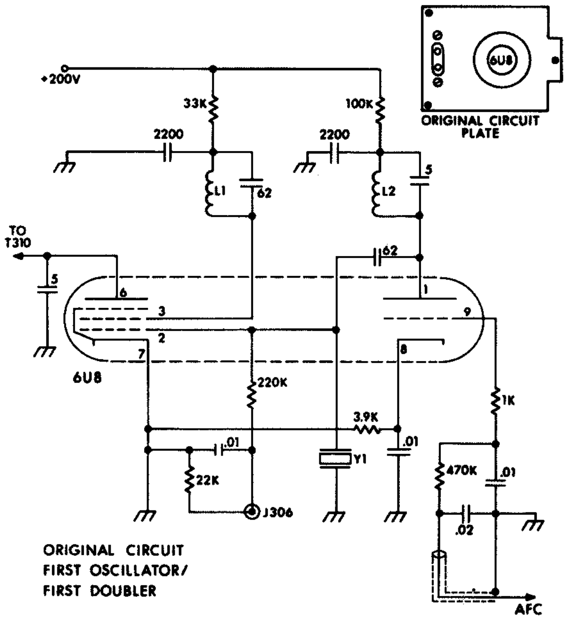

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Figure 1

Original Oscillator Circuit

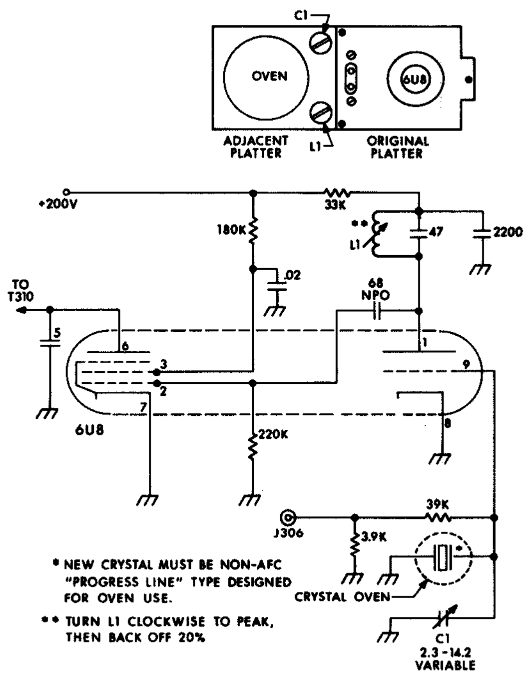


Figure 2

Modified Oscillator Circuit

73628143

The AFC pull-in range is reduced in order to keep the receiver from responding to adjacent-frequency signals. This is done by simply cross-connecting a pair of diodes so the anode of the first one attaches to the cathode of the second, and the cathode of the first attaches to the anode of the other. This diode pack is then connected from the AFC bus to ground.

Probably one of the most effective circuit improvements is the oscillator modification designed by James J. Lev (K6DGX) of Long Beach, California. His modified Preprog oscillator circuit is compatible with a design by which several oscillators may be used with the single GE multiplier for converting the Preprog to a two- or three-frequency system. But the most important feature of his oscillator design is its stability. The circuit has, in fact, become such an adopted conversion around Los Angeles that a Preprog sale will -- as likely as not -- hinge on whether or not the oscillator has been modified per Jim's design.

The K6DGX modification involves total removal of the oscillator chassis plate from the Preprog receiver and building a new oscillator which will use a Progress Line crystal AND OVEN. The result is a receiver stability of 0.0005%.

For the convenience of those who want to incorporate the DGX oscillator into their own GE Preprog units, the circuit is included. Figure 1 shows the configuration of the original oscillator as it comes from the factory. Figure 2 is the modification. As can be seen, the new oscillator is actually somewhat simpler then the original.

The thing to remember when modifying your Preprog oscillator circuit is to reorder the receiver crystal. The old one will oscillate in the new circuit, but it will be around 150 kHz low in frequency. Also, it will not have the same 0.0005% frequency stability characteristics of the new one. When ordering the new crystal, specify the following information:

- Receive frequency
- Crystal frequency ($f_{xtal} = \frac{f_{rcvr} - 48}{36}$)
- GE "Progress Line" oscillator circuit
- 85°C crystal oven, F605, 4ER26
- Non-AFC use

There will be no room on the original circuit plate for the crystal oven. But there is an abundance of plates on the Pre-Prog receiver, so the oven can be easily mounted onto the adjacent plate. Chassis holes through which the original tuning coils were mounted can be used for the new variable capacitor and slug-tuned coil. The tuning range of the variable capacitor is not critical, and can be anywhere in the general region shown in figure 2.

There really isn't much that can be done about Motorola's T44 transmitter problems. Corrective action would involve a major mechanical redesign. (Perhaps I'm underestimating the ability of FM'ers. In any case, the world awaits a satisfactory solution to Motorola's T44 design blunder.) Most owners of the T44 simply grit their teeth and live with the problems. They probably feel that the design discrepancies of the transmitter are more than compensated for by the excellent stability, selectivity, and sensitivity of the T44 receiver. And they may well be right.

The Fine Art of Receiver Alignment

and adjust the primary several times to make certain the discriminator is properly aligned.

Motorola receivers are somewhat different from GE, and call for a variance in the tuneup procedure. In future issues, alignment procedures for other receiver circuits will be described.

