FM

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volume 3 number 1

IN
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PROG MOBILEPHONE

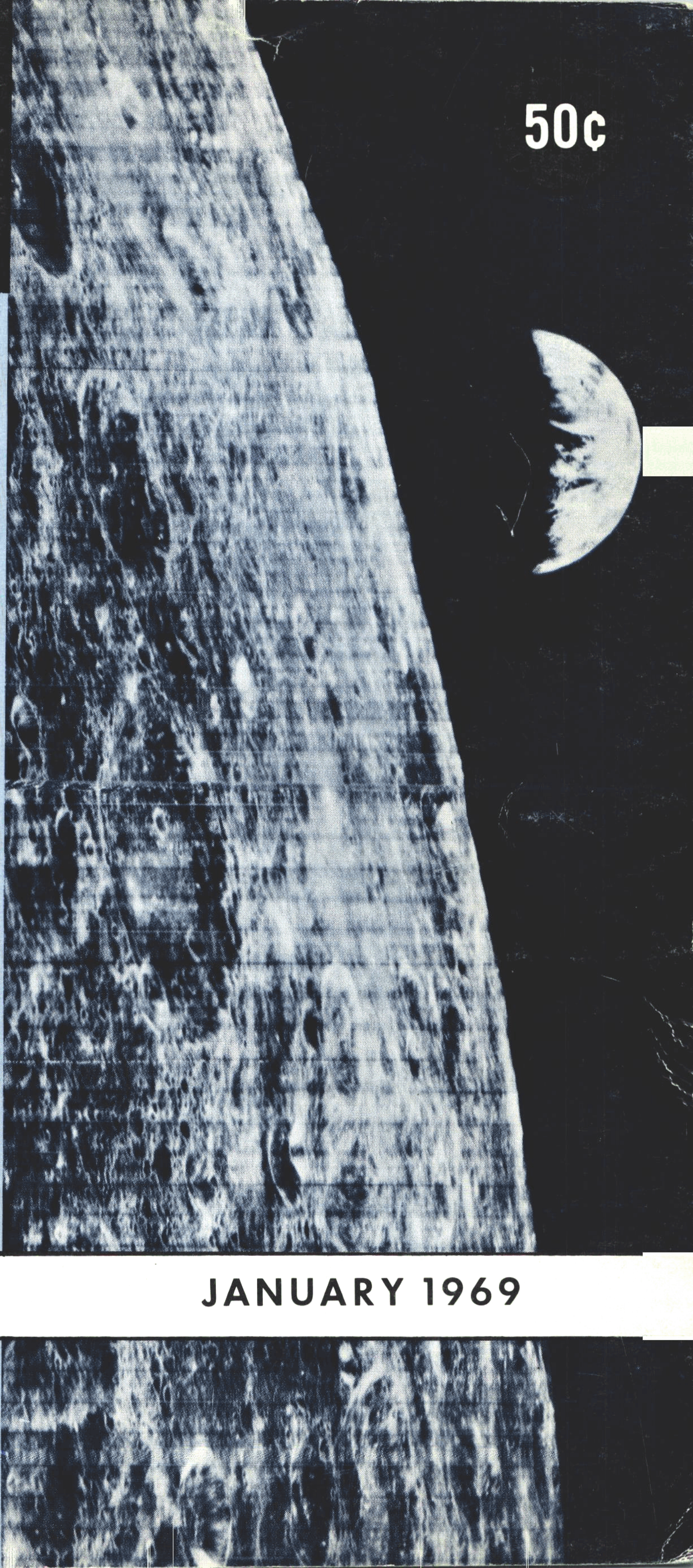
PHONE-LINE RPTR CONTROL

10 METERS FM

ENCODER

IC RPTR IDENT

IC APPLICATIONS



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LAS VEGAS
JANUARY
8, 9, 10, 11 & 12

JANUARY 1969

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Cover Photo: Lunar Orbiter looks at Earth from that Great Repeater Site in the Sky. Future generations of amateurs and two-way pros will be able to provide almost hemispherical repeater coverage from sites atop peaks on the lunar. surface. Earth-based servicemen will have to plan on high reliability, though; a bad integrated circuit or transistor will mean a great deal more than "a quick trip to the site".

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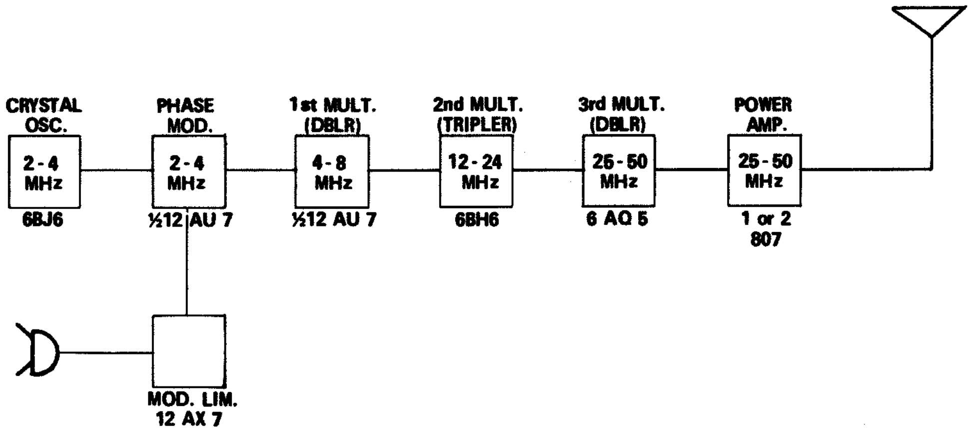

Block Diagram of the Transmitter Types ET-5-A, ET-5-C, ET-6-A, ET-6-C, and ET-7-A (RC-73)
Figure 1

TRANSMITTER

The transmitter I am using is the 4ET6A5 which will tune 30-40 MHz. (See Fig. 1.) It was really not necessary to make any changes operating so close to 30 MHz (29.6), but I decided to modify the unit slightly to allow the tuned circuits in the transmitter to function at maximum Q and gain. This means good rejection of any unwanted harmonics getting to the tank circuits.

Table 1 and the schematic of Fig. 2 illustrate the capacitor changes to allow retuning the transmitter to a lower frequency in my case. Just paralleling capacitors and minor tuning was all that was necessary to change frequency of operation. With a multiplier of 12 from oscillator to output (or FX = FC/12), a crystal frequency of 2466.666 kHz (HC-17/U) was required for 29.6 MHz operation. The filaments require 3.5 amps at 6V and another 1.5 amps to activate the antenna relay. High voltage required was from 500 to 750 volts (250 mA).

TABLE 1

COMPONENT EQUIVALENCE CHART

	25-30 MHz	30-40 MHz	40-50 MHz
Model No.	4ET5A 4	4ET5A 5	4ET5A 6
Item Numbers and Values	C110 (120)	C142 (68)	C146 (47)
	C113 (120)	C143 (75)	C147 (47)
	C117 (47)	C144 (27)	C148 (15)
	C118 (47)	C145 (22)	C149 (10)
	C122 (39)	C150 (18)	C152 (3)
	C153 (91)	C154 (47)	C155 (22)
	C156 (180)	C166 (150)	C133 (100)
	L112	L112	L113
	L115	None	None
	Y101	Y103	Y103
	Y102	Y104	Y104

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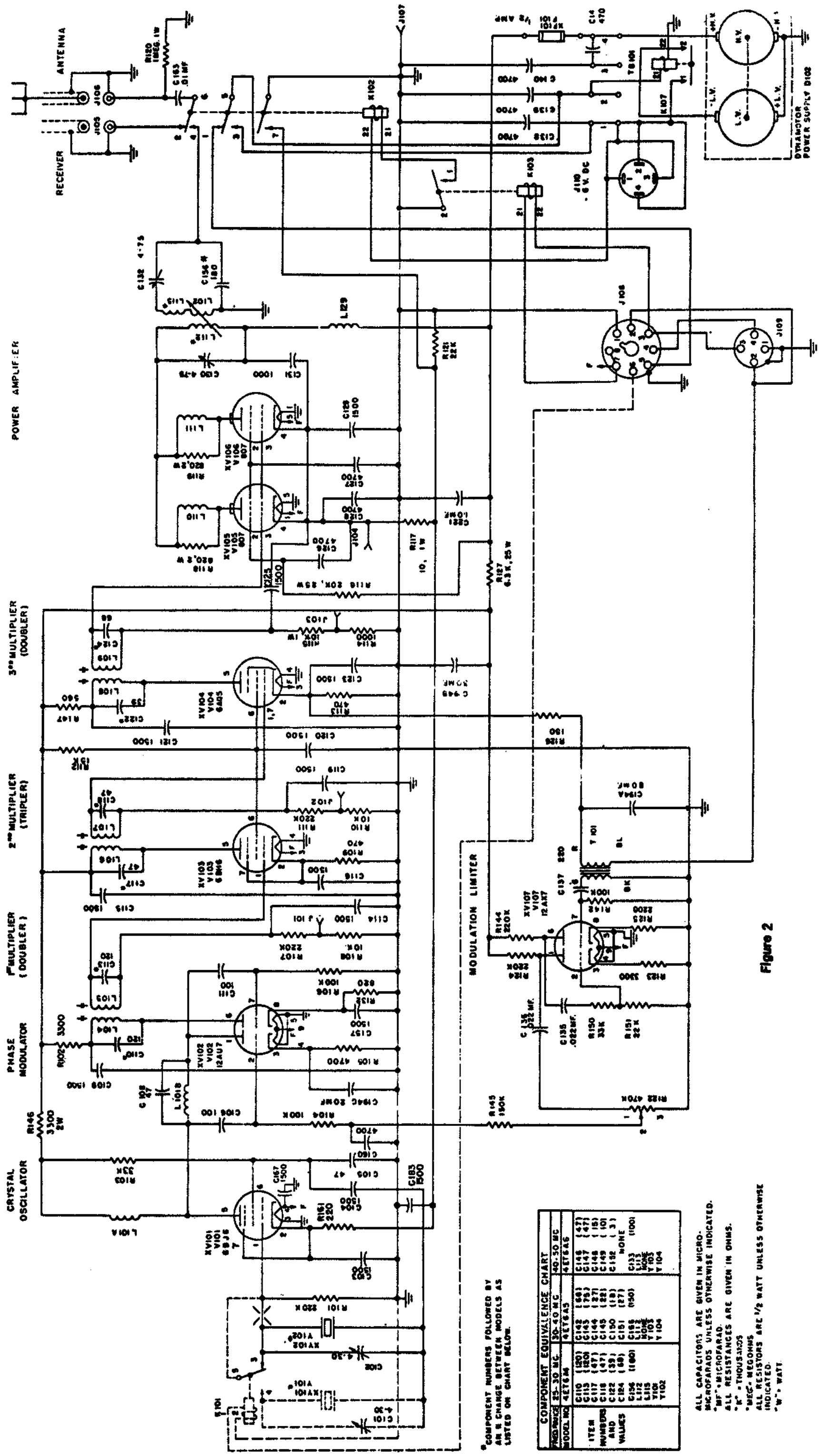


Figure 2

is required, unless you are making drastic frequency change (such as 10 MHz or so). Table 2 and the schematic of Fig. 4 show component changes for large frequency conversions. A 23.6

high frequency oscillator crystal and retuning the oscillator and rf stages. The procedure for making these adjustments is given below. If the receiver needs to be completely retuned, use the procedure outlined

Before applying power to the transmitter, use a grid dip meter to tune the first, second, and third multipliers to maximum dip on the multiplier frequencies. If you don't have a grid dip meter, you can tune up with a meter inserted in the test jacks. Although the latter is done anyway, the grid-dip tuneup could be eliminated, but that is not recom-

5. Insert the 1.0 mA dc meter in third multiplier grid jack J102 (green jack adjacent to the 6AQ5) and tune the second multiplier plate coils as in step 4 above. The maximum grid current will be between 0.2 and 0.6 mA.

6. Connect the 15 mA dc meter between power amplifier grid jack J103 (green jack on front panel) and the

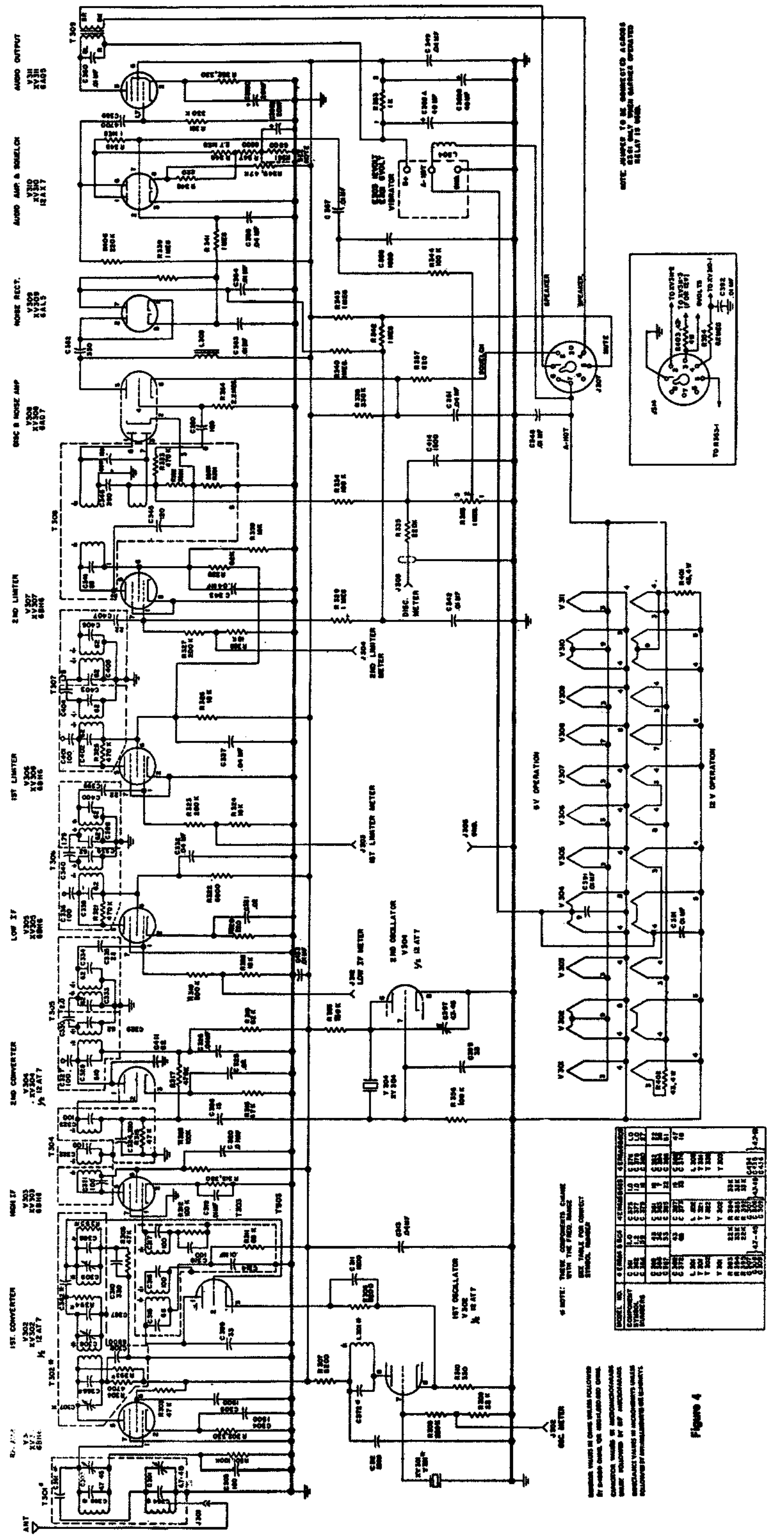


Figure 4

TABLE 2

Model No.	4ER6A4 & 6C4		4ER6A5 & 6C5		4ER6A6 & 6C6	
Component Symbol Numbers	C361	1.0	C375	1.0	C376	1.0
	C362	1.2	C377	1.0	C378	1.0
	C364	39	C379	18	C380	27
	C365	43	C381	18	C382	22
	C366	36	C383	7	C384	39
	C367	33	C385	22	C386	51
	C368	43	C387	15	C388	47
	C372	68	C373	33	C374	18
	L301		L302		L303	
	T301		T321		T331	
	T302		T322		T332	
	Y301		Y302		Y303	
	R393	22K	R384	33K		
	R394	33K	R385	33K		
	R395	22K	R392	33K		
	C307		C307		C434	
	C308	4.7-45	C308	4.7-45	C435	4.7-53
	C309		C309		C436	

Equipment needed:

1. A nonmetallic screwdriver.
2. Two meters (0-50 and 0-250 microamperes).
3. A crystal of the proper frequency for the high frequency oscillator.
4. Signal generator (25-50 MHz ranges).

To change frequency or align the rf and antenna stages:

1. Turn the receiver on and allow it to warm up for two or three minutes.
2. Insert the new crystal in the high frequency oscillator crystal socket.
3. Insert the 0-50 microammeter in oscillator grid jack J302.
4. Tune oscillator plate tank coil L301, L302, or L303 for maximum oscillator grid current.
5. Note the reading and turn the iron core counterclockwise until meter reads 50 percent of the maximum grid current (approximately one-half turn).
6. Insert a 0-250 μA meter in first-limiter grid jack J303.
7. Apply an unmodulated signal to pin 1 XV301, the first rf grid, through a 0.01 μF capacitor.
8. Peak transformer T302, T322, or T332, the first rf plate transformer, for maximum first-limiter grid current. Start at the bottom trimmer and work toward the top.
9. With the receiver connected to the proper antenna, transmit on the operating frequency a weak, unmodulated signal from the signal generator. Keep the signal level low enough so that the limiters will not saturate.
10. Peak transformer T301, T321, or T331, the antenna transformer for maximum first-limiter grid current.

GENERAL DATA

I have noted many FM surplus centers around the country are selling these GE rigs with control heads and cables for around $50. I would recommend that if you are going to purchase any units, specify the model which would suit your frequency of operation and, of course, a 6 or 12V unit for mobile or fixed. Figures 5 and 6 show outline diagrams for various transmitter and receiver types.

I have in operation two units, one mobile and one fixed. The mobile transmitter unit derives its high voltage from a dynamotor supply. To increase the transmitter efficiency, I built a transistorized converter to give the necessary high voltage upon replacing the dynamotor. Keep an eye on the surplus market for converter transformers. In the interest of completeness, Fig. 7 shows the mobile interconnection data. For the fixed installation, television transformers do very nicely to supply the high voltage required and with the dynamotor and dynamotor relay removed from the chassis, there is ample room for these components. Fixed installations require no control head. Removing the power connectors and adding small aluminum plates to the end of the chassis, you can mount the microphone socket and power switch for the transmitter, squelch, and volume in the receiver. In the receiver chassis, there is sufficient room for a speaker if a power transformer is placed close to 6AQ5. Cut a hole in the side of the cover and mount the speaker grill.

Well, with the conversion complete, plug in an old CB ground plane (shortened, of course). We'll be looking for you on 29.6 MHz!

