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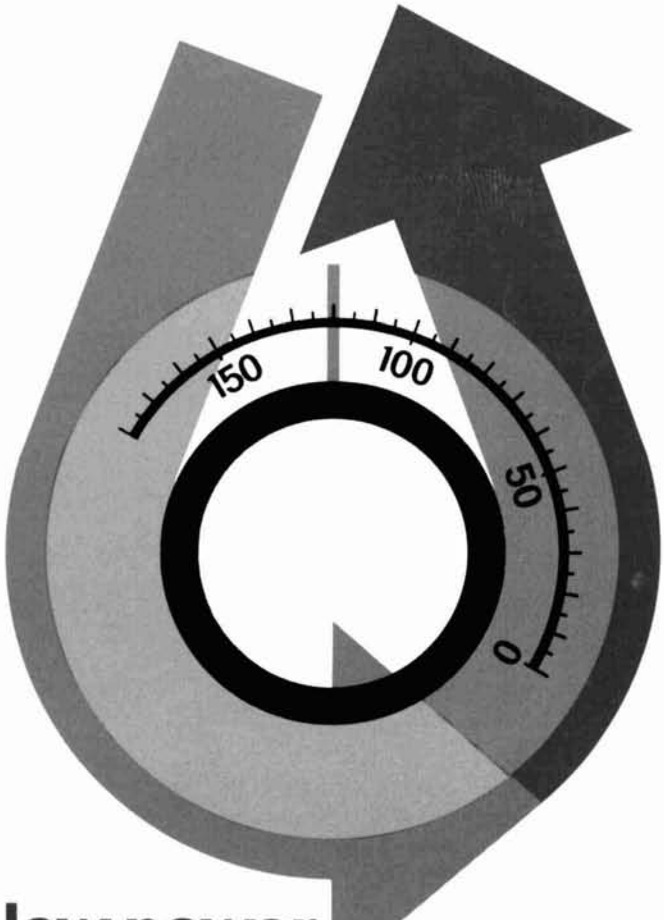
ham radio

magazine

hr

APRIL 1980



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More Details? CHECK—OFF Page 94

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APRIL 1980

volume 13, number 4

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contents

a second look

by Jim Fisk

The widely escalating precious metals market and Amateur Radio. What you might ask, does one have to do with the other? As a starter, consider the fact that the basic construction of practically every component in that new transceiver you're thinking about buying uses silver, gold, or palladium. Those inexpensive and innocent looking ceramic bypass capacitors that are used by the hundreds, for example, use thin silver layers deposited on ceramic substrates. Most transistors, diodes, and integrated circuits use gold contact wires and many are built within a tiny gold frame; and palladium is often used in precious monolithic resistors. When you add the precious metals in these common components to the more obvious ones like silver-mica capacitors and silver-plated switch contacts, tank circuits, and variable capacitors, it is suddenly apparent that the transceiver on your operating desk is a source of hidden wealth. More important, it is indicative of the great increases in the cost of Amateur Radio equipment you can expect in the not-too-distant future.

As recently as last year, the cost of precious metals used in the manufacturing processes of electronic components was relatively minor, and the manufacturers simply factored that cost into the selling price of the part. The commodities market was fairly stable, so the manufacturers absorbed any minor fluctuations in material costs. With the recent volatility of the precious metals market, however, the manufacturers are no longer able to absorb the huge cost burden and are beginning to pass it along to their customers in the form of a surcharge. At the present time a 10 to 15 per cent surcharge is not uncommon for many components; it is even higher on some high-grade parts that depend heavily on the use of gold.

And while the soaring costs of gold and silver have been capturing the headlines, costs of other commodities which are important — often vital — to electronics are also going out of sight. Consider for a moment that penny in your pocket; the cost of the copper has now reached the point where the Lincoln penny's monetary value is essentially the same as its copper value. When you translate that into the huge amount of copper used by industry in the manufacture of printed-circuit boards, hookup wire, coaxial cable, and a hundred other electronic products, you are struck with the enormity of the situation — and the great impact it will eventually have on the costs of all electronics equipment.

The costs of equipment will also be greatly affected in the future by the OPEC oil cartel because of the great quantities of petroleum-based materials used in electronics: epoxy-fiberglass circuit boards, thermoplastic insulation, polythylene coaxial cable — the list goes on and on. If you have watched the price of coaxial cable for the past few months, you've probably noticed that the prices quoted in the magazine advertisements seem to be higher in each new issue of the magazine; ditto for rotator cable and hookup wire. Just as one example, when I bought a few feet of Teflon-insulated RG-141A/U coaxial cable (silver-plated conductors) for a W1JR Broadband balun back in the summer of 1978, I paid a bit less than a dollar a foot — that same coax is now about $2.50 per foot in small quantities and the supplier refuses to guarantee the price for more than 30 days! Price increases for RG-8/U type coax have been somewhat less startling so far, but if I were planning a major new antenna installation this year, I think I would order the necessary coax before the soaring price of raw copper has a chance to filter down to the consumer level. Indeed, if you're thinking about buying any new Amateur Radio equipment, this would be a good time to make your final decision; the longer you wait, the more it is likely to cost.

Jim Fisk, W1HR
editor-in-chief

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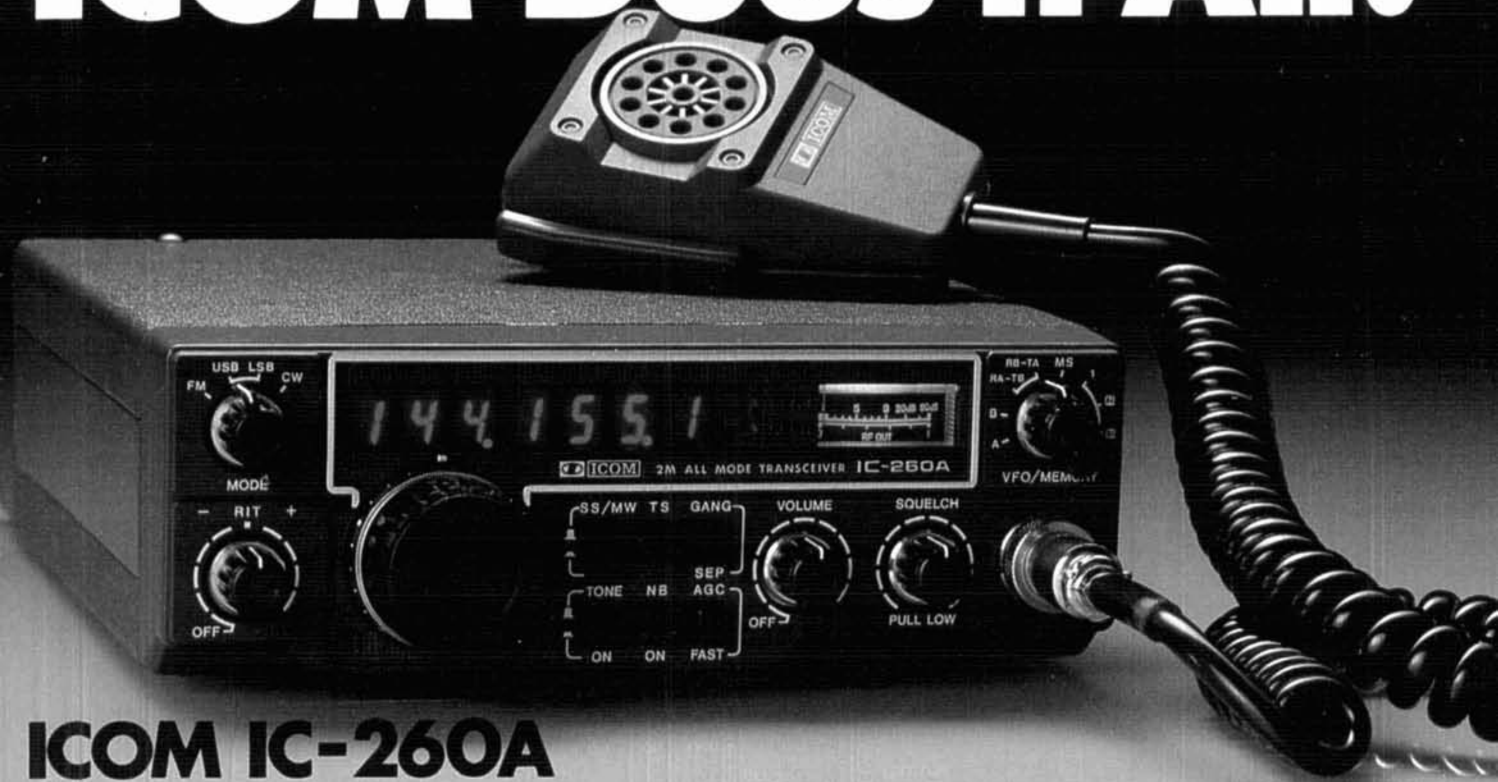

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comments

FCC actions

Dear HR:

I agree strongly with your editorial in December *ham radio*! It seems that since a segment of the Amateur world behaves like CBers with regard to self-discipline, the lay public and the FCC tar us all with the same brush, and have in mind the slow attrition of all the non-voice, non-rag-chewing privileges. The part that really concerns me is the loss of our ability to be on the cutting edge of radio technology. The RTTY restrictions and the CW requirement matter are really shameful.

Your editorial has moved me to try to compose a literate letter of objection to send to my governmental representatives on this matter . . . what else should one do?

J.L. Ragle, W1ZI
Amherst, Massachusetts

Dear HR:

Congratulations on your December editorial; that says it all. I recommended to the Dayton Amateur Radio Association members at the last meeting that it was *must* reading if we are to understand the shakey position of Amateur Radio in the hands of the present FCC crowd.

I'm afraid that our success in Geneva is going to develop complacency in the ham ranks at a time when Amateur Radio, as we know it, is really threatened. I hesitate to think what might have happened if the FCC could have slipped through the no code deal. I also feel that if we accept this action by the FCC without challenging it, we will be in for more unhappy surprises in the future.

I sent copies of your editorial to my Congressmen asking that Congress take a look at what is happening in the FCC. It is good to see that there are others as irked about this sellout as I am. We may not get anywhere but they aren't going to turn me into a Citizens Bander without a fight.

Also sent a letter to the ARRL asking that they use the "freedom of information act" to get to the bottom of this. What we really need is a couple of aggressive young lawyers and let them dig. If the kind of information could be developed that I think is there somewhere, Congress or the Chairman would have to do some house cleaning.

Robert R. McKay, N8ADA
Editor, RF Carrier
Dayton Amateur
Radio Association

speed of light

Dear HR:

Harold Tolles, W7ITB, wrote a very interesting article on the speed of light which appeared in the January issue of *ham radio*. May I be another pair of eyes viewing the subject from a different point of view?

In 1675 the Danish astronomer Roemer determined the speed of light at 186,000 miles per second. Considering the crude equipment, it was remarkable that he came so close. Later this was translated into 300,000 kilometers per second. In appreciation of the longhand computations required, this was close enough.

However, in 1926, Michelson was able to refine this speed to 29979 ± 4 kilometers per second. Per Tolles' article, ITT determined in 1970 that the speed was 299,793 kilometers per second.

Joe Reisert, W1JAA, stated in the July, 1976, issue of *ham radio* that the latest revision was determined by several authorities that light travels at 299792.456 kilometers per second. I would be interested in the method used to arrive at this datum. Was it averaged from several readings or were weighted averages used?

John Kraus, W8JK, wrote *The Big Ear*, in which he reaches out 12 billion light years into space. According to the spectrum red shift, there matter is traveling at 6/10 the speed of light. It is estimated at 16 to 20 billion light years away, objects are traveling at the speed of light. May I pose a question? If the center of the universe is at that distance, then we must be traveling through space at the speed of light, in which case the tip of my little finger would weigh several thousand million tons! It doesn't. Why not?

Another factor in astronomy, the Hertzsprung-Russel diagram, shows the main-sequence of the stars. From these data, it is possible for some smaller stars to be much older than the entire universe, according to the big bang theory. How come?

To answer these two questions, can it be that light slows down after traveling 10 billion light years? This decrement of speed might be the result of light traveling the great distance or of the intrinsic micro-nanowatt of the power left in the light beam. In other words: The speed of light is a variable constant!

This super accuracy is very fine, but practical radio communication and antenna design dictate approximate speed of light (and radio waves) to be roughly 299793 kilometers per second, or 186283 miles per second, or 11803 inches per megahertz for a full wavelength dimension.

Keith Rhodes, WB2AOT
Syracuse, New York

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More Details? CHECK—OFF Page 94

presstop

OWNERS OF REPEATERS MUST BEAR responsibility for what goes out over them, FCC Long Beach Field Office Engineer-in-Charge Larry Guy recently told an Anaheim Amateur Radio Club meeting. His office intends to enforce that regulation. The question arose when Larry, himself K6EZM, spoke to the club on the subject of malicious interference, a topic that's been particularly hot in southern California. Exactly what enforcement action they'd take wasn't spelled out, but he did say that, under their interpretation of the rules, regulatory violations committed over a repeater would be treated as if the repeater owner had made them.

General Agreement with that far-reaching concept was expressed by a majority of the Amateurs attending, though several repeater owners pointed out that this would leave them no choice other than to "pull the plug" on their machines whenever a maverick operator wanted them to.

A Repeater In Southeast Wisconsin was reported to have been shut down by the FCC in February, with a number of "Show Cause" citations issued. According to preliminary reports, the repeater itself, the sponsoring club, and a number of users were all cited for numerous rules violations in that crackdown.

RFI FROM AND TO PERSONAL COMPUTERS has been a problem for Amateurs who've become involved in both hobby areas, and it will be multiplied greatly when computer-to-computer communications via Amateur Radio becomes a reality shortly. The FCC has new RFI standards for computers due to go into effect July 1, but a number of computer makers are objecting strongly to that date and want it extended — some by as much as two years. The Commissioners are likely to consider the question soon.

THE DISASTER COMMUNICATIONS Service under Part 99 of the FCC Rules would be eliminated in favor of a "Disaster Response Program" under Part 90, Local Government Service, if General Docket 80-7 becomes part of the rules. Under the Notice of Proposed Rule Making adopted in January, present Part 99 frequencies and authorizations would fall under Part 90. Amateurs active in CD or other emergency programs would probably be affected.

RESTRICTIONS ON USE OF AMATEUR frequencies for radio control has upset the R/C modelers. The issue arose following an FCC legal opinion that only a licensed Amateur can operate a model using 6-meter R/C; Amateurs cannot supervise another non-Amateur who is at the model's controls. Many modelers have been buying 6-meter control systems to avoid 27 and 72 MHz QRM problems, expecting to be "legalized" at meets by friendly Amateurs. Following the FCC legal opinion, however, the Academy of Model Aeronautics announced that non-Amateurs using 6-meter R/C may no longer compete in AMA meets.

The AMA Is Pushing to reverse the FCC opinion, on the grounds that non-licensees are permitted to operate on the other R/C bands under a licensed operator's supervision.

AMATEUR RADIO'S NEW 10-MHZ BAND should be limited to CW only, the IARU Region 1 Executive Committee agreed at its London meeting, to provide minimum utilization of the shared 50-kHz allocation when it becomes available January 1, 1982.

Strong Support for an all CW "30-meter" band has also been registered by U.S. Amateurs who have written ARRL headquarters on the subject, with only a small minority advocating setting aside sub-bands for other modes.

AMSAT'S PHASE III-A SATELLITE will be flying earlier than planned. Latest word is that the launch date for Phase III has been moved back to May 20th from May 30th.

Acceptance Tests on the Phase III transponder were successful and the unit has been approved and licensed by the Deutsche Bundepost.

The Phase III-A Spacecraft was shipped to Frankfurt on February 19 and then brought by a special trailer to Toulouse, France, for vibration tests (February 27) and final acceptance of the satellite flight plans. W3GEY, K1JX, DJ4ZC, and other members of AMSAT/Deutschland were in Toulouse to oversee the tests.

TWO NEW RUSSIAN AMATEUR SATELLITES should be launched and in operation very soon, JR1SWB, secretary of JAMSAT, reports. He says he was told of the forthcoming launch by a high ranking official of the Russian Radiosport Federation. The two satellites, designated "RS-3" and "RS-4," are both supposed to be checked out and ready to go. This report seems to confirm recent suspicions that unusal 10-meter signals heard from Russia in mid-January were satellite related.

OSCAR Users And Other Amateurs are urged to watch the 29.3 to 29.5 MHz slot carefully for unusual telemetry signals, and report anything unusual to AMSAT or ARRL.

OPERATION BY CANADIAN AMATEURS on 75 meters between 3950 and 4000 kHz is likely to be eliminated as a result of the CBC's plan to use two frequencies in that range for internal shortwave broadcasts. The CBC hopes to have 250-kilowatt transmitters operating on 75 by mid 1981.

HAM RADIO has a new Advertising Manager, Craig Clark, N1ACH, who will also retain his title of Assistant Publisher in the Ham Radio organization. Jim Gray, W1XU, continues as Assistant Advertising Manager, while Dottie Sargent, KA1BEB, becomes Assistant to the Publisher.

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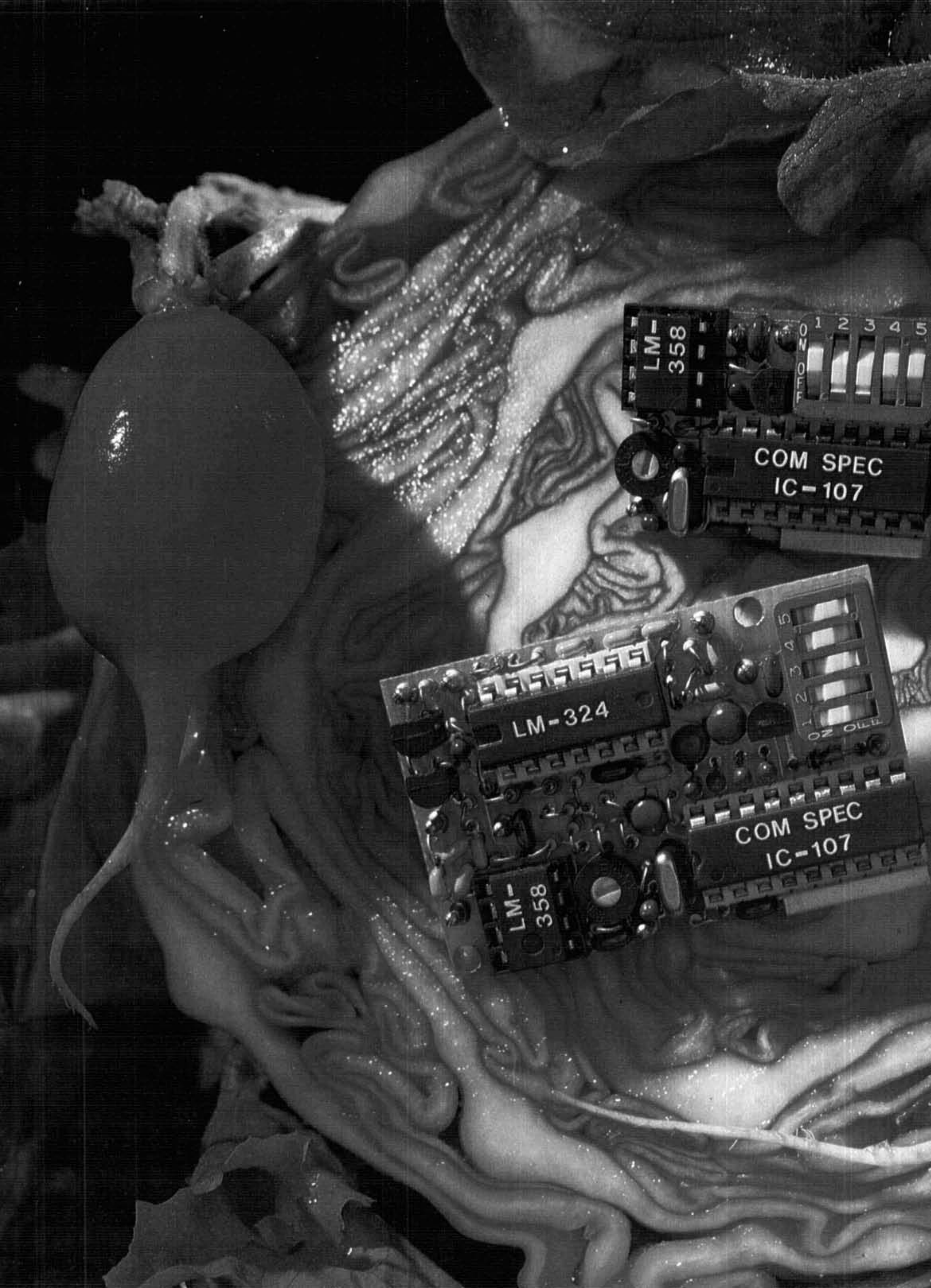
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77.0 XB	100.0 1Z	131.8 3B	173.8 6A
79.7 SP	103.5 1A	136.5 4Z	179.9 6B
82.5 YZ	107.2 1B	141.3 4A	186.2 7Z
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40-meter transceiver for low-power operation

Design and construction details for a QRP CW transceiver operating in the 40-meter band

Have you seen the many articles that have been published on building simple receivers? Or how about the many QRP transmitter articles? How about a deluxe QRP transceiver that has a superior receiver and a healthy 1-watt transmitter, both of which are VFO controlled? Read on.

The excitement of operating QRP accounts for the recent number of articles on the subject, but I feel we've not seen a good transceiver that allows portable, mobile, or fixed operation. So I came up with the rig presented here. I feel sure you'll be amazed by its performance.

The project had some problems getting off the ground. Every direct-conversion (DC) receiver I tried ended up in the scrap bin because it hummed, had tunable hum, overloaded easily, or had microphonics and/or all the above. Then I discovered the design presented here, which has none of these problems.

receiver

This direct-conversion receiver features:

1. Wide dynamic range (resistance to overload)
2. Excellent a-m signal rejection
3. No hum, tunable hum, or microphonics
4. VFO that operates at one-half the desired received frequency

The receiver (see **fig. 1**) has a grounded gate fet rf amplifier, Q101, which is used to bring the typical 40-meter-band noise floor (on a quiet day) above the receiver internal noise floor. This action provides approximately 1.5-microvolt input level for a 10-dB (S + N)/N. The rf stage is electrostatically and electromagnetically isolated from the VFO by T101 and T102 to prevent rf/VFO interaction. T102 provides rf VFO signals to a pair of detectors, each of which a complete detector: CR101, CR102, and CR103, CR104, which operate differentially.