W6YAN

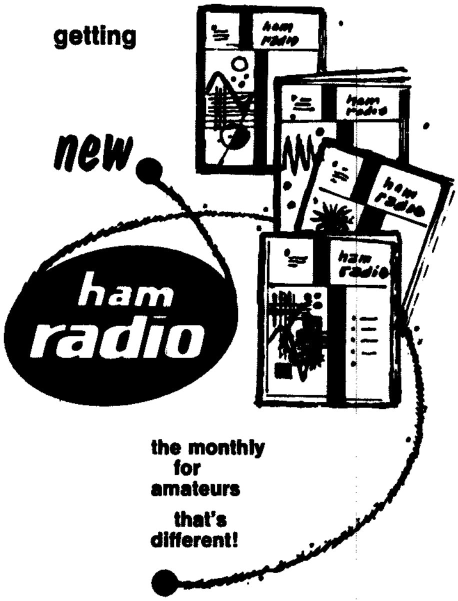
Duplexing Your 450 MHz Mobile

an output waveform that is unbalanced to such an extent that the audiofrequency tone generated by the transformer becomes overcoupled from the transformer to the adjacent circuitry. The result of this is an irrepressible, loud, and irritating whine. Unmatched transistors also can result in overheating during one of the operational half-cycles. If the heatsink is incapable of coping with the excess, the added heat causes an exponential temperature rise similar to thermal runaway -and the transistor is soon destroyed. A sound approach would be to use any transistor that will operate without overheating, but keep both transistors the same.

Modification of Unit

As noted previously, incorporation of a separate receiver supply involves nothing more than disconnecting one lead and reconnecting it elsewhere. This is true for the Pre-Prog as well as the T44. Then, in the event of T-supply failure, the unit can be returned to stock operation in no longer than it takes to resolder a lead.

The receiver high-voltage lead must be disconnected from the stock supply. In both the GE and Motorola units described, receiver B+ is routed through a push-to-talk relay. To keep the receiver operating continuously, the receiver B+ lead on the output of the relay should be moved to the B+ terminal of the added supply. This can be accomplished on the MC306 (Pre-Prog) by removing the receiver lead from pin 11 of the power connector on the strip, and replacing it with a lead from the transistor supply output. The equivalent location on the T44 receiver strip is pin 1.



LETTERS

Editor:

I would like to add my own comments to the .34 - .94 controversy.

The solution is to satisfy both camps - by having a two-frequency output repeater.

The Toronto (Ontario) repeater VE3RPT has the following sequence of operation.

Input of a signal on 146.46 (chosen to avoid conflict with Buffalo) results in talk back on 146.94.

If someone picks it up within 2 seconds, it stays on 146.94 output.

Otherwise the output switches to 147.06, and continues on that frequency until 5 minutes of inactivity.

Anytime the output frequency is changed, the repeater signs its call using 100% MCW. If audio is present, call is signed at 40% modulation.

Repeater can be locked on 146.94 output using Secode dial pulses.

Thus 146.94 is used for calling and for simplex operations, and is continuously monitored. 147.06 is used for rag-chew after contact is established. A mobile out in the boondocks is guaranteed an audience - either on 149.94 which is continuously monitored, or on 147.06 if it is in use, and 146.94 can be used as a calling channel - which is its stated purpose.

73
J. W. Atwood
VE3BHT/W9
Champaign, Ill.

Dear Sir:

I have been trying to get two-meter FM going in Lincoln for several years now, and it looks better all the time. We have a beautiful spot for a repeater--only 1250 ft up--but interest is too low.

Took a trip south to Texas and west to LA this last summer and was amazed at the two-meter repeaters in the midwest. Omaha has one which I use occasionally.

Maybe it's repetition but the newcomers need information. We have two rigs we don't have circuits for and another that I don't know the i-f for. How about an article on a deviation meter? Could one be made out of a calibrated discrimination?

Keep FM going! 73,

Dick Simonsen W∅CHV
2020 North 58th
Lincoln, Nebraska 68505

RECENT QUESTIONNAIRES HAVE INDICATED MANY WANT INFO FOR NEWCOMERS. A SERIES IS IN THE WORKS. IF YOU HAVE SPECIAL PROBLEMS, SUGGEST YOU WRITE OUR TECH EDITOR, ONE RADIO RANCH, SAN DIMAS 91773.

LANSING CRAFT SHOW FEEDBACK

Under the very able direction of Harold Bell, WA8LAY, and Harold Bowers, W8CRP, representing the Central Michigan Amateur Radio Club, a fine booth demonstrating ham radio was part of the show this year for the Lansing Craft and Hobby Show. On display were many QSL cards from all over the entire world. The Amateur Radio Relay League was well represented with all of their fine books and publications. The operating station was a Motorola 5V. Also in a very prominent spot on the display table --yes, sir, you guessed correctly--several copies of FM.

Harold Bowers W8CRP

Repeater W5DI is going to be moved to a 1100 ft mountain west of Little Rock and will more than double its range. We hope to have it moved by Jan '69. Also this repeater is a "PYE" unit (40 watts out with homebrew cavities) with no problems since Feb of this year.

Anyone putting a repeater on using the Motorola Sensicon receivers? We use them on our RCC repeater here in Little Rock but we are talking of a 6 MHz difference in frequencies. I've heard that because of the capacity coupling in the front end, the problem of transmitter noise in the receiver is serious.

If you wonder why the strange frequency on the repeater of W5DI, it is because .94 was a personal frequency of a few hams in the area with very wide Motorola receivers; in order to keep peace and quiet, it was voted by the club not to interfere.

John M. Gavin W5ODF
2324 Summit
Little Rock, Ark 72206

FM RTTY

Dear Mike:

Would you or can you please publish a note in the next issue of FM Magazine to the effect that we have two stations on 146.7 RTTY here in Flint--WA8LXC and I have set up separate units for FM RTTY, only to find we hear no one on it. My understanding was that the nationally recognized frequency for FM RTTY is 146.7 and I'm sure there are stations in the Detroit area on it. For two weeks I've monitored nightly and sent out CQ's to no avail. If we could get some of the fellows down south to turn their antennas up into the north country, I feel we could get more stations on in our area. Your assistance will be appreciated.