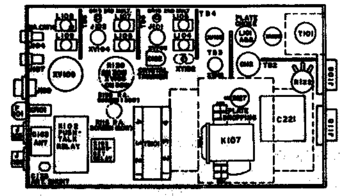


Figure 5a Outline Diagram of the Transmitter Models LST5A4, 5, 6; LST6A4, 5, 6; LST5B4, 5, 6; LST6B4, 5, 6, bottom view (RC-223)

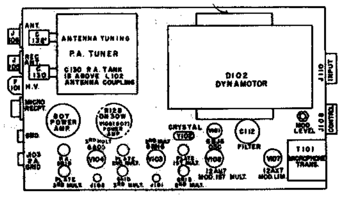


Figure 5b Outline Diagram of the Transmitter Models LST5A1-6, LST6A1-6, LST5B1-6, LST6B1-6, top view (RC-77)

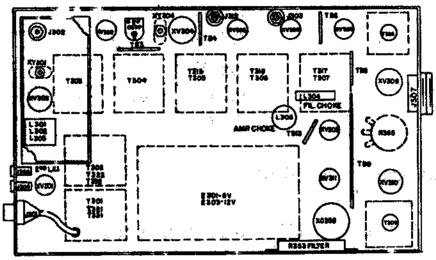


Figure 6a Outline Diagram of the Receiver Types ER-6-A, B, C, D (0-4, 5, 6) (RC-179)

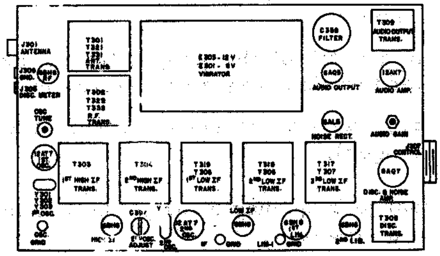


Figure 6b Outline Diagram of the Receiver Types ER-6-A, B, C, D (0-4, 5, 6) (RC-180)

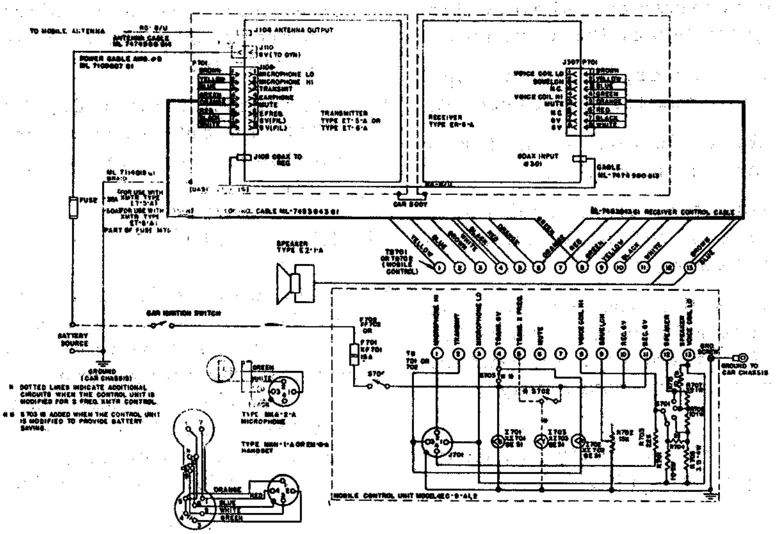
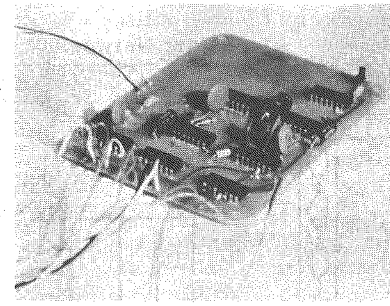


Figure 7 Connection Diagram of the Mobile Installation, Narrow Band Equipment (P-7772982, Rev. 8)



INTEGRATED CIRCUIT

Repeater Identifier

by Tom Woore - POMONA, CALIF.

There is no economically adequate way of identifying a repeater automatically. The FCC rules require that an amateur repeater be identified every three minutes that the system is in use. Though some systems disregard the rule, others are identified via voice by each person using the repeater. The more sophisticated systems identify automatically by employing mechanical code wheels or relays, both of which have a high mortality rate. The question comes to mind, why not a better mouse-trap ? Or in this case, why not a solid state or more state-of-the-art integrated circuit identification unit!!

With no moving parts and a parts cost of about $18, this digital identification unit can be built to outlast anything you put on top of a mountain.

- - - - -

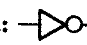
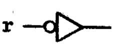
The digital identification unit (DIU) is unique in that it uses a simplified computer address principle for selecting the information it is programmed to send. There are three basic units in the DIU: counter, matrix (memory), and signal logic. The counter establishes which sequence is next. The matrix determines what instruction is next by the sequence. The signal logic converts the instruction information into the actual signal to be sent. The whole system is based on a closed loop and therefore no standard clock is employed in the logic.

To understand how the DIU works we must first become familiar with some of the simple logic units that the system is based on.

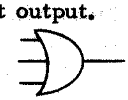
High: Output of logic unit (at least +1.5 volts)

Low: Output of logic unit (less than 0.5 volt)

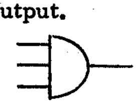
Inverter: Device used to produce opposite logic state of what is fed into it. Example: +2 volts input into an inverter would produce a zero output while a zero input would produce a +2 volt output.

Symbol:  or 

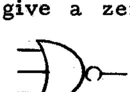
OR gate: Device used to give an output for any of the signals fed into the input. Example: 3 inputs, one at +2 volts, the other two at zero, would give a +2 volt output.

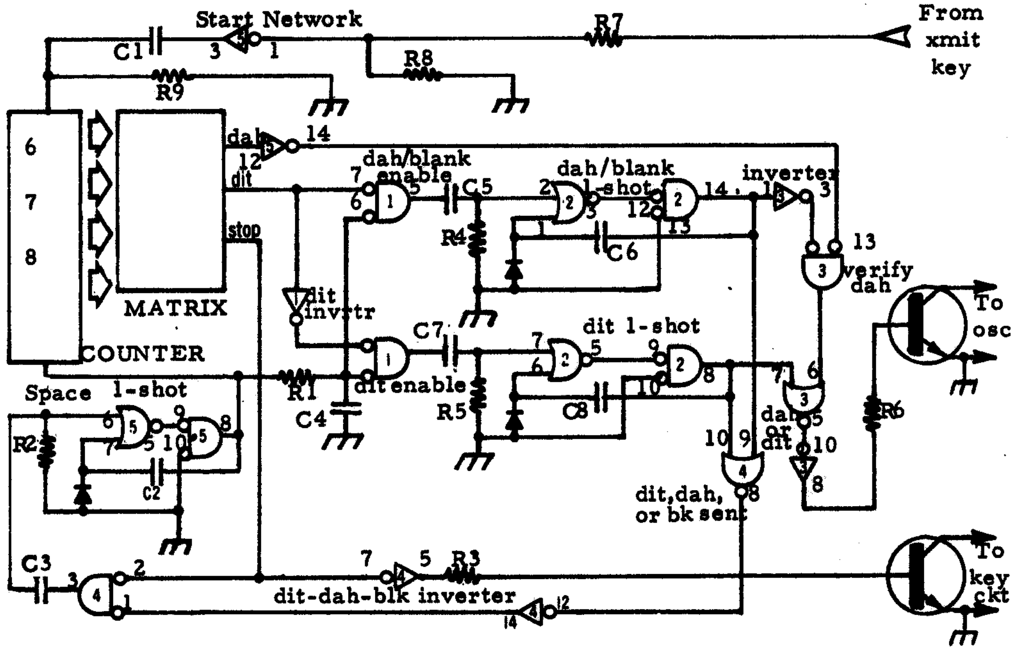
Symbol: 

AND gate: Device used to give an output for all input lines being high. Example: +2 volts on all 3 inputs of gate produces +2 volts on the output.

Symbol: 

NOR gate: An inverted OR gate; device to give a zero output when any of its inputs are high. Example: 3 inputs, one at +2 volts, the other two at zero, would give a zero output.

Symbol: 



PARTS LIST

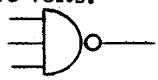
R1, R7	3.3K
R2, R3, R4, R5, R6, and R9	10K
R8	6.6K
C1, C3, C4, C5, and C7	.05 uF
C2, C8	10 uF
C6	30 uF
Diodes (including matrix diodes), 20 to 100	
1, 2, 3, 4, 5 (within symbols above)	HEP 570 (Motorola)
6, 7, 8 (within symbols above)	HEP 572 (Motorola)
Transistors	2N3415 (GE)

All resistors: one-quarter watt or greater capability.
All capacitors: 6 volts or greater, working capability.
Numbers outside symbols refer to pin contacts on IC's. Grounds not shown.
Ground contacts are as follows:

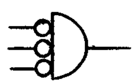
IC NUMBER	GROUND PINS
1	12,
2	12, 10,
3	2, 9
4	13, 6
5	10, 13, 2

FIG. 1 SYSTEM SCHEMATIC DIAGRAM, DIGITAL INTEGRATED CIRCUIT REPEATER IDENTIFICATION UNIT.

NAND gate: An inverted AND gate device used to give a zero output when all of its inputs are high. Example: 3 inputs all at +2 volts produces an output of zero volts.

Symbol: 

For this article, NOR gate logic was used for NAND functions; therefore, the definition for our purpose of a NAND gate is a device used to give a high output when all of its inputs are zero. Example: 3 inputs at zero produces +2 volts output.

Symbol: 

Note that the zero placed before or after the inverter, NOR, and NAND logic units defines the expected state of the input or output.

Unit: Smallest bit of information sent by the digital identification unit, dit, dah, and blank.

The digital identification unit uses the MC 700 series integrated circuits due to their inexpensiveness and availability. The new Motorola HEP line of integrated circuits can also be used.

DIGITAL IDENTIFIER UNIT

A 0 volt signal through the start network from the transmitter keying circuit resets all the flip-flops in the counter to the zero state. All $\overline{Q}$ lines become positive. The positive signals, approximately 2 volts, are fed into the diode matrix which decodes the counter number into an instruction for the oscillator keying logic. In the digital identification unit there are four basic instructions: (1) send a dit, (2) send a dah, (3) send neither dit nor dah (blank), and (4) stop

If the diode matrix decodes the first sequence count (0) to be instruction no. 1 (send dit), the dit signal line from the matrix will be high. This will cause the dit inverter to have a low output and one-half of the dit enable NAND gate would be enabled. Since the space line is also at zero level at this time, a trigger pulse would be sent through capacitor C7 to the dit one-shot. (A one-shot is a monostable device used to generate a predetermined pulse width.) The dit time pulse determined by the one-shot is sent through the dit/dah NOR gate and inverter to key the tone oscillator circuit.

At the same time the dit is being sent by the one-shot to the oscillator, the space one-shot logic is being reset ("dit, dah, or blank," NOR gate, "dit, dah, or blank," inverter, and "space enable" gate).

Upon completion of the dit signal, the "dit, dah, or blank" NOR gate output becomes high making "dit, dah, blank" inverter output low. Since the stop instruction has not been called for by the matrix, the space enable NAND gate produces a high output. The high output from the space enable NAND gate sends a pulse through capacitor C3 to trigger the space one-shot. (The space time period is used to separate the units of a letter. Example: D = dah space dit space dit.)

The space period is the same as the period for a dit. The space signal, besides allowing for the time to distinguish the units of a letter, advances the counter to the next unit and resets the dit and dah one-shots by discharging capacitors C5 and C7.

If the diode matrix decodes the next sequence to be instruction no. 2 (send dah), the dah signal line from the matrix will be high and the dit signal line will be low. When the space line becomes low, the dah/blank enable NAND gate will send a pulse through capacitor C5 triggering the dah/blank one-shot. The dah time pulse would then go through the dah/blank inverter and be challenged by "verify dah" NAND gate to see if the pulse was for a dah. An affirmative check would come from the dah inverter with a zero level output. The dah signal would then be sent through the dit/

dah NOR gate, inverted, and sent to the oscillator keying circuit. The space one-shot is then triggered to advance the counter to the next unit.

If the diode matrix decodes the next sequence to be instruction no. 3 (send a blank), neither the dah nor dit line will be positive. The same will occur again as if a dah were being sent, except that when the signal reaches the "verify dah" gate, it will be stopped from keying the oscillator. This generates the blank period which is put between letters. (DE = dah space dit space dit blank dit blank.) Again the loop through the space one-shot is triggered and the counter is advanced to the next unit of information.

The counter is advanced each time a unit of information is sent until it is advanced to the "stop" instruction. This instruction causes a blank to be automatically sent and stops the space enable NAND gate from triggering the space one-shot. The digital identification unit remains in the stop state until a reset pulse is sent to the counter from the transmitter keying circuit again.

The R1, C4 network is used to slow down the fall of the space line so that the counter is allowed to advance before the sending logic is ready to send the next unit of information. Transistor T2 is used to key the transmitter keying circuit while the digital identification unit is sending its identification code.

DIODE MATRIX

Up until now very little has been said about the diode matrix other than the fact that it determines what instruction to give the keying logic. The actual construction of the matrix can be made considerably cheaper by simplifying the diode logic. Up to 70 percent of the diodes necessary for the diode matrix can be eliminated by using mathematics. A much more sophisticated, economical, and space-saving layout can be achieved using Boolean Algebra. The matrix in this DIU employs the simplifying techniques of Boolean Algebra.

Thanks to Mr. Karnaugh, it is not necessary to give a complete discussion on Boolean Algebra. The Karnaugh map, which is shown below, is a device for mechanically determining the mathematical equivalent of the diode matrix. For the purposes of this discussion the MCW message for the DIU will be "DE W6FNO." Of course, any other message can be developed by this method and consequently this discussion may be used for developing any matrix logic for controlling a system.

The first step in determining the diode matrix for the message is to break up the message into the units to be sent (. = dit, - = dah, x = blank). This is shown in the breakdown diagram of Fig. 2.

FIG. 2

IDENTIFICATION UNIT BREAKDOWN

It is seen that 30 units of message will be sent (0 is actually used for a blank). To convert units 0 to 29 into information as to how many diodes will be used, the Karnaugh map is needed.

The numbers in the box (Fig. 3) correspond to the decimal number equivalent to units on the output of the counter. The numbers across the top and along the side of the chart correspond to the binary output of the flip-flops - 1 for true or 0 for false. The letters written diagonally refer to the five flip-flops. Example: Box 17 has flip-flop A true, B false, C false, D false, and E true. Written in Boolean form, 17 would be represented by $A\overline{B}\overline{C}\overline{D}E$, where the bar over the letter means that the flip-flop is false and, conversely, a letter without a bar (CBA) represents a flip-flop that is true.

To simplify the matrix, a Karnaugh map is constructed for both the dits and dahs to be sent. From Fig. 2, 2, 3, 5, 8, 13, 14, 15, 16, 18, 19, 21, and 24 represent the dits to be sent in the message. In the dit Karnaugh map (Fig. 3) a "1" is placed in each box corresponding to the number. An X (not the x which represents a blank) is placed in all boxes after the stop code number. These are "don't care" conditions because the counter will not count to these codes.

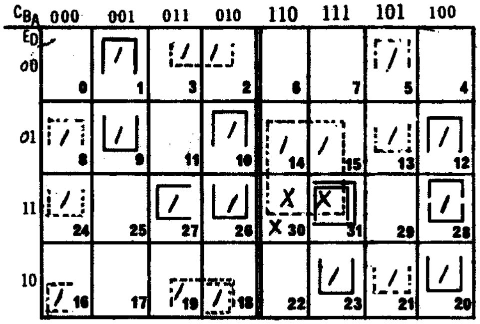


FIG. 3 KARNAUGH MAP (DIT= ---DAH=—)

From the dit Karnaugh map it can be seen that the third unit of information is a dit and that the flip-flop A is true, B is true, C is false, D is false, and E is false (or $AB\overline{CDE}$). To put this in matrix form, the Boolean Algebra tells us that this dit would be represented by a diode connected to Q_A lead (the true lead of flip-flop A), another to Q_B, another to $\overline{Q}_C$ (the false lead of flip-flop C), another to Q_D, another to Q_E. It would take five diodes normally for sending this information (Fig. 4).

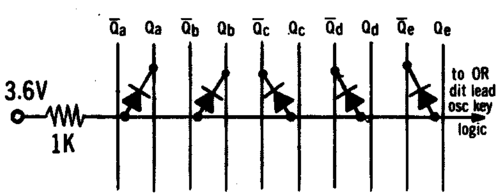


FIG. 4 UNIT 3 INFORMATION DIT

It would normally take five diodes for each unit of information in the message or 29 x 5 = 145 diodes. This does not count the diodes needed to OR the dahs together and dits together, which requires an additional 21 diodes. A total of 166 diodes would be used. This is where the Karnaugh map saves diodes. On the map (Fig. 3) any adjacent box or any box that changes just one variable from another box eliminates that variable. Boxes 8 and 24 simplify to $\overline{ABC}D$, eliminating the E flip-flop altogether. Boxes 3, 2, 19, 18 also simplify since they change one variable at a time (or $B\overline{C}\,\overline{D}$). Note that not only is 3 (Fig. 3) represented by $B\overline{C}\,\overline{D}$, but 2, 19, and 18, resulting in a savings of 20 - 3 = 17 diodes. 14, 15 combine with "don't cares" 30, 31 to equal BCD. The final expression for the dits is BCD + BCD + A B D C + A B C E + AB CE + AB CD. A total of 22 + 6 (number of OR groups) = 28 diodes are used to express all the dits in the message. A total of 61 diodes makes up the complete matrix including dits, dahs, and stop codes. Quite a few less than 166!

The final matrix appears in Fig. 5 for the message DE W6FNO. Note that any matrix of this magnitude can be determined by the above method. Figure 5b shows wiring for the counter. Note that Fig. 5b mates to the leads of Fig. 5a.

CONSTRUCTION

The layout used for the identifier was adopted so that the unit could be mounted to the side of the transmitter cabinet of the repeater on standoffs. However, any physical configuration can be used to develop the layout. The printed circuit board, seen in this article, is available from

If sockets are not used for the ICs, care should be taken so that they are not overheated. A small "pencil" iron will do nicely for soldering the ICs rapidly to the PC board.

All parts are readily available from most electronic parts houses. The ICs and the 3.9V zener used in the project were obtained from Hamilton Electro-sales. The power supply (Fig. 6) was designed to be shortproof and limits current to a maximum of 1 amp at 3.6 volts.

INSTALLATION

The signals normally received and sent to and from the DIU should meet the following criteria

1. From power supply - 3.6 volts dc, well filtered and regulated

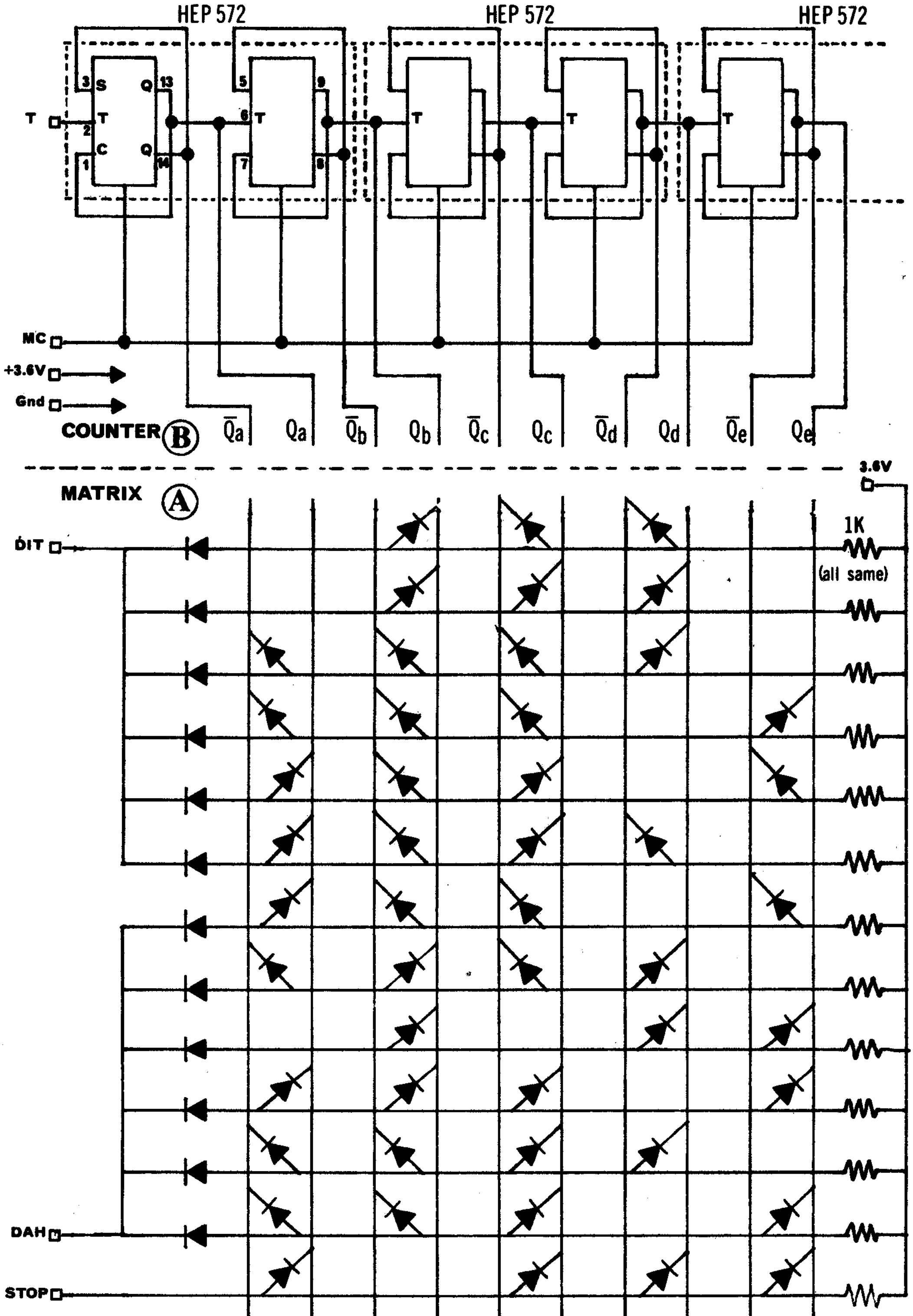


FIG. 5 "DE W6FNO" BOARD & UNIVERSAL COUNTER

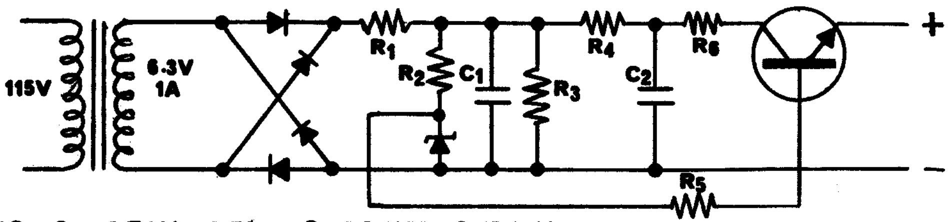


FIG. 6 REGULATED IC POWER SUPPLY

2. From transmitter keying circuit - 0 volt transmitter keyed; approximately 6 volts transmitter not keyed
3. To oscillator keying circuit - tone off: 10 megohms (nominal); tone: 10 ohms
4. To transmitter keying circuit - identifier off: 10 megohms (nominal); identifier on: 10 ohms

Note that all lines should be filtered dc. In some relay circuits the output of a bridge rectifier is used to directly key the transmitter. In order that the pulsating dc does not key the digital identification unit, a 60 µF capacitor or greater should be put across the relay supply. While installing the W6FNO DIU, it was discovered that the grounded 6.3 volt filament supply in the transmitter could not be used to power the DIU. The reason this arrangement could not be used was because the output of the rectifier in the DIU was grounded. If any of the signal lines do not meet the criteria set above, simple diode, resistor, and capacitor circuits can be used to condition the signal.