Detector characteristics. The operation of this detector is the single most important feature of the entire transceiver.* From previous descriptions of this detector, I have developed the detector in this rig, which solves the problem of VFO and rf intermodulation and provides translation voltage gain.

The intrinsic characteristics of this detector provide the features stated earlier, because the VFO operates at *one-half* the received frequency; therefore, a-m DSB signals contain a modulation envelope that cancels in each diode pair.

*This detector, which is sometimes referred to as a harmonic detector, has been described in an unbalanced configuration by others.

By John L. Keith, WB5DJE, 1633 Dell Oak Drive, Garland, Texas 75040

This operation is better understood if you consider that the diodes act as rf switches. When the VFO signal approaches its peak amplitude, positive or negative, it turns on a diode. Therefore, one diode in each pair turns on at every peak of the VFO signal. So to obtain an audio beat note, the incoming rf frequency must be twice that of the VFO. The mathematical expression that represents this detector takes on the form of a cubical parabola, which also verifies its inability to detect a-m signals (for which a square-law function is used).

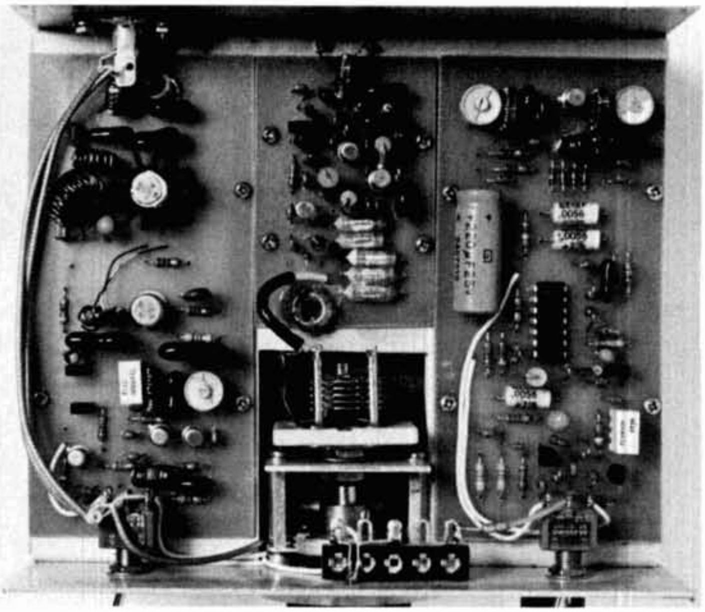
a-m signal rejection. So why such a big deal about a-m signal rejection? No one can hear your signal under an a-m foreign broadcast station, right? You might be surprised – but the big deal is that this feature 1) eliminates tunable hum, 2) reduces static level, and 3) improves microphonic rejection. These parameters benefit from the a-m rejection because all have DSB a-m components that normally go *right through* a product detector. Out-of-band signal rejection is improved because intermodulation is very low in the rf amplifier, VFO, and detector output circuit.

Detector output is dc coupled (since no dc component exists at the detector output) to a differential audio amplifier, U101A, which provides a single-ended output and 46 dB gain. U101B and U101C are 800-Hz filters with a bandwidth of 200 Hz and a gain of 30 dB. The Q of these filters is selected to prevent ringing. U101D provides the last 35 dB of receiver gain, picks up the sidetone when transmitting, and drives the headphones.

VFO

The VFO provides an output between 3500 kHz-3590 kHz to transmitter and receiver. On receive the VFO frequency is used directly but on transmit it is doubled. Also in receive the VFO frequency is offset so that a station that returns your call will be shifted in frequency approximately 800 Hz, set by C209, so that it will fall in the audio filter passband.

For a change of pace try operating QRP in the 40-meter Amateur band. What is QRP? It's an operating mode that uses the minimum amount of radio-frequency power that will sustain communications. Some QRP stations use less than 1 watt of input power, sometimes even less than 500 milliwatts. Others use up to, say, 5 or 10 watts. The idea in the QRP world is to see how far you can conduct reliable radio communications with the least amount of radiated power. This article provides construction information on a QRP transceiver that will do a good job on 40 meters with only 1 watt output. The receiver is a notch above most circuits using the direct-conversion process. QRP operation on the Amateur bands today is a real challenge, especially on 40 meters. The circuit and information by WB5DJE will get you started. Good luck and have infinite patience. **Editor.**

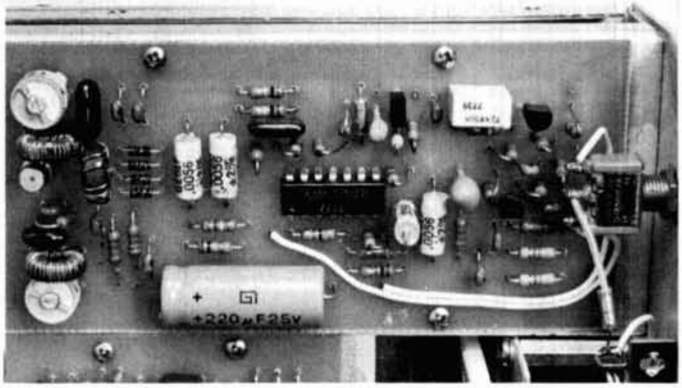


Inside top view of the transceiver, showing three PC boards. The miniature terminal strip secures the dial LED.

Description. The VFO is a Seiler type using a 2N4416 fet followed by an fet buffer and output amplifier. U201 in the VFO is a 5-volt, three-terminal regulator biased to provide +7 Vdc, set by R210. This regulator provides excellent voltage stability far superior to that provided by a zener. The VFO frequency holds within 10 Hz for input supply voltage variations between 15 and 9 Vdc.

The oscillator is very stable, although not temperature compensated, for changes in loading and mechanical vibration. The tank circuit is made of an SF material powdered-iron toroid and polypropylene capacitors. Dipped silver micas will work here but have poorer warmup drift because of the very small rf heating in their dielectrics.

I had an interesting experience with this VFO in the design stages. I started with a Colpitts oscillator,



Top view of the receiver board.

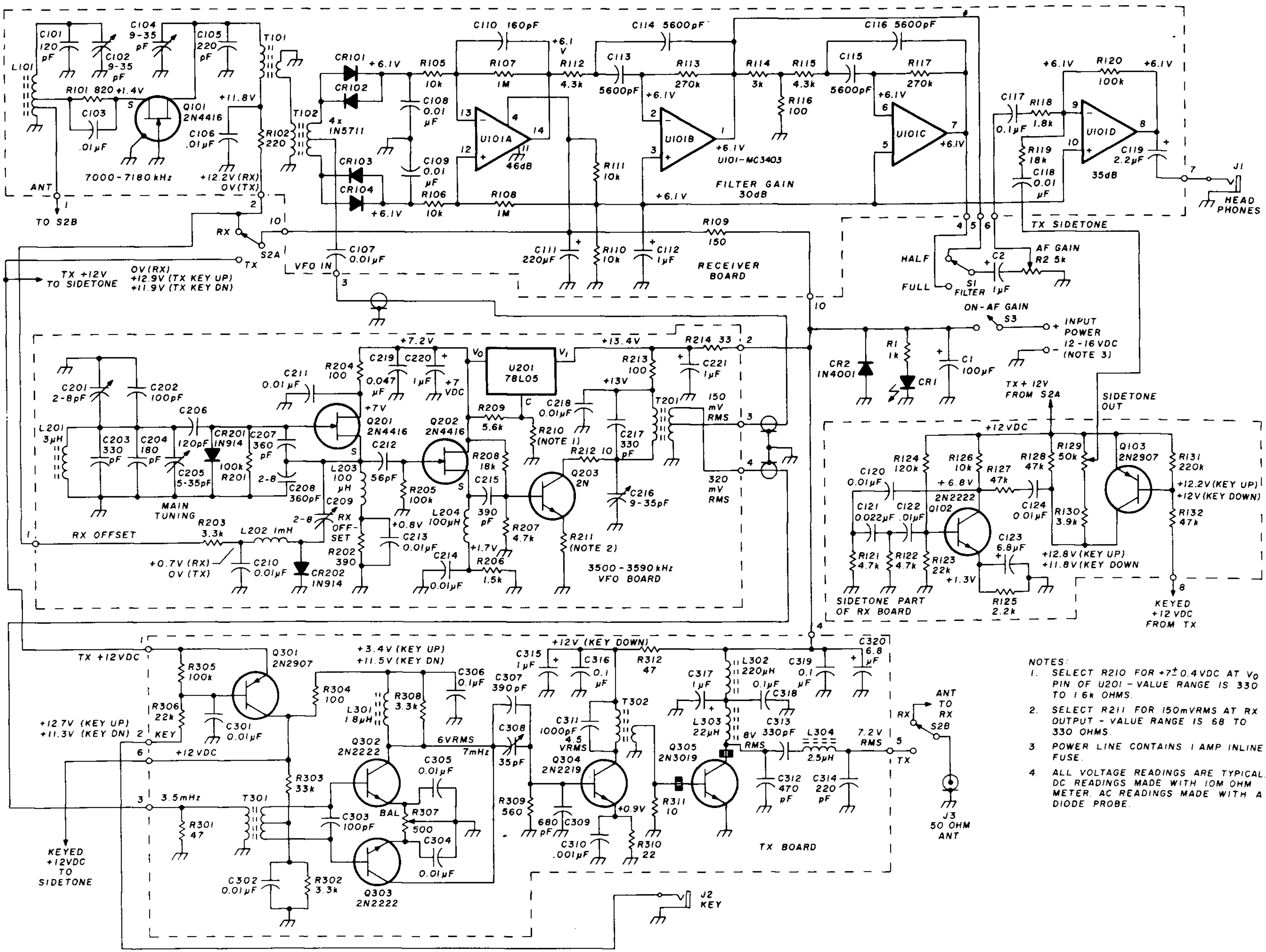
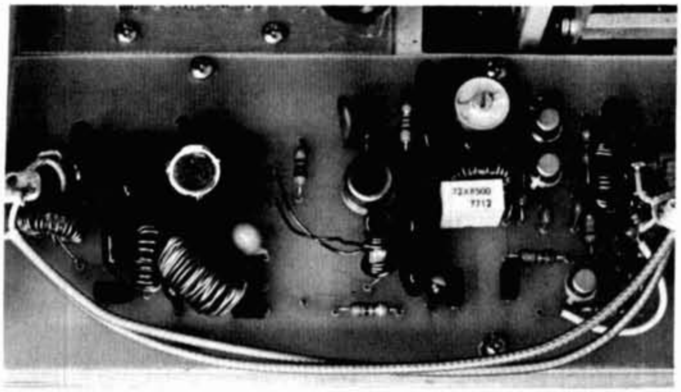


fig. 1. Schematic of the QRP transceiver. The receiver has some novel features not found in most direct-conversion circuits. The VFO is a Seiler type that provides an output between 3500-3590 kHz. On receive the VFO frequency is used directly; on transmit it's doubled. The transmitter provides 1 watt output and uses transistor keying. As an added operating aid, a sidetone circuit is also included.



Close-up view of the transmitter board.

which seemed to work very well. However, when I keyed the transmitter it shifted about 650 Hz. After working on shielding and buffering, and still stuck with a 300-Hz shift, I threw it out and designed the Seiler, which, without any shielding, shifts only about 25 Hz when the transmitter is keyed and sounds as if it is crystal controlled.

Tank inductor L201 is mounted with a coating of polystyrene Q-dope to secure the turns and the inductor to the board. This prevents VFO frequency shift when the rig is vibrated.

table 1. Coil and transformer winding data for the low-power 40-meter CW transceiver.

L101	3.5 μH (33 turns no. 28]0.3 mm] on T37-6 toroid core; tapped at 1 turn for antenna; tapped at 3 turns for Q101 source)
L201	3 μH (30 turns no. 28]0.3 mm] on T37-6 toroid core). Adjust number of turns and spacing to set center frequency and tuning range; coat with *Q-dope* when final adjustments are completed.
L301	1.8 μH (23 turns no. 26]0.4 mm] on T37-6 toroid core)
L302	220 μH (64 turns no. 30]0.25 mm] on FT50-1 ferrite toroid)
L303	22 μH (20 turns no. 24]0.5 mm] on FT37-1 ferrite toroid)
L304	2.5 μH (27 turns no. 26]0.4 mm] on T37-6 toroid core)
T101	2.2 μH primary (25 turns no. 28]0.3 mm] on T37-6 toroid core; secondary is 6 turns no. 26]0.4 mm])
T102	1.3 μH (5 trifilar wound turns no. 26]0.4 mm] on FT37-1 ferrite toroid)
T201	6.4 μH primary (48 turns no. 28]0.3 mm] on T37-6 toroid core; secondary is 6 turns no. 26]0.4 mm], tapped at 3 turns for the receiver)
T301	1.3 μH (5 trifilar wound turns no. 26]0.4 mm] FT37-1 ferrite toroid)
T302	0.53 μH primary (13 turns no. 26]0.4 mm] on T37-6 toroid core; secondary is 4 turns no. 24]0.5 mm])

Notes T37-6 powdered iron toroid core (SF material) has 3/8 inch (10 mm) outside diameter, is rated at 30 μH per 100 turns.

FT50-1 ferrite toroid (Q1 material) has ½ inch (25 mm) outside diameter, is rated at 510 μH per 100 turns.

FT37-1 ferrite toroid (Q1 material) has 3/8 inch (10 mm) outside diameter, is rated at 425 μH per 100 turns.

Dial calibration. Before the coil is coated, the VFO tuning range should be set to calibrate the dial, with C201 set at mid position, by adjusting the number of L201 turns and spacing. Once this is set, calibration can be made by adjusting C201, for which a hole is provided in the bottom cover.

I selected a tuning range of 7000-7180 kHz (3500 kHz-3590 kHz VFO frequency) so that my dial would provide 10 kHz per 10 degrees of rotation. This isn't quite right, because the change is not perfectly linear; but the dial can be laid out with a protractor without having to mark it on the tuning capacitor, and the error will be only a few kHz. Just make sure it's correct at 7025 kHz above, which isn't that critical.

You can calculate or measure the actual change if you want a more accurate calibration across the entire band. Also you can increase the range if you desire. A handy equation for this is:

$$L = \frac{1 - \frac{\omega_o}{\omega_1}}{(\omega_o)^2\,(\Delta C)} \qquad (1)$$

where L = inductance (henries)

$\omega_o = 2\pi f_o$, f_o being the lowest frequency of interest (Hz)

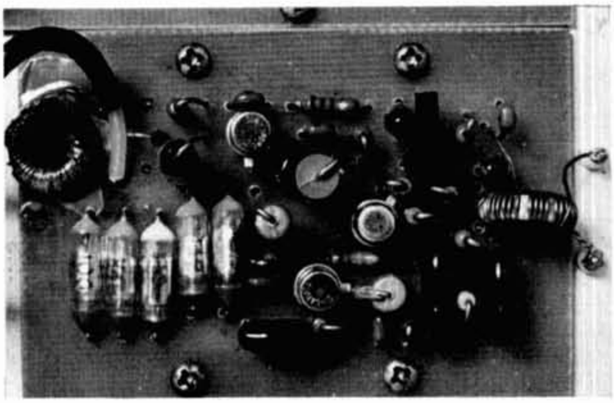
$\omega_1 = 2\pi f_1$, f_1 being the highest frequency of interest (Hz)

ΔC = change in capacitance available (farads)

Once the value of L is found, the total capacitance required for resonance is:

$$C_o = \frac{\frac{1}{(\omega_o)^2}}{L} \quad and\ C1 = C_o - \Delta C \qquad (2)$$

where $C1$ is the amount of fixed capacitance required and includes the oscillator capacitive loading.



The VFO board. Note coax connection to variable capacitor.

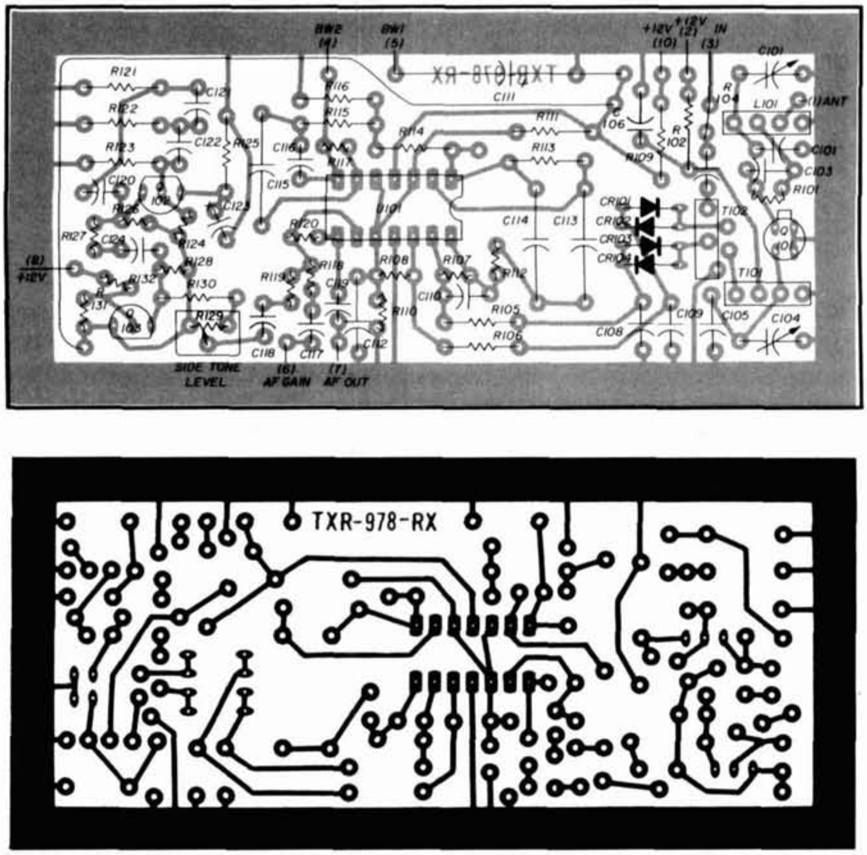


fig. 2. ***Above***, receiver-board parts layout. ***Below***, receiver board, foil side.

Output amplifier Q203 is operated class A into T201, which provides VFO energy to receiver and transmitter continuously. T201 is tuned with C216 to peak the VFO output in the center of the band. It operates with a *Q* that prevents excessive level variation across the band. The VFO output level should be 150 mV rms at the receive output. At this level the detector is optimized for Schottky diodes (for which germanium could be used), and the transmitter doubler is designed to operate at the level provided by the second output of 320 mV rms. (These readings were made with a diode probe.) R211 in Q301 emitter is selected to provide these levels. I prefer this method of level adjustment over dividing the VFO externally because it provides a lower noise floor.

transmitter

The transmitter is straightforward using transistor keying, a frequency doubler, a driver, and a power amplifier. The keying is accomplished by Q301, which turns on when the key is closed. However, Q301 has only +12 Vdc available when in the transmit mode to prevent keying the transmitter without an antenna. Also note that Q301 keys the +12 Vdc to only the frequency doubler stage, because the driver and PA operate class C and don't require keying of the dc supply.

Q302 and Q303 are connected as a push-push doubler with 180-degree base feed accomplished by trifilar-wound T301. R307 in the emitter circuits allows the 3500 kHz fundamental to be balanced out, so that the output waveform contains very little fundamental component. The doubler output is capacitively tapped down to provide the base drive for the driver Q304.

C308 tunes the doubler output and should be peaked in the center of the band. The doubler adjustments should be made carefully to ensure it's stable and operating properly. Do not peak R307 and C308 for maximum amplitude alone, but adjust them for a stable 7090-kHz output that contains a minimum amount of 3545-kHz energy.

Driver Q304 operates class C with some self bias, which should not be changed. The bias selected pro-

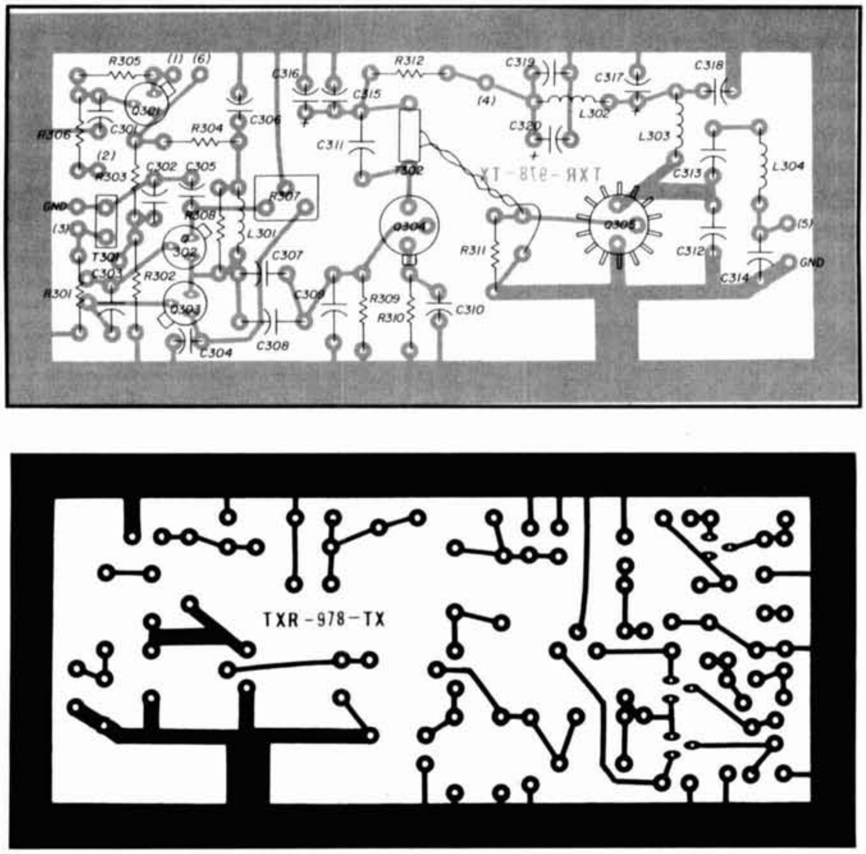


fig. 3. ***Above,*** **transmitter-board parts layout.** ***Below,*** **transmitter board, foil side.**

vides a clean optimum output for the drive level in use. T302 is tuned by C311 and provides a low-impedance drive to power amplifier Q305.