Hugh Quigley (Bill) WA8KMQ
1939 Penbrook Lane
Flint, Michigan 48507

Dear Mr. Sessions:

In regard to your editorial in the November 1968 issue, I think that you are strictly in left field. No code requirements, indeed! That's all the amateur bands need now is an easier way for some knucklehead to get on and clutter up the bands. If a person is too damned lazy to learn the code like the rest of us did, he doesn't deserve to be on the ham bands. Whether the code will do him any good after he gets his license is completely immaterial. The code is one of the hurdles that a prospective amateur has to jump if he wants to make the scene. Don't you think there are enough jokers cluttering up the VHF bands these days with falsely obtained Technician class licenses without helping this situation to deteriorate further? IF A PERSON CANNOT LEARN THE CODE JUST LIKE I DID HE HAS NO RIGHT TO BE ON THE SAME BAND WITH ME AND SHOULD BE SENT TO ELEVEN METERS.

While I've got your attention I would like to comment on the extremely sorry quality of your last two issues. They simply had nothing in them. I, for one, am getting a little tired of hearing about how wonderful K6MVH is, and also hearing about every time they change a tube in the Tulsa repeater setup. The Fort Worth area has a repeater setup that will very nearly equal or surpass Tulsa in the very very near future. I wrote Mike a letter about the activities in the Fort Worth area about six months ago. To date you haven't printed it, but I guess my not being from Tulsa or California would explain that. If you are going to increase your subscription rates like you say, you had better start shaping your magazine, such as sticking with amateur FM radio and leaving politics to the ARRL.

THE EDITOR RESPECTS YOUR RIGHT TO DISAGREE RE CODE EDITORIAL. YOUR POINT ABOUT OVERPUBLICIZING K6MVH IS WELL TAKEN, AND SITUATION HAS BEEN RECTIFIED. YOUR COMMENTS ON TULSA ARE COMPLETELY OUT OF LINE, HOW-

EVER. THE TULSA GROUP INCLUDES A FEW HIGHLY LITERATE AND TECHNICALLY COMPETENT PEOPLE WHO SHARE THEIR WEALTH WITH THE REST OF OUR FRATERNITY. THE TULSA GROUP IS CREDITED WITH FIRST PUBLISHED HOMEBREW TOUCHTONE DECODER, FOR EXAMPLE. TULSA PROVIDES TAPED LECTURES AND SLIDE SHOWS TO INTERESTED HAM GROUPS ON A NO-CHARGE BASIS. TULSA AMATEURS OPERATE AND MAINTAIN ONE OF FINEST AND MOST COMPLEX REPEATER NETWORKS IN THE COUNTRY. BUT NO ONE WOULD KNOW ANY OF THESE THINGS IF IT WERE NOT FOR THE DETAILED WRITEUPS SUBMITTED BY THE TULSA GROUP. IF YOU SENT IN DATA, CHANCES ARE IT WAS NOTHING MORE THAN STATISTICS; AND STATISTICS ARE PLACED IN OUR QUARTERLY REPEATER DIRECTORY. SUGGEST YOU START TOOTING IF YOU WANT TO BE HEARD AND STOP BLASTING OFF AT GROUPS WHO DO A SIGHT MORE THAN PAY LIP SERVICE TO THE WORDS "FRATERNITY" AND "BROTHERHOOD." FM MAGAZINE CAN SURVIVE WITHOUT CHRONIC COMPLAINERS, BUT WITHOUT THE WICHITAS AND TULSAS AND KILLINGTONS AND RADIO RANCHES AND SEATTLES, WE'RE DEAD. OK?

Dear Mr. Sessions:

I am disappointed to see your views about code as you express them in the November editorial. I doubt if you have ever enjoyed operating cw in the 40 or 20 meter bands or you would not have made the erroneous statement that the range of cw is not significantly better than FM. It most certainly is better than FM. I will not argue about SSB as I feel SSB is probably about equal to cw for range on the HF amateur bands.

As for your argument about "efficiency," you fail to comprehend what this whole business is about! Efficient communications is not what we all are radio amateurs for--for efficiency I have a telephone. The telephone is fast, cheap, and can reach virtually anyone at the moment you need them. Amateur radio is for relaxation, enjoyment, etc. I like to operate cw because I enjoy it; it relaxes me! If you wish to have efficient communications, try the commercial services that are available and let those of us who enjoy amateur radio as a hobby do so. Anyone who seriously wants to join our ranks and tinker on AM, FM, SSB, cw, or whatever mode is welcome so far as I am concerned, and I do not feel the measly 5 wpm code requirement is any obstacle at all.

Mere memorization of the characters for each letter will be sufficient for 5 wpm cw and anyone who can't do that for something he "seriously" wants is either incompetent or not as serious as he says he is. We have a group of frequencies set aside right now for use as "efficient communications" channel. No hamming is allowed to clutter up the spectrum and interfere with the business being conducted there. No code requirement, either. I'm sure you know where I mean and this is where your lazy friends can go with their "efficient communications."

As for your remarks regarding ARRL, they are entirely out of place in FM Magazine! Stick to your FM'ing and let it go at that. I will not support an organization that files a petition to FCC for the purpose of eliminating the code requirement and I will also not listen to mud-slinging against ARRL or any other organization. If you have something constructive to say, say it--but don't verbally tear apart other organizations for what they feel is right. Accomplish your purposes by telling of the merits of your proposals, not by using emotional arguments and mud-slinging.

I hope you will carefully consider this in your future editorializing.

George E. Anestis W3ANX

MORE .34-.94

Dear Sir:

In response to the letters from W2CFP and K9VVL in the October 1968 issue, I would like to make some observations.