When the final installation of the DIU was completed for W6FNO, the transmitter keying circuit from the DIU was disconnected; this was due to the fact that the DIU only takes 2 seconds (42 wpm) to identify the station. If the carrier keying the repeater dropped out while the DIU was identifying, the completion of the MCW would be lost in the squelch tail of the receiver.

Obviously, the PC board for the W6FNO matrix could not be used for other systems. The DIU, however, is applicable to all identification systems. Actual size patterns for the board (two sides) are provided in Fig. 7 (a and b).

SUPPLY PARTS

RESISTORS:

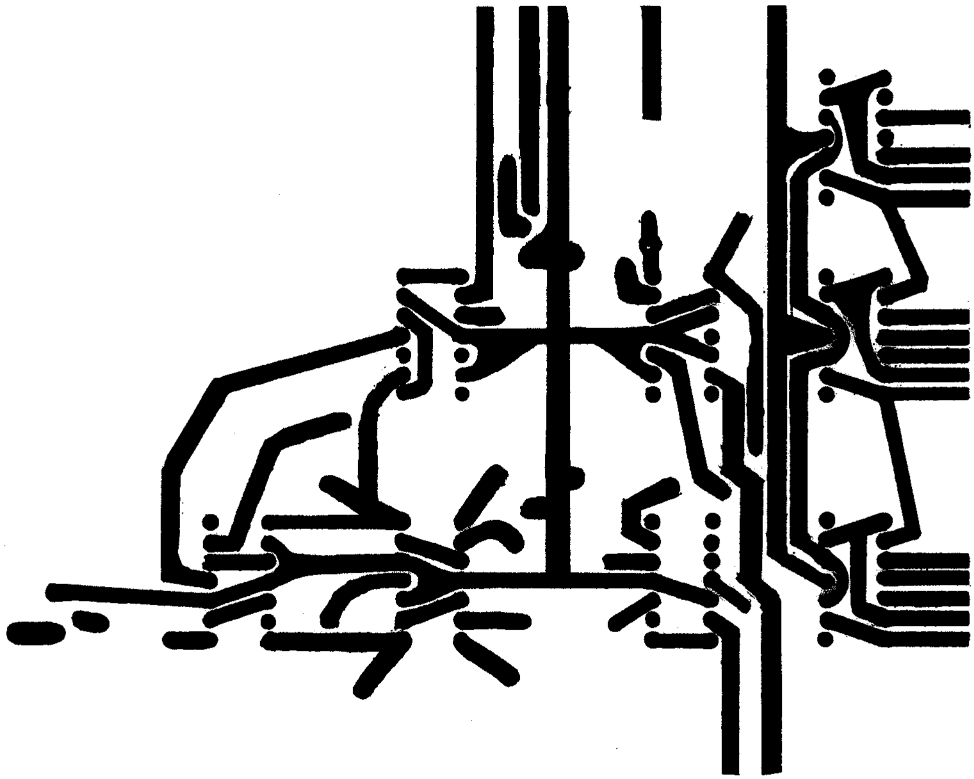
$R_{1,4}$	1 ohm, half watt	2
R_6	8 ohm, 2 watt	1
R_3	1K ohm, half watt	1
R_2	220 ohm, half watt	1
R_5	100 ohm, half watt	1

CAPACITOR:

200 µF, 15 volts	2

SEMICONDUCTORS:

HEP 245 (or 2N4921) Transistor	1
HEP 175 Bridge Rectifier	1
1N5228 Zener, 3.9V, 0.5W	1



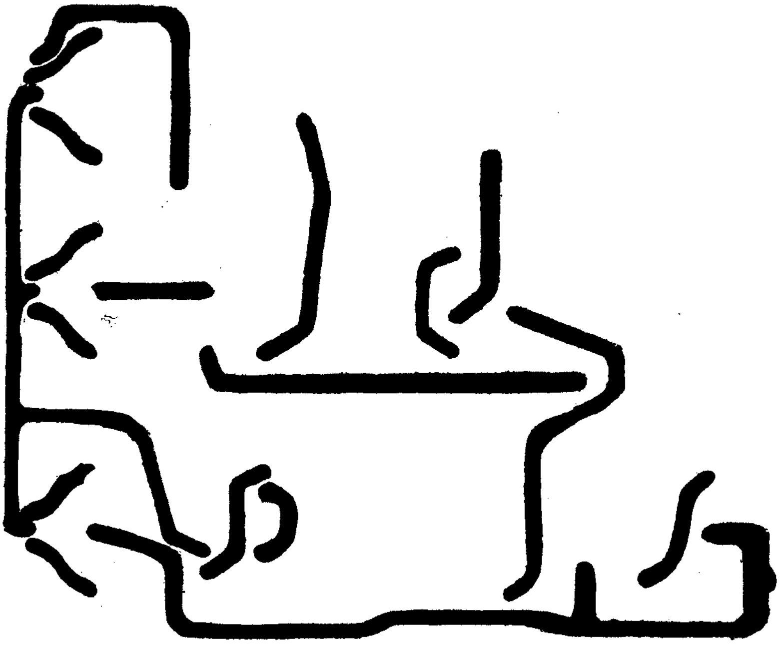
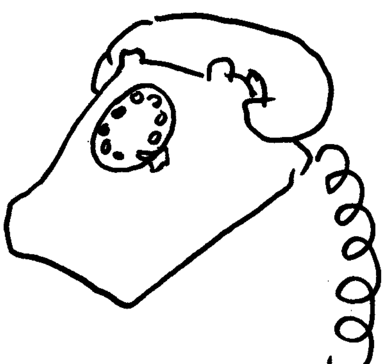


FIG. 7 CIRCUIT BOARD LAYOUT (2 SIDES)

TELEPHONE COMMAND OF REPEATER OPERATIONS



How to use the repeater site's landline for back-up control

A not-too-often considered means of remote control is the telephone itself (assuming a telephone is available at the remote site). As a principal control element, the telephone has certain disadvantages, but as a backup system the telephone has no equal. There is no feeling quite as comfortable to a remote or repeater owner as the knowledge that he can shut down his system regardless of what happens to the hilltop transmitter or receiver and regardless of where he is. For he knows that to accomplish shutdown, he need only go to the nearest telephone and dial the remote number. When the remotely situated telephone rings, the shutdown function will occur.

The circuit of Fig. 1 shows how the telephone ringing voltage can be used to trigger a selected function without causing interference to the phone line. The ac ringing voltage is isolated from the phone lines through C_1 and C_2 and rectified to produce a dc signal which triggers the current-operated relay. Omission of C_1 and C_2 would cause excessive loading of the phone line and would result in hum, level problems and dc entry. The filter capacitor must be low enough in value to allow full charging during a one-second ring so that enough power is available to pull in the relay.

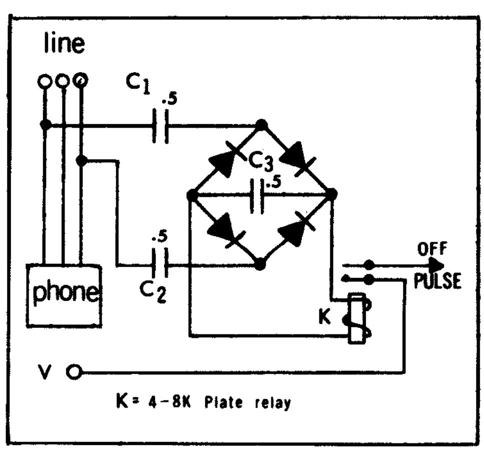
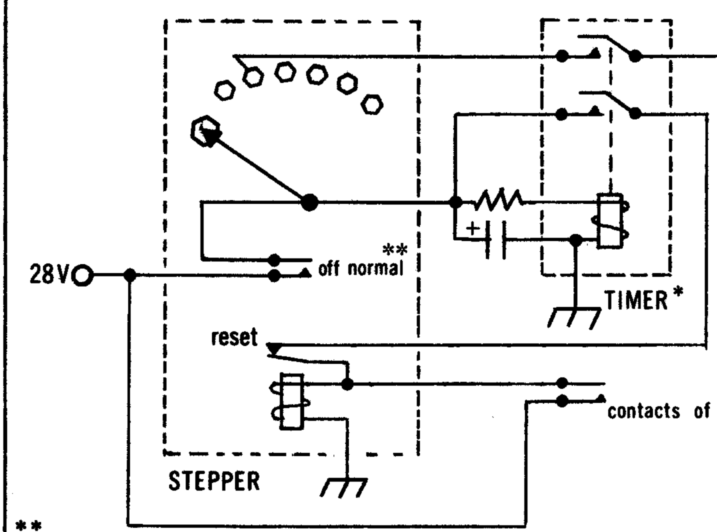


FIG. 1 SAFETY "OFF" SYSTEM.

It is easy to see the difficulties that could arise if the telephone number were commonly known, since any ring would cause immediate interruption of repeater service. This problem can be avoided by adding the extra circuitry required so that the system will shut down only when the phone rings a specific number of times. This circuit is shown in Fig. 2.

In the case shown, the desired function occurs when the phone has rung exactly twice. The first ring prevents the stepper from reaching the right point. If a third ring occurs, the function is canceled. The function occurs only when the phone has rung two times and the stepper rests on position 2. Ringing of the phone energizes the timer and moves the stepper. The stepper will automatically reset after it has been energized. The period of the timer should be selected to allow sufficient time for the stepper wiper to come to rest on the "off" contact with a few seconds to spare.



* Timer is standard relay with resistor and electrolytic chosen to provide desired period. Period should be set for time required for wiper to come to rest on contact, plus two seconds; otherwise timer could reset after multiple rings, be retriggered, and made to inadvertently land on OFF contact.

**
Off-normal contacts make when stepper is energized, break after reset is completed. Some steppers do not have this capability, but it can be simulated on multideck steppers by bussing the contacts of a deck together and using that deck's wiper as a switch contact.

FIG. 2 CODED "OFF" PULSING SCHEME

Converting the 450 MHz PROG LINE Telephone Mobile

by C L Coltin GLENDORA, CALIF

Because of the recent FCC land mobile Rule changes for commercial users, there should be an abundance of 450 MHz Progress Line mobile units being removed from service. A great many will be special mobile units set up for telephone service. Since these are equipped with Secode selectors, they are not usable "as is" on amateur systems.

But with a little time and a few simple conversions, the Progress Line telephone mobile can be made into a fine amateur unit.

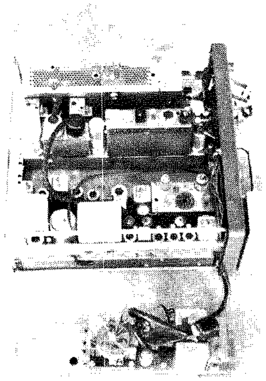
The first thing to do will be to unplug and remove the Secode selector. This is held to the frame by four bolts. Next unplug and remove the transmitter strip. This will give access to the front plug and the T-power side plate.

Very carefully, cut the wires to the cord from which you unplugged the selector (from the plug on the front plate). Three of these wires lead out of the T-power unit. Save as much of these three leads as you can so you can attach them up to the front plug. The shield wire goes to pin 19 on the plug, the red wire to pin 20, and the black wire to pin 21. There is a fourth orange wire feeding from the T-power to the selector cable. This is a B-plus wire. Cut and tape it.

Next, remove the side cover from the T-power strip. This is done by removing the three cross-recessed retaining screws from the top. The cover will then slide up and out.

NOTE

On top of the unit there is a control pot with a large washer. Remove this pot and all the connecting parts that go to the terminal board.



Disconnect the audio cables from the pot and wire cables together. (The wires are color-coded, so this should be no problem.)

If you wish, you can install a standard GE chassis mike connector in the hole from which you removed the pot and wire the cables to this for easy operation directly from your unit. The unit is now ready for tuneup and operation.

Sometimes these units will experience a T-power whine. If this should occur, turn the unit over. Note under the transmitter there is a ceramic trimmer in the osc. circuit. Pad the trimmer with a 10 to 15 pF NPO capacitor until you can get a reading on the multiplier 1 test jack of less than 0.5 volt. This will, in many cases, eliminate most of this problem.

ICE-1 2 METER FM TRANSCEIVERS

FULLY SOLID STATE - NO TUBES

- Operates on 117 VAC — 12 VDC — or optional internal NI-CAD battery
- Self-contained 3" X 5" speaker
- Military type fiberglass printed circuit boards
- Transmitter power output 4 watts minimum
- Regulated power supply — cannot be damaged by reverse polarity
- May be ordered for either wide or narrow band operation at no extra charge (wide band supplied unless specified)
- Small size: 8"w X 3½"h X 9½"d
- Light weight — Less than 4½ lbs.
- Built in 117 VAC power supply
- Simply plug in proper power cable to charge from 117 VAC to 12 VDC operation
- Transmitter and receiver channels individually switchable
- 3 channels transmit — 3 channels receive
- Push-to-talk operation

ICE

MANUFACTURED IN U.S.A. BY

INTERNATIONAL COMMUNICATIONS AND ELECTRONICS, INC.

1917 NW MILITARY HIGHWAY/SAN ANTONIO, TEXAS 78213/512 341-1311

Circle Number **14** on Reader Service Card

Quickie TONE GENERATOR

...for whistle-on use

In many ways, the W6FNO repeater at Radio Ranch could serve as a model installation. The repeater stands ready for use 24 hours a day and is never shut down where it cannot be accessed by a station on the input frequency (146.82 MHz). On the other hand, the repeater will shut itself off if a three-minute period elapses with no signals on the input. Sounds a little contradictory, but it isn't -- not really. The W6FNO repeater was an experiment to test the concept of subcontrol, i.e., limited control of the repeater from the actual frequency of operation.

The FCC sanctions use of semicontrol techniques such as continuous-tone squelch and single-tone in applications requiring limited access to a remote or repeater. The W6FNO repeater crew took the idea one step further, and the result is a repeater that is fully compatible with on-channel non-repeater operation, and one which does not pointlessly add to the congestion of a crowded band.

The repeater is equipped with two timers. The first timer is a transmission-limiting device: when the input carrier exceeds three minutes duration, B-plus is removed from the transmitter final; and it can only be reapplied after the input carrier drops out momentarily. The second timer removes the transmitter B-plus also. But in this case, it is activated from absence of an input signal for three minutes. Since the shutdown is only B-plus removal, the repeater stands ready to be activated immediately upon application of the proper signal, which in this case is nothing more than a shrill whistle.

The active FM channel in the W6FNO area is the input frequency, 146.82 MHz. The repeater output frequency is not used at all except to monitor the repeater output. When two stations

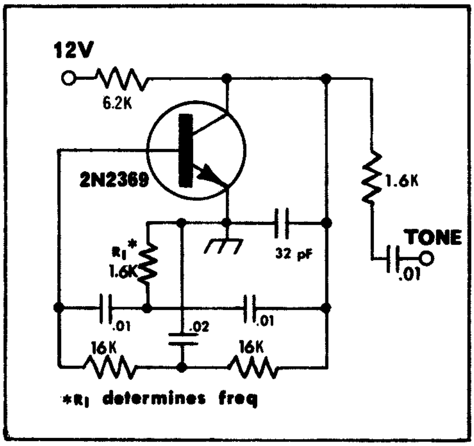


FIG. 1 AUTOMATIC "WHISTLER"

are conversing on the FM channel, the repeater is not even part of the operation unless one of the operators wants it to be (as for instance, when the copy gets rough).

When a user wants to monitor the active 146.82 channel, but he is too far away from the area of activity to hear the stations, he merely puts a carrier on 146.82 and whistles into the microphone. Instantly the repeater comes on, regardless of the

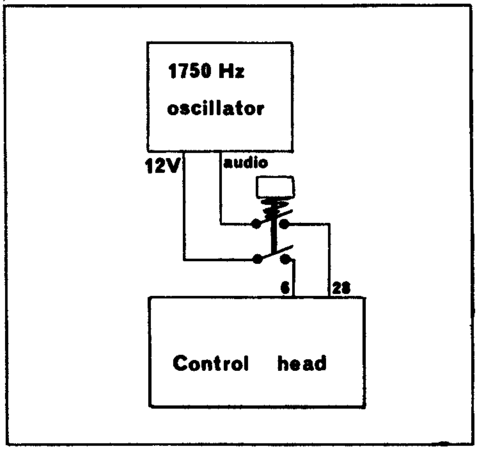


FIG. 2 INTERCONNECTION

time of day or night, and the user finds himself right in the middle of the action. The only difference is that he hears his .82 on 146.70.

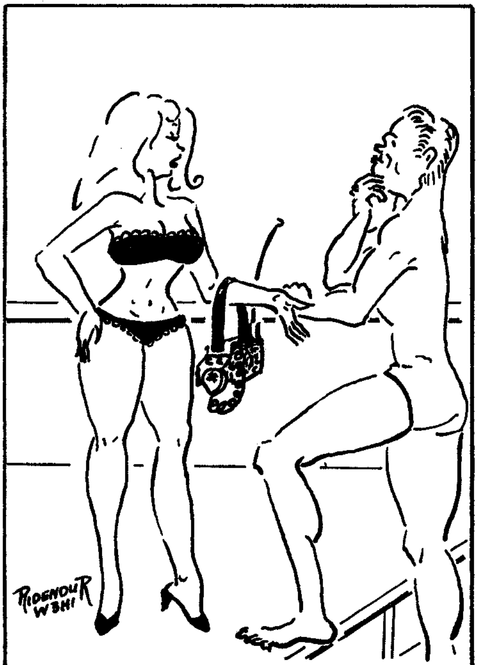
The decoder at the repeater site that provides the turn-on function is nothing more than a simple frequency-to-dc converter such as the semiconductor decoder shown in the July issue of FM Magazine (page 14). This device is set to respond to as broad a range of frequencies as possible without being energized from voice tripping.