The power amplifier is a 2N3019, for which other 5-watt, 1 ampere transistors could be used. However, if the 2N3019 is not used, select one with an f_T of about 100 MHz. If the f_T is much higher, such as in a 2N3866, the possibilities of VHF components on the output are very great (TVI).

Some component-value selection can be made in the output-matching circuit if desired. The values shown were slightly changed from the calculated values by using a spectrum analyzer to optimize the 7000-kHz-to-harmonic-energy content. The values shown provided 1 watt at 7000 kHz with the second harmonic down 40 dB, the third down 50 dB, and other harmonics down 60 dB or better. The VHF harmonics were down better than 90 dB.

When in the transmit mode, power is also applied to the sidetone, which is keyed by Q301. R129 provides an independent adjustment level for the sidetone regardless of the af gain setting.

construction

The QRP transceiver uses PC-board construction.* Parts layouts for the receiver, transmitter, and VFO boards are shown in **figs. 2** through **4** respectively. Coil data are given in **table 1**.

General notes. I have built an enclosure for my rig so that I could have the size I wanted and accessibility to both top and bottom of the circuit boards. Other types of enclosures can be used without any problems since the board interconnects are not very critical. I do suggest that 50-ohm cable be used to connect the VFO to the receiver and transmitter as well as to connect the antenna circuitry. The audio circuitry is low impedance and shouldn't require shielded cable.

As you can see from the pictures, I did not shield the VFO. I found that on 40 meters it was not necessary. However, on higher frequency bands it would be a good idea.

*Many components for this transceiver are available from Radiokit, Box 429, Hollis, New Hampshire 03049.

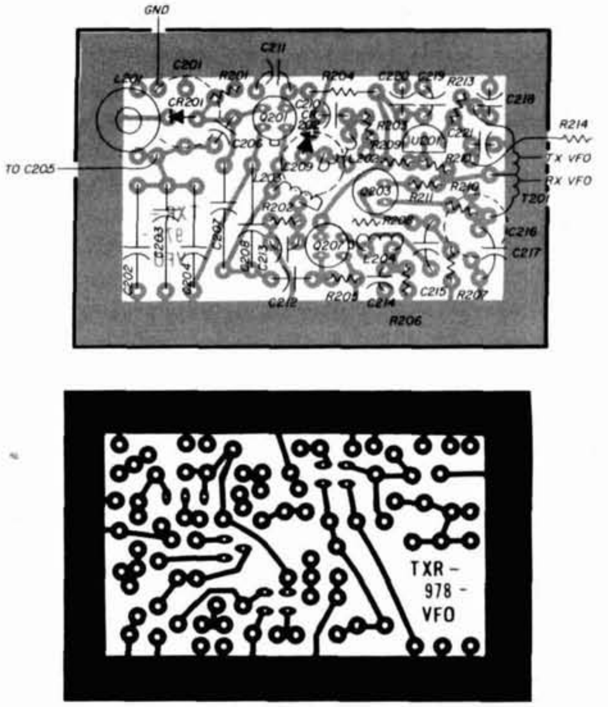


fig. 4. ***Above,*** **VFO-board parts layout.** ***Below,*** **VFO foil side.**

Making the VFO dial. I made the dial by cutting a piece of Plexiglas into a perfect 2-inch (50-mm) circle by pushing a file against the rotating disk.

I then cut a thin sheet of mylar onto which I lettered the markings with dry transfers. I then sprayed an adhesive onto the front of the Mylar and attached it to the *back* of the Plexiglas. This prevents fingernails from damaging the dial markings. To make the pointer, I cut a slit with a saw blade into a thin aluminum plate, which fits behind the dial, and I back-lighted the slit with a green LED. The dial mounts with two screws onto the Jackson Drive (a ball bearing 6:1 reduction drive).

Note that the transceiver is made up of three circuit boards. This allows you to choose the type of packaging that suits your needs — or your can build just the receiver or transmitter if you wish.

I think you will find this project to be well worth while if you have the QRP bug or think you might get it. I've worked coast-to-coast with this rig on 40 meters with very good signal reports.

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ham radio

Antique Radio Collector

Jim Fisk's editorial in the October *ham radio* seemed to be written for me, since I am in the position he described. Having been active in collecting for quite a few years, I have a rather representative collection of antiques, and I am still collecting interesting things. In recent years, I have reduced my collection to a manageable quantity, but the question remains: What will I do with it, when my own time comes?

Although neither of my sons is a ham, one is a physicist with a scientific company in San Diego, and heavily into electronics. We have often discussed the best way to handle my collection. Since he travels extensively — visiting universities in Japan, the British Isles, Europe and Scandinavia — he has rather intimate contact with the academic community. It is his opinion that giving one's collection to a university or college would offer little more probability of its being retained intact than one of several other possibilities. The staffs and administrations of universities change over time and the newer staffs may not value or protect collections as well as those to whom the collection was given.

A portion of W9LC's tube collection.

This phenomenon is true even in commercial establishments. A number of years ago, when I was working for WGN, an erratic personnel manager decided he needed more room, and without consulting the management, junked almost the entire file of 16-inch records of past programs. This was similar to those instances of junking valuable antique equipment, mentioned in the editorial.

My son has promised that my collection will be preserved, although I am not sure how this can be guaranteed. On the bottoms of the more desirable items I have attached notices, stating that these should be retained by the family.

If you learn what can best be done when the collector's final QSO has ended, I shall be most glad to hear.

Paul C. Crum, W9LC
Chicago, Illinois

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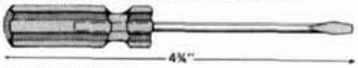

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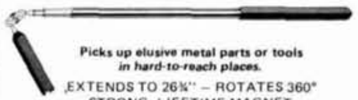

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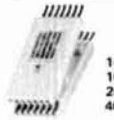

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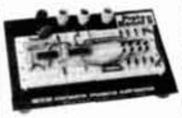

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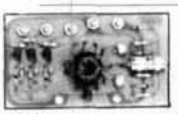

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Transmit Level	–15 dbm nominal. Adjustable from –6 dbm to –20 dbm
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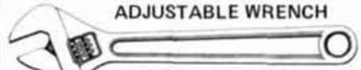

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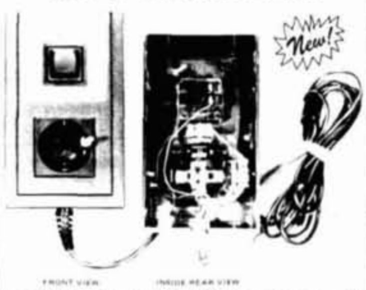

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recent developments in circuits and techniques for high-frequency communications receivers

The recent increase in high-frequency communication traffic and the present height in the sunspot cycle has further crowded the high-frequency spectrum. Because of the vulnerability of communication satellites to jamming and attack by missiles, use of the short-wave communications bands is expected to increase. Therefore, new receivers must have substantially improved large signal handling capability and better frequency resolution. The digital circuitry now in use has made it impossible to implement a number of mechanical solutions, such as tracking filters. A number of new approaches to improve and simplify shortwave receiver design will be presented in this article.

The work described here resulted from a research project and study for RCA Astro Division and a project now underway for the Naval Research Laboratory in Washington. In both cases, new ways had to be developed to increase the performance of a communications receiver; the following areas are of great importance:

Good input selectivity

Ultralinear amplifiers

High level mixers

Low distortion Thompson VHF crystal filters

Choice of AGC

Linear detectors

New low noise synthesizers

Microprocessor support

input selectivity

Because of electronic switching requirements, all modern receivers are double-conversion systems with a first intermediate frequency between 40 and 100 MHz. The second i-f is kept as low as possible; frequencies from 10.7 MHz down to 30 kHz are used. As a rule of thumb, the first i-f should be above 60 MHz and slightly more than twice the highest reception frequency. The first i-f filters should consist of a crystal filter with good selectivity and low insertion loss; 72.03 MHz for a second i-f of 30 kHz or 72.455 MHz for a second i-f of 455 MHz are recommended.

Modern mechanical filters are available with shape factors equally as good as crystal filters commonly used at about 10.7 MHz with superior group delay and pulse response. Siemens (West Germany) manufactures 30-kHz mechanical filters to suit all practical purposes; Collins and AEG Telefunken make 200-kHz mechanical filters with similar performance which are slightly less expensive.

The selection of 72...MHz first i-f also permits the use of a second local oscillator at 72 MHz, and modern technology permits the design of low noise, low aging 72-MHz crystal oscillators. **Fig. 1** is a block diagram of such a modern concept where, instead of the usual 5-MHz input for the sythesizer, an internal 72-MHz crystal in a proportional temperature controlled oven is responsible for the stability and can be phase locked against an external 1 MHz standard which has lower sideband noise requirements. Traditionally, 5 MHz crystals have been used because they combine low aging and low noise.[1,2]

In some cases where high-frequency receivers are

Dr. Ulrich L. Rohde, DJ2LR, 52 Hillcrest Drive, Upper Saddle River, New Jersey 07458.

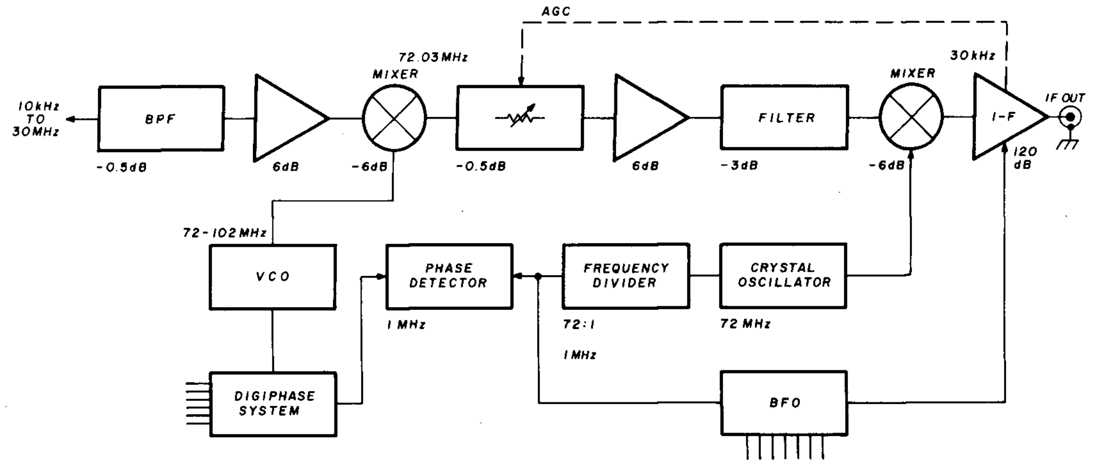

fig. 1. Block diagram of a modern high-frequency communications receiver showing the use of a 72-MHz first i-f and oven stabilized 72-MHz crystal oscillator as the reference oscillator for the phase-locked loop.

used in the vicinity of transmitters, an electronically tuned tracking input filter is required; these preselectors cannot be built with tuning diodes. **Fig. 2** shows such a preselector which uses PIN diodes as switching elements for the capacitors and inductors, and is controlled by a "look-up" table under microprocessor control. This type of input filter has been successfully used for shipboard applications where several 1 kW transmitters were present. **Fig. 3** shows a newly developed input stage for a similar application in the vhf band; **fig. 4** is a graph of the selectivity curve. It is apparent that this type of input filter exhibits the best image suppression and local-oscillator suppression of its kind with very few components. The mathematics of this filter are presented in reference 3; it has been used in a number of production receivers.

ultralinear amplifier

Since some receiving systems require a noise figure of less than 10 dB, even on the high-frequencies, and some requirements call for very low oscillator radiation through the antenna, it is unavoidable to use an antenna preamplifier with less than 10 dB gain. These amplifiers must be designed to combine very low distortion and low noise figure. A method called "noiseless feedback" has been developed in both Germany[4] and the United States.[5] While conventional feedback techniques use resistive elements like an unbypassed emitter resistor for current feedback and a resistor from input to output for voltage feedback, these methods introduce additional noise. The noiseless feedback technique permits independent choice of input and output impedance and power gain while maintaining the transistor's inherent noise figure. The circuit as shown in **fig. 5** should be built in a push-pull configuration to further reduce the second-order intermodulation distortion products. In selected cases, it has been possible to achieve an intercept point of 80 dBm with a noise figure of about 3 dB.

high level mixers

Even without the use of a preamplifier, the mixer has always been the weakest link in the chain because the mixing action requires a prescribed nonlinearity and the third-order term will always be apparent. A number of efforts were made to build an

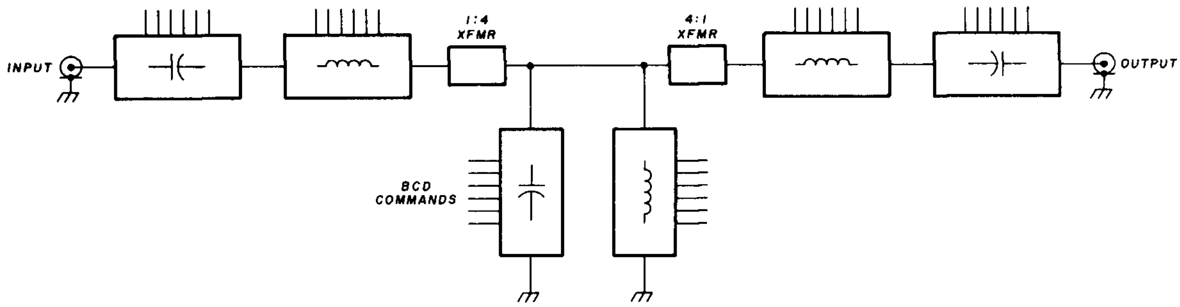

fig. 2. Preselector is microprocessor controlled, using PIN diodes to switch inductors and capacitors in the filter.

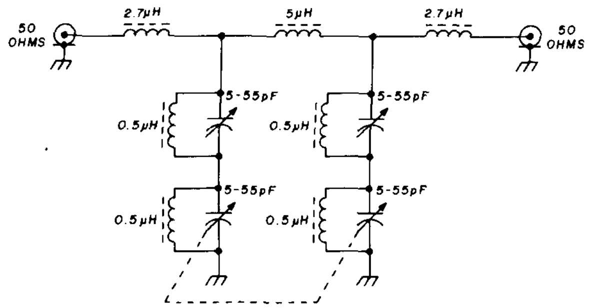

fig. 3. Vhf input filter covers the range from 118 to 136 MHz. Tuning capacitors are 5-55 pF trimmers. Selectivity curve is shown below in fig. 4.

active high dynamic mixer like the one shown in **fig. 6.**[6,7] These mixers are extremely sensitive to load changes and cannot be easily built totally symmetrically at the higher frequencies. The fet version of these mixers recommended by Siliconix requires fairly high local-oscillator drive. Since the input of these fets is purely capacitive, the cable requires a termination into 50 ohms and, ultimately, the same drive power as a passive mixer.

A novel high-level mixer circuit developed for the Rohde & Schwarz HF1030 shortwave receiver is shown in **fig. 7.** Here a push-pull version of two double balanced mixers is being used; since these mixers require perfect termination, an fet cascode arrangement with a 50 ohm termination is used. Previously, fets in grounded-gate circuits had been recommended, but this has two drawbacks: the drive impedance of about 50 ohms results in a worsening of the noise figure because the fet wants to see a higher drive impedance, and it was next to impossible to apply feedback to such a circuit (the circuit would also oscillate above 1000 MHz). The circuit in **fig. 7** has the advantages that the increased drive impedance of 200 ohms provides a much better noise figure; and the use of feedback more than compensates the differences between the grounded-gate and grounded-source configuration. While more gain can be achieved in the cascode arrangement, the tendency to uhf oscillation has not been observed.

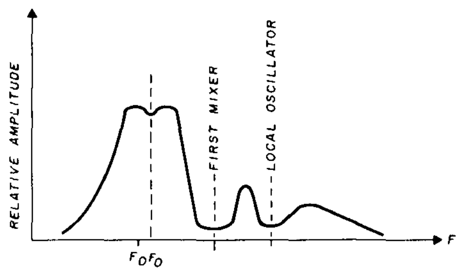

fig. 4. Selectivity curve of the vhf input filter of fig. 3.

A typical noise figure of 2 dB, intercept point of +35 dBm, and gain of 15 dB is possible with this stage in the frequency range from 40 to 120 MHz. The combination of this stage with the mixer maintains its intercept point, reduces the gain to about 10 dB, and reduces noise figure to about 8 dB. A PIN diode attenuator is incorporated in the circuit and will maintain its input and output impedance very closely and provide an agc range of 45 dB with insertion loss of less than 1 dB. It would have been possible to apply agc to the cascode, but measurements indicate that the PIN diode attenuator gives better dynamic range.

Thomson vhf crystal filters

Immediately following the mixer and its amplifier, it's necessary to provide as much selectivity as possible. The type of filter and its bandwidth depends on the receiver's application. In some cases, such as fast data transmission, it is desirable to use Thomson-type[8] crystal filters with bandwidths from ±3 kHz to ±8 kHz. The basic disadvantage of a Thomson filter is skirt selectivity, and it may not be possible to obtain 80 dB skirt selectivity 60 kHz away from the center frequency. In those cases where perfect pulse response and group delay performance are required, a higher second i-f between 200 kHz and 500 kHz must be chosen.

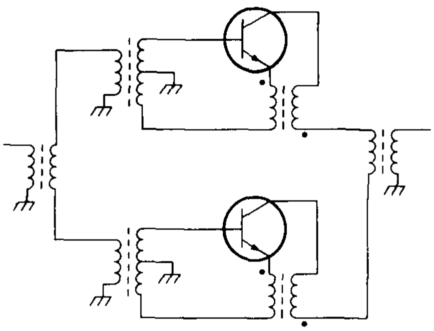

fig. 5. Basic circuit for an rf amplifier with feedback which enhances strong-signal handling ability without increasing noise figure. In selected cases, it has been possible to achieve a +70 dBm intercept point with 3 dB noise figure.

Thomson filters have been recently developed and are available commercially.* Such filters exhibit less than 3 dB attenuation even with 10 crystal resonators and have an intercept point in the vicinity of 35 dBm. Applications that require a higher intercept point should be based on helical resonators. These reso-

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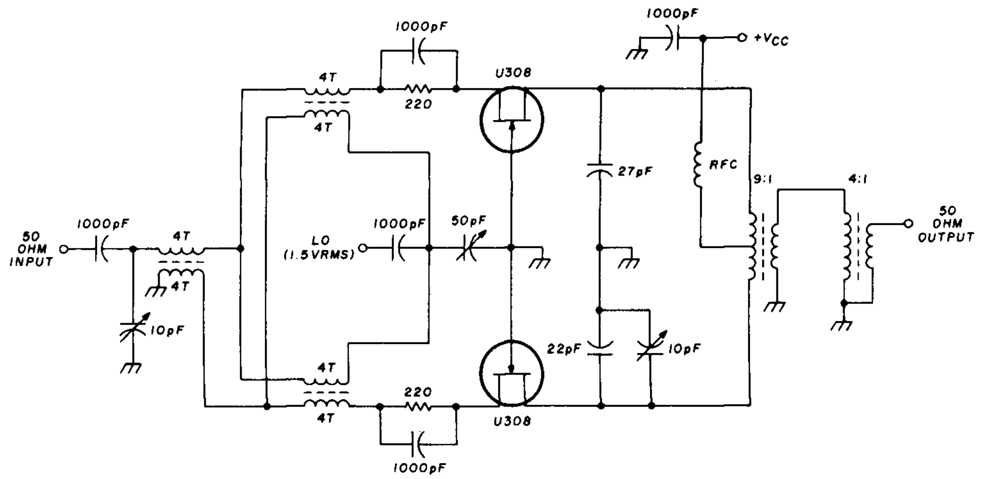

fig. 6. Circuit for a high-level balanced fet mixer. Local oscillator requirement is approximately 1.5 volts rms.

nators can have Q of 1000 or more and will not introduce any noticeable distortion.

One of the most critical characteristics of a receiver is its response to signals of varying strengths — it is not sufficient to optimize the filter for pulse response — the agc system must be present: fast agc is desirable for a-m reception while fast attack and slow decay time constants are required for CW and SSB. Fm requires somewhat intermediate time constants as the limiter is supposed to cancel on a-m components, but it is always desirable to have an S-meter to provide information on the input signal.

agc choice

It appears that most currently manufactured high-frequency receivers suffer from good agc; in most cases the agc is too slow and the attack time produces unpleasant overshoot in the audio circuits. The reason for choosing the insufficient attack time is the requirement of avoiding a peak detector for short pulses which would "hang up" the receiver during the decay time. A better way of handling this problem is through the use of a symmetrical audio limiter (clipper) which permits the audio to rise by about 10 dB over the audio under agc control. This prevents the unpleasant audio bursts and accepts 30-40 ms attack as a perfect choice. A number of agc circuits have been published in the past and described in references 9 and 10.

linear detectors

A-m detectors are frequently required to have very low distortion and because of this, the i-f level must be kept at a very high level. Because of gain distribution, this is not necessarily very desirable, and a feedback a-m detector as shown in **fig. 8** is ideal. The output distortion is substantially less than one per cent up to very high modulation percentages; it

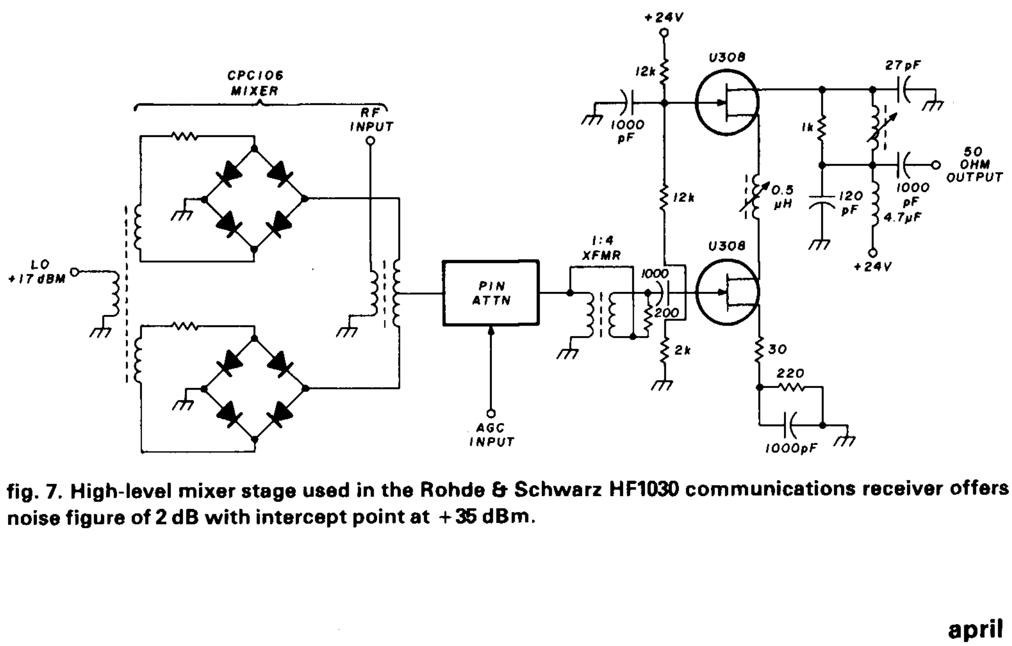

fig. 7. High-level mixer stage used in the Rohde & Schwarz HF1030 communications receiver offers noise figure of 2 dB with intercept point at +35 dBm.