First, .94 has been nationally agreed upon (with few exceptions) as THE 2 meter FM calling frequency for the last 10 years or more. I can see no reason to expect the many thousands of stations that operate on .94 to have to buy new crystals for some newly adopted calling frequency just because repeaters are now using .94 as their output. I feel it would be much less of an overall burden for the repeater stations to pick some other frequency for the output. There are many operators in my part of the country, and I feel sure that this holds true in other areas, that for one reason or another do not operate through the repeater(s) in their area. I believe it is unfair to penalize these operators who have as much right to properly use .94 as any of us.

Instead, I feel that it is the responsibility of the repeater licensees and users to agree upon a frequency that will not affect those stations that do not want to use the repeater. If the repeater output is on .94, the use of the frequency is limited to only one QSO at a time within the area of coverage, whereas several simplex QSO's can be conducted at the same time within the same area. Also, the station utilizing the repeater could very easily completely obliterate several other simplex QSO's already in progress when he keys up the repeater. This, although not deliberate, is very discourteous.

If, however, the repeater output is on some "exclusive" frequency, the users may feel confident that the only signal they will hear is that of the repeater, and that they will not be interrupting any other stations when they key up.

Don't get the idea that I'm opposed to repeaters. On the contrary, I'm one of the licensed control stations for the Baltimore repeater (WA3DZD) and I use it all the time. I feel that since the repeater is quite a technical project for its supporters, it is only fair that the users also be expected to put in some of their own time and effort in making their own equipment compatible with the repeater, rather than hand it to them on a silver platter.

It is for the above reasons that the repeaters in the Baltimore, Maryland (WA3DZD), Washington, DC (W3JCN), and Harrisburg, PA (WA3ICC) areas are all using .76 as the repeater output, and of course .34 input. Simplex operations on .94 are not affected, yet these operators all know that if they want to use the services of the repeater, they are welcome.

R. Gary Hendrickson W3DTN
Secretary, Md FM Assn, Inc WA3DZD

Dear Ken:

On Nov 4, I wrote you a letter expressing my views on the .34-.94 question. Those views were solely my own and do not necessarily reflect the opinions of the members of the St Louis Repeater Organization.

A couple of the guys here are working on offering the complete bill of materials for a preamp using the Motorola MM5000. They will be selling the board and all of the components at cost. The circuit is similar to the 2N3399 preamp that originally appeared in CQ.

Last week, we had a fellow in town from Chicago. His transmitter automatically gave an 1800 Hz "beep" every time he keyed it. They have a .34-.76 repeater there. The transmitter is located in the "loop," and there are two receivers. One is located on the north side of town and is activated by a 1800 Hz beep and the other is in the south and has a 2000 Hz beep to operate it.

FM is sold here at Gateway Electronics and yet I don't see any mention of this fact in the magazine where you mention where FM is sold.

Allen Kempe KØSSL

THANKS FOR THE INFO ON GATEWAY. IF THEY TAKE 25 COPIES PER MONTH, THEY WILL BE LISTED IN THE TABULATION. ON THE BEEP, WE ASSUME CHICAGO TO BE AN OPEN "WHISTLE-ON" SYSTEM; IF THIS IS NOT A CORRECT ASSUMPTION, PLEASE ADVISE SO THE DIRECTORY CAN BE CORRECTED.

Dear Ken:

This letter is meant as an answer to Terry Hancock WA9LKZ and David Flinn W2CFP, among others, who probably are interested in the so-called .34 — .94 mess.

First of all, I think the term "calling frequency" should be defined. A calling frequency is one which is monitored for the purpose of establishing contacts, as opposed to a "working frequency" which is used for maintaining communications.

As can be seen by the preceding description (my own), this implies neither repeater output nor simplex channel. What it means is that a calling frequency should be monitored by as many as possible; having facilities for omnidirectional reception if one is in the center of activity. Long ragchews should not be carried on on a calling frequency; the QSO should QSY once contact is established. This concept is the basis of almost all of our low-band traffic nets and has been worked out and tried for many years.

Now, getting back to the .94 and repeater question. A repeater with an output on .94 enhances the use of .94 as a calling frequency in several ways. It has been our experience in St Louis that the repeater was the major stimulus in getting many amateurs on two meters FM. Second, nobody can hear omnidirectionally as well as the repeater. True, a good sensitive base station with five beside five can outdo the repeater, but only in one direction. Thus, the repeater appears to enhance the use of .94 as a calling frequency, since anyone listening on .94 can hear more and there are more listening.

To further fulfill the definition of "calling frequency" it is necessary for individuals to inhabit this frequency for a minimum amount of time. Since mobiles are the ones that benefit most from the repeater, let's take a look at them first.

The average mobile isn't usually in a position to stay on the air for a great length of time before he gets to his destination. Mobiles tend to be an off-again on-again sort of operation. Base stations, however, are in a position where they can and will stay on the air for extended periods of time. If extended base station operations, whether simplex or duplex, can be moved to an adjacent simplex working frequency, the concept of a calling frequency and repeater output are compatible.

I think the question now resolves into "shall .94 be a calling frequency or a ragchewing frequency?" I don't want to abandon this thought completely before I make a few other points.

There will always be a lot of controversy over how much activity can be allowed on a calling frequency. This is primarily a local question. It is also a good point in favor of having a strong local club operating any repeater. A couple of examples here will show what can be done on a local level.

In 1967 I went up to EXPO 67 in Montreal. While in Toronto, I noticed that the Toronto repeater, when it was first keyed up after being off for a while, came out on .94. After it was keyed initially, it automatically switched to another working frequency. On my way back, I passed through Buffalo. There, no base station was allowed to use the repeater. It was reserved for mobiles only. Both of these cases illustrate that the local amateurs were interested in working out the problem.