Even though the W6FNO decoder was set to respond to a wide frequency range, a few users found it difficult to key the repeater on. Perhaps their audio was not quite what it should be to reproduce the required tone (1750 Hz), or perhaps they were simply not proficient at whistling. At any rate, one of the users (John, W6ZCL) hit upon the idea of installing a simple automatic whistler in each of his transmitters.

The circuit he designed was too uncomplicated to be considered an encoder; it consists of nothing more than a single-transistor oscillator using a twin-T feedback network. As can be seen from the circuit of Fig. 1, the design is the absolute epitome of simplicity -- and it works every time.

John didn't connect the whistler so that it would go on with each transmission; not only would this have defeated the purpose of the automatic-off function, but it would have given him the unpleasant characteristic of a squeal at the outset of each transmission. Instead, he connected the device into his unit so that it is energized by pressing a momentary-contact switch on the control head. Figure 2 shows how the oscillator is used with John's Motorola unit.

The automatic shutdown feature of the W6FNO repeater has done a great deal to enhance the relationship between the repeater users and the nonrepeater users in its locale. That segment of amateurdom that is against repeaters because they are used without necessity on many occasions can be satisfied that the repeater "responsibles" are doing their part to minimize the likelihood of unnecessary operation and use, but to provide an unmatched communications capability when it is needed.



"Why wont you believe I'm 34-76-94?"

FM Repeaters

IF THERE ARE ANY CLOSED OR RESTRICTED-ACCESS REPEATERS LISTED IN THIS DIRECTORY, PLEASE NOTIFY FM MAGAZINE IMMEDIATELY. THIS DIRECTORY IS ISSUED AS A COMPLETE LISTING OF ONLY OPEN REPEATERS.

Following the publication of the quarterly repeater directory, our incoming mail is dominated by "corrections," usually from individuals who have noted particular omissions from the listings. Most of the omissions, however, are intentional, because the repeater in question almost invariably belongs to a select group of users who restrict its use by CTS or other "semiprivate" signaling schemes. The directory is issued for the benefit of ALL FM operators, and does NOT include repeaters with a "secret" input or systems requiring special access codes. The only exception to this is the whistle-on repeater, and this exception is only made when all FM'ers are invited to access the repeater at their discretion.

So, if you notice a conspicuous omission from the directory, please be sure the unlisted repeater is free of attached strings before making a request to include that repeater in the official directory. THE REPEATER MUST BE ACTUATED ON A PURELY CARRIER-OPERATED BASIS TO QUALIFY AS AN OPEN SYSTEM.

Address all correspondence concerning repeaters to FM Repeater Directory, One Radio Ranch, San Dimas (8), California 91773.

Repeater	In	Out	Location (Coverage)
			ALABAMA
W4RFR	146.34	146.94	
			ARKANSAS
WA5NQO	50.50	50.40	Fayetteville (NB)
W5DI	146.30	145.50	Little Rock (NB)
			ARIZONA
WA7CEM	146.34	146.94	Greater Phoenix area
W7AJU	146.34	146.94	Prescott
			CALIFORNIA
W6FNO	146.82	146.70	San Gabriel Valley, Los Angeles (whistle on)
WB6SFU	(DELETED BECAUSE TONED)		
	.34-to-.94 deleted because intermittent		
WB6AAE	146.2	146.8	Grizzly Peak
WB6TSO	146.2	146.8	Central Coast
W6NCG	146.85	147.71	Meadow Lakes
WA6YCZ	146.85	147.71	(Mt Umunhum)
W6DOO	146.85	147.71	(Mt Allison)
W6AQU	146.85	147.71	(Mt Toro)
W6AEX	146.2	146.85	(Mt Vaca)
W6CX	147.8	146.94	(Walnut Creek)
K6JIM	146.0	147.7	Central Valley
WA6VFO	146.52	147.18	Los Angeles
WA6MPV	145.12	146.9	Los Angeles
WB6GUA	146.44	146.94	Los Angeles
WB6DSL	146.34	146.94	San Diego
WB6QEO	51.20	51.0	Alabama
WB6QVV	51.20	51.0	Placer County
WB6LJR	51.624	51.024	Santa Clara
	51.624	51.024	Solano County
WB6NDJ	51.70	51.075	Alameda
			CAROLINAS
W4WID	52.76	52.525	Lenoir NC
WA4FYS	52.76	52.525	Burlington NC
		146.98	Burlington NC
W4DCD	52.78	52.525	N Wilkesboro NC
	52.525	146.9	N Wilkesboro NC
	52.76	52.525	Columbia, SC
	146.34	146.94	Columbia, SC
			COLORADO
	145.32	146.94	(Grand Junction) Western Colorado, East Utah
	145.32	146.94	(Grand Valley) Local backup for above
	146.34	146.94	(Cheyenne Mt) Pueblo, Colo Springs
	146.34	146.94	(Denver)
	146.88	146.94	(Denver)

Repeater	In	Out	Location (Coverage)
			CONNECTICUT
W1VVK	146.34	146.94	(Avon) south to New-haven and East L.I.,
W1VVK	146.94	52.92	north to Greenfield
K1TKJ	146.88	52.98	Bantam
W1LRC	146.34	146.94	(Danbury) intermittent
K1TKJ	53.10	146.31	(also out on 52.98)
WA1JTB	146.31	146.88	Trumbull to NY
W1LVL	146.94	52.525	East Conn
			FLORIDA
WB4GLK	146.34	146.94	Okeechobee
WB4GLK	146.94	146.76	(to Tampa)
WB4HAE	146.34	146.76	(Tampa) (NB)
	146.34	146.94	(Starke)(NB)
WA4EVU	146.34	146.76	(Ft Walton Beach) (WB)
WB4HAA	146.34	146.76	(Miami) (NB)
			GEORGIA
W4VO	146.34	146.94	NW Georgia, NE Alabama
			HAWAII
KH6EQF	52.525	53.52	Diamond Head
KH6EQF	146.20	146.80	Diamond Head
KH6EQF	147.0	146.80	Diamond Head (AM in)
KH6EQF	148.01	143.98	MARS (AM)
			IDAHO
			(none)
			ILLINOIS
W9ZND	146.46	146.88	Upper Chicago
WA9EAE	146.46	146.64	Chicago
WA9EAE	146.46	146.88	South Chicago
WA9ORC	146.34	146.76	Also 52.76 to 52.525
WA9GCK	146.34	146.94	Bloomington
W9NGI	147.45	147.75	SRO CFAR
WA9EAM	146.34	146.94	(Petersburg)
W9YRB	147.40	147.81	Aurora
			INDIANA
	146.94	52.525	(South Bend)
WA9GOP	146.46	146.88	(South Bend)
			IOWA
			(none)
			KANSAS
WØDKU	146.34	146.94	Wichita (extended)
	146.34	146.94	Topeka (intermittent)
WAØCJQ	146.34	146.94	(Salina)
	146.34	146.94	(Canton)
WAØOFH	146.34	146.94	(Kansas City)
	52.70	52.525	(Kansas City)

Repeater	In	Out	Location (Coverage)
			KENTUCKY
W4MOP	146.34	146.94	(Louisville)
K4UCS	146.34	146.94	(Owensboro)
			LOUISIANA
W5UK	146.34	146.94	New Orleans
W5MCC	146.34	146.94	Galliano
			MAINE
			(none)
			MARYLAND
WA3DZD	146.34	146.76	(Harmans) Baltimore,
	52.525	146.82	Wash D.C.
	146.22	52.525	(Baltimore)
WA3DZD	146.34	146.76	
			MASSACHUSETTS
W1VAK	146.34	146.94	(Cape Code)
	146.94	52.92	(Cape Code)
	146.94	52.525	(Cape Code)
W1CDO	146.34	146.94	New Bedford to
W1CDO	146.34	52.525	Providence
W1DRP	146.34	146.94	Wooster and
	146.34	52.525	Boston
	146.34	146.94	North Adams
W1ALE	146.34	146.94	Concord NH to Boston
			MICHIGAN
K8TIW	146.34	146.94	Kalamazoo (inter
	146.46	146.94	Pontiac-Rochester
WA8OYE	146.34	146.76	Detroit
			Strings attached: no base stations
			MINNESOTA
WØPZT	146.54	146.85	Hennepin County
			MISSISSIPPI
			(none)
			MISSOURI
KØOKI	52.88	52.525	Kansas City
WAØAMR	146.34	146.94	Kansas City
KØFRA	52.70	52.525	Kansas City (inter-mittent)
WAØCJW	146.34	146.94	St Louis
			MONTANA
			.34-.94 in the works for Anaconda, Butte
			NEBRASKA
	146.34	146.94	Omaha
			NEVADA
W7DDB	146.34	146.94	Las Vegas
W7DDB	146.94	147.84	Las Vegas (inter-mittent)
K7UGT	146.34	146.94	Reno
			NEW HAMPSHIRE
W1ALE	146.34	146.94	Concord (thru Boston)
K1MNS	146.34	146.94	E Derry (whistle on)
			NEW JERSEY
			Coverage from NY repeaters
			NEW MEXICO
WA5KUI	146.34	146.94	Alamagordo
WA5JDZ	146.34	146.94	Albuquerque
K5CQH	146.46	147.06	Albuquerque
WA5DMQ	145.50	146.50	Roswell
W5PDO	146.34	146.94	Los Alamos
	146.34	146.94	Caprock
			NEW YORK
WA2VNU	146.34	52.72	
	52.80	146.76	
K2SDP	146.34	146.76	Schenectady
W2GHR	146.34	146.94	(Manhasset) Vermont, Mass, N.J., N.Y.
W2OQI	146.34	146.94	Long Island (Center Moriches)
K2GUG	146.34	146.94	(Buffalo)
	146.76	52.92	Suffolk County
W2CVT	146.34	146.76	(Poughkeepsie)
W2CVT	146.94	149.40	(Poughkeepsie)
K2GVI	146.34	146.94	(Utica)
W1JTB	146.94	146.34	Tone operated (Manhasset)
WB2YQJ	146.94	(?)	(Milbrook)
W2YRL	146.46	146.94	(Syracuse)
K2AE	146.46	146.94	(Troy)
WB2NNZ	146.34	146.94	(Newburgh)
			OHIO
W8IOO	146.34	146.94	Youngstown
W8LGL	146.34	146.94	(Delaware)
	146.34	146.76	(Lorain)
W8THC	146.34	146.94	Newscomerstown
	146.34	146.76	Cleveland
	146.34	146.94	Pittsburg
			OKLAHOMA
WA5LVT*	52.68	52.525	(Tulsa) extended coverage
WA5LVT*	146.34	146.94	(Tulsa) extended coverage
WA5LDB	146.34	146.94	(Bartlesville)
*Interconnected for common output			
			OREGON
K7TBL	146.34	146.94	(Eugene)
WA7ANG	146.76	146.58	Portland
	146.76	146.94	(Newport)
	53.46	52.92	Dalles (Mt Livingston)
	146.34	146.76	(Pendleton)
	146.34	146.76	(LaGrande)
			PENNSYLVANIA
K3UQD	146.34	146.94	Pittsburgh
	146.34	146.76	(Alternate for UQD)
K3PQZ	146.34	146.76	York
WA3ICC	146.34	146.76	(Harrisburg)
WA3BKO	146.34	146.76	Philadelphia (Berwyn)
	146.34	146.76	State College
	146.40	146.46	Sayreville
			RHODE ISLAND
W1CDO	146.34	146.94	Providence
	146.34	52.525	Providence
			TENNESSEE
WA4HBY*	146.34	146.94	Memphis
	146.94	146.20	Nashville
	146.22	146.94	Nashville
	146.34	146.94	Chattanooga
W4IWV	146.34	146.94	(Shelbyville)
*Not official call.			
			TEXAS
	53.05	53.15	Fort Worth
W5OZW	146.34	146.94	Fort Worth
W5YUO	146.16	146.76	Fort Worth
WA5LDL	146.34	146.94	(Tyler)
WA5QLA	146.28	146.88	Houston
	146.34	146.94	Austin
	146.22	146.82	Dallas
	52.85	52.95	Dallas
	146.34	146.94	San Antonio
	146.34	146.94	(Port Arthur)

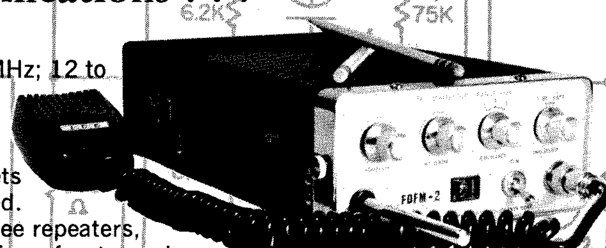
Repeater	In	Out	Location (Coverage)
			UTAH
	146.34	146.94	Salt Lake City
			VERMONT*
W1JTB	146.34	146.94	Killington (multistate coverage)
W1KOO	146.34	146.94	Mt Mansfield (multi-state coverage)
	146.34	146.94	Mt Snow
*See also listings for New York.			
			VIRGINIA
WB4HCX	146.34	146.94	Lynchburg (WB in NBout)
W4GCE	146.22	147.42	Lynchburg
K8SXO	146.76	52.525	Ridgeley
W4DXC	52.72	52.640	Richmond
K8SXO	52.525	146.76	Ridgeley
			WASHINGTON (STATE)
W7AAG	146.34	146.76	Spokane
W7AJF	146.58	146.76	Upper state
W7DAQ*	146.76	53.290	Longview (intermit.)
W7DAQ	53.290	146.76	Longview (intermit.)
	*146.34	146.58	Seattle
	*146.76	146.58	Seattle
	145.26	147.21	Yakima
	52.525	53.290	Richland
* Interlinked, with precedence to .34			
			WASHINGTON D.C.
W3JCN	146.34	146.76	(Throughout district)
			WEST VIRGINIA
COVERAGE ONLY FROM SURROUNDING STATES			
			WISCONSIN
W9ROM	146.34	146.94	Milwaukee
			WYOMING
WA7EGK	146.34	146.94	Sherman Hill (Laramie, Cheyenne)
			CANADA
VE2CRA	146.46.	146.94	Ottawa
VE2CTR	146.46	146.94	Trois-Rivieres
VE2FZ	146.46	146.94	Sherbrooke
VE2JE	146.46	146.94	Drummundville
VE2JE	146.52	147.50	Eastern Montreal
VE2MT	146.46	146.94	Montreal
VE2RM	147.40	147.18	
VE2TA	146.34	147.06	Montreal (intermittent)
VE2VD	146.46	146.94	Quebec
VE2XW	146.70	147.60	Mt St Bruno
VE4XK	146.46	147.33	Winnpeg
VE3NPS	146.22	147.24	Niagara Falls
VE3RPT	146.46	146.94	Toronto
VE3RPT	146.46	147.06	Toronto
VE3SIX	146.22	147.24	St Catherine
VE3SSM	146.34	146.94	Sault Ste Marie
VE7MQ	146.34*	146.58	Vancouver to Seattle
VE7APU	147.33*	146.58	Vancouver to Seattle
			NEWFOUNDLAND
VO1GT	146.46	146.94	All of cape

*UBC repeater, precedence to 146.34 MHz

NOTES

FAR MORE

. . . yes, far more two meter FM Repeater action with this superbly engineered deluxe transceiver. . . Look at these specifications . . .



GENERAL
Frequency range — 144 to 147 MHz; 12 to 14.5 VDC operation; solid-state devices — 32 silicon transistors, 10 diodes; microphone, battery pack, whip antenna, and three sets of crystals of your choice included. Tough modular construction. Three repeaters, transmit and receive, selectable from front panel.

RECEIVER
Two RF sections; three IF sections; dual conversion; 1 μV sensitivity at 20 DB signal to noise ratio; minimum cross modulation; squelch; noise limiter.

TRANSMITTER
1 or 2½ watts output; wide range audio; minimum spurious output; push-to-talk included.

2 watt input FDFM-2	$219.95
5 watt input FDFM-2C	259.95
2 watt 6 meter FM/FDAM-3 AM with VFO	219.95

Inoue Communications Equipment Corporation
Available only through
VARITRONICS INCORPORATED
4109 North 39th Street, Phoenix, Arizona 85018
See these transceivers at the 1969 SAROC Convention in Las Vegas, January 8 through 12. Order direct at above address.

CIRCLE NO. 88 ON READER SERVICE CARD

FM Reviews

the FDFM-2 FM transceiver

FM is rapidly becoming a very popular amateur mode, so it is not surprising that the ever-vigilant Japan electronic industry is beginning to see the potential market in this area. The past year has seen the advent of several new lines of VHF FM amateur equipment from the Japanese giants.

One such item is the FDFM-2, a compact but complete transmitter and receiver for two-meter operation. (A six-meter model is also available now.) The FDFM-2 is not to be confused with the ICE transceiver being marketed by International Communications and Electronics, of San Antonio, Texas. The FDFM-2 is a product of Inoue Communications Equipment Corporation, and is distributed by Varitronics, Inc., of Phoenix, Arizona.

Distributors of both FM units were invited to submit models for evaluation and review (and comparison) by FM's technical staff, but only one of the two actually provided such a unit: Varitronics, Incorporated.

In general, the FDFM-2 comes in two power ranges, one watt and five watts. The unit evaluated herein is the one-watt model. Specifications are as follows:

Freq:	144 - 147 MHz
Pwr Input:	12 - 14.5 volts dc
Semiconductors:	32 silicon transistors 10 diodes
Equipment includes:	Microphone Whip antenna (collaps.) Carrying case One set of crystals on freq. of your choice.

The receiver has two rf sections, 3 i-f sections. It is of dual-conversion design, and boasts a sensitivity of less than 1 uV for 20 dB of quieting. It is equipped with standard squelch and has an audio output capability of 0.7 watt.

Both transmitter and receiver are of modularized construction, with all circuits built on printed boards.

At our request, the Varitronics people supplied a set of crystals with the unit, but the crystals were not on a standard frequency as supplied by the manufacturer, so Varitronics ordered the crystals from a large manufacturer of CB crystals. To the initiated readers of FM, it would be hardly necessary to elaborate on this, but for the benefit of the newcomer, let it suffice to say that Varitronics erred by ordering the rocks from a noncommercial supplier; they were 10 miles off frequency and couldn't be tweaked on with the rubbering capacitor built into the rig. Varitronics could avoid this problem in the future by supplying a copy of the oscillator circuits to Sentry or International so that the oscillator characteristics can be taken into consideration on future crystal orders.

In evaluating the unit, we found the following faults:

The battery pack portion of the unit is of lower general quality than the electronics -- it required a bit of spring-bending to assure firm contact with all the cells. (The cells are standard D flashlight type.)

The receiver squelch control is quite critical, too. If set too tight only the transmitter in the building next door could be heard.

The portable whip antenna that attaches to the top of the unit is on the fragile side, and it would likely require replacement if subjected to the typical rigors of portable operation.

The current of one of the limiters (probably the second) is indicated on a front meter labeled "S-meter" -- hardly in keeping with traditional FM standards. Also, the meter is so sensitive that all respectable (quieting) signals deflect the meter fully. It would seem more valuable to have a meter indicating the discriminator reading rather than limiter. This would at least allow the operator to monitor his receiver frequency against that of the local repeater. A front-mounted discriminator meter would also be handy for those who use their units on vacation trips, where .94 might be a few kilohertz away from .94 (depending on the area of use).

The FDFM-2 is actually quite a bargain, though. It has a three-channel capability on both transmit and receive, as selected by a panel switch. And the unit sells for less than $200 ($189.50, if our information is correct).

The printed-circuit construction is of very high quality, and each internal section is completely shielded from the others (to minimize the problems of intermod and spurious interference).

Although the specifications show the sensitivity of the unit to be on the order of 1 uV, tests proved the FDFM-2 to be better than 0.5 uV for 20 dB of quieting.