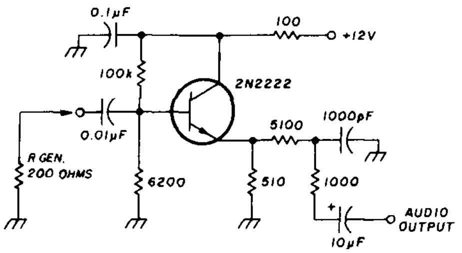

fig. 8. Linear detector is highly recommended for a-m.

should be driven from an impedance of less than 200 ohms which can easily be provided by using an emitter follower.

low noise synthesizers

I previously discussed the impact of nonlinear effects like intermodulation distortion of second, third, and higher order, and will now consider reciprocal mixing or blocking. The so-called blocking effect (which is commonly confused with receiver desensitization) is a result of poor sideband noise performance of the local oscillator.[11,12] Synthesizers are traditionally built with a compromise of three parameters in mind: noise sideband performance; spurious response; and settling time. Some military applications require a switching time of less than 10 microseconds, but practical applications can live with about 1 millisecond switching time. Most current synthesizers are multiloop synthesizers using the techniques described in references 13, 14, and 15. The recently developed *digiphase* system[16] or fractional division N system offers new capabilities and

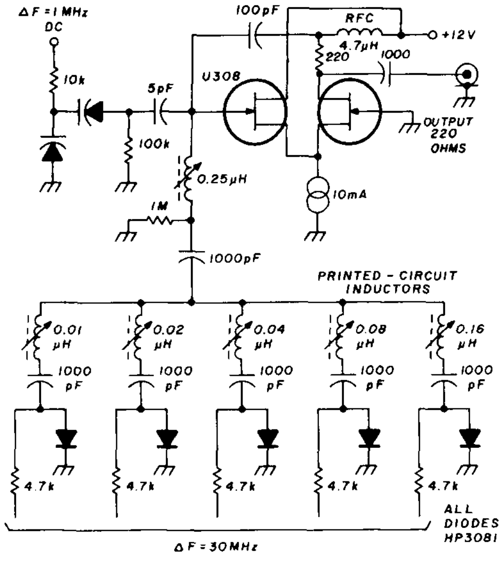

fig. 9. Ultra low-noise oscillator. Tuning range is held to about 1 MHz; coarse steering is accomplished with a *lookup table* under microprocessor control.

substantially higher resolution. The digiphase system is used by Hewlett-Packard[17] and Racal[18] and offers a number of advantages. While the presently published digiphase systems suffer from the noise sideband limitations of this technique, an improved version of this would use the phase locked loop not only as a control mechanism for almost infinite resolutions but also for suppressing these sidebands. If it were possible to build a VCO and use it with a very narrow loop bandwidth of less than 500 Hz, the unwanted sidebands of the digiphase system could be kept under control; if the tuning range of each oscillator could be kept extremely small, the added noise from

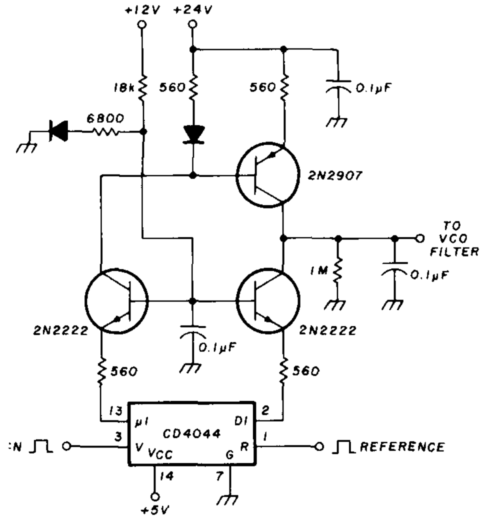

fig. 10. Low noise phase detector for use up to 1 MHz.

the tuning diode would not have to be taken into consideration. **Fig. 9** shows such an oscillator where the tuning range is held to about 1 MHz while the coarse steering is done by a "look-up table" under microprocessor control. Such an oscillator exhibits a noise figure of about 90-100 dB/Hz 1 kHz from the carrier and 140 dB 20 kHz from the carrier.

In the past, a number of discrete oscillators were used for this purpose, but since it may require several hundred milliseconds for the oscillator to settle before it is under control of the phase lock loop, inductor switching is fast enough that it does not degrade the switching performance. Such low noise systems also require very good phase frequency detectors and dc amplifiers; **fig. 10** shows such a circuit that is recommended for use up to a 1 MHz reference frequency.

microprocessor support

Microprocessors can help in a number of ways to improve the performance of an "imperfect" receiver. As mentioned earlier, a microprocessor may be used to control the antenna preselector, pre-steer the sythesizer oscillators, or programmed for sweeping and frequency hopping. A large number of channels can be stored and selected — the microprocessor quickly switches the synthesizer. Thus new applications for automated systems become feasible.

Such a system has been built in a joint development with RCA Astro Division for a satellite sounder system in which a transmitter generates bursts and the receiver, acting as a phase-coherent radar detector, analyzes the signal and provides information about the various layers of the ionosphere.

conclusion

A number of circuit developments have been shown which will substantially improve high-frequency receiver design. Some of these circuits have already been incorporated in equipment. In some cases only the highlights have been shown, and it is apparent that further improvements are possible. Because of this, I am interested in the exchange of ideas and would appreciate your comments and recommendations.

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ham radio

log-periodic fixed-wire beams for 40 meters

Extensive tests with overseas Amateurs have resulted in an LP antenna with excellent characteristics and performance

During the testing of the various 75-meter antennas described in an earlier article,[1] QRN hadn't been too bad and many overseas contacts with New Zealand resulted in much useful data on antenna performance. During June, 1978, however, propagation conditions deteriorated and QRN on 75 meters became so bad that many of the morning DXers (usually on 3808 kHz) moved to 40 meters.

Because the QRN on 40 meters was generally less than that on 75 meters during the DX window (1000-12000 UTC), I decided to remove the three-element 75-meter beam[1] and replace it with a similar beam for 40 meters, also using an optimum LP design.

40-meter LP design

Using W6PYK's LP design data,[2] I built a 40-meter LP using taper factor τ, = *0.95* and spacing factor σ, = *0.18*. This beam would be about 18 meters (60 feet) above ground, or almost one-half wavelength on 40 meters, so it should give about the maximum gain possible. The design was a four-element truncated log periodic with a boom length of 22 meters (71.8 feet). Complete dimensions and VSWR response are shown in **fig. 1**.

I'd hoped to make this 40-meter LP a five-element array, but a tree near the center of the forward-element end of the antenna prevented extending the feeder to include a fifth element. However, two trees

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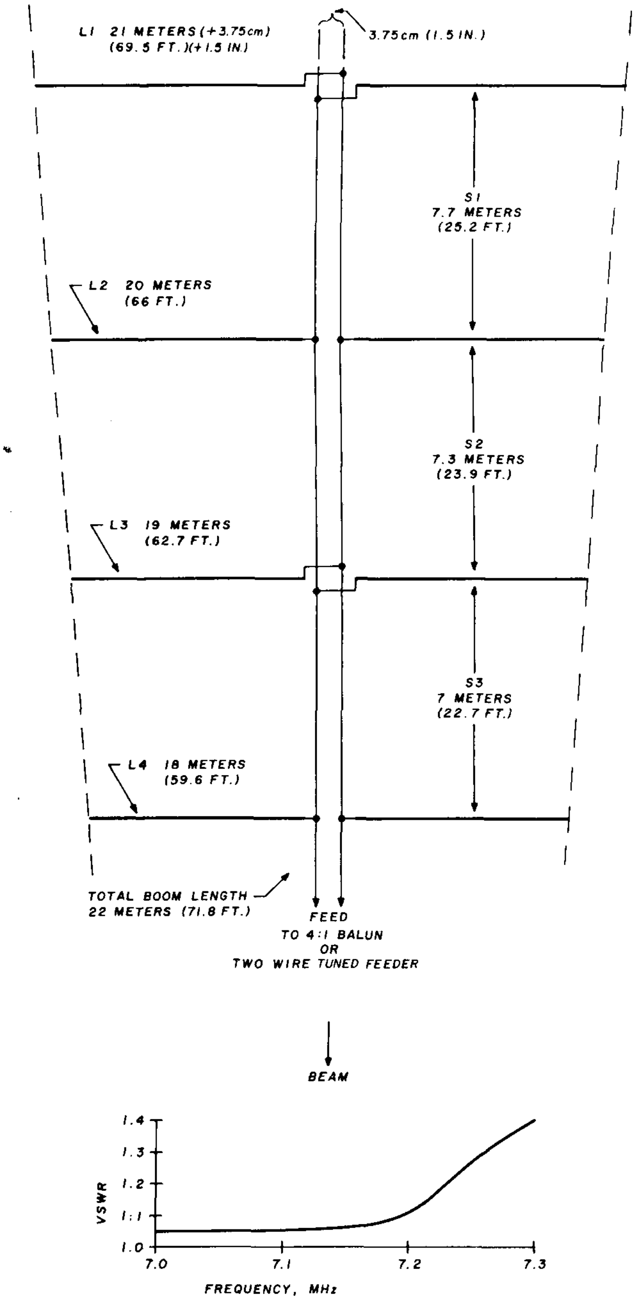

fig. 1. Four-element truncated LP antenna for 40 meters designed from data provided by W6PYK (reference 2). Curve showing VSWR is also provided.

to the sides allowed the addition of a parasitic director as shown in **fig. 2**. Paul, W6PYK, estimated that this director should add about 1 dB additional gain.*

Fig. 2 also shows the method of suspending the 40-meter LP. (Also added later was a 40-meter dipole to the side and in line with the director.) This dipole was used as a standard for comparison with the beam. Both antennas were about the same height above ground, exactly parallel, and oriented broadside to the west.

*Before considering the addition of this director element in your design, note that 1 dB represents a power gain of 1.26. Note also that, to double the power, a gain of 3 dB is required. Considering the fact that a 1-dB increase in signal strength is virtually imperceptible at the receiving end of a radio circuit, adding the director hardly seems worthwhile. **Editor.**

test antennas

For the 40-meter tests I used four antennas for direct comparison with the 40-meter west beam illustrated in **figs. 1** and **2**. The comparison antennas were:

1) a 40/75 meter trap dipole sloper suspended over a pond;

2) a four-band Hustler trap vertical mounted on the roof of my house at about 9 meters (35 feet) above ground. Radial elements were used in the ground system;

3) the dipole shown in **fig. 2**;

4) a 40-meter LP-Yagi consisting of seven elements directed north.

The north-oriented LP-Yagi deserves special mention. I've had many requests for information about its design and performance.

40-meter north beam

This antenna had four driven elements and three parasitic directors. Boom length was 29 meters (93.8 feet). *Height above ground was only 12 meters* (40 feet). If the height above ground could have been increased to one-half wavelength, and if the antenna could have been beamed to the northeast, it probably would have been a good DX antenna for Europe. However, trees on my property aren't properly spaced for that direction.

The 40-meter north beam was constructed in an inverted-V configuration, with the center supported by a nylon line between two trees. Element ends were supported by two side catenary lines attached to trees at either end. An inverted-V configuration is shown in reference 3. This design is used by a number of commercial LP-antenna manufacturers.

The north beam was aimed about 90 degrees north of the west beam. It was interesting to switch from west to north when monitoring ZLs and VKs on 40 meters. At times, these stations were almost nil on the north beam but were received strongly on the west beam, which demonstrated the side attenuation of the north beam.

construction notes

The construction information presented in part 1 and its references apply to the 40-meter designs shown here.

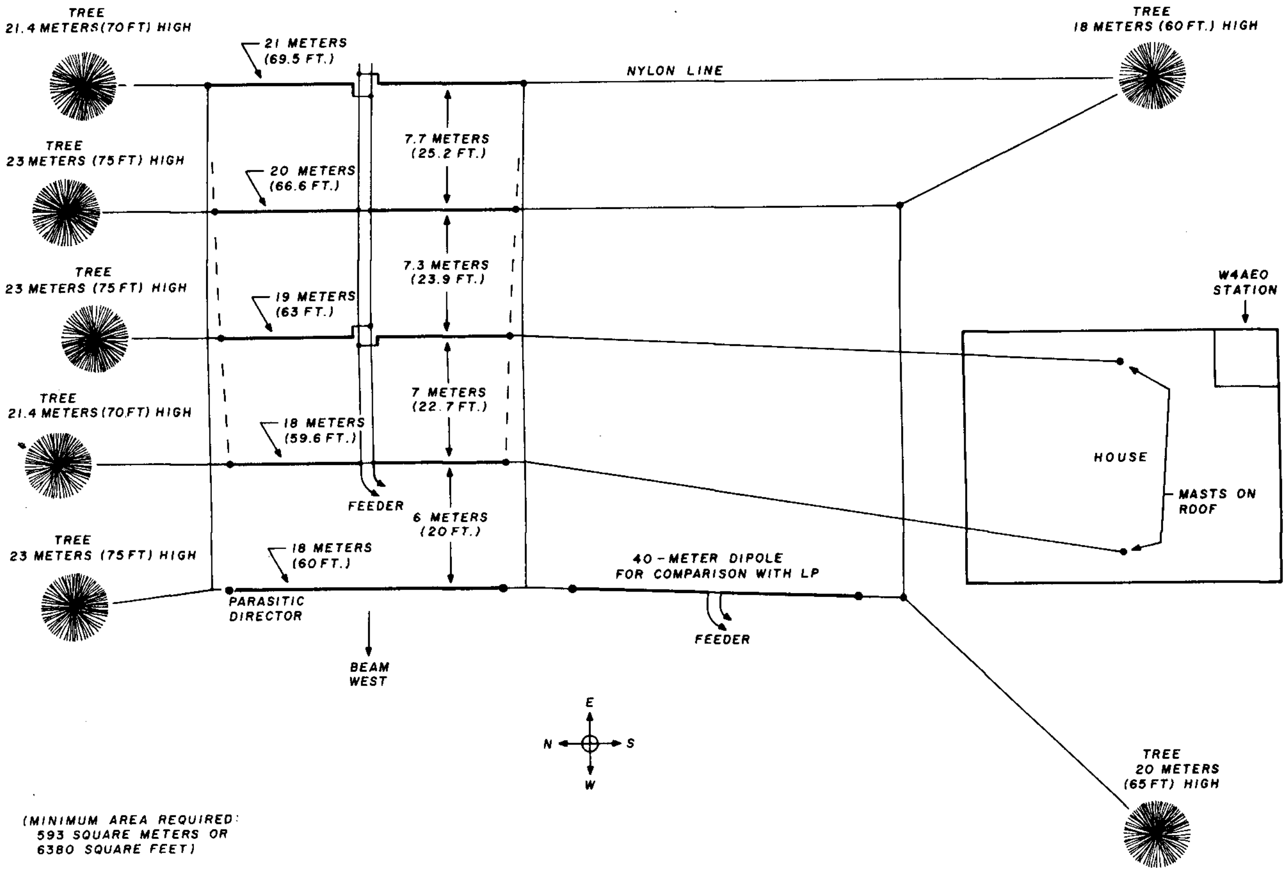

fig. 2. Author's 40-meter LP west beam using four driven elements and a director. A dipole was added for comparison in the 40-meter tests described in the text.

My 75- and 40-meter LPs required no side catenaries because enough trees and other supports were available on either side of the antenna elements for halyards, which made construction and suspension simple and easy — each antenna element could be adjusted separately for proper tension and alignment.

The two lines shown on either side of the 40-meter LP (**fig. 2**) aren't support catenaries; they're merely spacing lines of nylon to keep the ends of the elements parallel. This gives the same spacing as determined by the center feeder.

If you don't have trees available for supports, you'll need four masts or towers and you'll need two side catenaries to support the one- and two-element sections between the rear (no. 1) element and the forward element.

Feedline considerations. Little information has been published on the spacing of the two-wire intra-array feedline for high-frequency LP wire beams, so I tried various spacing distances from 3.75 to 15 cm (1½ to 6 inches). All LPs constructed here since 1975, including the 75- and 40-meter arrays described, have used a feedline spacing of 3.75 cm (1½ inches) and no. 16 (1.3 mm) insulated wire.

With this wire size and spacing, the feedline impedance appears to be near 450 ohms, which is about right for use with a 4:1 balun feeding 52-ohm coax. The driving-point impedance appears to be approximately one-half that of the feedline characteristic impedance for LP arrays.

Flexible stranded feeder wire is desirable so that the two wires will be straight and parallel with little fore and aft tension required on the center feeder. Insulated wire is used should the two wires touch in a high wind. I use trees for supports, so it's important to reduce element and center-feeder weight to a minimum. Reference 4 gives suggested feed methods for the high-frequency LP beams tested here and may be of interest if one of these LPs is to be assembled.

If you don't want to make the two-wire feeder you might consider the 450-ohm, low-loss, open-wire TV line offered by Saxton Products.* This line has been used for years by Amateurs for feedlines and stubs. It uses no. 18 AWG (1-mm) wire spaced at 25.5 mm (1

*Saxton Products, Inc., 215 North Route 303, Congers, New York 10920 (Catalog no. 2500 or C-4-500-6).

inch) and has molded insulators spaced every 153 mm (6 inches). It's available in standard lengths of 30.5, 76, and 153 meters (100, 250, and 500 feet).

I've received inquiries as to whether standard 300-ohm TV line (ribbon) can be used for the intra-array center feedline. The answer is absolutely *no*. This is because the 0.82 velocity factor of TV line would not be compatible with the required element spacing, as given by the LP formulas. To confirm this I removed the two-wire center feeder from one of the LPs here and replaced these sections with a good grade of 300-ohm TV feeder. The LP immediately showed a loss in gain, both on transmission and reception. Therefore, some types of two-wire open feeder (air dielectric) *must be used*. A velocity factor of at least 95 per cent or better is recommended, which rules out any solid-dielectric 300-ohm feeder, including the tubular-shaped 300-ohm uhf "low loss" TV line (velocity factor of 0.82).

W6PYK mentions the requirement of air dielectric "to be used to prevent excessive phase shift within the array feed. Any other dielectric has the effect of increasing the spacing factor, σ, in a complex manner."[2]

Now, the above remarks don't rule out the use of 300-ohm solid-dielectric line between the 4:1 balun and the feed point of the intra-array center feeder (LP feed point at the short element, or front of the array). I've used this method of feeding many of my LPs; some use 31-61 meters (100-200 feet) of good grade 300-ohm TV line.

Most of my LPs are supported by trees, so weight must be kept to a minimum. The weight of a 4:1 balun plus the weight of RG-8/U, or even RG-58/U, coax would cause the front end to sag, resulting in a height loss of the forward end (above ground).

Even the best, or rather highest gain, LP used here to date and described in reference 6 was fed by about 76 meters (250 feet) of 300-ohm TV line between this 17-element LP feed point and the 4:1 balun, which was located at about 3 meters (10 feet) above ground to the rear of the LP. From the balun I used RG-8/U coax, buried to the station. The 300-ohm feeder was suspended from the forward element and draped under the full length of the 17-element array.

Insulators. I've been unable to locate four-hole "off-the-shelf" insulators suitable for the two-wire center feeder-spacer insulators, so homemade Lucite insulators[5] are used. Reference 5 also shows the best method for securing these insulators to the open-wire feedline as well as an assembly sketch of a seven-element LP showing the transposition method of feed to alternate elements.

If the open-wire TV line described above is used, the homemade Lucite center insulators can be replaced by standard 64-mm (2.5-inch) ceramic or porcelain ribbed insulators. These insulators are available from dealers selling antennas for shortwave listeners.

The two outside ribs of these SWL-antenna insulators are spaced at about 25.5 mm (1 inch), and the 450-ohm TV line can be secured to, and suspended below, these insulators. The two insulator holes secure the element centers. Connect short jumper wires between element-center ends and the feedline.

As I mentioned in previous articles, small strain insulators (Johnny Ball) are suggested for the center and end insulators used on the long, rear element (S1) and the short forward element.

a higher-gain LP

Should you have the available space and necessary supports and want a 40-meter wire beam having a gain of 10 dB over a dipole, you can build a mono-band LP giving this gain. Referring to W6PYK's article[2] **table 1** ($B = 1$), and using $\tau = 0.972 - 0.978$ and $\sigma = 0.180 - 0.181$, will give about maximum gain for an LP.