Most of the repeaters in the country are .34 — .94. Therefore, it would be silly to advocate abandoning this uniformity. This uniformity is one of the most desirable aspects of the use of these two frequencies. A mobile so equipped can go to almost every major city in the country and use a repeater (Chicago excepted). Also, if you sell or trade a rig to an amateur in another city, your investment in crystals can be protected only if there are common frequencies in use in both areas. Chicago amateurs on .46 — .88 are throwing away $13 more or less if they take their rig to a hamfest and sell it to somebody in St Louis. Joliet hams are even worse off. Their crystals for .385 and .987 are useless to everybody else in the country.

In conclusion, I don't think that the question is what is going to be the calling frequency or where the repeaters are going to be but when are the hams going to start cooperating with each other? .94 is established as a national repeater output and as a national calling frequency. Let's keep it that way, but let's clean up our repeaters and 146.94.

Ken, I'd like to add that the magazine keeps getting better each month.

Allen Kempe KØSSL

I have started a new FM organization here in Milwaukee called the Circuit Breakers Society; to become a member you must have a rig on 146.94 that's active. There are at present about 10 original members, and we should have about 20 more soon that are on the FM bands. We meet once a month and discuss new articles about FM communication and techniques. We have a new certificate coming and we will make you an honorary member because we think you are editing a magazine that amateurs have been awaiting for a long time. I have also made you a member of the Famous Humbug Society.*

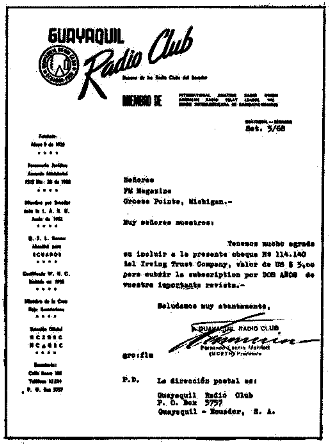
I have been on commercial (BC) FM for 5 years with a polka program on WTOS-FM, so after I get off the station I enjoy my contacts in the mobile on 146.94 FM.

I will send you more info on the CBS after our next meeting.

Gutten Hoerren
Herman Kalter Auf Schnitt
Alias Vic Weissbrodt W9JFP

*See below.

HOW'S THAT AGAIN?



GUAYAQUIL Radio Club

Set. 5/68

Señores
FM Magazine
Grosse Pointe, Michigan.-

Muy señores nuestros:

Tenemos mucho agrado en incluir a la presente cheque No 114.140 del Irving Trust Company, valor de US $ 5,oo para cubrir la subscription por DOS AÑOS de vuestra importante revista.-

Saludamos muy atentamente,

GUAYAQUIL RADIO CLUB
Fernando Landín Marriott
(HC2FM) Presidente

gro:flm

P.D. La dirección postal es:

Guayaquil Radio Club
P. O. Box 5757
Guayaquil - Ecuador, S. A.

HELP!

Our local AREC/RC has a small supply of Motorola series 15V units for which we need crystal data and schematics. Anybody have any?

We also have acquired, through the local power company, over 100 units of FMTR-7A equipment, for which we have only wiring diagrams. The cases are marked "LINK" but the type number is obviously Motorola and the chassis are stamped "Inspected by W.E." and a number. The units are two-piece WBFM, formerly on 48.14 MHz. Transmitters are of type 35 WFM-Ed. 7A, Series 31345 or thereabouts; some have been converted to two-frequency operation. Output stage is an 807 at 60W input and about 30 output. Receivers are type 11-UF-Ed. 7, Series 31738 or vicinity, some of which are marked as converted for selective calling: Do NOT plug in test set w/o adapter as provided. The set operates on 6V dc at present, but we will be converting to 12V or 110 ac operation.

If you know of a place where we could find schematics and cabling diagrams for these units, we would be pleased to hear from you. We will be happy to provide you with the conversion data so that you can pass it along to your readers, whom I am about to join. Keep up the great work in 73, too. We hope to hear from you soon.

Karl F. Beckman WA8NVW
4586 West 214 St
Fairview Park, Ohio 44126

34 - 94

FM Magazine:

I disagree with David Flinn's idea (pp. 19-20, FM, 1968 Oct) of creating a new simplex channel. Essentially everyone who is on two-meter FM is on 146.94 MHz. Many of those came onto that frequency for simplex operation. (The main reason for coming on for simplex operation is because there was nothing else when they came on.) Now it is suggested that those who are on .94 and want to continue to use simplex operation should get off so that repeaters can operate. It seems much fairer to suggest that those wishing to operate with a repeater move to some other frequency while using a repeater rather than to require those who are not using a repeater to move to some other frequency.

Ron Guentzler W8BBB

FM

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Non-commercial advertising is accepted Free of charge from individuals, provided that the copy pertains to equipment relative to FM two-way service. However, insertion is contingent upon space availability. Classified Advertising of a commercial nature is accepted at 10¢ per word, including the address. Payment must accompany the Ad copy and Agency commissions do not apply. A Reader Service Card number may be used in your Ad, for an additional five dollars.

FM is not responsible for the reliability of the statements made herein.

FOR SALE

MOTOROLA Wide Band Permakay filters K8436 $4.50 ea. 3/$10; FMTRU-5V Transceivers $25; Hartman 120 watt Hi band Mobile Linear $85; RCA CMV4 Hi Band, 12 volt $35, four units $100; Pye Hi Band Mobiles PTC 8202U $65; Dumont 5814 $65; Bendix Base & Mobile, both $85; Low Band ¼ KW Amplifier $35; Link 1938 Remote control $25; HIGLEY, 1196 Elberon Ave., Elberon, New Jersey 07740.

MOTOROLA HT-200, late-mod Handie-Talkie, H23-DEN, on 146.940 MHz, like new, $160. 2-freq. H23DEN, 136-151 MHz range, w/o crystals, $190. Both include ni-cad and work perfectly. P33BAM-3101AM 5 watt, 144-174 MHz pack set with two sets of ni-cads, NLN6029A charger, without mic or crystals, $70. TU596TS, 12 volt, T-power strip for 60 watt (T-53, 140D), $40. L43GGV Base, on 146-940 MHz, 25 watts, $120. H. R. Greenlee, 430 Island Beach Blvd., Merritt Island, Florida 32952.