It was refreshing to note that the manufacturer's specifications were all on the conservative side. The FDFM-2 is a good value when the price tag is compared with other amateur radio units. It is difficult to refrain from making comparisons with Motorola and GE, both of which are made for commercial use and which are priced at many times the cost of the FDFM-2. Obviously, this low-cost unit is not a MASTR or Motrac, but we think it would be hard to find a better value in new equipment of the FDFM's price class.

Texan named as SARAH 'Outstanding Amateur'

FM's winner of the coveted SARAH is Chuck Horton, of Lubbock, Texas. In spite of the fact that Chuck operates a two-way radio sales and service center in his area, he has earned a reputation for providing FM units to local amateurs on a no-charge basis, and of assisting the unfamiliar amateurs by giving his own time, equipment, and materials to tune up, install, and service those two-way units that he has converted to amateur use and donated to his fellow amateurs. Presentation of Chuck Horton's SARAH is FM's way of recognizing his outstanding contribution to amateur radio, and it is Sentry Manufacturing Company's way of telling him that his efforts exemplify the true ham spirit of friendliness and goodwill.

The SARAH, a trophy whose acronym stands for Sentry Amateur Radio Award of Honor, will be presented to Chuck by Ray Meyers (W6MLZ), noted newspaper columnist and radio personality.

The presentation will take place at the Sahara Hotel in Las Vegas during the January 1969 SAROC festivities.

Several other presentations will also be made at the Sahara. 73 Magazine will award a SARAH to Beatrice Dietz (WA2GPT) of Valley Stream, New York, who was cited for outstanding performance in the field of traffic-handling.

Honorable Mention notices go to Charles Bressette (W9YYL) of Sturtevant, Wisconsin, on behalf of FM, and to Robert Stone (WA6WHP) of Manhattan Beach, California, on behalf of 73 Magazine. Bressette's citation is made in recognition of the time, effort, and material contributions made by him to the amateur radio fraternity. Stone's citation of merit is made in recognition of his outstanding personal achievements and continued devotion to serving others. Stone's notice is particularly significant in view of the fact that he is totally sightless!

Motorola Integrated Circuit

APPLICATION NOTE ABSTRACTS

Motorola applications engineers have been busy preparing technical information geared to help the designer of sophisticated circuits. Some of these application articles are described here. Copies of them may be obtained by writing (using your company letterhead) to Technical Information Center, Motorola Semiconductors, Box 13408, Phoenix, Arizona. The papers described herein are based on the use of Motorola's expanding line of integrated circuits, Epicaps, and monolithic chips.

AN-133 Designing Low-Noise RF Input Transistor Stages
This comprehensive paper discusses methods of reducing noise in basic amplifier circuits. Methods of measuring noise, and "typical" noise data for circuit operating at 30 MHz are given.

AN-134 Low-Cost Power Inverter Circuits Using Off-the-Shelf Components
Design of efficient power inverters requires careful matching of transistors, transformers, and starting network. This note provides insights to this matching problem and gives a comprehensive table allowing the designer to select the proper transistor for his specific inverter requirement.

AN-135 Selecting Commercial Power Transistor Heat Sinks
This report describes the critical factors in heat sink selection and evaluates commercially available heat sinks on this basis.

AN-139 Understanding Transistor Response Parameters
This note explains high-frequency transistor response parameters and discusses their interdependance. Useful nomograms are given for determining h_{fe}, f_T, $f_{\alpha c}$, f_{max}, and many other parameters.

AN-140 Characterization of SCR's as Switches for Line Type Modulators
Although Silicon Controlled Rectifiers are highly desirable as switches in DC pulse circuits, they are usually specified and characterized for AC applications only. This article discusses the SCR characteristics desirable for DC pulse applications, and proposes simple test circuits for evaluating such devices as pulse circuit switches. A device already characterized for such applications is described.

AN-147 High-Power Varactor Diodes: Theory and Application
This article treats varactors in non-rigorous terms, discussing what they are, how they work, and how to use them in practical high-power, high-frequency, output circuits.

AN-148 Integrated Circuit Reliability
Equipment reliability is a prime justification for the tremendous effort being expended by the military and industry on integrated circuits. A recently compiled survey of electronic equipment field performance indicates that this improved reliability is being realized; this note illustrates how Motorola reliability research verifies the survey.

AN-150 Getting Transistors Into Single-Sideband Amplifiers
Silicon power transistors coupled with unique circuit design approaches make possible a 30 watt peak-power single-sideband transmitter operating at 30 MHz.

AN-151 Charge Storage Varactors for Extra UHF Power
This report describes a varactor multiplier which may be used to achieve power outputs of more than 50 Watts at 150 MHz, and 20 Watts at 450 MHz. With such high-frequency capabilities, transistor-varactor combinations can replace triodes and klystrons in many UHF and microwave applications.

AN-156 An All-Solid-State Marine Band Transmitter
This report gives all the necessary details: circuit drawings, construction techniques, etc., for a low-cost all-solid-state, crystal-controlled, marine-band transmitter. The unit operates between 2.0 and 2.85 MHz, and features low current drain (1.5 Adc), a high efficiency output stage, and direct operation from a 13 volt dc supply.

AN-159 Design Tips for Coaxial-Cavity Varactor Multipliers
Most microwave engineers picture a coaxial cavity as a bulky construction, difficult to design easily. This report demonstrates that varactor multipliers can easily be designed as small as any other. Design principles and operational data for 500 MHz - 1000 MHz doublers are given.

AN-161 High Power RF Switching Diode Can Replace Mechanical Coax Relays
This report gives a complete description of the design and capabilities of the new MV1892 RF switching diode. Characterizing parameters and various circuit recommendations are also given.

AN-163 Silicon Power Transistors Provide New Solutions to Voltage Control Problems
Three useful circuits - a short circuit proof voltage regulator, an inexpensive switching regulator and a 100 kHz dc-to-dc converter are described.

AN-165 Solid-State Television Video Amplifiers
A two-stage, all solid-state video amplifier, designed for use in large-screen television receivers, combines high-performance circuitry and low cost.

AN-166 Using Linvill Techniques for RF Amplifiers
A design procedure, derived from theory developed by J. G. Linvill, simplifies the design of single stage small-signal RF amplifiers. A 200 MHz amplifier serves as an example of the technique.

AN-167 Silicon Annular Switching Transistor Design Considerations
Transistor design considerations, such as geometry, trade-offs between transistor characteristics, and basic differences between NPN and PNP transistors, are discussed to provide an insight into optimum transistor performance.

AN-169 A Low Voltage High Current Converter
The output of low-voltage sources, i.e. solar cells, etc., often must be converted to a higher voltage to be useful. Utilizing a high-performance power transistor to efficiently perform this task, this converter can switch currents as high as 50 amperes.

AN-171 Design Considerations in High Voltage Video Output Circuitry
The relationship between transistor parameters and the gain and bandwidth of wide-band video output circuit is discussed and a circuit example is given to illustrate a typical application.

AN-173 Reducing (di/dt) – Effect Failures in Silicon Controlled Rectifiers
In SCR circuits with device-limited currents, severe local heating problems often develop in the SCR's. Three useful techniques are presented to eliminate this problem.

AN-174 High-Efficiency, Low-Voltage Inverters
Two low-voltage inverter circuits, employing a new fast-switching power transistor, operate at approximately 80% efficiency, reducing heat dissipation to a minimum.

AN-176 Power Varactor Gives 5 Watts Output at 3 GHz
A discussion of the design and performance of the high power MV1808 varactor, including design details of a 1 GHz frequency doubler and a 1 GHz to 3 GHz tripler.

AN-177 Two Stage Varactor Multiplier Provides High Power at 400 MHz
This "times-eight" frequency multiplier can provide a nominal 40 watts of CW power at an output frequency of 400 MHz with a conversion efficiency of 30 percent.

AN-178 Epicap Tuning Diode Theory and Applications
General electronic-tuning considerations are discussed, including important parameters such as Q, tuning range, and temperature stability.

AN-180 A 4.5 MHz FET FM Phase Detector
A 3N126 junction tetrode FET allows the design of an all solid-state quadrature phase detector.

AN-181 A Regulated Power Supply Using a Reference Amplifier
This useful industrial circuit, specially designed to provide highly stable output, uses a reference amplifier semiconductor device to minimize voltage fluctuations and temperature variations.

AN-182 A Method of Predicting Thermal Stability
Variations in DC bias current with temperature is an important consideration in the design of reliable transistor audio amplifiers. This note gives a useful method of predicting the thermal stability of biasing circuits.

AN-183 A Line Operated Solid State Phonograph Amplifier
FET's and a high voltage transistors combine to provide circuit simplicity hitherto unachievable in transistorized phonograph amplifiers.

AN-186 A Single Stage Video Amplifier
High-performance germanium transistors allow the design of this simple, low-cost, single-stage video amplifier, suitable for small-screen television receivers.

AN-187 MECL Integrated Circuit Line Driver
Specially designed for high fan-out capabilities, this integrated circuit line driver can supply a signal to 150 logic gates without deterioration.

AN-189 Solid-State Pulse Width Modulation DC Motor Control
Pulse-width modulation, an effective method of dc voltage control, provides motor speed regulation under varying torque conditions - ideal for traction drive vehicles.

AN-190 High Voltage Audio Amplifiers
A line-operated, class A audio amplifier, for consumer applications utilizes the 2N3739 high-voltage transistor to provide simple circuitry combined with high performance.

AN-191 Varactor Diodes and Circuits for High Power Output and Linear Response
Three new varactors are described, and varactor multiplier circuits - a 50 MHz to 100 MHz push-push doubler, a 500 MHz to 1000 MHz harmonic doubler, and a 200 MHz to 600 MHz harmonic tripler - - are presented in detail.

AN-193 Using Negative Bias to Improve SCR Performance
The circuit designer can take advantage of a fundamental SCR property - turn-off gain at low anode current - - to reduce turn-off time and increase holding current.

AN-194 Designing Integrated Serial Counters
MECL monolithic integrated J-K flip-flops serve as building blocks for ultra-high-speed ripple counters. General design techniques for designing counters of any arbitrary count.

AN-196 Epicap Tuning of Resonant Circuits
Designers may now extend reliability and circuit performance by replacing mechanical tuning parts with new high Q Epicap voltage-variable capacitor tuning diodes. A design procedure leads to the selection of the optimum Epicap for any circuit.

AN-199 A Solid-State 15 kHz Power Inverter
Fast-switching power transistors allows the design of a high-frequency power converter featuring minimum size and weight of reactive components.

AN-202 Noise Margins of MECL Integrated Circuits
A knowledge of ground line and signal line dc and pulse noise margins is essential to the logic designers. Many curves illustrate the variations of input and ground line noise margins with temperature and fan-out.

AN-203 Tuned Amplifier Design with an Emitter-Coupled Integrated RF Amplifier
This note describes the design of a tuned amplifier utilizing the MC1110 integrated circuit as a basic building block. DC considerations, characterization in terms of y-parameters, and amplifier design using Linvill's method are discussed.

AN-204 High Performance Integrated Operational Amplifiers
Two new high performance monolithic operational amplifiers feature exceptionally high input impedance and high open loop gain. This note describes the function of each stage in the circuit, methods of frequency compensating and dc biasing. Four applications are discussed: a summing circuit, an integrator, a dc comparator, and transfer function simulation.

AN-207 Low-Cost FM Stereo Multiplex Demodulator
An FM stereo multiplex demodulator employs low-cost silicon annular plastic encapsulated NPN and PNP transistors to provide high performance for consumer applications.

AN-208 A Unique, Ultra-High-Speed, Switching-Time Test Device
Ultra-high-speed test fixture allows accurate measurement of switching times for a wide variety of transistors.

AN-209 A 4-Watt Wide-Band Solid-State Amplifier
A simple, direct-coupled, wide-band amplifier provides 4 watts into an 8 ohm load from 35 Hz to 100 kHz with less than 1% harmonic distortion to 20 kHz.

AN-210 FM Modulation Capabilities of Epicap VVC's
The author shows by empirical methods that the frequency vs. voltage curve for Epicap voltage variable capacitors is linear for small (sufficient for most FM modulator applications) voltage variations.
A rigorous mathematical explanation of this linear interdependence follows the empirical demonstration.

AN-211 Field Effect Transistors in Theory and Practice
The basic theory, construction, and application information for field effect transistors (junction and MOS types) are given. Also included are some typical test circuits for checking FET parameters.

AN-212 A Low-Cost All Solid-State FM Discriminator for Consumer Applications
The application of a matched pair of diodes in one plastic encapsulated package to a discriminator type FM detector can eliminate that difficult and expensive problem of diode-matching usually necessary in these circuits. Critical performance curves of an FM detector with a two stage limiter, designed especially for solid-state TV applications, illustrate the excellent performance available using this device.

AN-213 Varactor Multipliers Provide High Output Power Above 6 GHz
The author employs a high performance varactor diode in the design of several multiplier circuits which feature exceptionally high output power versus frequency capabilities. Among the circuits discussed are a 2 to 5 GHz doubler, a 2 to 6 GHz tripler, a 2.83 to 8.5 GHz tripler, and a 500 MHz to 4 GHz one-step multiplier.
A physical and electrical characterization of the 1N5154, 1N5155 varactors, sufficient for design purposes, precedes the actual design discussion.

AN-214 A 160 MHz 15 Watt Solid-State Power Amplifier
High performance RF power transistors make possible the design of a three stage 160 MHz amplifier with 15 Watts power output. The amplifier operates on 28 Vdc supply voltage with ansoverall efficiency of 62%, and features 30.5 dB overall power gain
The author employs large-signal transistor input-output admittance data in the network designs for this amplifier.

AN-215 RF Small Signal Design Using Admittance Parameters
The author shows that the power gain and stability of high frequency transistors may be completely described by two-port parameters.
This paper presents a summary of the overall design solution for the small signal RF amplifier using admittance parameters. Design considerations and relationships for both stable and the potentially unstable transistor are presented together with a discussion of the neutralized, unneutralized, matched, and mis-matched amplifiers.

AN-216 UHF Transmission-Line Oscillator-Design Using the Smith Chart
Two high performance UHF oscillators; a 500 MHz, 1 Watt oscillator; and a 1 GHz, 0.5 Watt oscillator employ transmission lines for linear elements. The author illustrates that the use of transmission lines simplifies the breadboard design of many UHF circuits. An important feature is the use of the Smith Chart to simplify the network synthesis.

AN-217 UHF Transmission Line Power Amplifier Designed with Smith Chart Techniques
A UHF power amplifier capable of 2 Watts power output at 450 MHz employs transmission lines for linear elements. The author illustrates that the use of transmission lines simplifies the design of many UHF circuits.

AN-219 The Field Effect Transistor in Digital Applications
Field effect transistors have definite advantages over junction transistors in many digital applications; high fan-out, direct coupled circuitry (lower component count), extremely low power dissipation, and low temperature coefficient circuits are among the most important.
This paper provides the designer with an up-to-date discussion of JFET and IGFET switching characteristics and how they are used in the design of basic digital circuits. The final portion of this paper discusses a family of JFET logic circuits, a family of IGFET, and future prospects.

AN-220 FET's in Chopper and Analog Switching Circuits
The author's discussion begins with elementary chopper and analog switch characteristics -- explores fully the considerations required for conventional and FET chopper and analog switch design -- and finishes with specific FET circuit examples.

AN-221 4-Layer and Current-Limiter Diodes Reduce Circuit Cost and Complexity
The authors present four simple circuits in which 4-layer diodes and current-limiter diodes are used to provide increased circuit performance: A Saw-tooth generator (two variations), a staircase generator and a ring counter.
A brief discussion of the electrical characteristics of 4-layer and field effect diodes precedes the circuit examples.

AN-222 The ABCs of Solid-State DC to AC Inverters
The author provides an exhaustive examination of the entire field of dc to ac inverters. Among the topics discussed are: the proper inverter for a specific application; operation principles of different types of inverters; the problem of proper device selection in the design of inverters; an inverter design example.

AN-223 Cascade Noise Figure for Integrated Circuit Transistors
In vacuum tube circuitry, the combination of the grounded-cathode and the grounded-grid cascade has superior noise properties to all other two stage amplifiers. In transistor circuitry the noise performance of a single-stage amplifier is well known, but little information has been published about the best performance obtainable from two-stage transistor amplifiers. This paper evaluates the noise performance of all possible two-stage transistor amplifiers. Also, since the noise contribution of stages beyond the second is normally small, this analysis will be valid for amplifiers with any number of stages.

AN-224 Safe Areas of Silicon Annular Transistors
Twenty-five high frequency silicon annular transistors are characterized by their safe area operating curves.
A short discussion of the test procedures and circuits used to obtain these safe area curves introduces the topic.

AN-225 High Performance All Solid-State Servo Amplifiers
The design of 7.5 Watt transformer-coupled solid-state servo amplifier and a 10 Watt complementary transistor servo amplifier are fully discussed. The transformer coupled amplifier, requiring only three transistors, provides a stable voltage gain of 100. The complementary amplifier, though more complex, is direct coupled throughout thus eliminating the transformer and its accompanying phase shift problems.

AN-226 Thermal Measurements on Semiconductors
This note describes the techniques used by Motorola to obtain the thermal resistance of transistors, rectifiers, and thyristors.

AN-227 Thyristor Trigger Circuits for Power-Control Applications
Featuring simplicity and low cost, these new power-control circuits can control up to 3 kW from a 120 volt line with the proper SCR and heat sink.

AN-228 20 Watts at 1 GHz with Step Recovery Varactors
Varactor harmonic multiplier circuit power handling capabilities have now been extended to 20 Watts at 1 GHz and 10 Watts at 2 GHz by two new varactors, the 1N5149 and 1N5150. This note provides a complete discussion of the design and performance of these two varactors. Several high performance multiplier circuits: a 0.5 GHz to 1 GHz doubler; a 0.4 GHz to 1.2 GHz tripler; and a 0.46 GHz to 1.84 GHz quadrupler are also discussed.

AN-229 High Speed Complementary Flip-Flop Features Extremely Low Power Dissipation
New complementary micro-power transistors permit the design of a ultra-high speed flip-flop featuring extremely low power dissipation. The complementary character of the 2N3493 and 2N2409 "0-pF" transistors allow the engineer to design flip-flops with high operating frequency, high circuit efficiency, and high gain.

AN-230 Complementary Solid-State Audio Amplifiers
Two direct coupled complementary amplifiers are discussed - - a 10 watt and a 50 watt amplifier. Both amplifiers have excellent frequency response and provide their rated output from 20 Hz to 20 kHz at less than 1% harmonic distortion.

AN-2 FET Differential Amplifier
The field effect transistor is often a better choice than the bipolar transistor in many differential amplifier applications, particularly when high input impedance is required. This report discusses drift compensation of field effect transistors for differential amplifier applications.

AN-232 1.5 GHz 10 Watt Two-Stage Cascade Multiplier
Two high-performance varactors -- the 1N5149 and 1N5150 -- are employed in a cascade multiplier which features over 10 watts power output at 1.5 GHz.

AN-233 Design of Monostable Multivibrators Using MECL Integrated Circuits
This application note describes an integrated monostable multivibrator composed of a MECL R-S or J-K flip-flop plus a few discrete components. A main feature of the multivibrators is their complete compatibility with the MECL family of current mode integrated circuits. These multivibrators can provide a timed output ranging from 60 ns to the millisecond range. The note discusses special circuits which have even faster recovery times. Pulsed recovery (recovery during any point during the delay time) is possible with both types of multivibrators.

AN-234 MRTL Family of Integrated Circuits
The purpose of this note is to familiarize the logic designer with the Motorola Resistor Transistor Logic (MRTL) family. Logic diagrams, pin layouts, and loading data are given for each device. Three illustrative applications of MRTL; an asynchronous 4-bit comparator, an asynchronous 5-bit adder, and a shift register, serve as design examples. This family is noted for its economy and variety of logical elements.

AN-235 Using the Motorola MDTL Line of Integrated Circuits
The MDTL line of integrated circuits is briefly characterized with important capabilities of the MDTL series, such as noise immunity, discussed. MDTL applications are presented, including shift registers, ripple counters, clocked counters, and decade shift counters.