Referring to the four-element 40-meter LP described above, **fig. 1**, for which I used ($\tau = 0.95$ and $\sigma = 0.18$); this beam can be extended to seven elements and will require a length of only 40.7 meters (133.4 feet). This will, of course, increase gain and bandwidth over the four-element model tested here, which was only 22 meters (71.8 feet) long. Thus by using an open space about 30 meters (100 feet) wide by 46 meters (150 feet) long in the desired beam direction, an excellent 40-meter wire LP beam can be erected. **Fig. 3** illustrates this LP with dimensions for element lengths and spacing.

If the length of the open space can be extended to about 69 meters (225 feet), a 40-meter LP beam having 10.6-dBd gain can be erected, as shown by W6PYK's article. This requires ten elements. Parameters are: $\tau = 0.978$ and $\sigma = 0.181$, resulting in an array length of ($/\lambda = 1.48$), or overall LP length of $\lambda O = 984/7\ (MHz) = 140.6\,feet \times 1.48 = 208\,feet$ *(63.39 meters)* boom. It's assumed that this array would be at least 18 meters (60 feet) above ground to provide maximum possible gain.

summary of 75- and 40-meter LP antenna tests

These tests were made to determine if there is any type antenna or beam best suited for long-haul, multi-hop DX on 75 or 40 meters.

At my location, the last 75-meter LP, designed for 3808 kHz with $\tau = 0.94$ and $\sigma = 0.175$ (reference 1), appeared to be the best of the various beams tested. Second best were the first 75-meter LPs and the

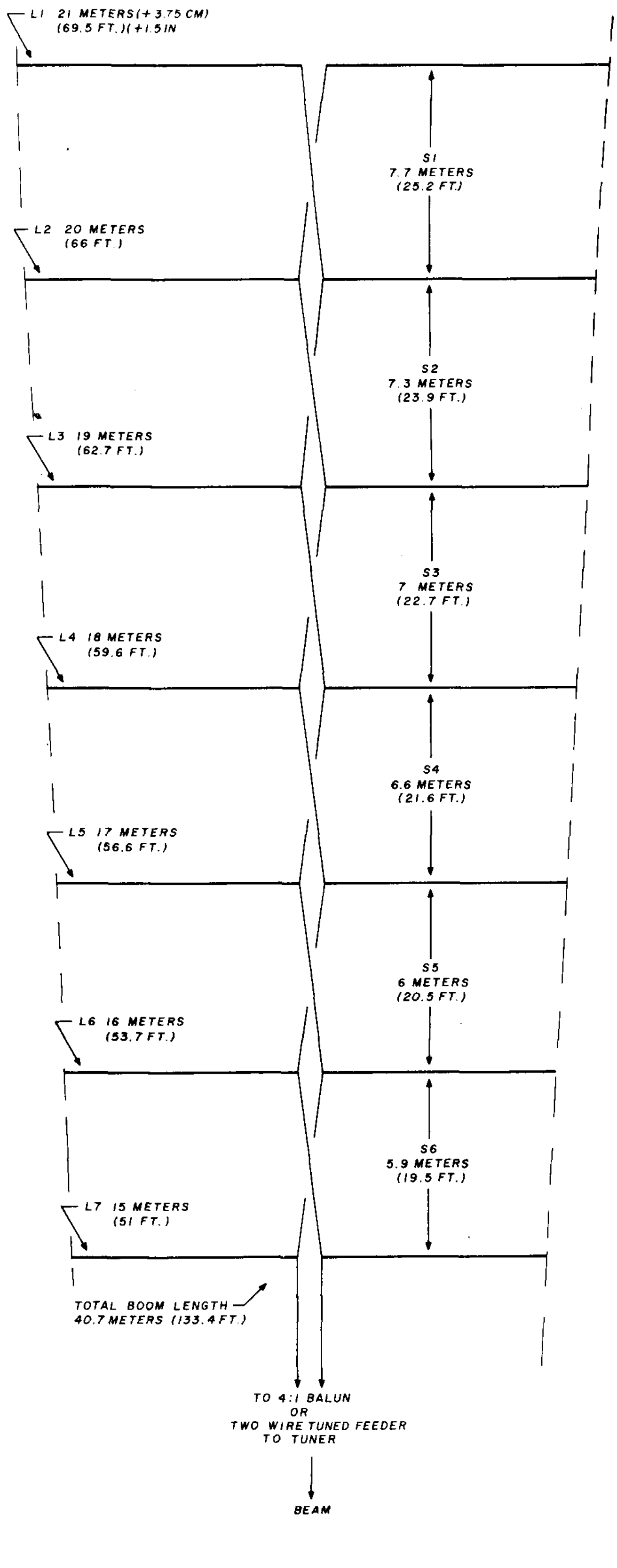

fig. 3. Seven-element LP for 40 meters with improved performance. You'll need an open space about 30 meters (100 feet) wide by about 46 meters (150 feet) long in the desired beam direction.

Yagi. These were compared with the more common antennas.

The LPs and the Yagi were the only unidirectional beams tested. There was little difference between the LPs (prior to the last) and the Yagi; however, the Yagi had the disadvantage of smaller bandwidth and it didn't cover the entire 75-80 meter band, which the LPs did. The Yagi was used only for a short time before being destroyed by lightning.

The other 75-meter antennas tested were nongain. However, some were bidirectional, as mentioned in part 1, and were thus no more than 50 per cent effective because of half the power, or radiation loss, in the undesired direction.

One of the three delta loops performed fairly well and was used throughout the test. One of the verticals was also used during most of the test; however, both of these antennas were generally about 10 dB below the LPs.

The 75-meter beams were all less than one-quarter wavelength above ground, so their radiation angle was probably far from optimum for the DX path. However, multi-element end-fire arrays should tend to lower the takeoff (and arrival) angle, compared with a dipole at the same height. The latter, of course, has most of its radiation straight up when only one-quarter wavelength above ground.

It appears that, for my location, a radiation angle of about 35 degrees for 75 meters and 25-30 degrees for 40 meters is about optimum for the early morning (local time) DX path. At another location a lower angle could possibly be more effective.

No single-type antenna is best suited for *all* locations. An antenna that may perform well at one location may give poor DX performance at another. Anyone desiring a good antenna for a long-haul DX circuit on 40 or 80 meters should first try, at least, two *entirely different* types of antenna; possibly a quarter or half-wavelength vertical, with *at least* 50 radials to start and a good dipole at least 22 meters (72 feet) above ground. Then compare these antennas directly for a few days, preferably with the same DX station. Then repeat the test several times during the DX opening for that day.

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Power:	4 'AA' cells, 12 V AC/DC
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More Details? CHECK—OFF Page 94

homebrew hardline-to-uhf coaxial cable connectors

Easy method for making your own coaxial connectors for CATV cable

While the CATV industry has made hardline cable more readily available, it has not been as generous with the required cable terminations; the Amateur without CATV friends has little choice but to make his own. The inexpensive method described here requires no machine work or CATV hardware and will accommodate any cable with a 12.7-mm (0.500-inch) OD shield and a center conductor of 2.92 mm (0.115 inch) OD or less. It consists of a standard PL-259 (Amphenol 83-1SP) type uhf plug mated to a common brass plumbing fitting known as a "1/2 inch OD × 3/8 inch OD compression union," typically $1.50 at plumbing supply houses.

assembly

Open the hole in the smaller union hex nut with a 12.7-mm (1/2-inch) taper reamer until it's a tight press fit over the cable end of the PL-259. Screw the nut onto the union firmly *by hand*, omitting the small compression ring. Temporarily fit a spare SO-239 chassis connector to the PL-259 to sink heat away from the pin insulation and to keep the threaded coupling barrel out of the way when soldering. Press the PL-259 through the hex nut hole until its end abuts squarely with the body of the union. Apply a small amount of water-soluble acid flux (oleic acid, available at most stained-glass hobby shops) to the joint and sweat solder, using moderate heat from a pencil-flame torch played onto the nut. After it cools, wash the connector thoroughly and dry it.

installation

Prepare the end of the hardline as in **fig. 1**. A tubing cutter is generally used to cut the solid shield; unfortunately this method often results in metal being swaged into the foam core, severely reducing the ID of the aluminum shield at this point. The use of a new, sharp cutter may minimize the problem. An alternative is to lightly score the shield with the cutter, then chase the mark with a rat-tail file or fine-tooth hobby saw until the metal just parts. Admittedly, the latter is a chore.

Clean off any coatings found on the inner and outer conductors with lacquer thinner and lightly polish both with fine steel wool. With the large hex nut and compression ring slipped on, insert the cable fully into the connector. This will require firm yet gentle pressure, as the core OD and union ID are pretty much the same. Tighten the hex nut with the appropriate wrenches. Soldering the center conductor to the pin completes the installation.

By Bud Weisberg, K2YOF, 62 Harriet Avenue, Bergenfield, New Jersey 07621

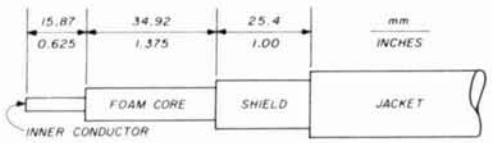

fig. 1. Stripping dimensions for hardline. Inner conductor may be left longer and trimmed after installing connector.

The final connection should be waterproofed with heat-shrink tubing or Mylar tape wrap. Although this is unconfirmed, I expect that the compression union will add little or no impedance disturbance to the line, because the union bore conveniently approximates the shield ID for its entire length. Compression unions are available in straight and reducing configurations, from 1/4 inch OD to 5/8 inch OD in 1/8-inch steps, suggesting that similar connectors could be made for other hardline sizes.

Above, component and assembled view of hardline connector. Smaller compression ring, not shown, is not used. At right, result of trimming shield with tubing cutter. Original ID of 11.43 mm (0.450 inch) was reduced to 8.39 mm (0.330 inch) at right.

A slightly divergent yet related final comment: should you be tempted to regard hardline as "state of the art" coax, consider for a moment a 78-ohm cable with a 2.1-mm (no. 12) tinned solid copper center conductor and a solid drawn-copper shield, both separated by a continuous string of polystyrene beads. The round nose of each bead fitted the concave base of the adjacent one, allowing a bending radius of 101.6 mm (4 inches). Rated at 700 watts rms to 100 MHz, it cost 50¢ per foot. That was Amphenol 72-12C, marketed to hams in the mid 1930s! And they offered the connectors, too.

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ham radio

high-frequency diversity receiver from the 1930s

A report on the development of the Hallicrafters DD-1, the first dual-diversity receiving system for Amateur use

It was a monster — but a very friendly monster. It weighed 102 kg (225 pounds), measured 112 cm wide × 48 cm deep × 30 cm high (44 × 19 × 12 inches) and occupied a giant parking place on my operating table. It had twenty-five vacuum tubes, four meters, a seven-gang variable tuning capacitor, no transistors, and it received the same signal twice! What was it? A Hallicrafters Dual Diversity receiver, model DD-1, which Hallicrafters presented to the world in June of 1938 with a two-page spread in *QST*. It took two pages, too, to do justice to the receiver.

the monster

To the best of my knowledge, the DD-1 was the only commercially available diversity receiver at that time; it was designed for Amateur as well as commercial use. **Fig. 1** shows the tuner portion only of the receiver without the external power supply and audio amplifier chassis. Inside and bottom views are shown in **figs. 2** and **3** respectively. All three photographs add up to an impressive piece of equipment.

The DD-1 failed to become popular for several reasons, the most important probably being its cost. The receiver cost $422.00 complete at a time when the top-of-the-line HRO was $179.00, and a man who made $20 a week was considered moderately successful. Another reason may have been its many advanced engineering features: like those of the Airflow Chrysler, they weren't appreciated at that time, and some of them are not available even today.

diversity reception

To fully appreciate the DD-1, you must first understand diversity reception. A more detailed description is given in a previous article,[1] but briefly, diversity reception is a technique for reducing the adverse

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effects of multipath fading by receiving the same signal on two or more diverse, or different, antenna-receiver combinations with a means of choosing the combination with the strongest signal.

Under some ionospheric conditions, signals in the shortwave bands may travel between the transmitter and receiver over more than one path. If the lengths of two of these paths differ by an odd multiple of half wavelengths (only 10 meters [30 feet] for the 20 meter band), the two signals will arrive out of phase at the receiving antenna. The signal will appear to be in a fade even though either of the two signals, if received separately, would be strong. The short, sharp fades that characterize high-frequency propagation are caused by this effect.

While there are several different forms of diversity reception, what is known as polarization diversity reception appears to be the most practical for Amateur use because it doesn't require additional real estate. With polarization diversity two antennas are used: one vertical, the other horizontal. Each antenna is connected to its own receiver. Polarization diversity is effective because, in general, the horizontal and vertical components of a signal will not travel over the same paths and therefore will not fade at the same time. By choosing the antenna-receiver combination with the stronger signal, communications can be carried on when signals on a single receiver would be in a fade.

fig. 1. The tuner section only of a Hallicrafters DD-1 receiver. There was also a power supply chassis and an audio amplifier chassis. Dual S-meters sat on top of the receiver, all of which added impressiveness to the system.

Although two separate receivers can be and have been used,[2,3] operating convenience and performance improvements can be had by designing a receiver specifically for diversity operation.

brief history of diversity reception

The development of the DD-1 is closely tied to the development of diversity reception, which in turn is tied to the exploitation of the shortwave bands by commercial operators more than 50 years ago.

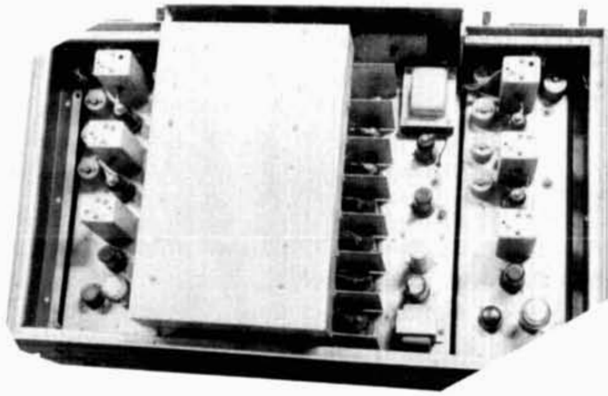

fig. 2. Top inside of the DD-1. The pushbutton bandswitch is under the cover.

Following World War I, the commercial radio interests forced Amateurs out of what are now called low- and medium-frequency bands and into the shortwave or high-frequency bands. After Amateurs demonstrated that the shortwave bands could be used for communications over long distances much more economically than could the longwave bands, the commercials began to investigate shortwave propagation phenomena.

The fading problem. Particular attention was paid to fading, since fading considerably lowered the reliability of the circuit and could not be tolerated in a commercial system. Around 1925-26, Drs. Beverage and Peterson of RCA Communications, Inc., began experimenting with high-frequency communications and had installed a shortwave receiver at the RCA receiving station at Riverhead, Long Island, in New York. They were using a Beverage longwave antenna system that was over 14 km (9 miles) long!

Fading was present. A second receiver was installed

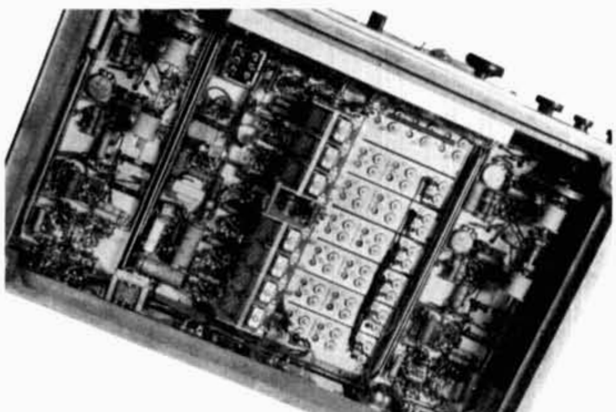

fig. 3. Underside of the receiver. Notice the seven-gang variable capacitor; they don't make them like that anymore.

in Dr. Peterson's home about 1.6 km (1 mile) away; fading, of course, was present there, too. Correlating the fading by telephone, the two experimenters observed that there was no relationship in the fading between the two locations. Hence space diversity was born. Beverage and Peterson jointly hold the basic patent in this art.

Multipath. By the late 1920s the causes of short-term fading were reasonably well understood; the villain was multipath propagation. It was also determined that fading did not occur uniformly over the earth's surface or uniformly with polarity; that is, a signal received on a horizontal antenna might be in a fade when a signal received on a vertical antenna at the same location could be loud and clear — or vice versa. Rice in a 1927 *QST* article[4] describes this phenomenon.

Early commercial system. Before 1930 a triple diversity receiving system (three antennas and receivers) was in operation at RCA Communications, Inc., Riverhead, Long Island. Two papers by Beverage et al[5] describe this installation. The receivers used at Riverhead were truly mammoth, as shown in the photograph of **fig. 4**. An installation of this type was suitable for commercials because they operate on one frequency for many hours continuously; but it was obviously not practical for Amateur use. Imagine trying to tune across 40 meters with this equipment!

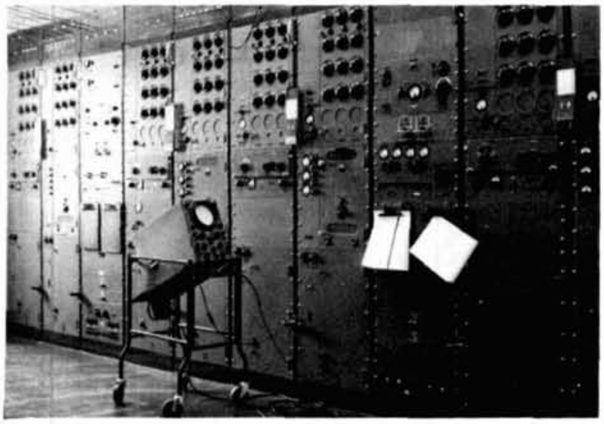

fig. 4. The diversity receivers used by RCA Communications, Inc., Riverhead, Long Island, New York. Notice the clipboards in the center; these held the receiver log. The log clipped at the top, in the usual way, indicates that receiver is in use. The log held by the corner indicates that that receiver is on standby. The index file on each receiver gives dial settings for commonly used frequencies. (Photo courtesy Robert McGraw, W2LYH, and Harlod Moore.)

Diversity reception for Amateur use. About this time, James L.A. McLaughlin began experimenting with diversity reception using two similar receivers. He was later joined by James Lamb, then technical editor of *QST*. Their early experiments were successful in proving the advantages of diversity reception for Amateur use, but were not successful in developing a practical receiver for Amateurs, mostly because of the lack of suitable components, especially vacuum tubes. By the middle 1930s, when improved tubes were available, McLaughlin and Lamb designed and constructed a single-tuning control, dual-diversity receiver for Dr. James Hard, XE1G, an American who operated a pharmaceutical factory in Mexico 1936.[6] A photograph of Dr. Hard's very elaborate station including this receiver is shown in *Radio*.[7]

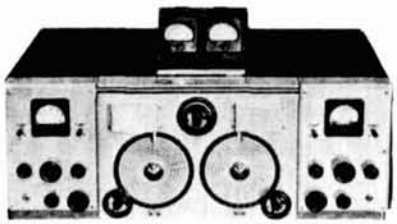

fig. 5. The prototype of the DD-1 as described by McLaughlin and Miles (from reference 8).

fig. 6. Advertisement announcing the DD-1 in the June, 1938, issue of *QST*. The complete receiver was pictured.

fig. 7. An early Hallicrafters advertisement for the DD-1 tuner as well as several accessories. (Photo courtesy Steve Sullivan, N4GZ.)

The results obtained by Dr. Hard under actual operating conditions were very encouraging proof of the practicality of diversity reception for Amateur use.

Hallicrafters design. McLaughlin later joined Hallicrafters as a consultant and collaborated with Karl Miles, then Chief Engineer of Hallicrafters, in redesigning the earlier receiver. Some electrical improvements were made, but the major changes appear to be mechanical; that is, repackaging. This receiver is described in *QST*, December, 1937.[8] It was also made under the sponsorship of Dr. Hard and is what I call the prototype model of the DD-1. A photograph taken from the McLaughlin-Miles article is shown in **fig. 5**.

Although early Hallicrafters advertisements show this receiver, I believe Dr. Hard's model was the only one made of this exact design. Later advertisements feature the receiver shown in **fig. 6**, which I call the production version. **Fig. 6** is a reproduction of the two-page spread in *QST* announcing the receiver. A better picture of this version is given in **fig. 1**. The differences between this and the prototype appear to be cosmetic. I'll briefly mention these for the benefit of collectors and historians.

Mechanical developments. On the prototype, the pointer on the tuning dials moves up and down as the band switch is rotated, much like the pointer on the Model SX-16, -17, and -18 receivers. The production version, shown in **fig. 4**, shows a simple piece of plastic as the tuning dial markers.

A second difference is in the band-changing mechanism. The prototype used a rotary switch, while **fig. 1** shows a row of pushbuttons. The change in the band switch may explain the change in pointers because, without a rotary bandswitching mechanism, there's nothing the pointer cord can wind up on to move the pointer.

The third difference is in the cabinet. The center portion of the left- and right-hand front panels has a slight slope, while these panels are vertical in the prototype. The cabinet used for the production receiver appears to be the same as that used for the Hallicrafters HT-1 Amateur transmitter, the HT-3 marine transmitter, and the upper half of the famous HT-4, all of which came out at about the same time. The

fig. 8. The late production or "jazzed-up" version of the DD-1 showing the special hi-fi loud speaker made by Jensen especially for this receiver. Note that the bandspread dial is blank. (Photo courtesy Charles Dachis, WD4EOG.)

change was probably made to achieve manufacturing economy as well as to jazz up the appearance for commercial sales.

It should also be pointed out that **fig. 1** shows only the tuner. In addition to the tuner, there were two other chassis, a high-fidelity audio amplifier using a pair of 2A3s and a power-supply chassis. These went on the right and left sides of the tuner respectively. Diversity S-meters, which measured the signal strength in each receiver, were also available and mounted in a separate housing, which sat on top of the receivers. These accessories all increased the size and impressiveness of the receiver. A copy of a Hallicrafters advertisement showing the various options and prices is shown in **fig. 7**. This advertisement was obtained through the kindness of Steve Sullivan, N4GZ.