MOTOROLA MOTRAC, hi-band, 60 watt; $200. Motorola Station Monitor, 30-50 MHz; $200. HP 524 with plugins to cover 10-220 MHz, calibrated by HP on 12-1-68; $900. GE TPL, hi-band, 15 watt; $130. Motorola H23 series portables, Lo-Band; $75. GE PTL portables, hi-band; $50. Motorola consolet base station Lo or Hi band; $250. Motorola remotes; $50. ATV equip. (will trade for Gertch or Motorola Freq. & Dev. Meter) Contact: H. W. Pfeiffer, 52 Scotch Pine Dr., Voorheesville, New York 12186.

MOBILE ACCESSORIES, Microphones, Communications quality (Brand Name). Carbon $6.95 each, Miniature Control Heads $3.00, 15 Conductor 18' Cable Kits $1.25, Power Cables $1.00 each. For complete listings circle number 77 on Reader Service Card or write to: K-Enterprises, 763 Colfax, Elmhurst, Illinois 60126

For Sale Continued

PROGRESS LINE, 144-174 MHz transistor powered, mobile MT-36, accessories, manual, $195. Antenna Specialists, 130-174 MHz mobile antenna, new, never mounted, 3 db gain, $20. Low band 829B transmitter, $18. Hewlett Packard 410B VTVM, manual, $150. RCA Low band FM CMV-3EI, 60 watt transmitter, manual, no accessories, $40. Six meter handbook transmitter, $5. Six meter transistorized transmitter and modulator, PC board (new) $17. 4CX1000A ok or refund $38. 4-125A's New, $9. You pay shipping. Loyd Woodham, Albertville, Alabama 35950.

GE PROGRESS LINE, 100 mobile units, MZ 33 6/12 volt, 25 watts, transmitter uses dynamotor, Units complete with control head, speaker cables and microphone; $80 each. GE Pre-Progress Line 4ES16, 25 watts, dynamotor power. Units include control head, speaker, cables and microphone; $50 each. All of the above units sold on As Is basis. Voice Commander II with lapel speaker and charger; $65 each. GE TPL, 12 volt, 10 watt, Front mount complete with all new accessories; $165 each. Several misc. GE components for Pre-Progress and Progress Line units. Rec., Trans., Ctl., units, cables, Xtal ovens, etc. Please send your requirements for a quotation. M. H. Klapp; W2EOV, 25 Gladwish Rd., Delmar, New York 12054.

MOTOROLA 80D transmitter strip with tone oscillator and tubes less crystal oscillator deck; clean, $10. Pete Adely, 36 Worth Street, South Hackensack, N. J. 07024.

CRYSTAL OVENS, standard base Westinghouse, 6.3v, dual HC 6/v type, 75 degree, Postage paid: $1.25 each. John Kuivinen, 126 Annapolis Drive, Claremont, California 91711.

MOTOROLA T43GGV, with control head, mic, speaker; $70. Motorola T44A6A; $50. Lo Band 140D transmitter strip; $20. Hi Band 80D transmitter strip; $20. RCA Lo Band receiver strip narrow band; $15. RCA 450MHz receiver strip, wide band; $15. Charles Copp, 6 Northfield Lane, Westbury, New York 11590.

MOTOROLA H11-1AM, handie-talkie, 39 MHz dual channel receiver, with handset and schematic, but no power supply, works okay, $10. John Kuivinen, 126 Annapolis Drive, Claremont, California 91711.

BUDELMAN 17A, Frequency and Deviation Meter; $50. Richard A. Des Rosiers, 540 Clay Street, Manchester, New Hampshire 03103.

PERMAKAY FILTERS, Motorola Permakay Filters #TFN 6013AW wide band for Motrac 450MHz receivers, $4.00 each. Art Housholder, 1774 Farwell, Des Plaines, Illinois 60018. Ph. 827-3433.

GE TPL, Receiver, complete but less case, $40. Jones Michromatch SWR Bridge with 400 watt element $20. Bob Koren, 107 Moorewood Avenue, Avon Lake, Ohio 44012.

BACK ISSUES of FM are available for a limited time. Specify which issues you want. Aug. '67 and Jan., July, Aug., Sept., Oct., Nov., and Dec. 1968. Send 40¢ for each issue wanted and allow at least 4 weeks for mail delivery. Mail to **FM**, Back Issues, 2005 Hollywood, Grosse Pointe, Michigan 48236.

For Sale Continued

OWN YOUR OWN FM BIZ in the U.S. Virgin Islands! Started business June '68 as spare time venture while here on CATV contract. Contract will move me back to States soon. Boom area. Excellent business. $4,000. Full details–Bob Cooper, Jr., KV4FU, P. O. Box 1355, Frederiksted, St. Croix, U.S. Virgin Islands 00840.

INTERNATIONAL CRYSTALS, one set for 52.525 MHz, model T41G – $7.50. Ralph Sieloff, 64 S. Cottage St., Valley Stream, New York 11580.

GE MTS mobile telephone, or will trade for a Motorola Lo-band station monitor. R.W. Purkey, Kincaid Tr. Ct., Rt. #4, Box 86-KL, Mt. Pleasant, Ia. 52641.

MOTOROLA TRANSISTORIZED, Hi and Lo band, dispatchers and portables. Also have operating Motorola T41G on 52.525 MHz. Can also get some lo-band transmitter and receiver strips. H. Stanley Staten, 3535 Marvin St., Annandale, Va. 22003. (703) 573-2489.