AN-236 Using the Motorola Milliwatt Family of Integrated Circuits
This note familiarizes the logic designer with the Motorola Milliwatt Resistor Transistor Logic (mW

MRTL) family. Logic diagrams, pin layout, and loading data are given for each device. Several applications of mW MRTL devices are also given throughout the paper. This family is noted for low power dissipation and a variety of logic elements.

AN-237 Feedback Capacitance of Transistors

The maximum useable gain of an amplifier is a function of two separate mechanisms: the available forward gain, and the reverse transfer impedance. This report tells how to improve feedback capacitance so as to achieve greater amplifier gain.

AN-238 Transistor Mixer Design Using Admittance Parameters

Mixer circuit design may be simplified by the use of small-signal admittance parameters. This note describes in detail the effective application of this design technique and the corresponding results. Several design examples are discussed.

AN-239 MECL Integrated Circuit Schmitt Triggers

The Schmitt Trigger, a regenerative circuit which changes state abruptly when the input signal crosses specified dc trigger levels, can be fabricated from MECL integrated logic gates. This note describes the modifications necessary to convert standard MECL logic gates to Schmitt Triggers, and also the performance to be expected from such units. Examples of the MECL Schmitt Trigger used for wave shaping and pulse generator applications are also included.

AN-240 SCR Power Control Fundamentals

Recent high volume production techniques have brought SCR prices down to the point that almost any electrical product can benefit from electronic control. This article takes a look at some fundamentals of power control using these devices.

AN-241 Low-Cost High-Voltage Servo Amplifier

The availability of low-cost high-voltage power transistors make possible the design of a practical high voltage servo amplifier without transformers and with greatly reduced phase shift problems.

AN-242 A Modulated SCR Zero-Point Switching Circuit

By employing SCR devices in a zero-point switching mode, the circuit designer can greatly reduce RFI generation. This note describes the zero-point switching concept, and provides a circuit design example (AC controller - - DC half-wave controller).

AN-243 Transistor-Varactor-Multiplier Versus Transistor-Multiplier

Several watts of power in the upper portion of the L band may be obtained with either the transistor amplifier driving a varactor multiplier (TAVM), or the transistor amplifier-multiplier (TAM). This report presents a careful evaluation of both types of circuits.

AN-244 The MECL Line of Digital Integrated Circuits

This note familiarizes the digital integrated circuit user with Motorola MECL integrated circuits; pin layouts, and logical diagrams. Pertinent characteristics for each device in the MECL integrated circuit line are given. The note includes applications of various circuits illustrating the versatility of the MECL family. High speed operation, high input impedance, high fan-out, and very low internally generated noise characterize the line of integrated circuits.

AN-245 An Integrated Core Memory Sense Amplifier

This application note discusses core memories and related design considerations for a sense amplifier. Performance and environmental specifications for the amplifier design are carefully established so that the circuit will work with any computer using core memories. The final circuit design is then analyzed and measured performance is discussed. The amplifier features a small uncertainty region (6 mV max), adjustable voltage gain, and fast cycle time (0.5 μs).

AN-246 A 50 Watt 50 MHz Solid-State Transmitter

This three-stage, three-transistor transmitter can provide 50 watts continuous power output at 50 MHz with 62% overall efficiency. The author employs a straightforward design approach based on large-signal transistor input/output admittances.

AN-247 An Integrated Circuit RF-IF Amplifier

A new, versatile integrated circuit for RF-IF applications is introduced which offers high gain, extremely low internal feedback and wide AGC range. The circuit is a common-emitter, common-base pair (the cascade connection) with an AGC transistor and associated biasing circuitry. The amplifier is built on a very small die and is economically comparable to a single transistor, yet it offers performance advantages unobtainable with a single device. This application note describes the AC and DC operation of the circuit, a discussion of Y-parameters for calculating optimum power and voltage gain, and a variety of applications as an IF single-tuned amplifier, IF stagger tuner amplifier, oscillator, video-audio amplifier and modulator. A discussion of noise figure is also included.

AN-248 A High Voltage Monolithic Operational Amplifier

This note introduces a high voltage monolithic operational amplifier featuring high open loop gain, large common mode input signal, and low drift. The function of each stage in the circuit is analyzed, and methods for frequency compensating the amplifier are discussed. DC biasing parameters are also examined. Four applications using the amplifier are discussed: a source follower, a twin tee filter and oscillator, a voltage regulator, and a high input impedance voltmeter.

AN-249 Designing Around the Tuning Diode Inductance

The effect of varactor inductance is described, and equations and graphs are presented in order to predict the inductance value and to determine when its effects on performance is significant.

In addition a design example of a varactor-tuned capacity-loaded half-wave cavity from 470 MHz to 890 MHz, and derivations of design equations for varactor tuned quarter wave and half-wave cavities as well as for lumped series tuned circuits are shown.

AN-251 Decade Counters Using MRTL Integrated Circuits

This application note discusses the design and implementation of decade counters using the MRTL family of integrated logic. Ripple counters, shift counters, and parallel clocked counters are developed using BCD, 2'421, and excess 3 digital codes. Up and down counting techniques are discussed. Output decoding, problem areas and circuit limitations are covered for all counter types.

AN-252 Choosing MRTL Integrated Logic Circuits

This article discusses resistor-transistor logic. MRTL, integrated circuits, and the considerations a user should make prior to using this integrated circuit family. Full consideration is given to the advantages as well as the limitations one encounters with this logic form. The discussion is general in nature and applies to all popular versions of resistor-transistor logic.

AN-253 An Analysis of MRTL Integrated Logic Circuits

Special emphasis is given to noise margin specifications, large circuit fan-out, operating speeds, and interfacing with saturated logic in this analysis of Motorola MRTL integrated logic circuits. The J-K flip-flop circuit is reviewed and basic counting and shifting circuits are presented to illustrate typical J-K applications.

AN-254 Using MRTL Integrated Circuit Flip-Flops

Circuit operation of MRTL J-K flip-flop is explained fully. The R-S flip-flop is also briefly discussed. Pulse input requirements and loading considerations are discussed and some applications of the J-K flip-flop shown in the form of minimum-logic small-count counters.

AN-255 Comparison of Seven Digital Integrated Circuit Logic Lines

No one logic line is clearly superior to all others for all applications. Each logic line has certain applications for which it is ideally suited. For each application the user must select the integrated circuit line which best meets his total systems requirements. Such factors as power consumption, speed, system flexibility, noise immunity, and, of course, cost, must be considered.

This application note discusses the relative trade-offs of seven different integrated circuit logic lines. The strengths and weaknesses of each logic line is discussed, and the lines are compared on the basis of the critical factors mentioned above.

AN-256 Examining Ultra High-Speed Integrated Circuit System Interconnections

If the digital systems are to benefit fully from the latest increase in integrated circuit speeds, the wiring delays between circuits must be reduced.

Reducing the wiring length to minimize these delays requires structures with a high density of interconnections. However, even with such micro-interconnection structures, transmission-line considerations — output loading, signal reflections and signal cross-coupling — must be applied to the wiring design because the new circuits are so fast.

In addition to the above considerations, cross-talk, multi-layer printed circuit boards, methods of interconnecting numerous unpackaged integrated circuits, system-design and thermal problems will be considered in this note.

AN-257 Decade Counters Using MECL J-K Flip-Flops

This note discusses the use of MECL integrated circuits in four types of decade counters. The logic and circuit design of an excess three up-down counter, a 2'421 up-down counter, a gray code counter, and a switch-tail ring counter with ten line output are illustrated.

AN-258 Monostable Multivibrator Design Using An Integrated Circuit Operational Amplifier

This application note discusses the use of integrated operational amplifiers connected as monostable multivibrators. The classical monostable circuit including some limitations with respect to the conventional component and integrated device designs are briefly reviewed. The basic circuit theory and qualifications of the operational amplifier connected as a monostable device are then discussed and the timing equation derived. Alternate monostable configurations and their ultimate design limitations are briefly reviewed with respect to utilization of the MC1430/1530 and MC1431/1531 family of devices. Finally a design example is used to illustrate the principles and limitations outlined.

AN-259 Using Integrated Circuits in a Stagger Tuned IF Strip

Integrated Circuits are quickly becoming "the way to go" in the electronic industry, and justifiably so. Their small size and high reliability, coupled with low cost make them an ideal component for radio, television, communication gear, computers, and an infinite number of other uses. This application note describes the use of an Integrated Circuit High Frequency Amplifier, the MC1550, in a stagger tuned I-F strip. The design frequency is 45 MHz; however, the procedure is similar for designs covering its full range of operation (DC to 300 MHz).

AN-260 Selecting Varactor Diodes

High output power in the UHF region can be achieved with varactors. A device selection procedure based on experience, theory and common sense is offered.

AN-261 Transistor Logarithmic Conversion Using an Operational Amplifier

The design of a log amplifier using a common base transistor configuration as the feedback element of an integrated circuit operational amplifier circuit is discussed in this application note. Six decades of logarithmic conversion are obtained with less than 1% error of output voltage. The possible causes of error are discussed followed by two applications: direct multiplication of two numbers, and solution of the equation $Z = X^n$.

AN-262 Decade Counters Using MDTL Integrated Circuits

Decade counting is a basic digital operation and may be performed by a wide variety of counting circuits. This note illustrates how some of the commonly used ÷ 10 counting techniques can be accomplished with Motorola Diode-Transistor Logic (MDTL) integrated circuits. Ripple, clocked, and shift decade counters using a variety of coding methods are discussed.

AN-263 Choosing DTL Integrated Logic Circuits

This article discusses diode-transistor logic, DTL, integrated circuits, and the considerations a user should make in choosing this integrated circuit family. Consideration is given to the advantages and limitations one encounters with this logic form. Three versions of DTL are considered in this report; conventional DTL, modified DTL, and high noise immunity DTL.

AN-264 MRTL Integrated Circuit Shift Registers

This note discusses the design considerations for the implementation of a 16-bit shift register using J-K flip-flops. The shift register described has the capability, upon command, to shift left or shift right and to enter information serially or in parallel. All problems encountered in the implementation and operation of the register are discussed.

AN-266 MECL Integrated Circuit Flip-Flops
Current Mode bi-stable elements are discussed along with pertinent characteristics and specifications. The R-S, J-K, and Master-Slave types of flip-flops are evaluated according to performance. Methods of reducing overshoot when driving a large number of flip-flops and flip-flop fan-in, fan-out capabilities are also given.

AN-267 Matching Network Designs with Computer Solutions
Computer solutions for four networks commonly used in solid-state high frequency amplifiers have been tabulated.

AN-268 Pulse Triggering of Radar Modulator SCR's
Factors involved in dynamic gate triggering are examined and relations of gate triggering characteristics to variations of total current amplifications with gate current are shown.

AN-270 Nanosecond Pulse Handling Techniques
The rapid advancement in the field of high speed digital integrated circuits has brought into focus many problem areas in the methods of pulse measurement techniques and new concepts dealing with these problems. This paper is intended to discuss the more common, yet perhaps not well known, pitfalls of measurement systems, a method of detecting them and possible solutions.

AN-271 Breadboard Techniques For Low Frequency Integrated Circuit Feedback Amplifiers
Certain considerations, unnecessary for discrete devices, are of critical importance in the breadboarding of integrated circuit systems. This paper provides the engineer or technician with some wiring tips and important precautions for integrated circuit breadboarding.

AN-273 More Value out of Integrated Operational Amplifier Data Sheets
The operational amplifier is rapidly becoming a basic building block in present day solid state electronic systems. The purpose of this application note is to provide a better understanding of the open loop characteristics of the amplifier and their significance to overall circuit operation. Also, each parameter is defined and reviewed with respect to closed loop considerations. The importance of loop gain stability and bandwidth is discussed at length. Input offset circuit are also reviewed with respect to closed loop operation.

AN-274 MECL Integrated Circuit Shift Registers
A generic shift-right, shift-left register with parallel entry, end-around-shift, and complementation capabilities is discussed. Maximum practical operating speed, delay times and timing considerations of the logic gating signals are determined. The basic register as developed may be used for data handling, for number scaling, or in the arithmetic portion of a digital computer.

AN-275 Audio Power Generation Using Integrated Circuit Operational Amplifiers
Three complementary audio frequency amplifiers are discussed, each using an MC1533 integrated circuit operational amplifier to obtain the desired voltage gain and reduce the distortion figure. The 4 Watt and 20 Watt amplifiers have strictly Class B output stages, while the 50 Watt amplifier employs a Class AB output stage. Harmonic distortion is less than 0.7% and intermodulation distortion is less than 0.6% for all three amplifiers. Frequency response of the amplifiers is from dc to 20 kHz.

AN-276 Useful Frequency Range Extension for MC1530 Operational Amplifiers
This application note explains various frequency compensating techniques designed to extend operating frequency of the MC1530. In addition circuit configurations are frequency response curves are shown for various compensation techniques. Examination shows this amplifier can be used at frequencies up to 14 MHz.

AN-277 Overshoot and Ringing in High-Speed Digital Systems
The amount of overshoot and ringing that may be expected in a system is determined as a function of driving source impedance, rise-time, wiring length, and loading. Determination of allowed overshoot and methods of reducing overshoot are discussed for conventional point to point wiring methods. Capacitive loading effects of MECL devices and circuit hardware are also discussed.

AN-278 Using Shift Registers as Pulse Delay Networks
This note discusses high speed clocked shift register using J-K flip-flops and employed as a digital incremental delay. The register may be clocked with a frequency division counter to accomplish any desired delay with increments as small as 20 ns. The circuit as developed may be used for timing basic computer decisions or as an adjustable delay line for pulse.

AN-279 Setup and Release Times in the MRTL J-K Flip-Flop
This application note discusses the setup and release times for J-K flip-flops. The method used to measure setup and release time is discussed. A few simple decade counters are analyzed for worst case release times.

AN-280 MECL 70 MHz J-K Flip-Flop
A new high-speed J-K flip-flop is discussed. Capabilities, performance, and applications are explained along with typical and worst case operating data. This flip-flop with four J inputs and four K inputs more than doubles the operating speed of registers and counters as employed in a system.

AN-282 Systemizing RF Power Amplifier Design
The design of high-power, Class C, RF transistor amplifiers can be greatly simplified through the use of large-signal device characterization. This note explains design procedures and furnishes large-signal impedance data for thirteen Motorola RF power transistors.

AN-283 Using MDTL IC Flip-Flops
To properly implement a logic system with integrated circuits, it is important that the logic designer be familiar with the devices he uses. One of the more complex of integrated circuits is the clocked flip-flop. The purpose of this report is to acquaint the reader with the operation of the MDTL flip-flop, to discuss the different modes of operation, and to show some typical uses for this flip-flop.

AN-284 MDTL IC Shift Registers
This report shows some frequently encountered shift register designs implemented with MDTL logic devices. Various operating characteristics are discussed as well as some of the important design considerations.

AN-285 Loading Factors and Paralleling Rules for MRTL Integrated Circuits
The need for loading factors in Motorola Resistor Transistor Logic (MRTL) is discussed and proper usage is illustrated. Modification of loading factors is covered for the case when circuit outputs are paralleled. Illustrations are provided by using the MC700P Series of integrated circuits.

• AN-286 Binary Addition Using MRTL IC's
This note discusses the principles of binary addition with positive numbers and considers the implementation of binary adders with MRTL. The full adder function is illustrated using MRTL half adders, NOR gates arranged to simulate half adders, and with NOR gates in a two level logic scheme.
The full adder and associated logic is developed for a four-bit parallel (asynchronous) adder and for serial (synchronous) adder.

• AN-406 UHF Broadband Amplifier Amplifier Design
A design technique is given for a wideband amplifier operating at UHF frequencies. A shunt-shunt feed-back network and Y-parameters at sampled frequencies are used.

• AN-288 Color TV Solid State Horizontal Deflection
This report describes a horizontal deflection system for a large screen (23 inch) color television receiver capable of delivering an ultor power in excess of 40 Watts at 24 kV. The system includes a horizontal phase detector, AFC amplifier, horizontal oscillator, pre-driver, driver, and two horizontal output devices operating in a parallel mode.

• AN-290 Mounting Procedure and Thermal Aspects of Motorola Plastic Power Transistors
Heat sink mounting methods are described and illustrated and thermal resistance characteristics are shown.

• AN-291 External Direct Setting of MRTL Dual J-K Flip-Flops
A method is described to obtain full functional capability from MRTL dual flip-flops by connecting external circuitry to the proper terminals. Applications are provided that illustrate a reduction in package count by using this configuration as compared to the employment of single unit, full capability flip-flop circuits.

• AN-292 Thermal Response of Semiconductors
This note explains a workable method – using the concept of transient thermal resistance – of predicting junction temperature at any point in time regardless of the power waveform.

• AN-293 Theory and Characteristics of the Unijunction Transistor
The unijunction transistor is examined as to theory of operation, design structures, static and transient characteristics.

• AN-294 Unijunction Transistor Timers and Oscillators
Twelve different unijunction transistor circuits, complete with parts lists are given. Temperature stabilization of the peak-point voltage is examined and dynamic operation paths are discussed.

• AN-295 Suppressing RFI in Thyristor Circuits
Measures taken to suppress RFI are shown. Design considerations and examples are explored as well as some solutions to the RFI problem.

• AN-296 Construction of A Master-Slave Flip-Flop from MRTL Gates
Information is provided on the construction of a master-slave flip-flop circuit from standard MRTL gates. Characteristics of the resulting circuit are given and an application of the configuration illustrates the advantage of this type of flip-flop.

• AN-297 Integrated Circuits for High Frequency to Voltage Conversion
This application note concerns the technique of using integrated circuits in a linear frequency to voltage converter from 1 MHz to 30 MHz. A theoretical analysis is given as well as a working design.

• AN-298 Noise Immunity With High Threshold Logic
A comparison of noise immunity characteristics is made between MHTL devices and standard saturated logic devices.

• AN-410 A Unified Approach to Optimum FET Mixer Design
The optimization of conversion gain, noise figure, and cross modulation are treated in relation to the basic mixer analysis and meaningful device parameters.

• AN-400 An Operational Amplifier Tester
A simple and inexpensive tester for Motorola's line of operational amplifiers is described which will measure the open loop voltage gain, the equivalent input offset voltage, the maximum positive and negative output voltage swing, and a view of the transfer function which shows the linearity of the device.

• AN-401 The MC1554 One-Watt Monolithic Integrated Circuit Power Amplifier
This application note discusses four different applications for the MC1554, along with a circuit description including dc characteristics, frequency response, and distortion. A section of the note is also devoted to package power dissipation calculations including the use of the curves on the power amplifier data sheet.

• AN-402 Insulated Gate FET's Used in IC's
The note acquaints the circuit designer with the integrated FET. A brief description of the operation of the Insulated-Gate Field Effect transistor is presented. This discussion is followed by a description of the FET in integrated form and finally, the basic advantages of FET IC's are explored.

• AN-403 Single Power Supply Operation of IC Op Amps
A split zener biasing technique that permits use of the MC1530/1531, MC1533, and MC1709 operational amplifiers and their restricted temperature counterparts MC1430/1431, MC1433 and MC1709C from a single power supply voltage is discussed in detail. General circuit considerations as well as specific ac and dc device considerations are outlined to minimize operating and design problems.

• AN-404 A Wideband Monolithic Video Amplifier
This note describes the basic principles of ac and dc operation of the MC1552G and MC1553G, characteristics obtained as a function of the device operating modes, and typical circuit applications.

• AN-405 DC Comparator Operations Utilizing Monolithic IC Amplifiers
The use of the MC1533 operational amplifier and the MC1710 differential comparator are discussed. The capabilities and performance are given along with typical operating curves for both devices.

Editor's Report:

FM TO BACK REPEATER RULES PLEA

Most FM'ers are aware of the fact that a petition submitted by the Buffalo Amateur Repeater Society is now under consideration by the FCC. The Buffalo petition represents a long-needed change in FCC rulemaking philosophy. Current indications are, however, that certain portions of this petition will be denied. For this reason, the editorial staff of FM Magazine has committed itself to the drafting of a completely new petition based on: (1) urgent needs of repeater owners, (2) current operating and control practices, and (3) sensible and reasonable methods for logging and monitoring.