A later change in cabinet design made the receiver even more stylish. The top center of the cabinet was raised and rounded off, while the diversity S-meters were enclosed in the cabinet instead of sitting on top. This version is shown in **fig. 8**; I call this version *a late production model*. This particular receiver belongs to Charles Dachis, WD5EOG, of Austin, Texas. The photograph also shows the special speaker cabinet that was made by Jensen for the DD-1. The cabinet has compartments in the back that hold the audio amplifier and power-supply chassis. WD5EOG has these items, but they are not visible in the photo. The two receivers shown in **figs. 1** and **8** are the only two copies of this receiver that are still in existence that I'm aware of. I'd be happy to hear from any reader who knows of others.

Technical description. A simplified schematic of the DD-1 is shown in **fig. 9.** It consists of two identical superheterodyne receivers with a common first local oscillator and a common BFO. Provision is made at the output of each second detector for switching to either receiver separately or combining the two outputs in a summing network for diversity reception. It's not too apparent, but the agc buses (avc in those days) of each receiver are also tied together. The receiver with the stronger signal and higher agc voltage will thereby tend to mute the "down" receiver, so that it doesn't put out a lot of noise.

Since many of the electrical features are conveniently identified by the front-panel controls, I show three detailed photographs of the left, center, and right panels in **figs. 10, 11,** and **12** respectively.

Left-hand panel. The upper half of the left-front panel (**fig. 10**) shows the send-receive switch. The

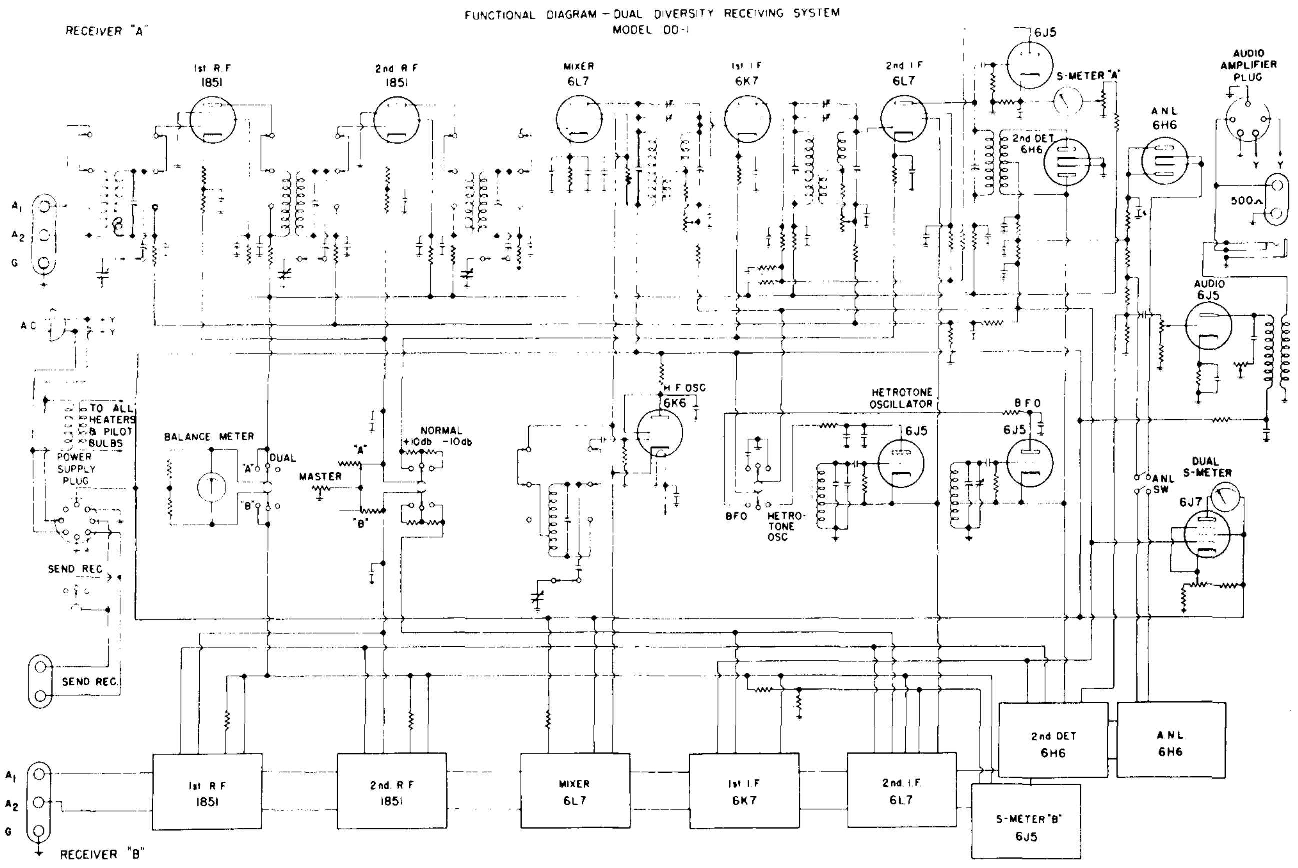

fig. 9. Simplified schematic of the Hallicrafters model DD-1 dual diversity receiver.

fig. 10. The left-hand control panel of the DD-1.

upper send position of the lever-type switch has a spring return for a quick transmit; the lower send position has a holding position. Separate contacts on the switch are wired to terminals on the rear apron, which may be used to turn on the transmitter. These are conveniences not found on many receivers today.

The S-meter on the left-hand is the combined S-meter; that is, it shows the sum of the two received signals, and as such will usually read high. To the right of this meter is another lever switch marked "Hetero*tone* Oscillator" (up) and "Hetero*dyne* Oscillator" (down). The hetero*dyne* oscillator is the conventional BFO with a pitch control knob in the lower left-hand corner of the panel. The hetero*tone* oscillator is a unique and interesting circuit I'll describe in detail later. For the present, I'll only say that it serves the same purpose as the BFO except that the pitch of a CW signal remains constant as the receiver is tuned through the signal instead of decreasing to zero and increasing, as in a conventional BFO.

The tone control in the center of the lower left-hand panel is conventional. The knob on the lower right controls the i-f bandwidth through a very interesting system developed earlier by the designers of this receiver. I describe this, too, in greater detail later.

fig. 11. The main tuning dial of the monster. Note the "writ by hand" calibration on the bandspread dial.

Center panel. The center panel, **fig. 11**, has the main tuning dial and control on the left and the bandspread dial and control on the right. The controls tune both receivers simultaneously. The small windows just above each control are a vernier scale that is used in conjunction with the outer scale on the tuning dial for logging. The bandspread dial was originally supplied blank, to be calibrated by the owner according to his desires. The scale on my set was calibrated by the previous owner for the Amateur bands. The phone jack and noise switch, again, are conventional.

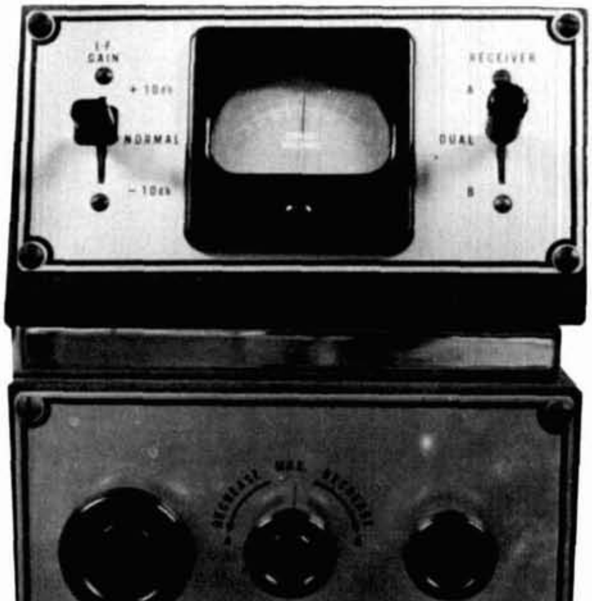

fig. 12. The right-hand control panel. The S-meter is a differential type.

The column of pushbuttons is a combined band-

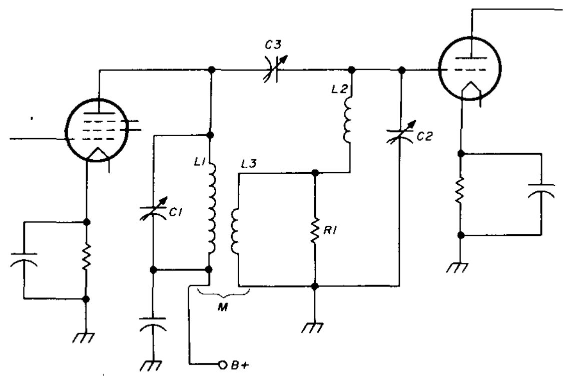

fig. 13. Basic schematic of the infinite off-frequency rejection coupling system used on the DD-1.

switch and primary power switch. The top button turns the receiver off; any of the remaining six buttons simultaneously select the desired band and apply ac power.

Right-hand panel. The right-hand control panel, **fig. 12**, has a zero-center meter used as a differential S-meter; it reads the difference in signal strength between the two receivers. Under poor propagation conditions it's fascinating to watch this meter swing back and forth as first the vertical then the horizontal signal predominates, while the combined S-meter remains relatively constant. At times like this the advantages of diversity reception become most apparent.

The selector switch to the right of the differential S-meter selects the audio output of either receiver separately or the combined output for diversity reception. An i-f gain control switch to the left of the meter increases or decreases the gain of both i-f amplifiers by 10 dB. I'm not certain what the purpose of this control is but have found it convenient when signals were either very strong or very weak.

The lower left-hand knob on this panel is the master rf gain control; it controls the rf gain of both receivers. The center knob is the rf gain balance control. It is used to roughly balance the signal levels in the two receivers. With this control in the center, the rf gain of the two receivers is approximately equal. Adjusting the knob off-center increases the gain in one channel while decreasing it in the other. The control is adjusted until the differential S-meter reads zero on the average.

The audio gain control is common to both channels and needs no comment.

The DD-1 featured several engineering advances, two of which may be of interest to receiver designers today. The first was a continuously adjustable bandwidth control that did not use a crystal filter; the second was the heterotone oscillator.

The off-frequency rejection system. This circuit was described by McLaughlin and Miles[9] a month before the DD-1 itself. The basic schematic is shown in **fig. 13**. To quote the author:

> It will be observed that coupling is provided by the mutual inductance, M, between L_1 and L_3 and the capacitive coupling, C_3 . . . Mutual inductance, M, and the capacity coupling, C_3, are so chosen that at some determined frequency off resonance the voltage induced through M is opposite in sign to the voltage induced in C_3 and will therefore cancel it out. In other words, no coupling exists at this particular frequency. In order to achieve infinite rejection at this undesired frequency, correction for power factor in the circuit must be made. Resistor R_1 in the diagram is the power factor corrector. The rejector control, C_3, can be made variable and tuned over a fairly wide frequency range of rejection without noticeable interlocking effect on the i-f. For proper operation, resistor R_1 should be variable; but once the infinite rejection point has been found, it need not be touched again . . .
>
> [**Fig. 14** shows the response of] a single rejector circuit set to reject a frequency 4.5 kHz off resonance. The rejector slot, as is apparent, goes to infinity at this frequency and its action is very similar to the rejection in a crystal filter . . .

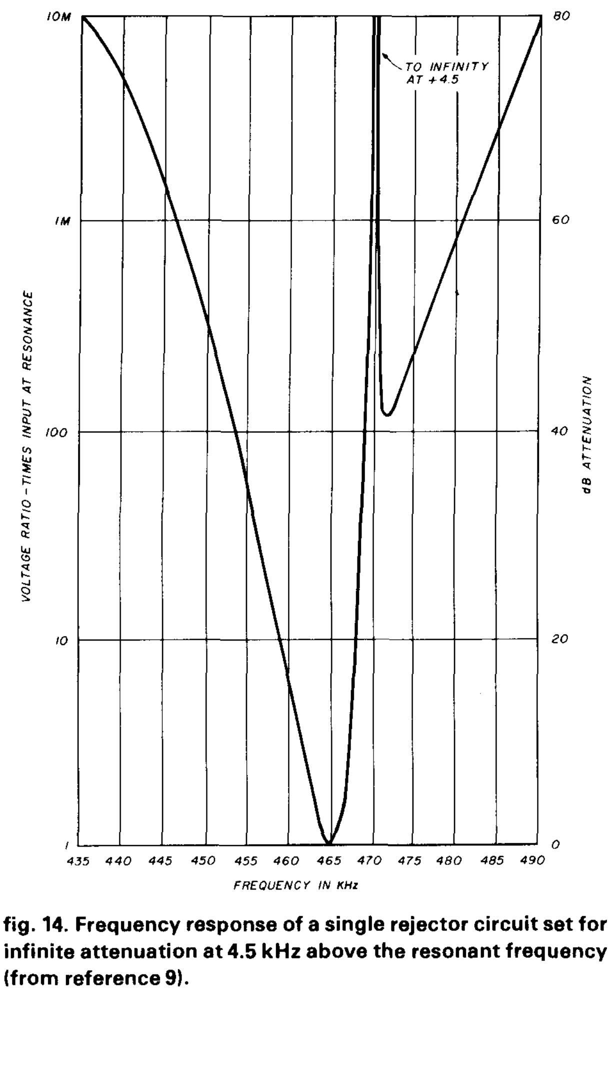

fig. 14. Frequency response of a single rejector circuit set for infinite attenuation at 4.5 kHz above the resonant frequency (from reference 9).

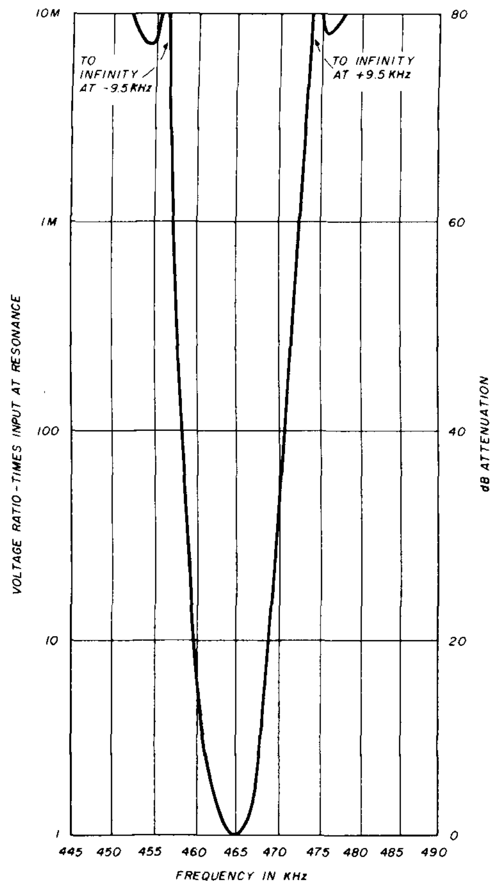

fig. 15. Bandpass of two rejector circuits set at 9.5 kHz above and below the resonant frequency (from reference 9).

To obtain a symmetrical response, two such circuits replaced the i-f transformers for two consecutive stages. The coupling capacitors, C_3, were chosen so that one infinite rejection slot was above the desired center frequency and the other below it. These variable capacitors were also ganged so that one increased the slot frequency while the other decreased it. Thus the bandwidth could be made continuously adjustable by means of tuning the two capacitors.

Figs. 15 and **16** show the resulting bandpass with the rejector control set at ±9.5 kHz and ±5 kHz above and below resonance.

The schematic of **fig. 17** can be used to obtain a continuously adjustable bandwidth for a single receiver. In the DD-1, it's necessary to gang two rejector pairs, one for each receiver. Although this system is relatively simple and straightforward, I'm not aware of its use on present receivers. One variation might be to use a varicap for remote bandwidth control. The circuit seems to be a forerunner of the so-called single-sideband mixer used in the microwave region today.

Heterotone feature. Another interesting feature of the DD-1 is the hetero*tone* oscillator used to receive diversity CW signals. Receiving diversity CW presents a problem not found in diversity phone reception; that is, in phone reception the combining of the two signals occurs after all rf phase information is lost. With CW reception, using a conventional hetero*dyne* BFO system, the phase information is still present in the audio output, since the audio signal is a CW signal itself.

When we discussed short-term fading, we said it was caused by two signals from the same transmitter traveling over two different paths varying in distance by one-half wavelength and arriving at the receiving antenna out of phase. Assuming polarization diversity, it's entirely probable at times that the signals *arriving at the horizontal and vertical antennas would* travel over slightly different paths and arrive at their respective antennas out of phase. The audio output of each channel would also be out of phase, as the

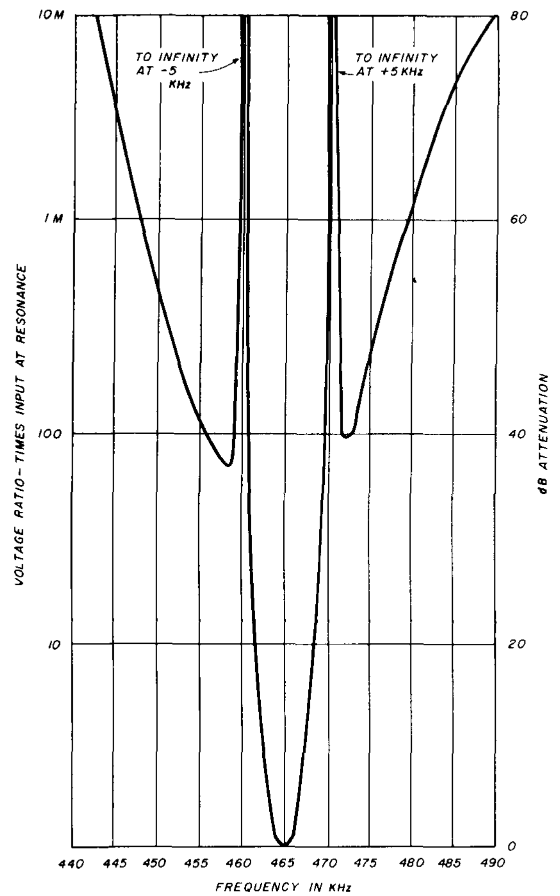

fig. 16. Same as fig. 15 except that rejector circuits are 5 kHz above and below resonance (from reference 9).

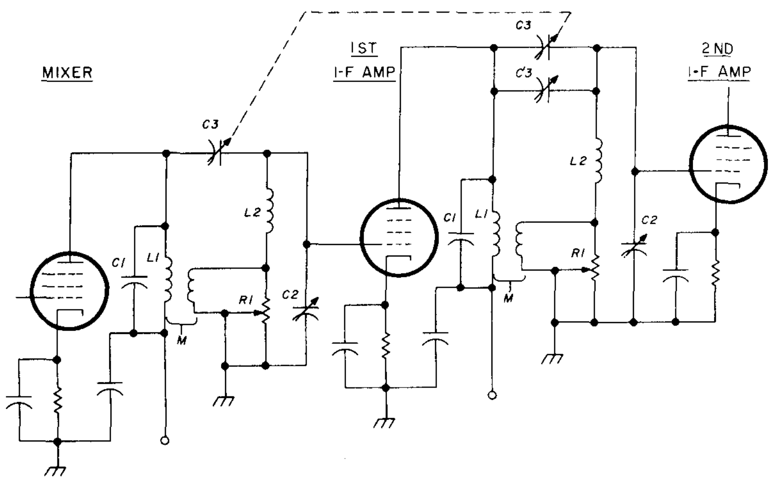

fig. 17. Two infinite rejection circuits ganged to give continuously adjustable bandwidth. In the DD-1, the i-f amplifier of each receiver has its own infinite rejection pair, and all four circuits are ganged together.

same hetero*dyne* oscillators are used for both channels, so that the combined audio signals would null. We have then, in effect, generated a fade inside the receiver, when both signals are strong at their antenna terminals. But this is just what we're trying to avoid! The answer is, of course, to remove all phase information before combining the signals. Two ways of doing this are generally accepted.

The method used by the commercials is to feed the output of the i-f amplifier for each channel into its own diode detector without using a BFO. Each detector output becomes a series of dc pulses, in Morse code, from which all phase information has been removed. The detector outputs are then summed in a conventional summing network; as this sum is the total of all channels, it is relatively fade-free. The summed output is used to key a local audio oscillator, which the operator hears in his headset.

Another method is the hetero*tone* circuit as used in the DD-1. With this circuit, no BFO is used. Instead, an audio-frequency oscillator is used to amplitude-modulate the i-f signal in each receiver. A conventional diode (envelope) detector is used in each channel. The detector output is therefore an audio tone when a carrier is present and no tone when one is not present. All rf phase information is lost, so the two signals can be combined without phase effects.

It's interesting that the hetero*tone* type of CW reception was originally developed by James Lamb[10] and has some advantages over heterodyne detection, even in single-receiver applications. This is especially valuable for operators who spend long periods of time at the key, such as in contests or moving traffic.

Let's go back some forty-odd years and read what James Lamb had to say on the subject:

> In heterodyne reception of pure dc telegraph signals there is a monotony, an exasperating tiresomeness about that piercing beat-note that makes old-time operators wish for the good old days and makes those who haven't had modulated mcw or icw experience wish they could do something besides change the beat note to just another single tone that drills a hole into the hearing system. This fatigue and monotony from listening to a pure dc beat-note isn't all imagination, either. It's quite real and demonstrable by authentic scientific proof . . .

Although I don't do a lot of operating, my own limited experience with hetero*tone* reception has been very favorable. This appears to be another engineering feature not available that perhaps ought to be.

closing comments

As a writer interested in the history of diversity reception, particularly for Amateur applications, I've been frustrated in researching this article. There is so much I have not been able to find out!

For instance, I'd like to know more about Dr. Hard, XE1G, and how he became interested enough in diversity reception to finance the development of two early diversity receivers. Where are his receivers now? What became of Dr. Hard's two very elaborate stations? What became of Dr. Hard? I assume he's long since become a silent key. The Mexican Embassy in Washington, D.C., has no record of a Hard chemical works today.

How many DD-1s were actually manufactured? In the August, 1976, issue of *QST* I ran an "I would like to get in touch with" notice for present or former owners of the DD-1. I received three responses. One said he understood "about a dozen" sets were manufactured. Bill Halligan tells me he thinks it was more like 200 sets. Who bought them? How were they used? Where are they now? I only know of two, my own and Chuck Dachis's.