MOTOROLA T-51GGV on frequency 52-252 MHz. Like new, with transistorized mike. Two freq. xmit capability. All cables and head. $100. or trade. T.E. Hartsen, 31 Sanderson St., Battle Creek, Michigan 49015.

AN/PRC 40. Hi-band FM Walkie Talkie, excellent condition with Manual. Amtr crystalled for 146.340 MHz. Just $35.00. Robert P. Eckard, R.D. #2, Box 30, Cogan Station, Pa. 17728.

MOTOROLA MOTRAC, U51HHT, Lo-band in rough shape, rcur ok, PWR supply, Xmtr dirty and missing parts, with manual, no acc. A challenge for cheap – $90. Gratten Gray, 636 Hollywood, Monroe, Mich. 48161.

MOTOROLA FSTR-520BR, hi-pwr, lo-band base. Exc. – $275 pick-up. HP 526A plug-in amp for HP 524 series counters, like new with case – $85. Gratten Gray, 636 Hollywood, Monroe, Michigan 48161.

MOTOROLA 41V BASE, on 52.525 MHz with xtals. Also with two freq. conv. kits for tran and rec. $75.00. Bob Coburn, R.F.D. #2, Tinkham Lane, Londonderry, N.H. 03053. Phone (203) 432-2615.

MOTOROLA H23BAM, hi-band FM portable, has NiCad battery and transistor receiver. $90. It works great! H. Stanley Staten, 3535 Marvin St., Annandale, Va. 22003. Phone (703) 573-2489.

MOTOROLA 450 T44A-6 excellent condition $40. ea. T44AAV $20. – $50. ea. J44AAB with PL $125. RCA CMU-15A less mic and spkr, some have 2-freq. receivers $15. ea. GE ¼ KW base Tx final $55. Hi-band T43GGV $125. ea. FMTRU-80D $50. ea. Motorola Station Monitor $275. Lo-band D41GGV with PL $40.–$70. ea. T41GGV with PL $75. – $100. ea. U41GGT with PL $150. ea. L51GJB 60w PL base $250. GE MT-16N 60w T-Power like new $175. All equipment complete with accessories. Lo-band equipment in the 40-50 MHz range. Also have Tx, Rx and P.S. strips, xtals, single tone equipment, reeds and parts. Sorry we do not ship. Illinois Communications Co., Inc. 10347 S. Oxford Avenue, Chicago Ridge, Illinois, 60415, (312) 445-0364, 423-0364.

MOTOROLA – FMRU16V RCVR, FMTU30D XMTR, Mobile 12 volts, all cables, control head, mike & spkr–tuned up on 146.940mc. $65.00 K. E. Booher, 1421 Williamsburg Road, Flint, Michigan 48507.

MOTOROLA PRAM-33 handie-talkie, with nicad batteries, mic, $60.00. Some other Motorola stuff, cellar full of FAX, RTTY gear, models 29, #32, #33 etc. Write for list. Gordon Eliot White, 5716 N. King's Highway, Alexandria, Virginia 22303.

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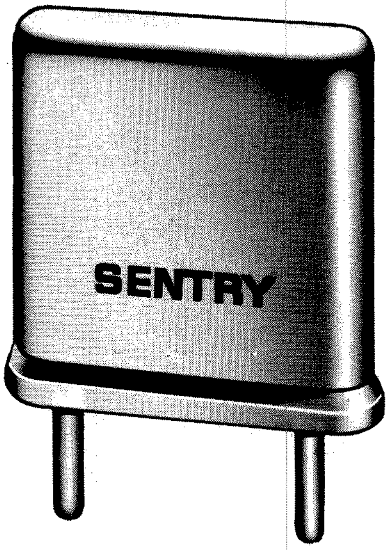

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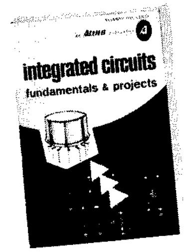

New Book--Integrated Circuits, Fundamentals and Projects (New from Allied Radio Corp.)

With all the amazing developments in electronics, few rival the introduction of the integrated circuit (IC) which may have greater influence on the design and application of electronics products and systems than any other single component since the vacuum tube.

This new book by Rufus P. Turner, Ph.D., of California State College at Los Angeles, covers the historic and technical development of the IC, its general features, types, and--most important--applications.

The reader will learn how this device can contain, in an area as small as 1/20 of a square inch, complete electronic circuits consisting of scores of transistors, diodes, capacitors, and resistors, permanently connected and extremely rugged.

Experimenters will be guided in the use of the device in inexpensive building projects. The book provides details on assembling such useful circuits as audio preamplifier, high-gain preamplifier, quarter-watt audio amplifier, crystal oscillator / frequency standard, af / rf signal tracer, and dc voltmeter.

The book runs 96 pages, paperback. Published and sold (75¢ postpaid) by Allied Radio Corporation, 100 N. Western Avenue, Chicago, Ill. 60680.

For Sale Continued

MOTOROLA T41G, Lo Band, 12 volt mobile, operating on 52-525 MHz. Also Motorola Hi Band Dispatcher and Portable (with transistor receiver). H. Stanley Slaten, 3535 Marvin Street, Annadale, Virginia 22003.

RINGING GENERATORS, Three 20Hz ringing generators for telephone system, 19" panel mount, 115v AC in (sub-cycle principle) $15. each. Also all kinds of electronic equipment – some FM, RTTY and ATV – and components. Send for list available February, 1969. Circle number 78 on Reader Service Card for listing. G. M. Pugh, 89 Trumbull Road, Manhasset, New York 11030.

WANTED

MOTOROLA P-33 series handie talkie on 146-940 MHz with nicad battery, reasonable only. Pete Adely, 36 Worth Street, South Hackensack, New Jersey 07024.

BACK ISSUES of FM to buy or borrow to photo copy and I will return magazine safe and sound pronto after copying. Please! Ed Howell, P.O. Box 73, Folly Beach, South Carolina 29439.