A conflict of FCC requirements with regard to repeater identification prompted me to query Mr. James Barr, chief of the FCC's Special Radio Services Bureau. I was also troubled by the virtually impossible "time" logging requirements, the varying interpretations of fixed control, and a multitude of other problems, not the least of which is the noticeable absence of repeater references in FCC Rules and Regulations. Here, in part, is the letter to Mr. Barr:

James E. Barr, Chief, Safety & Special Radio Services Bureau
Federal Communications Commission
Washington, D. C. 20554

19 Oct. 1968

Dear Mr. Barr;

A year ago there were less than one thousand FM amateur radio operators. Today, there are more than <u>ten</u> thousand. The vague areas in the Rules (Part 97) pertaining to remote control and repeater operation were unimportant a few months back; today they are being read, reread, analyzed, and dissected by thousands who either: (1) intend to remotely control amateur equipment, (2) do <u>now</u> remotely control amateur equipment, (3) intend to own or operate through a repeater, or (4) do <u>now</u> own or operate a repeater.

Occasionally, an amateur writes the FCC to interpret a particular passage in the Rules. More frequently, amateurs write FM Magazine to get the editor's opinion. As editor, when I receive queries, I try to be as liberal as possible in my interpretation while staying within the intent of the ruling in question. The FCC's responses, however, are often as puzzling as the Rules themselves.

A few weeks ago, I questioned the FCC about a "three-minute-identification" ruling handed down by an FCC representative. The mandate...is a requirement to identify a repeater at three-minute intervals. Close examination of the referenced Rule (Part 97) is at variance with the FCC man's statement. My query about this inconsistency has not yet been answered, but I look forward to a clarification in response to this letter...

More recently, another amateur questioned the FCC about remote control. The response, from your office, states that the call signs of all stations using a remote must be logged, and that user stations need not log the data...

Clearly, a definite and growing need exists for a complete definition of the Rules, as I think you'll agree. For this reason, I would like to describe typical remotes and repeaters and show how they are used. Then, I would like to itemize certain of the Rules and show my interpretation. Finally, I would like to question you as to how you would interpret certain listed regulations that are ambiguous.

The reasons for all this are manyfold. First, I am writing, under contract to Editors & Engineers, Ltd. (Howard W. Sams, Inc.), a complete treatise on repeaters and remotes entitled "The Radio Amateur's FM Repeater Handbook." Also, as author of this handbook and editor of FM Magazine, I would like to express interpretations of the Rules according to the educated viewpoints of FCC representatives, and publish these opinions...

Second, I would like to get a "fix" on the aspects of the Rules where the FCC's interpretation differs from the adopted interpretation (as in the 3-minute ID case), so that a petition can be put into motion to change these areas of the Rules.

Let me describe the operation of a typical remote installation. One UHF repeater (usually operating in the 450 MHz band) is placed in service at a hilltop location. On command from the licensee, a remotely situated base station (usually 50 MHz or 150 MHz) is interconnected with the UHF repeater so that all incoming repeater signals are relayed by the remote base station (and vice versa). Although the remote installation may be licensed to but one individual, there are usually between five and twenty users of the remote operating on the control frequency so as to communicate through the remote base station.

Referring again now, my fourth paragraph, you will see wherein the confusion lies. "User stations" in FCC's eyes are not "user stations" in the eyes of the repeater operators. These individuals consider "user stations" to be UHF repeater users who have the capability of accessing the base station at will. The FCC's definition appears to include all stations <u>heard</u> by the base station.

The next point I wish to bring up has more impact and overall significance to remote operation than any other: Frequently in the Rules and in FCC letters are references to control "from the fixed authorized control site." Many amateurs have been afraid to control their equipment from mobile or portable control installations because of the emphasis on "fixed." On the back of an amateur license, however, it states that the control point is "considered...fixed," though "operated fixed, portable, or mobile." An FCC statement concurring with this interpretation would be welcomed by all remote operators.

As an added safety measure -- and to minimize the congestion on already crowded bands -- some repeater owners have installed methods for "subcontrol," which are not covered in the Rules. Let me give an example.

I operate a licensed two-meter remotely controlled repeater at Radio Ranch that is capable of being used at any time the unit is subject to control by the licensee...which is virtually a 24-hour-a-day proposition. Some of my associates felt that a continuously operating repeater was not a good thing because: (1) some people would use the input channel to communicate directly, without the need for a repeater, so the repeater would be operating without being used; and (2) some amateurs would transmit on the input channel without an awareness of a repeater, causing the repeater to interfere with possible activity on the output channel.

To preclude these possibilities, I installed a mechanism whereby the entire repeater would shut down automatically two minutes after the last carrier disappears from the input channel. But to regain the usefulness of the system, I also installed a broad decoder at the receiver so that it could be turned back on again by any operator on the channel with the ability to utter a short whistle.

I refer to this as "subcontrol" because it in no way affects my own control, which is ready to turn the repeater on or off regardless of the subcontrol status.

...I am apprised that the Buffalo Amateur Repeater Association has submitted a petition to you dealing with operation of repeaters in general. This letter should in no way influence your decision on that. What I am asking for is a fair and liberal interpretation of the existing Rules so amateurs will need not fear using a little initiative in their projects.

I think you'll agree that the "subcontrol" concept is in the best interest of amateur radio; that the "fixed" requirement can be interpreted more broadly; and that three-minute identification for repeaters is only necessary in explicit compliance with Part 97.87 (a) (i) (ii) and (iii).

...Most of us who own and maintain repeaters are sympathetic with the FCC on (logging). We realize that the Rules were written before the advent of repeaters, and therefore that the FCC has no choice in the matter. Speaking for all FM'ers, however, I ask your indulgence with respect to logging. Be particularly liberal here, and remember that amateur radio will not best be served by strict enforcement of outdated Rules. The need now is for reasonable and just interpretation of excessively stringent requirements. The Rules were set down when amateur radio was in its infancy. The FCC has always been an agency that relied heavily on "intent" rather than the "letter" of the law. The logging intent, as I understand it, was to provide legal evidence of a person's activity in the event of eventual questions regarding that station's operation. This intent could be served by the following:

1. Log the time at which the repeater is activated.
2. Log the time that it is shut down (for repair or other reason).
3. Log all changes in power, radiation characteristics, etc.

Mr. Barr, you will acknowledge, I'm sure, the fact that the FCC does have the power to delineate policies at variance with the Rules. As an example, I make reference to the stated requirement in the Rules (Part 97.103b) where a log must show the signatures of all amateurs who key the transmitter. The FCC, recognizing the impossibility of this, made a prima facie exception to the Rules in this regard. I call upon you now to make another exception. I ask you to consider a repeater in the same permissive light you consider a mobile, which (Part 97.103a) requires a log entry only (1) at the time of initiating mobile operation and (2) at the time of completion of mobile operation...

Very sincerely yours,

Ken W. Sessions, Jr.
K6MVH
Editor, FM Magazine

And here is Mr. Barr's response:

Dear Mr. Sessions:

I have asked Mr. Everett Henry, Chief of the Amateur and Citizens Division, to look into the various problems raised in your October 19 letter, and a further response will be made. It occurs to me, however, that your principal concern is basically the fact that present Rules may not be compatible with current conditions and practices. This seems to me to call for a change in the Rules, rather than for a strained interpretation. You may want to try your hand at redrafting the troublesome Rules and submitting a formal request for amendment. See Sections 1.401 through 1.427 regarding procedure.

Sincerely yours,

James E. Barr

These two letters brings us up to date. Now, it behooves all of us to draft a set of Rules which are not excessively lax but which are not so stringent as to restrict reasonable and sound repeater operation. For this reason, the FM Magazine editorial staff will begin the procedure by publicizing the following recommended Rules (accompanied by explanatory comments).

Each and every interested amateur should read these recommended Rules and draft his own modifications, additions, or deletions. Send your comments to FM Editor, One Radio Ranch, San Dimas, California 91773. The incoming comments will be sorted and worked into a new draft to be published later. At the end of the process, the final draft will be submitted to the FCC as a formal petition for Rule changing.

PROPOSED RULES

The Rules have a section devoted to definitions. The first order of business would be to include an accurate definition of the term repeater. (Present Rules make no mention of repeaters.)

Definition:

> Amateur Repeater: An automatic relay station which retransmits information from one amateur frequency onto another, and which is operated in accordance with the class of license held by the authorized licensee. (Unless otherwise noted, all Rules pertaining to amateur stations shall also apply to amateur repeaters.)

In order to demonstrate to the FCC a willingness on the part of repeater owners to provide communications capability without adding to the congestion, FM Magazine will propose that repeater outputs be legal only on frequencies above 51 MHz (where duplex is condoned and AØ emissions are permitted). Also, FM will propose that a relaxed form of "subcontrol" be authorized, so that the repeater shuts down when not being used and can be reenergized by a simple "repeater input" control scheme, such as a whistle-on decoder or the equivalent. And since the FCC obviously will not sanction unmonitored repeaters, FM will further propose that partial control (for off commands) be designated to other amateurs than the licensee. In this way each repeater may have as many "authorized monitors" as necessary to assure continuous compliance with the Rules, while the licensee himself can be freed from the burden. A "monitor" will have the capability of commanding the system to shut down but not to turn it on again:

> Means shall be provided for automatic timed shutdown of the repeater when it is not in use. A means for reactivating the repeater from the frequency of use may be included provided that such control can be overridden by a turn-off command from an authorized monitor or the licensee, and provided that such turn-off is irreversible except by direct command of (1) an authorized amateur at the repeater site or (2) remotely transmitted control signals (by wire or radio, as authorized) from the fixed control point.

In recognition of the fact that a repeater is not an ordinary amateur station, FM proposes a method for licensing all repeaters, whether controlled locally or by remote. This proposed entry will be proposed as a change to FCC Rules, Part 97.43(d):

> 97.43(d)
> An amateur station (including a remotely operated amateur station) may be operated as a permanent repeater provided that the FCC Form 610 is accompanied by sufficient information to show compliance with paragraph (b) (1) through (5) of this section (as applicable) and that supplementary information is submitted therewith which shows: (1) frequency and type(s) of emission to be received and retransmitted by the repeater, (2) frequency and type of emission to be employed by the transmitter, provided that no repeater shall transmit on any frequency below

51.00 MHz, (3) type of activation or method of access (continuous carrier, carrier-operated, tone-activated, etc.), (4) method for automatically shutting down the repeater when it is not in use, remotely controlled or operated from an authorized amateur station, and (5) names, addresses, and signatures of all amateurs who will accept responsibility for monitoring the repeater output, provided each has the capability of immediately suspending repeater operation should the emissions deviate from the terms and conditions of the FCC Rules and Regulations (although in no case will multiple shutdown authority be construed as a Rule which relieves the authorized licensee from this responsibility).

The existing logging requirements are truly inapplicable to repeaters, although still a requirement. FM believes the intent of the ruling can be satisfied without detailed logging of time and date of each transmission. The tentative proposal is as follows:

97.104 Repeater log requirements. (a) Each license of an authorized repeater stations shall be responsible for maintaining, at the transmitter site, an accurate log of repeater operation, which shall include the following:

1. The date and time the repeater is placed in service.
2. The date and time the repeater is shut down by the licensee or is inaccessible for any reason by the amateurs who operate on its input frequency.
3. The input power to the repeater transmitter's final amplifier. (This must be entered after each period of shutdown.
4. The frequency being repeated and the frequency of transmission. (This information need be entered only once unless there is a change in input or output frequency.)
5. The type of emission used. (This need be entered but once unless there is a change in emission type.)
6 The method of activation; e.g., carrier-operated, tone-operated, continuous-transmit, etc. (This need be logged but once unless there is a change in activation method.) Where tone-operated, the access tone frequency must be shown in the repeater log.

(b) The repeater must at all times be monitored by an authorized amateur with the capability of suspending operation in the event the emissions are not in compliance with the Rules. (Authorized monitors are to be listed in accordance to paragraph 97.94 (d) (6). Each authorized monitor must show on his own station log the period for which he accepts repeater-monitoring responsibility. This information will consist of: (1) date and time monitoring duty is assumed, (2) name and call of previous monitor, (3) date and time at which monitoring responsibility is relinquished provided that it will only be relinquished to an authorized monitor in accordance with paragraph 97.94(d)(6), and name and call of amateur to whom monitoring authority is released. In the event that no monitor is available, the repeater shall be shut down by the last appointed monitor pursuant to the terms and conditions of 97.43(b)(4), and an entry made in that monitor's log to show date and time of shutdown. The shutdown shall be of such finality that resumption of service can be accomplished only by in-person attendance of an authorized amateur at the repeater site or, in the event of remote control, a command signal from the authorized control licensee

Repeaters, like amateur stations, should be identified periodically, but the identification need not be of the same nature as a conventional amateur station. So, to add paragraph (v) to Part 97.87, FM proposes the following modification:

(iv) Continuation from para. iv..... at least once every ten minutes during any single transmission of more than ten minutes duration, except that:

v. in the case of a repeater, the repeater may be identified automatically each time the repeater is keyed and at intervals of two minutes thereafter until cessation of transmission or each two minutes of on-the-air repeater time.

As the last entry in 97.87 (b), immediately preceding 97.87 (c), FM proposes:

> Where a repeater identification is to be made automatically, such identification shall be in compliance with paragraph 97.87(a)(1)(v), and may consist of a recorded or synthetically generated sequence (voice or Morse code) containing not less than the assigned call letters of the repeater.

Well, there it is so far. Since rulemaking is a serious business and one of lasting significance, every single repeater owner should look over these proposed changes, and make deletions, additions, or corrections, as applicable. By hashing and rehashing, the FM repeater communities will come to terms with the problem of rulemaking -- and the result will be a sound and workable set of constraints that are not too binding nor too lax for effective implementation.

Send your comments to FM Rulemaking, One Radio Ranch, San Dimas (8), California 91773.

it started in chocaga!

by

Bill Harris LAFAYETTE, IND

Being an avid ham and a full-fledged FM'er, naturally I can't seem to allot the time nor gather the resources to make needed repairs to the family TV set at those rare times when a breakdown occurs. In short, I'm scared to touch the thing; too complicated for my blood. So it was only natural to find yours truly, one chill, snowy evening, lugging the boob-tube across the threshold of Friendly Neighborhood TV Service, Inc.

Kicking off the overshoes and attempting to wipe the snow off my glasses with a numb index finger, I was greeted by Joe Harold, the younger partner in Friendly, Inc. As it was after regular business hours, I surmised the old-timer had shuffled off in the direction of the barber shop a few doors down the street to talk over old times and sing a few bars of "Gay '90s" pop tunes with the tonsorial threesome at that emporium;

I heaved a sigh of relief. The OT had been a ham since before the FCC entered the embryo stage, and could talk the legs off a bowling ball. He always made it a point to ask me when I was going to graduate from a Technician class to a "real ticket." Bless his old soul, he meant well, but he always makes me a little uneasy when he brings up that subject.

Joe, on the other hand, never bothered to get any sort of amateur ticket for some reason known only to him, but he's one of the sharpest electronic men in the business. He can fix anything from a UHF garage door opener to a Viking I with equal ease, has the Photofact manuals memorized from number 3 right on up to date, and is especially proficient on sweep and sync circuits. Joe has one occasional shortcoming: He imbibes. And when he does, he gets nostalgic and talkative.

When I got there, Joe was sober, but I could tell from the bulge in his hip pocket that he wouldn't be that way long. He stayed at the shop to do his tippling in order to stay well out of sight of his XYL, and naturally he had had to wait for the OT to leave before proceeding. So I knew what was inevitable if I waited for the TV set to be repaired: one of Joe's magnanimous rehashes of his old school days. Nevertheless, I pulled up a table-model cabinet, sat down and made myself comfortable for the long wait.

THE STRAIGHT SCOOP

Joe took a surreptitious nip from the bottle, drove the last few phillips screws into the portable stereo on the bench, dropped on the test record, spun all the knobs a time or two, pulled off the test disk and threw it back across the room to its normal resting place among a pile of old flybacks, hastily made out a ticket which he taped to the stereo, and carried it out front to the wait shelf. Carrying my set back to the shop area, he took a glance out the front window in the direction of my parked chariot. He flashed a tobacco-stained grin at me: "Whatcha got under all them antennas?"

I swear, people never get tired of asking that question. "Two-meter FM, six meter FM, Biz band and AM/FM

BC--they're all in use." I picked up a small "cassette" recorder and started playing with it. Later I was to realize what a timely act that was to be, for I taped a story that every true FM'er should know.

I noticed that the recorder had a full cartridge, and immediately conceived the idea of recording Joe for the purpose of showing him how he sounded when he went off into one of his pickled story-telling ventures. Hastily, I switched the unit to the record mode and placed the recorder and mike carefully back down on the display case. Read Joe's story and tell me if you can find it in your heart to blame me for what I later did--I SHOPLIFTED that tape cartridge!

EMBRYO OF AN IDEA

"You hams and your four-wheeled attention-getters!" Joe rather cherishes anonymity. "What kind of radios you got in there, anyway?"

I tried to suppress a shudder as Joe heaved the set's back cover across the room and relegated the screws to the bench amid a half-acre of other nondescript hardware. I told him the regular dope about the Big Three--rather, the Big One and Other Two. I hadn't even got to Link and Comco when I noticed Joe chuckling under his breath. He asked me: "Have you ever heard of a 4-to-1 Vee?" Oh, yes, I assured him--THAT was one of the more popular and plentiful sets on the used FM equipment scene; how did HE know about it?

Joe took a rather immodest swig of Old Nailer and stuck a 'CG7 in the tube checker. "Well, it's like this here," he began. "I wuz goin' to residence school at DeFry up in Chocaga back in about the latter part of '48--the early part of '49 think it was, an' I was workin' my way through doing odd jobs, and one'a them was tending bar in the afternoon at a li'l place called Noubie's Bar and Grill on Canyon Street, I think it was, on the West Side. I remember it was snowing just about like this one day, it was just after one o'clock, or just before--anyway, it was lunchtime or thereabouts, and we wasn't too busy. I was keepin' two guys at the bar in beer and doin' homework in between. I didn't expect a big lunch rush from the plants up the street; it seems on those bad days most of the guys' wives really went all-out, packin' up a real nice tote lunch 'cause they knew it wouldn't take much to make hubby buzz down to the corner tavern for a warmer. Seems funny, but we actually lost business on bad days. You'd think it'd be the other way around, wouldn't ya?" He threw the fresh tube at a cockroach on the far back wall and retrieved another from the shelf.

'Well, I was about ready to get a bowl of bean soup myself when a big tan Hudson pulls up out front and two fellas jump out and stomp in the front door. Recognized 'em right off as a couple of Motoroller engineers that came in the place quite often--think their names were Hank Spaznowski and Burt Marvin, if I 'member right. "Anyway, they looked sorta downcast, like they'd lost their last friend or somethin', and since I'm a natcheral curious sort, I took 'em their businessmen's lunch, which was merely martinis, got my bean soup an' slipped inta the booth behind 'em where I could keep an eye on things, ya know?"

Jue unscrewed the cap and dipped his beak again. "Well, it seems they had got the word. Either cook up something new and radically different in the two-way field or heads was gonna roll back at the plant. The wheels in Consumer Research said they'd been usin' the old postwar design too long already and it was time for a design change. Hank and Burt were frantic. I made up my mind from looking at the way they was pushed that I'd never be an engineer."

"Anyhow, instead of finishin' up with a ham san'wich and headin' back to the plant like they usually did, they sat there an' drank purty steady all afternoon. Hank workin' his slipstick and Burt drawin' all over the tablecloth, and when it got full, he used napkins an' even the wall. After a while they really

had a thing goin', in more ways than one!"

By this time, Joe had a "thing" going also--he had a noticeable 15-degree list to starboard and he was dexterously, considering his ploxed condition, fishing around in the vertical integrator circuit of my set with a rather large set of dikes. I chewed a fingernail, turned my eyes from the scene, leaned back and tried to relax. In doing so, I went into a sort of dream-like state in which I was listening to Joe's description of the incident while at the same time imagining having been there myself 'way back in '49 ... That Joe is some storyteller .....

"Burt ran his fingers through his hair. 'Hank, ole buddy, say we use the same circuit that's in the Turkey Roaster, only with these new 7- and 9-pin tiny tubes. Now we know the circuit works, there's no sense going off on a tangent. Right?' Swig of martini; eat olive.