In addition to being the first and only diversity receiver available commercially, the DD-1 featured many engineering advances as well. I believe it deserves more prominence in the annals of Amateur Radio than it's been given to date. If it's going to assume its rightful place, questions like these should be answered. I'd be pleased to correspond with anyone who knows these answers.

I've heard the DD-1 referred to as the Edsel of the radio industry; I'd rather think of it as the Airflow Chrysler of the industry, since it was so far ahead of its time.

With the development of solid-state components and PC board techniques, a diversity receiver can now be built that's considerably smaller than the "monster"; smaller, in fact, than a modern transceiver. Diversity reception has proved itself in over fifty years of commercial service. Isn't it time Amateurs tried it?

acknowledgments

Thanks to Harold Moore and Robert McGraw, W2LYH, both former employees of RCA Communications, Inc., for the photograph of the RCA diversity receivers. They also provided much additional information which I'd have included in my other diversity article,[1] except that that article was too far down the editorial path to change. My thanks, too, to Steve Sullivan, N4ZG, for his Hallicrafters advertisements, and to Charles Dachis, WD5EOG, for his much-needed encouragement and photograph of his own "monster."

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ham radio

More Details? CHECK—OFF Page 94

capacitance-measurement accessory for your frequency counter

Still another use for the NE-555 timer IC — this time in a unit of test equipment for measuring capacitance

Here is a very useful accessory for your counter that will allow you to measure capacitance from about 5 pF to 50 μF in two overlapping ranges. Resolution is 1 pF or 100 pF, provided the counter can display 1 Hz. Accuracy depends chiefly on standards used for calibration or comparison with a digital capacitance meter of known accuracy. Using all new parts, it costs about $18.00.

This is a modification of the W6ALF[1] circuit using the 555 timer IC in the one-shot mode to produce an output pulse of length proportional to the capacitance used in the RC timing network. The pulse is used to gate a transistor switch, which passes 1-MHz pulses obtained from the counter time base. The counter displays the number of 1-MHz pulses passed through during the timing period.

The basic circuit has the disadvantage that the 555 timer will produce an output pulse with no external capacitor; thus the counter will display anywhere from about 9 to over 30 depending on layout, strays, etc. The improved circuit uses another 555 to output a pulse that can be adjusted to the same length, which delays output of the 1-MHz pulses so that the count can be zeroed when no capacitor is connected to the test terminals.

This unit needs no external power. It will work with TTL- or CMOS-level signals, requiring only a 1-second gating pulse and 1-MHz clock pulses from the counter. Current drain from the internal 9-volt alkaline battery is 16 mA maximum. I tend to be forgetful, so I used a momentary push-to-test switch.

circuit operation

Refer to **fig. 1**. A positive-going gating pulse from the counter at E1 is differentiated by R1C1, inverted by Q1,and the required short negative-going trigger pulse is applied to U1 pin 2, the main timer, and also to U2 pin 2, the delay timer. Pin 3 of each 555 very rapidly goes high. U1 pin 3 back biases CR1 for the duration of U1 output pulse. When S1A is in the low-range position, U2 pin 3 switches Q2 emitter high, which cuts off Q2 and back biases CR2. When both CR1 and CR2 cathodes are high, Q3 turns on and its collector goes low to the output at E3.

When U2 times out, its pin 3 goes low, which enables Q2 to switch 1-MHz pulses coming in from the counter time base at E2. CR2 is then switched on and off, which turns Q3 off and on at a 1-MHz rate. When U1 times out, CR1 cathode goes low, disabling Q3 so the output at E3 ceases. The counter accumulates the 1-MHz pulses and displays the number.

The delay timer, therefore, inhibits the count for a

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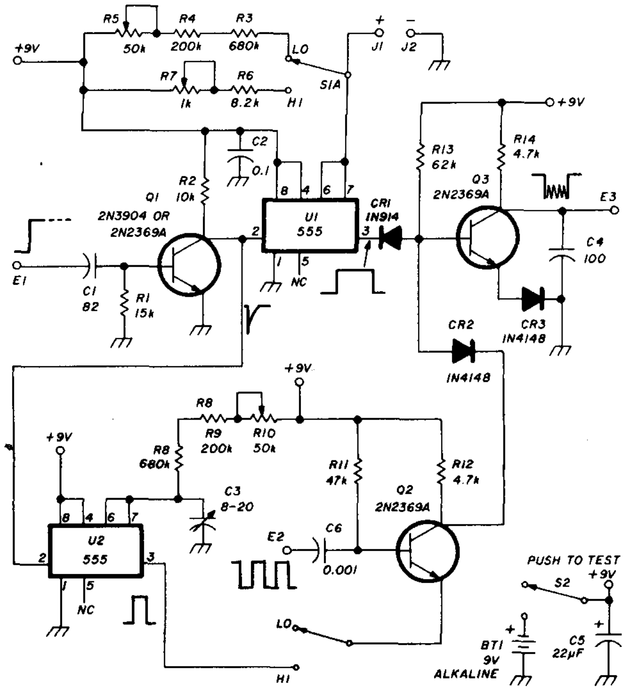


C1,C4,C6	mica or ceramic
C2	disc ceramic
C3	miniature ceramic trimmer
C5	tantalum
E1	gating pulse in
E2	1-MHz pulses in
E3	gated 1-MHz pulses to counter
S1	range switch, dpdt toggle
All resistors	¼-watt, 5 per cent carbon composition; pots 10 mm (0.4 inch) square PC-board mount

fig. 1. Schematic of the capacitance-measurement accessory for use with a frequency counter. Circuit is a modification of that in reference 1. It uses a second NE-555 timer IC, which allows the count to be zeroed when no capacitor is connected to the test terminal. Circuit works with TTL- or CMOS-level signals, requiring only a 1-second gating pulse and 1-MHz clock pulses from the counter.

time interval that is adjustable by R10 and C3. That interval is made equal to the open-circuit time of U1 — the pulse length that occurs when no external capacitor is connected to the test terminals. The delay circuit is not needed on the high range. S1B grounds Q2 emitter on that range.

The diode in Q3 emitter circuit ensures that the transistor is turned off when either CR1 or CR2 cathode is low. Pin 3 of the 555 goes to less than 100 millivolts when low; but when this voltage is added to the drop across either CR1 or CR2, Q3 base may be sufficiently positive to cause some conduction in Q3.

Bypass capacitors C2 and C5 were included for good design practice. No jitter on the timer output pulse was seen using a 15-MHz scope. Capacitor C4 suppresses a vhf oscillation in the counter input circuit when the tester is connected but not in use.

Battery voltage is not at all critical. The unit works over a range of 5-15 volts. Stability was slightly better at 9 volts than at 5 volts, but no noticeable improvement occurred at 13.8 volts. I used the 9-volt battery for convenience. It should last a long time in this service. It can be checked easily by loading with a 470-ohm resistor. If its voltage drops below 8 volts after a few seconds, replace the battery.

component selection

The total resistance needed for the timer circuit can be calculated from $t = 1.1\,RC$. When $t = 1$ *second* and $C = 1\ pF$, $R = 909$ *kilohms*. The series string, R3, R4 and R5, allows adjustment from about 880 to 930 kilohms. For the high range, which is one hundred times the low range, *R calculated* $= 9.09$ *kilohms*. R6 and R7 provide adjustment from 8.2 kilohms to 9.2 kilohms.

The low range will allow measurement from typically 2 or 3 pF to nearly 1 μF on a six-digit counter, or up to 0.1 μF on a five-digit counter, provided the counter will resolve 1 Hz. The high range is useful from about 0.01 μF (count of 100) to over 50 μF.

The resistor string for the delay timer uses the same values as the main timer. The two should track reasonably well with changes in temperature and humidity.

There's no point in using precision resistors in this circuit except for improved long-term stability that might be obtained. Likewise, multiturn pots aren't really needed.

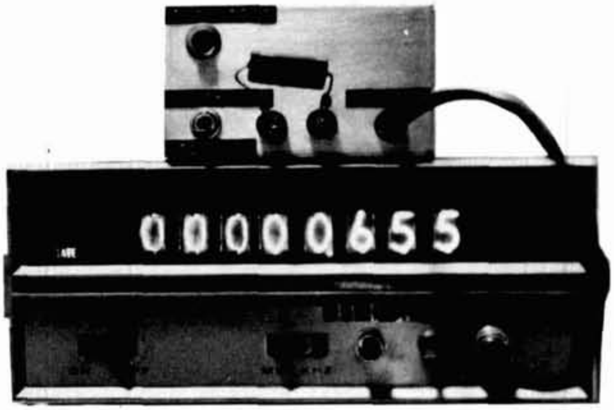
Battery voltage change from 8.0-9.5 volts made less than 0.1 per cent change in counter reading.

Transistor Q1 can be any medium-speed switch, but Q2 and Q3 should be fast-switching. The 2N2369A works well at low collector current. Some 2N3904s tried as Q2 and Q3 were found not to switch reliably.

Capacitor C1 was the smallest value that allowed reliable triggering of the 555s. Pin 2 of the 555 should be driven close to ground; but if it's held low too long, the timer will be fired again when the output pulse is short.

counter interface

This accessory unit was built to be used with a Heathkit IB-1102 counter. A pin jack and a BNC connector were mounted on the counter back panel, from which unshielded leads were connected to J4-1 and J4-3 respectively on the timebase-board socket, which are the gate (1-second or 1-millisecond) and 1-



Accessory unit in use with the Heath IB 1102 counter. The extra BNC socket to the right of the counter *MHz-kHz* switch is for input to a divide-by-10 scaler.

MHz outputs. Connections to these points didn't disturb the normal operation of the counter in any way.

Other counters may be used. The gate-pulse line is loaded very lightly. The 1-MHz pulses should be taken from a buffer rather than directly from the timebase oscillator. In the IB-1102, a 7473 divide-by-four flipflop supplies the 1-MHz signal to the string of decade dividers, which provides excellent isolation.

It should be possible to use the 3.579545-MHz clock in counters using a TV color-oscillator crystal time base, although I have not tried it. The resistor string should then total 254 kilohms for the low-C range, for 1 pF and 100 pF resolution respectively.

If your counter has a 0.1-second gate time — and resolves to 10 Hz — you can increase the resistor string to ten times values given and still obtain desired resolution. You may enounter some jitter and drift, however, because of varying leakage associated with resistance values that are as great as 9 megohms.

Actually, the gate-time length in the counter isn't important provided it's long enough to allow full count of the 1-MHz pulses. For instance, the IB-1102 has selectable 1-second and 1-millisecond gate times. The switch is labeled **MHz** and **kHz**. Used as a frequency counter, the gate time must be 1 second to count and display to the closest 1 Hz; and for 1 second of counting time it will, of course, display 1,000.000 kHz (1,000,000 Hz) for an input signal of 1 MHz. For 1-millisecond counting time, the display is 1.000 MHz.

As a pulse counter or totalizer, the displayed digits are the same regardless of the **MHz-kHz** switch position if the number of pulses is less than allowed by the gate time. For example, a 910-pF 5 per cent mica cap measured 877 pF on the low-C range using a 1-second gate (**1-MHz** position) and exactly the same using a 1-millisecond gate (**1-kHz** position). This is an interesting observation, because it shows that the pulse length is essentially independent of the duty cycle of the 555 timer. But a 1500-pF cap, which measured 1506 pF using 1-second gate, caused a display of 970 using the 1-millisecond gate. The reason for 970 instead of 1000 is that the delay circuit suppressed the first 30 pulses, and the shorter gate time eliminated counting the last 506 pulses.

construction

The entire circuit was put on a 50- by 75-mm (2- by 3-inch) single-side board with room to spare. Lines and pads were made with a high-speed hand grinder using dental burrs — used burrs are free from your friendly dentist (thanks to Murray, WB2DXD). It could just as well have been done on perf board or etched if you wish.

A single 16-pin socket accommodates both 555s. The board fits inside the 57 x 57 by 100 mm (2¼ by 2¼ by 4 inch) aluminum box. The dpdt **HI-LO** range switch, momentary **NO** pushbutton switch, and the banana jacks are on the face of the box. A length of RG-58/U comes through a grommet, and a UG-88/U BNC connector on its end goes to the counter input jack. A single angle bracket holds the board in position. The 9-volt battery fits at the end of the board; it's held in place by a bit of polystyrene foam.

Another length of RG-58/U with BNC plug, and a single unshielded wire with a phone tip plug, pass through a grommet in the back of the box. These go respectively to the 1-MHz output and to a pin jack connected to the counter gate pulse line.

calibration and use

An acceptable calibration can be made with an assortment of 5 per cent silver mica and 5 per cent polyester or polystyrene caps. If you have access to a good bridge or digital capacitance meter, or some known 1 per cent caps, so much the better.

First, remove the delay 555 from the socket, and put a wire jumper from socket pin 3 to ground. This grounds Q2 emitter and disables the delay circuit. Do not ground pin 3 directly when the 555 is in the circuit, because this will short-circuit the 555 output and exceed its current rating.

checks for low-range operation

Set the range switch at **LO**. Set main timer pot R5 at about 50 per cent resistance. Do not connect anything to the test jacks. Connect unit to counter and push the test switch. The counter should display some number — approximately 30. If it doesn't, check the board for cold solder joints and solder bridges. Use a scope to check at U1 pin 3 for an output pulse. Unless you have a very fast scope, you can't see the trigger pulse at pin 2; but if there's no pulse at pin 3, the 555 may be bad or simply not triggered. Also check at Q1 base for a 1-second gate and at Q2 base for a 1-MHz pulse.

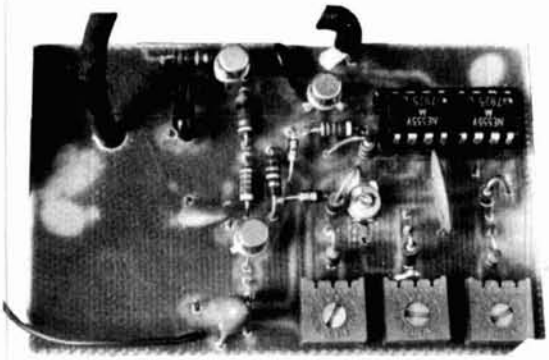
When all is well, connect a known value of capacitor to the test jacks — something in, say the 50-200 pF range. Adjust the 50-kilohms pot, R5, to make the display read a known value of test capacitor plus the open-circuit reading. Remove the test cap to see whether the "open" reading changed. If it did change, repeat the above procedure until the open reading does not change.

Remove the jumper in the delay 555 socket, replace the chip, and replace the test capacitor. Now adjust the delay timer pot, R10, and C3 trimmer until the display is correct. Check with the smallest value cap you have for which capacitance is accurately known.

high-range checks

Switch to **HI** range. Insert a known value capacitor of about 0.5 μF. Adjust the 1-kilohm pot, R7, for correct reading. There is no delay adjustment on this range.

Check readings on various capacitors (observe polarity). Electrolytics generally show increasing readings. This can be caused by gradual reformation of the dielectric, especially if the cap is old. Note that capacitance values obtained by measurement with this or any other low-voltage tester may be quite different from the effective values if working voltage is much higher. Also, measurements on very high K ceramic caps may be erratic. That's not the fault of the tester — it simply indicates that the retrace (charge and discharge) times for such dielectrics aren't constant, so it's a useful check on whether an unknown cap is stable enough for some intended use.



Circuit board and parts. The three square pots are at lower right; the two 555s are in one sixteen-pin socket. Q1 is at top left; Q2 at top right, which is nearest the 555s. Q3 is at bottom left. (Some resistors are standing on end.)

final checks

Check linearity by measuring two caps separately and in parallel. There should be good agreement. I measured two 650-pF, 0.5 per cent micas as 647 pF and 652 pF and together 1300 pF. Two 0.1-μF polystyrene caps were 0.1001 μF and 0.1026 μF; together they were 0.2025 μF.

Small-value caps should be checked by insertion directly into the test jacks with no extra leads. I made some small spring clips soldered to bananna plugs to allow good contact. Test leads can be used for connection to larger value caps with negligible error — or the actual capacitance across the leads can be noted and readings corrected.

Another useful check can be made on a capacitor of about 0.01-1.0 μF. Measure it on both ranges. Very close agreement should occur if the calibration is accurate. But note that some metallized and ordinary paper caps may have enough leakage so that the readings on the low range are higher than on the high range. Only the best quality polyester or other high-grade caps will consistently give equivalent readings on both ranges.

On the high range, the counter display with test terminals open is 10. According to a note in the National Semiconductor data for the 555, this occurs because comparator storage time limits pulse width to 10 microseconds minimum when pin 2 is driven fully to ground for triggering. I made a series of tests using caps of 100 pF-1500 pF in approximately 100-pF steps. From 100-700 pF, the counter displayed an increasing count, as expected, up to 17 for a 700-pF cap. But with an 800-pF cap the count dropped to 10, and at 1500 pF the display was 16; at 10,000 pF the count was 100. Evidently, with a large enough capacitor in the test position, the minimum 10-microsecond pulse is swallowed. This particular bit of serendipity was accepted gladly, for it made delay compensation unnecessary on the high range.

To me, the most useful feature of this accessory is that I can match caps closely, using the full resolution capability of the counter, which can't be done on the usual four-digit capacitance meter, and the cost is a lot less. Besides, it was fun to design and build.

reference

1. Ray Kramer, "Using a Frequency Counter as a Capacitance Meter," *QST*, August, 1977, Page 19.

ham radio

KENWOOD
...pacesetter in amateur radio

Easy selection.

15 memories/offset recall, scan, priority, DTMF
Touch-Tone ®

TR-7800

Kenwood's remarkable TR-7800 2-meter FM mobile transceiver provides all the features you could desire for maximum operating enjoyment. Frequency selection is easier than ever, and the rig incorporates new memory developments for repeater shift, priority, and scan, and includes a built-in autopatch DTMF encoder.

TR-7800 FEATURES:

- ***15 multifunction memory channels,* easily selectable with a rotary control**

  M1-M13... memorize frequency and offset (±600 kHz or simplex).
  M14... memorize transmit and receive frequencies independently for nonstandard offset.
  M0... priority channel, with simplex, ±600 kHz, or nonstandard offset operation.

- **Internal battery backup for all memories**

  All memory channels (including transmit offset) are retained when four AA NiCd batteries (not Kenwood-supplied) are installed in battery holder inside TR-7800. Batteries are automatically charged while transceiver is connected to 12-VDC source.

- **Priority alert**

  M0 memory is priority channel. "Beep" alerts operator when signal appears on priority channel. Operation can be switched immediately to priority channel with the push of a switch.

- **Extended frequency coverage**

  143.900-148.995 MHz, in switchable 5-kHz or 10-kHz steps.

- **Built-in autopatch DTMF (Touch-Tone®) encoder**

- **Front-panel keyboard**

  For frequency selection, transmit offset selection, memory programming, scan control, and selection of autopatch encoder tones.

- **Autoscan**

  Entire band (5-kHz or 10-kHz steps) and memories. Automatically locks on busy channel; scan resumes automatically after several seconds, unless CLEAR or mic PTT button is pressed to cancel scan.

- **Up/down manual scan**

  Entire band (5-kHz or 10-kHz steps) and memories, with UP/DOWN microphone (standard).

- **Repeater reverse switch**

  Handy for checking signals on the input of a repeater or for determining if a repeater is "upside down".

- **Separate digital readouts**

  To display frequency (both receive and transmit) and memory channel.

- **Selectable power output**

  25 watts (HI)/5 watts (LOW).

- **LED bar meter**

  For monitoring received signal level and RF output.

- **LED indicators**

  To show: +600 kHz, simplex, or -600 kHz transmitter offset; BUSY channel; ON AIR.

- **TONE switch**

  To actuate subaudible tone module (not Kenwood-supplied).

- **Compact size**

  Depth is reduced substantially.

- **Mobile mounting bracket**

  With quick-release levers.

See your Authorized Kenwood Dealer now for details on the TR-7800... the remarkable 2-meter FM mobile transceiver!

NOTE: *Price, specifications subject to change without notice and obligation.*

Subject to FCC Approval

MATCHING ACCESSORY:

- KPS-7 fixed-station power supply

TRIO-KENWOOD COMMUNICATIONS INC.
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"Cents-ability" in an HF rig.

A quality 160-10 meter SSB/CW transceiver

TS-520SE

The TS-520SE is the economical, full-featured, most popular 160-10 meter Amateur transceiver in the world. Now anyone can easily afford to put a high-quality HF transceiver in his ham-shack... a rig which provides 200 watts PEP input on SSB and 160 watts DC on CW!

TS-520SE FEATURES:

- **Covers 160-10 meters... and WWV**
  Provides full coverage of all Amateur bands from 1.8 to 29.7 MHz, plus WWV on 15 MHz
- **Digital display (optional)**
  The optional DG-5 provides easy, accurate readout of the actual operating frequency while transmitting and receiving
- **CW WIDE/NARROW bandwidth switch**
  For use with optional CW-520 500-Hz filter
- **Speech processor**
  Provides extra audio punch on transmit, while suppressing sideband splatter
- **Highly effective noise blanker**
  Virtually eliminates pulse-type noise
- **Solid-state, with tube driver and final**
  Vernier control allows easy and accurate adjustment of final plate tuning
- **High sensitivity and dynamic range**
  Dual-gate MOSFET provides outstanding cross-modulation and spurious response characteristics, with low noise figure and high gain for excellent sensitivity
- **Amplified-type AGC circuit**
  Three-position AGC switch (OFF/FAST/SLOW) provides optimum receiver operation on CW and SSB, under all signal-strength conditions
- **RF attenuator**
  Built-in 20-dB attenuator activated by front-panel push-button switch
- **RIT control**
  Receiver incremental tuning, or "clarifier"
- **Eight-pole crystal filter**
  For excellent selectivity
- **Built-in 25-kHz calibrator**
  To maintain frequency accuracy. Adjustable to WWV
- **Amplified-type ALC**
  Improves quality of transmitted signal
- **Front-panel carrier level control**
  To adjust CW output power
- **Semi-break-in CW with sidetone**
  Keying delay adjustable with VOX delay control
- **VOX/PTT/MANUAL operation**
  Suits all operating requirements
- **TUNE position for low-power tune-up**
  Provides longer final tube life
- **Built-in speaker**
  Excellent audio quality
- **Built-in cooling fan**
  Extends life of components
- **Provisions for four fixed channels**
  Ideal for net or MARS operation
- **Rugged die-cast front panel**
  Very attractive design

Ask your Authorized Kenwood Dealer about the TS-520SE... and its surprisingly affordable price!