GE PROGRESS LINE high band and 450 MHz receiver and transmitter strips. Also dual front ends, T-power supplies, 4-frequency decks, what have you. State price with first letter. Travis R. Jarman, P.O. Box 17316, Tampa, Florida 33612.

COMMUNICATIONS TECH., FCC license is not necessary but some experience with FM communications equipment is required. Starting rates from $3.50 to $4.50 depending on exp. New modern facilities located in N.W. Chicago Suburb. Full line of company paid benefits. Call Mr. Holmen at (312) 894-4040 or write "Electronics" P.O. Box 572, Hoffman Estates, Illinois 60172.

HI-BAND GEAR both mobile and base. Prefer Midwest deal to reduce freight. Planning to have about 6 mobiles in N.E. Michigan by next summer. Will consider gear either "as is" or on freq. Want some two channel and some that is low power mobile local stuff . . . Write details to John Alexander, 536 Huron Hills Dr., Rte. 2, East Tawas, Michigan 48730.

HI-BAND ANTENNA for the mobile, vertical gain type. Pete Adely, 36 Worth Street, South Hackensack, New Jersey 07024.

CF-1B Carrier telephone equipment either single channel units or the whole thing. Need four to six units, or equivalent. Northeast FM Repeater Association, 18 Mary Ave., Fords, N.D. 08863.

ITT-KELLOGG HI-BAND, someone, someplace, has a warehouse full of ITT-Kellogg model K30H base and mobile sets. Units manufactured circa 1962-63, never actively sold domestic market. Reward for information leading to any of these units, new or used, base or mobile, single or large lots. Bob Cooper, Jr., Island Communications Service, P.O. Box 1355, Frederiksted, ST. Croix, U.S. Virgin Islands 00840.

Wanted Continued

GE PROGRESS LINE, Lo band 50 watt base preferred but will accept mobile. Have a GE Progress Line on 146-940 MHz to trade. Also would consider a Motorola FSTR 140BY(H). Bob Coburn, RFD-2, Tinkham Lane, Londonderry, N.H. 03053.

MOTOROLA OR GE, recent Motorola or GE Progress Line, Lo band, 12 volt mobile rig. 60-100 watts. Transistorized power supply. Dan Vernier, 7626 Brentwood, Detroit, Michigan 48234.

HELP WANTED, Schematic or manual or information leading to same for: Motorola "Handy Talkie" FM Radiophone Pack, Model P11 1A M; transmitter strips plate 13A813618F; Serial 754; frequency 30.46 MHz; date stamped on chassis – July '55. Model No. is apparently not Motorola. Tube types 3V4, 1AH4, 1AJ5, CK5672, Etc. All correspondence will be answered. T. M. Allison, 4211 Indian Lane, Phoenix, Arizona 85013.

TCC-3 MULTIPLEX equipment. State condition and price. G.M. Pugh, 89 Trumbull Road, Manhasset, New York 11030.

APOLLO FLIGHTS, specific frequencies, HF, VHF, UHF, S-Band, along with point to point ground communication channels used by NASA. Richard M. Jacobs, 4941 Tracy Ave., Kansas City, Mo. 64110. (816) 444-1968.

GE PROG LINE, 60 watt transistor power supply, four freq. low band osc. deck, front mount control head. Also looking for Base Station Power Supplies for rec. and tran. Bob Coburn, R.F.D., 2 Tinkham Lane, Londonderry, N.H. 03053, Phone (203) 432-2615.

FM ISSUES, Volume #1, all, Volume #2, numbers 1, 2, and 4. I would like to make copies of these for my collection. Jim Card, 3434 Oakhurst Dr., Burtonville, MD. 20730. Phone (301) 384-5064.

MOTOROLA MONITOR, Lo-band, also need model 80 or 80-R signal generator. R.W. Purkey, Kincaid Tr. Ct., Rt. #4, Box 86-KL, Mt. Pleasant, Ia. 52641.

MOTOROLA G RECEIVER, high-band strip. Also need some good used small tubes, such as 6AK6, 6BH6, etc. Ralph Sieloff, 64 S. Cottage St., Valley Stream, N. Y. 11580.

MISCELLANEOUS

THANKS to all who made the 4th Annual Northeast Michigan Hamfest such a whopping success. We'll see you for the 5th Annual on the first weekend of October, 1969!! Seasons Greetings from the IOSCO Amateur Radio Club.

WCRA SWAP & SHOP, The Wheaton Community Radio Amateurs will hold the seventh annual Mid-Winter Swap and Shop on Sunday, February 16, 1969 at the Du Page County Fair Grounds, Wheaton, Illinois. Hours – 9:00 a.m. to 5:00 p.m. $1.00 donation at the door. Refreshments and unlimited parking. Free coffee and doughnuts 9:00–10:00 a.m. Contact Bill Lester, Box 1, Lombard, Illinois 60148, for information.

MARCH 29TH, the Wexaukee Radio Club is holding their 9th Annual Swapshop in Cadillac, Michigan at the National Guard Armory, 9 A.M. to 4 p.m. No charge for table space and everyone is welcome. Lunches will be available at the armory.

MICH. ARRL CONV., May 9-10 at the Grand Rapids Civic Auditorium and Pantlind Hotel in Grand Rapids, Michigan. FM meeting 11 A.M. Saturday, May 10. See ad in this issue. Check in on 52.525 or 146.940 MHz.

DAYTON HAMVENTION, April 26, 1969: Sponsored by the Dayton Amateur Radio Association for the 18th year. Technical sessions, exhibits and hidden transmitter hunt. An interesting ladies' program for XYLs. For information watch ads or circle number 76 on the Reader Service Card or write to: Dayton Hamvention, FM Activities, Box 44, Dayton, Ohio 45401.

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