" 'I'll agree, but they DO wanna use that newfangled "Parmaclay" thing in the low i-f's, and somebody wants to sell us overtone crystals for the front end. Can't you imagine how often the converter output's gonna drift back an' forth across that 455 kc i-f? I don't see how we can possibly get the thing that damn stable. State of the art just hasn't got that far yet!'

"Burt beckoned for two more drinks. 'Well, we'll take care of THAT little problem; we'll just stick the slab in one of them little heaters. That'll just stabilize the hell outa it.'

" 'Alrighty. How about inductors?'

" 'Well, we can't use the tuned-line bit unless we bend 'em over or somethin'; I'd say let's sneak in a few cans from the Fye-Vee project ... you know, the one everybody admitted was a real flop?'

"Hank snapped his fingers and peeled out his slide rule. 'Looks sensible. Speaking of using leftover production parts, we've got a lot of those silly locknut coil forms, silver-plated huge doubler plate cans, and sorta fat round coils and shields from the car-radio division to use up. Whatsay we try to stick as much of that stuff as possible in the transmitter?'

" 'Sounds like you're not aware of the new trend toward space-saving and miniaturization that's going on; Man, we gotta conserve space!'

" 'Here's how we do it!' announced Hank. 'We save gobs of room by using selenium rectifiers--you know those dry-plate thingamabobs--instead of OZ4's and the like. Also, we use an open-frame transformer instead of those ludicrous potted things they've been sending us; and to REALLY tiny it up, we wire the whole thing with about number 26 telephone wire. You know wire lasts forever in a radio--I don't foresee any possible problems from using small wire.' Then, as an afterthought, he added, 'Besides, this will give us some saving in copper.'

"Burt reached up and dropped a dime into the jikebox remote on the wall; across the room the console rattled as if in complaint. The mechanical noise ceased; the McGuire Sisters began singing. Burt gave them some assistance.

" 'And,' Burt jabbed his finger in Hank's direction, 'don't forget we've gotta get away from having the power supply on the tranny chassis. Gee Hee has been doing that for years and it just ain't too good. THIS time, Sam, we're gonna put the receiver on one chassis, transmitter on another, and power supply on another. That should make servicing and troubleshooting 200 percent easier, in addition to making the unit more versatile.'

"Hank brightened. 'Never thoughta that! You figured out what we're goin' to do for the power supply yet?'

" 'Yup! Don' wanna use a dynamotor, so--look here--I've figgered out a way to get about a dozen different voltages and biases outa one vibrator shupply.' " (There was a definite hic, but I'm not sure whether it was supposed to be Joe's or Burt's.) " '--'course it's a little complicated, ain't it? But betcha it'll work the firsht time off; jush betcha!'

" 'Shay, the Head wants us to built it into a one-piece case wit' a ree-movable lid. Tell ya what! I shaw a nifty tool box other day--plumber had it; looks like--thish--here, an' it measured 'bout 7 by 10 by 22. Think we c'n cram all that radie into it?'

" 'Now there'sh an idea! You get the furlined punchbowl, ol' buddy. Now howsh about thish: Evaluation just got a couple baskets of CK5829 tubes from some surplus house other day--what shay we make it look good by usin' shome a' them, shay, in' a squelch an' clipper stages, hah?'

"Burt slapped Hank on the shoulder. 'Gotta award ya the plastic deep-fat fryer fer that bit'a thinkin', Hank! An' I got one fer ya: (Another hic of questionable source.) How 'bout we put all the connectors on the front panel--includin' the meter sockets? That oughta leave ush a lot more chash---chassis room.' Hank was on his hands and knees on the floor looking for part of his slide rule. Burt yelled: 'BARTENDER, ol' buddy! How 'bout a couple more big ones, HAH?' "

Early afternoon gave way to late afternoon. Joe, homework long since forgotten, was leaning over the bar listening to the noisy discussion, mixed between being impressed and wondering whether these drunken engineers would get violent and have to be thrown out. It was obvious that they were pretty far over the hill.

"Hank was stirring his drink with the remaining part of his slide rule and muttering something barely coherent about ambient temperature. Burt stuck his fountain pen back into his shirt pocket with the cap off and announced to nobody in particular that as far as he was concerned they had come up with the design of the century. He started piling booze-stained paper napkins into his briefcase. 'Well, Hank ole boy, thash it! We've really got something this time! They're really gonna love ush up there on Disgusted Street after tomarra mornin', shee if I ain't right. Lesh take all thish shtuff up to Clawson an' have 'im run off a couple prototypes on it, an' if there ain't room fer all of it in the case he can let Phil Wize in Portable Research shrink it up a little for ush, an' we'll nail the whole thing to the wall an' shee how it hangsh. Right, ol' boddy?'

" 'Right, yer so RIGHT! Shay, wot're we gonna call thish new baby?'

" 'Why, 4-to-1 Vee, of courshe!'

" 'Why 4-to-1 Vee?'

" 'Because it's V fer Vibrator powered; and 4-to-1 stands fer number of parts per square inch of chassis shpace. What else COULD it be?'

"Hank threw the remains of the slip-stick across the barroom where it bounced off the jukebox. 'Shur can't argue wi' that, ol' pal! Leshgo home!' "

LEGACY

The two disheveled men, arms around each other and singing some unidentifiable tune, staggered out into the bitter evening cold and weaved down the side-walks of uptown Chocaga. The door slammed with a loud bang . . .

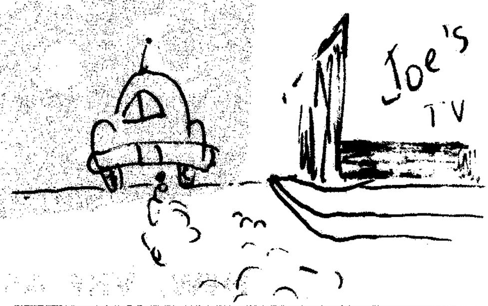
A loud bang brought me back to the present. I straightened up and looked around to the bench. My set was playing, both picture and sound normal, but Joe was not standing beside it. Joe was on the floor, passed out. I jumped up and ran over to where he lay. I felt his pulse, looked for bruises. He was out cold, smiling, mumbling to himself. Sounded like he said, "Douse the light, honey; it'll be daylight before you know it!" I placed a rolled-up shop blanket under his head and covered him with a couple of shopcoats.

I shut off the bench power, switched on the night light and headed for the front door. I could come back after the set later. As I passed the display counter, I realized the little tape recorder was still running. I turned it off and lifted the cover. Removing the tape cartridge, I replaced the tape machine in the display case. Into a coat pocket went the tape.

The barber shop was closed, the street was deserted. I tried the door lock, pulled up my coat collar and headed for the car. Sleep well, Joe Harold--you earned it. The strains of "Auld Lang Syne" came from somewhere far down the street.

I climbed into the car and headed off toward home, smiling as I thought of those two engineers and that night so like this one, way back when in Chocaga. Reaching over to the front-mount unit, I snapped the volume control several times until the vibrator started.

K9FOV



REPEATER COORDINATION

A meeting was held in Ford, New Jersey recently to coordinate frequencies for two new metropolitan New York repeaters. Use of 146.94 MHz in the area was discussed at length. The majority of representatives opposed repeater operation on this channel within the metropolitan area. Existing repeaters on 146.94 MHz serve areas outside the congested area or operate on a limited basis only.

Metropolitan New York has not been considered to be overly crowded on two meter FM. In order to pick new frequencies a table was drawn up showing existing use of the 146 MHz frequencies. The table was based upon information available and reflected present channel use and the approaching saturation -- even on the "splits."

The following amateurs were present: WB2AKG, WA1DEL, K2EWB, WA2HXV, K2IEZ, W1JTB, K2MHP, WA2QWL, WB2RAA, WA2RHL, WA2VFB, W2WJS, K3WKV.

Gordon Pugh W2GHR

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LETTERS

THE CODE

OK Ken:

I'm for your proposal about dropping the code requirements. You can count on me to help.

Keep up the good work on FM. It's great!

Dick Ulrich K6KCY
"76" Tujunga

Sir:

In regard to your article in Nov FM titled "The Code: A Step Backward," I would like to say I certainly agree with you 100%.

Everything you said in the article is just as I have felt for years.

I hold a Technician license (also a first class commercial) and the only reason I have never tried for a higher amateur grade of license is because of the code. Keep up the good articles as I enjoy your magazine very much.

Gordon E. Gregory KØKWH
3808 Robert
St Louis, Missouri 63116

Sir:

I have just read your editorial in "The Code" and I agree with you 100%. I now hold an Advanced Class amateur license, and a first class phone license (P1-11-18193).

The code kept me off of the amateur bands for twenty years; I am so strong against it I would feel proud to be included on the original petition to the FCC.

Leonard R. Fox WA6SXK
Maywood, Calif

Re "The Code: A Step Backward?"

Nuts. I dig the cw requirement! It is a useful obstacle. It keeps the "pretenders" off the hambands. If an individual wants a license he should work for same. Many persons (not excluding myself) can memorize study guides sufficiently to pass any exam; the code exam requires a skill, and this must be acquired. Perhaps a "practicum" exam could be used in place of the code exam --I'd buy that!

Perhaps if Hon. Ed. were to "beat the machine," his feelings might change. Anyway, I never use the ol' code 'cept to work Novices, field day, etc.

It's a good rag--keep 'em comin'.

73's

W6EJK
3563 Helms Ave #2
Culver City, Calif 90230

I support your views about ARRL, FCC, and the waste of frequencies on cw.

T. J. Barnes K9TFJ
Greenwood, Indiana

Dear Ken:

I agree 100% with your editorial on code, the ARRL establishment and its influence on our license examination structure and content.

I believe a successful attack on the Technician code requirement would be significant in that there is no international agreement entered into by our government in these frequencies. This has been the typical FCC retort to pleas for code abolishment--so why continue in the UHF range?

I'm with you, Ken, and I hope you're able to muster the support needed.

A. R. Farrant WA8WLI
19201 Euclid Avenue, #648
Euclid, Ohio 44117

Gentlemen:

I should like to make a few comments regarding your proposals to eliminate the code requirement for FCC license on the VHF and up amateur bands. Let me say that I was once for the idea myself. I was a Technician licenseholder for over nine years before I got gumption enough to get my code speed up to pass the General examination. All that time, I somehow had the feeling I was being cheated because I hardly ever used cw.

As to cw being difficult to learn at the 5 wpm level, I have taught several people cw, and the longest time that it took any of them to get to 5 wpm was about 10 hours. One must practice longer than that to get a proficiency award (or license) in any other hobby I know of. As to cw being useless, has anyone tried to use modes other than cw for moonbounce? For meteor scatter communication? For "Oscar" satellite communication? For ionospheric scatter communications? For just plain old hard-to-hear fast-fading DX? Those who have will tell you that any other mode except cw almost guarantees failure to communicate. Have you ever tried to use modes other than cw for operations (such as military) where codes and ciphers were necessary? Cw is much safer, much surer, and much much easier.

Thus, it is my opinion that the almost trivial requirement for a 5 wpm code test is not a hindrance to amateur radio above 50 MHz. Rather, it provides at least a minimum skill level necessary for an amateur operator to communicate utilizing the wide range of equipment and continuously varying propagation conditions in our VHF-and-up spectrum.

Let us not take the attitude that because cw is not needed to operate in the FM mode, therefore cw is unnecessary, obsolete, and useless. Tomorrow, you or I may (heaven forbid!) not be interested in FM any longer, and instead we may be interested in moonbounce. Let us be prepared. Let's keep cw as a prerequisite for an Amateur license.

J. M. Mehaffey K4IHP and
WB4JBW (wife)
6835 Sunnybrook Lane, NE
Atlanta, Georgia 30328

I must assume that your write-up about code in the November issue of FM Magazine is an editorial. It was not identified as such and no author was listed.

I can begin by saying that before the time I received my license I would have been happy to agree with you. From the time I was in grade school until I finished my time in the service, I wanted an Amateur license more than anything else in the world. The only bar was the 13 wpm code requirement. Fully a year before I finally got my license I held a first-class commercial telephone operator's license. The turning point came when one of my amateur friends finally put it very bluntly. In short, he said, "Al, stop fooling around; get busy and learn code."

It turned out that he was right. By the simple process of getting down to business I was able to pass the code requirement at 13 wpm after only three months. I'll admit I felt rather foolish when looking back over the many years that I had convinced myself that I simply could not do it.

Returning to some of the comments in your editorial, your third paragraph makes some statements with which I will argue. Stated more concisely, you simply say that a phone mode will handle more traffic faster. My comment here is, what do you consider traffic? If traffic is a simple statement such as "The water is rising over the bridge on South Main Street," then I will agree with you. If your traffic is in formal style, sent to a person having an odd name, contains combinations of numbers and letters such as aircraft flight numbers and arrival times, catalog numbers, unfamiliar amateur call letters, aircraft serial numbers, quantities and descriptions of emergency supplies, then I will not agree. Under these conditions the main advantage of phone is that you learn quickly how badly the message has been received. You then go back and carefully spell everything phonetically. In other words, the message is sent one character at a time.

The next paragraph says that "if relative numerical values are assigned, cw would always come out lowest . . ." This statement can be true for any mode of communication you care to name. All you need do is change the relative numerical values to suit your argument. Your next paragraph remarks that code proficiency as a license requirement hinders progress. I fail to find anywhere in your editorial where you point out just how it hinders progress. The following paragraph says that none will deny the inefficiency of cw. Here, you are wrong. I for one do deny this alleged inefficiency--given some conditions. I believe I am entitled to my opinion as you are to yours. I won't comment on the ARRL and their reasons. This whole area is too filled with emotion.

I suspect that the whole reason for your having written this article begins at the bottom of the third column. You make the comment that code proficiency may not be acquired by anyone -- that some are more adept than others. Experience in the armed forces has shown that given enough motivation anyone can learn code. During World War II, Africans of the Belgian Congo were trained to copy code with typewriters and did so over a period of several years at radio Brazzaville. With this history I will state flatly that a code test will not discriminate against "those best suited for amateur privileges." These "best suited" persons may not want to learn code, but if they are intelligent enough to have the interest they certainly can learn it.

Toward the bottom of page 5, you say that as it happens the United States is allegedly bound by an archaic rule to an international agreement that code will be a requirement for certain high frequencies. To set the record straight, this requirement appears in the agreement of the Geneva Convention of 1959. You will find it in Chapter X, Article 41, Paragraph 1563. This portion says that persons licensed in the amateur service will demonstrate an ability to correctly send and receive plain language text using international Morse code. You are right concerning frequencies above 144 MHz. No code test is required here under international agreement.

However, perhaps you missed the most important point of all. In the United States anyone issued a license in any radio service first must demonstrate that the license will be used in the public interest, convenience or necessity. This is the old PICON concept. I will grant that persons can render immeasurable service using VHF two-meter FM without knowing any code whatever. But, if a person is to truly be able to step in and fill any position during a communication emergency, the knowledge of international code certainly will not hurt and in some cases might be an immense advantage. I can conceive of cases where code might be sent using an F-3 rig but where signal level was too low to provide solid voice copy.

As I stated at the beginning, my first reaction to your editorial was: so what? I still have this feeling. If you are looking for a controversial subject in order to generate letters to the editor, there must be any number of truly pressing and important issues which could be used instead. If it happens that you have some friend who would like to join you on two-meter FM but who can't bother to learn the code, then I have little sympathy for either of you. You say the FCC will listen attentively to arguments from any source. I fully agree. I have had some dealings with the FCC and above all they do appear to be fair-minded. It might be interesting to see the outcome of any docket you care to submit.

Allen Auten WØECN
President
Denver Radio Club, Inc.

Dear Editor:

I am opposed to your editorial, "The Code: A Step Backward?". Your article covered those operating in the VHF spectra and commented about other bands now reserved for cw.

Many people are also saying "Why have a technical exam for amateur radio?" I have taught many novices the code. Those who cannot learn "five words" do not have the mental ability to learn the technical requirements for Novice.

There is a need for code even if you don't operate cw (as in my case). RTTY is the "modern cw." Cw is justifiably required for identification of an RTTY station. Many FM and AM repeaters are station identified by cw. Cw is required in many cases under emergency conditions.

So let's not spend our time and efforts trying to take the "5 wpm" out of the Technician test, but rather spend it in promoting FM station and repeater standardization and how to make more equipment available to the amateur at reasonable prices.

There are many active programs for those who do not want to spend the time and effort to get the Amateur license. The license costs only $8 without the test. These programs are important, and we use them for many worthwhile causes.

Russell R. Bateman W7NFT/WA7AKI
State Communications Officer
Emergency Operations & Civil Defense
Salt Lake City, Utah 84108

Dear Editor:

I've been operating on two-meter FM since 1962, so I think that I can objectively comment on its various aspects.

Your November issue asked for our opinions on your FCC petition regarding code requirements on VHF. Please indicate one vote against your petition.

My reason is this: I feel that it separates those who really are interested Since 1965 or so there has been a trend toward the people I call "pushbutton boys" who just get on and "yak" and don't even have the slightest desire to pick up a soldering iron and apply themselves. Let us not forget that this was the original intent of the Technician class license.

As my close friends will attest, I very seldom agree with the ARRL, but on this point and this point only I agree with their stand.

You may print this if you care to.

Also, I really enjoy FM Magazine and really get much valuable info from it. Keep up the good work!

Ed Denton W1VAK
14 Holland Road
Falmouth, Mass 02540

A Step Backward - for FM

With lack of a byline, your article on "The Code" becomes somewhat of a mystery. Was the writer a CB'er, novice, or just a poor bloke who learned five words per, then joined the rest of us amnesiatics? The logic supporting abandonment has been warmed over at virtually every amateur gathering and is a part of the patter commonly heard below 25 MHz. But the code is destined to be around a while longer, no matter how anyone tries to expurge it. When Hiram Percy Maxim no longer countenances from page one, that will be the signal, not before. The Honorable H. P. M. has departed from a distant age but left its remnants, unfortunately. The idea, though, is great. I am for keeping with the times. The fact that FM has entered the arena to thrust a small banderillo into old Code is retrogressive in that so many picadores and matadores have tried it before. Do we FM'ers have such a strong following already to draw proper support against such a durable perennial? Not quite. More important to our interests and more demanding of our talents is the current attention to amateur relay operations. Two petitions have been received by the FCC to alter regulations for relays, and the ARRL is forming a Relay Advisory Committee to "study" the matter. This is where our voices will be heard, not on stagnant code issues. Take up that banner again later, but move forward now toward that which will be with us for quite some time.

Robert Kelty
Calif Amateur Relay Council

OMISSION OF EDITORIAL BYLINE WAS EDITORIAL ERROR. WE STAND CORRECTED.

PAGE 57 IS MISSING FROM SOURCE

PAGE 58 IS MISSING FROM SOURCE

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FOR SALE

MOTOROLA Wide Band Permakey 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; W2EQV, 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.

PERMAKEY FILTERS, Motorola Permakey 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

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 20 Hz 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.

TOUCHTONE equipment, especially 16 button Touchtone dials, but other dials, decoders, etc. Needed for remote control. H. Alan Rhodes, Box 1071, Castle Pointe Station, Hoboken, N.J. 07030.

BASE STATION, hi band, 60 watt, list type, condition and price in first letter. Ed Galovic, 86 Egbert Rd., Bedford, Ohio 44146.

CANNON PLUG, 16 pin, female, No. NK-R-16-21-1, used on RCA carfone 150. Walter Gill, Box 725, Roswell, N. M. 88201.

SWAP

TYPE 15 TTY unit, mod. for friction feed, Rec – 13 power supply, Reperf, table, SCI-1-60 indicator unit (solid-state). LGE box spare new parts, maint. manual. Two line feed/indicator units, 0-90 w/red lamp. Joe Feagons, Box 103, Tallula, Illinois 62688.

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.

ILLIANA NET, The Illiana Two Meter AM Net will Monitor 145.620 MHz with commercial grade crystals. We will monitor 24 hrs. a day and cover Western Indiana and Eastern Illinois. We hope to expand our coverage, so come on and jump on the band wagon. The crystals for your set are easily obtained from Sentry Crystal. Contact Terry Hancock, 11-7 Ross Ade Drive, W. Lafayette, Indiana 47905 for more information.

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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