NOTE: Price, specifications subject to change without notice and obligation.

MATCHING ACCESSORIES FOR FIXED-STATION OPERATION:
- SP-520 external speaker
- DG-5 digital frequency display/counter
- VFO-520S remote VFO

Other accessories not shown:
- CW-520 500-Hz CW filter
- AT-200 antenna tuner/SWR and RF power meter/antenna switch
- TL-922A linear amplifier
- SM-220 Station Monitor with BS-5 pan display module option
- MC-50 dynamic desk microphone
- MC-35S noise-cancelling, high-impedance microphone
- HS-5 and HS-4 headphones
- PC-1 phone patch
- HC-10 world digital clock

600-MHz prescaler
for use with electronic counters

A simple prescaler for LSI chips that covers frequencies to 600 MHz

The production of LSI integrated circuits has allowed complete frequency counters on a single chip. The disadvantage of these devices is that the maximum input frequency is limited, usually to about 6 MHz. However, the frequency range can be extended by using a prescaler. This article presents a frequency prescaler usable to 600 MHz.

To achieve maximum input frequency, emitter-coupled logic (ECL) is used because of its high speed. (MECL is Motorola's trade name for ECL.) The prescaler has three separate amplifiers, one for direct counting and the other two for inputs to be prescaled. Exclusive ORs automatically switch the outputs of each amplifier, which eliminates the need for front-panel rf switching. None of the amplifier inputs were diode protected. Diodes add extra input capacitance, which degrades frequency response.

design

The sensitivity of the uhf range is shown in **fig. 1**, input impedance in **table 1**. As shown in **fig. 2**, the uhf front end is an Amperex ATF-417 broadband amplifier. The gain of this device is approximately 25 dB, with a bandwidth of 960 MHz (40 MHz - 1 GHz).

The Fairchild 11C90 divides the output of the ATF-417 by ten. The Motorola MC10107 exclusive OR gates this signal to the next divide-by-ten, which an MC10138. The signal level from the MC10138 is ECL and the output (74S86) is TTL, so the two levels must be interfaced. The interface circuit is a Signetics SD211 DMOS fet, which shifts the ECL level to TTL through the 74S86 exclusive-OR to the output buffer, which completes the dividing chain.

The vhf front-end amplifier is a MECL triple-line receiver. Using the MC10116 as an amplifier produces a gain of approximately 20 dB. The vhf-input sensitivity is shown in **fig. 1** and input impedance in **table 2**. Since this signal must be divided by ten once, the MC10107 exclusive-OR gates the output of this amplifier directly to the MC10138. The signal is divided by ten and gated to the output buffer, which completes the vhf dividing chain.

The schematic of the prescaler is shown in **fig. 3**. To achieve a higher input impedance in the hf front end, the amplifier has a fet input. The RCA 3028 differential amplifier is used as an amplifier and limiter with a gain of approximately 30 dB. The sensitivity of the hf input is shown in **fig. 4** and input impedance in **table 3**. The output of the amplifier is a limited sinewave but not directly compatible with TTL. The fet at the amplifier output converts the signal to a TTL level. This signal isn't divided, so the 74S86 gates the signal to the output buffer, completing the hf section.

Power requirements for the prescaler are 15 Vdc, 35 mA and 5 Vdc, 325 mA. A Motorola MWA120 broadband amplifier can be used in place of the ATF-417. The MWA120 has a gain of 14 dB to 600 MHz; the cost is much lower than that of the ATF-417.

table 1. Uhf input impedance.

frequency (MHz)	magnitude (ohms)	phase (degrees)
60	88.6	−16.3
80	85.4	−20.5
100	80.7	−21.8
200	58.7	−20.4
300	41.1	−13.3
400	41.2	+14.0
500	53.8	+33.2
600	91.7	+29.3

By Thomas Cefalo, Jr., WA1SPI, 29 Oak Street, Winchester, Massachusetts 01890

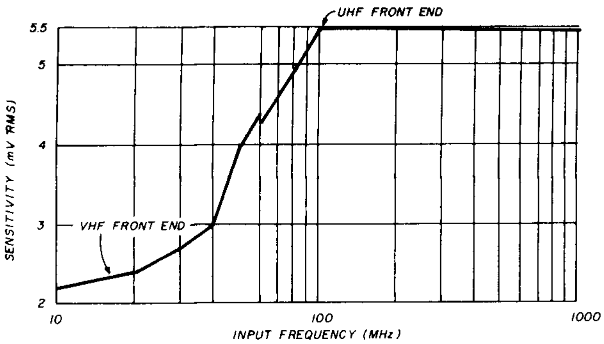

fig. 1

fig. 1. (*top*). Sensitivity of the vhf and uhf ranges.
fig. 2. (*center*). Functional block diagram of the 600-MHz prescaler. Three separate amplifiers are used, one for direct counting and two for inputs to be prescaled.
fig. 3. (*bottom*). Prescaler schematic: circuit was constructed on a PC board. Power requirements are 15 Vdc at 35 mA and 5 Vdc at 325 mA. L1 is six turns no. 30 (0.6-mm) on 3B ferrite bead.

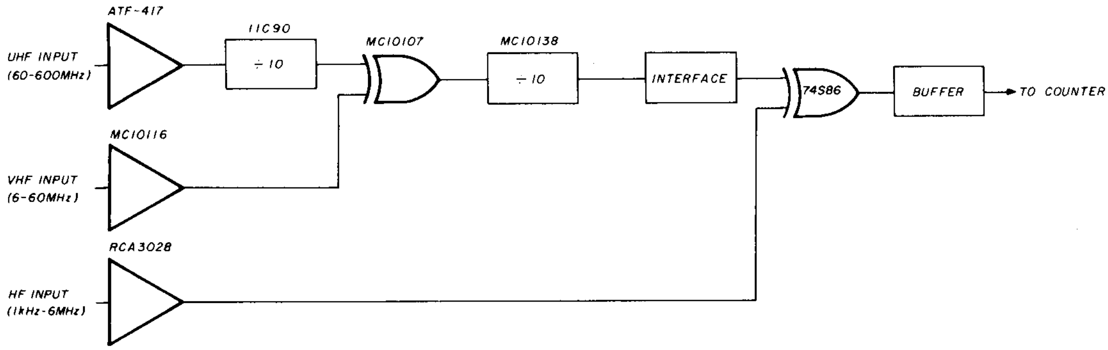

fig. 2

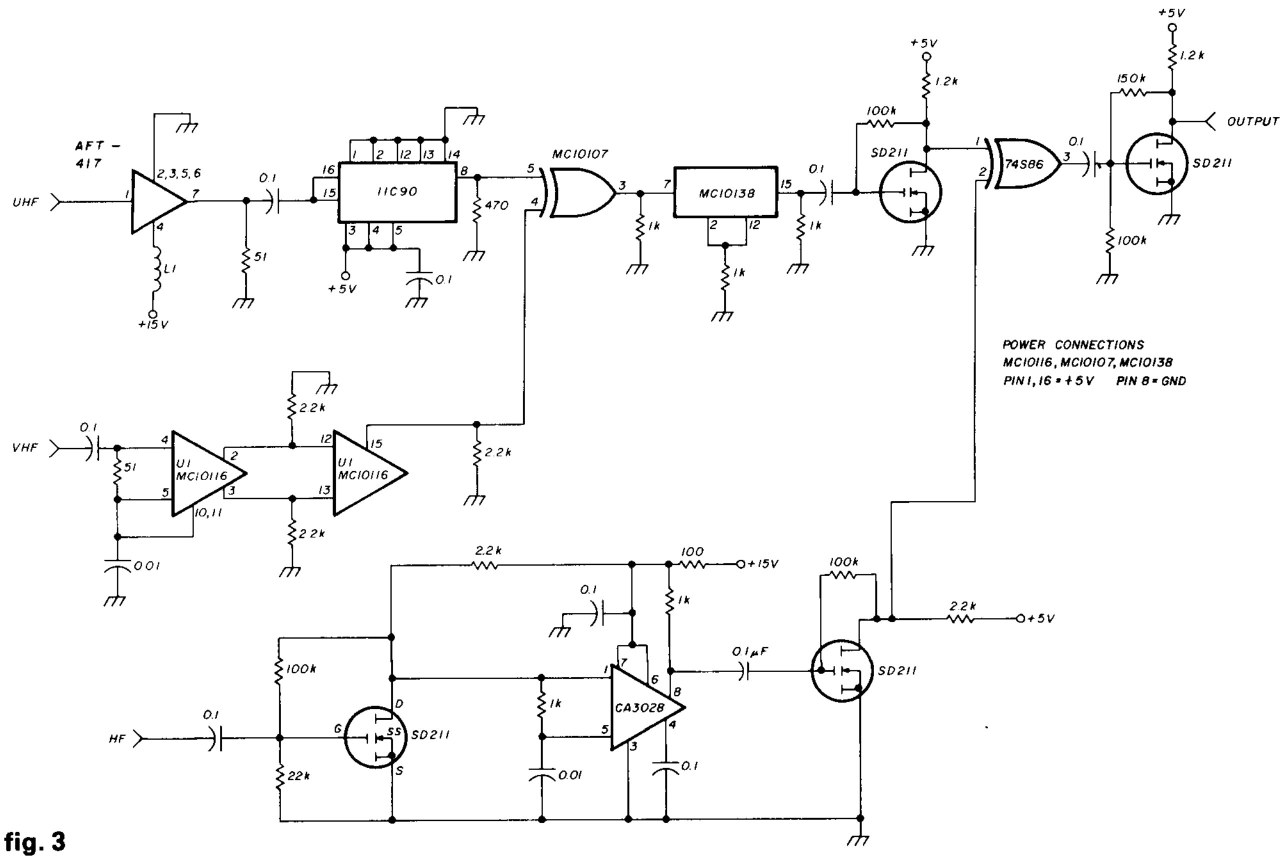

fig. 3

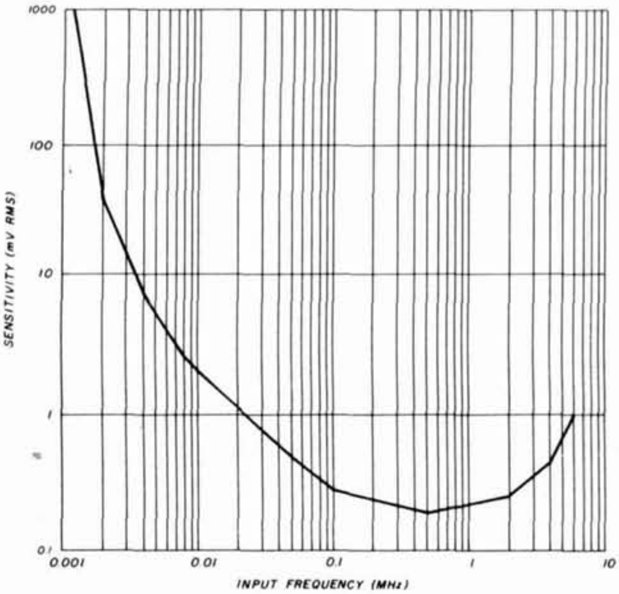

fig. 4. Measured sensitivity of the high-frequency range.

The advantage of high sensitivity is that a small loop soldered to a piece of coax can be used as a probe. This method of taking measurements won't load down a circuit. This prescaler is presently being used with the Intersil ICM 7028 counter chip.

table 2. Vhf input impedance.

frequency (MHz)	magnitude (ohms)	phase (degrees)
6	54	−2
10	54	0
20	52	0
30	51	+3
40	51	+7
50	52	+8
60	54	+10

table 3. Hf input impedance.

frequency (kHz)	magnitude (ohms)	phase (degrees)
500	12,500	−30
600	11,000	−34
700	11,000	−38
800	10,000	−42
900	9,800	−46
1000	9,000	−50
2000	5,300	−62
3000	3,800	−69
4000	2,900	−74
5000	2,300	−76
6000	2,000	−78

acknowledgment

I would like to thank Eric Blomberg, N1BF, for his time and advice.

ham radio

More Details? CHECK—OFF Page 94

Collins amateur radio equipment survey

After much deliberation, and weighing the pros and cons, we've decided that the Collins 75S- series receivers, the 32S- series transmitters, as well as the KWM-2 series of transceivers, are fair game for our owners' report column.

The fact that many of these rigs have survived more than 20 years on the Amateur market is an indication of their durability and design solidarity. Also, long considered to be the "Cadillac" of Amateur gear, they still command premium prices in the bargain sheets, classified advertising sections of magazines, and at flea markets. The later versions will be useful on the new bands coming out of WARC with a simple addition of crystals (earlier models will also cover the new WARC bands, but do not have sufficient bandswitch positions); the tuned circuits will accommodate any operating frequency between 3.4 and 30 MHz.

So, the expectation is that these rigs will be around for some time to come. Therefore our survey will be very useful to you who are shopping for a used rig — either to use as is, to modify, to use with converters, or as a back-up rig to supplement your other station gear. By reading these reports, you'll be able to find out what made them so popular, what the most troublesome areas were, how frequently these troubles occurred, what was done to fix them, and, in general, what many users had to say about the operation, reliability, service, and just plain fun of owning and using a Collins station.

If you'll look at the first question on the form, you'll see something different from previous ones: It's *all* Collins. In going through the list of models to be considered, it turned out that there were several variations to take into account. Rather than try to separate the early from the late, and trying to outguess the statistics on which would be the most popular (or used in the greater number of hamshacks), we've listed the whole range. It's going to provide our bean-counters with an interesting problem in translating this into words, charts, and tables, but the results should prove very useful.

For this reason, I'd like to ask that you report on a *system*. It is conceivable that some hams have owned, at one time or another, one of each model. If you are one who has, and want to report on more than one, that's great — just use a separate copy of the form for each one, please.

Another way you can be helpful is if you will indicate which combination you are reporting on. If you've used (or are using) a 32S-1 transmitter with a 75S3-B receiver, or any other combination, as a system, please indicate by circling each one in Question 1. You can even draw a line linking the two together if you like.

Just remember, the more information we can extract from these reports, the better they will serve prospective buyers. If you had a 32S-1, but later upgraded to a 32S-3, for example, you should report each on a separate sheet — don't mix one rig's troubles/good features with those of another.

Looking to the future, the number of new rigs in use, the FT901s, Omni-Ds, and the TR-7, is growing all the time, and soon there will be enough of them out there to represent a broad sample of opinion and experience. If you're interested in these, or if you are an owner, hang in there, you'll see the questionnaire for them soon.

Now, all you Collins owners, go to the top of the next page and start telling it like it is.

By Thomas McMullen, W1SL, Managing Editor, *Ham Radio Horizons*

Owner Report on Amateur Radio Equipment

(Fill out this form in accordance with your experience. Please type or print clearly.)

1. Make and Model (please indicate the exact unit or system you are reporting on).

32S-1	75S-1	KWM-2
32S-2	75S-2	KWM-2A
32S-3	75S-3	
32S-3A	75S-3A	
	75S-3B	
	75S-3C	

2. What year did you buy it?__________ New?__________ Used?__________

3. Where did you buy it? Dealer__________ Mail Order__________ Individual__________ Flea Market__________
800 Number__________ Other__________

4. Would you buy from the same source again?__________

5. Amount of use: Daily__________ Often__________ Occasional__________ Seldom__________

6. Is this your primary__________ or backup__________rig?

7. What modes have you used? CW_______ SSB_______ RTTY_______ SSTV_______ AM_______ Other_______

8. What is the rig's best feature?______________________________

9. Worst feature? ______________________________

10. Have you had any problems?__________ Explain ______________________________

11. Have you had the rig serviced?__________ Where? Manufacturer__________ Dealer__________ Other__________

12. Was the service satisfactory? Yes__________ No__________

13. What accessories have you purchased for this rig? ______________________________

14. Have you been able to obtain all the accessories and parts you need? ____________________

15. Have you been satisfied with these accessories? Yes__________ No__________

16. If not, why? ______________________________

17. Additional features you would like to see built into a rig of this type ______________________________

____

____

____

18. Give the equipment a score from 1 to 10 (with 1 being poorest, 4 to 6 average, and 10 perfect).

Ease of operation ______________

Reliability ______________

Durability
(in continuous use) ______________

Instruction Book ______________

Factory/Dealer Service ______________

Quality of Workmanship ______________

Performance ______________

Maintenance ______________

Parts Availability ______________

Accessories
(ease of connection) ______________

Price ______________

Flexibility ______________

19. How long have you been licensed?__________ Your Age__________ License Class ______________

Principal activities: Contest__________ DX__________ Rag Chewing__________

Traffic Handling__________ Experimenter__________

20. What antenna do you use most? Beam__________ Wire__________ Other__________

21. What rig would you like to see reported on in the future? ______________________________

22. Would you buy this same rig again? ______________________________

23. (Optional: fill in the following only if you wish.)

Submitted by: Name ______________________________ Call______________

Address ______________________________

City______________ State______________ Zip______________

____
(Signature)

(Your signature authorizes *Ham Radio Horizons* to quote portions of your comments in our report.) May we use your name and/or call?

Yes__________ No__________

Note: If you own more than one of the rigs indicated, please use a separate form for a report on each rig.

Completed survey forms must be returned no later than May 30, 1980, to be included in our report.

Mail To: Ham Radio Horizons, User's Report No. 3, Greenville, NH 03048

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- Battery and Five free Xtal pairs of your choice with radio.

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WMH 440TT	Mobile Amplifier Charger	1-6	4	40	5.0
WMH 480TT	Mobile Amplifier Charger	1-6	4	85	15.6
WA 440	Broad Band Amplifier	1-6	4	40	4.8
WA 480	Broad Band Amplifier	1-6	4	85	15.5
WA 2080	Broad Band Amplifier	10-25	20	90	11.0

MOBILE AMPLIFIER FEATURES

- 5-watt audio amplifier for external speaker.
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(Detach Here)

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☐	BP-4	Extra Battery Pack	19.00
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☐	LC-3P	Leather Case for Touch-Tone* Pad	15.00
☐	TTP	Touch-Tone* Pad (Factory Installed)	48.50
☐	MC-12	Mobile Charger Only	135.00
☐	WMH 440	40W Mobile Amplifier Charger	199.00
☐	WMH 480	80W Mobile Amplifier Charger	271.00
☐	WMH 440TT	40W Mobile Amplifier Charger with Touch-Tone* Pad	240.00
☐	WMH 480TT	80W Mobile Amplifier Charger with Touch-Tone* Pad	309.00
☐	WA 440	40W No Tuning Amplifier for Portable Radios	108.00
☐	WA 480	80W No Tuning Amplifier for Portable Radio	181.00
☐	WA 2080	80W No Tuning Amplifier for Mobile Units	147.00

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FCC study guide

Study Guide for Amateur Radio License Examinations

We're very happy to present, on the following pages, the complete text of the FCC Study Guide for all classes of Amateur License. This is FCC Bulletin 1035, dated January, 1980. You should use this material to find areas of study in each subject listed under the class of license you are trying for.

Note that the FCC lists two publications available from the Government Printing Office. Previously issued license-study manuals will still be helpful, but you'll have to do considerable interpreting to be sure that the subjects mentioned in this syllabus are thoroughly covered in those books.

As this goes to press, we've just learned of an electronics textbook that has been specifically revised to include study material listed in this FCC bulletin. It is *Electronic Communication*, by Robert L. Shrader, published by McGraw-Hill Book Company. This book is one of the best all-around electronic texts we've seen, and the inclusion of new material for the Amateur licenses can only make it more useful. This new fourth edition should be available soon after you read this, so watch for advertisements or write to Ham Radio's Bookstore for availability and price.

This Bulletin contains syllabi for the FCC Amateur radio examinations.

Why Are Amateur Radio Operator Examinations Required?

The examinations determine if you are qualified for the privileges conveyed by an Amateur radio license. Those privileges are many and diverse. As an Amateur radio operator, you will be allowed to build, repair, and modify your radio transmitters. You will be responsible for the technical quality of your station's transmissions. You will be allowed to communicate with Amateur radio operators in other countries around the world and, in some cases, send messages for friends. As you upgrade to the higher operator license classes, you will be allowed to communicate using not only telegraphy and voice, but also teleprinting, facsimile, and several forms of television. For such a flexible radio service to be practical, you and every other Amateur radio operator must thoroughly understand your responsibilities and develop the skills needed to operate your Amateur radio station properly.

What Subjects Do The Amateur Radio Examinations Cover?

The examinations cover the rules, practices, procedures, and technical material that you will need to know in order to operate your Amateur radio station properly. Each examination element is composed of questions which will determine whether you have an adequate understanding of the topics listed in the corresponding syllabus. For example, all Element 3 examination questions are derived from the Element 3 syllabus, which appears later in this Bulletin. To properly prepare for an examination, you should become knowledgeable about all of the topics in the syllabus for the element you will be taking. Every examination covers nine general subjects:

- Rules and Regulations
- Operating Procedures
- Electrical Principles
- Antennas and Feedlines
- Signals and Emissions
- Radio Wave Propagation
- Circuit Components
- Amateur Radio Practice
- Practical Circuits

Periodically, the syllabi are updated to reflect changing technology and Amateur radio practices. Comments on the study guide contents are welcome. Mail them to:

Personal Radio Branch
Federal Communications Commission
Washington, D.C. 20554

Where Can Study Manuals Be Obtained?

A study manual can be helpful in preparing for an examination. Several publishers offer manuals or courses based upon the material in this Bulletin. These may be found in many public libraries and radio stores. The FCC does not offer such manuals, nor recommend any specific publisher. However, you will find two FCC publications, *Part 97 — Rules and Regulations for the Amateur Radio Service* and *How to Identify and Resolve Radio-TV Interference Problems*, useful when preparing for the Amateur radio examinations. Copies are sold by the Superintendent of Documents, U.S. Government Printing office, Washington, D.C. 20402. Specify stock number 004-000-00357-8 for Part 97 and stock number 004-000-00345-4 for the Radio-TV interference booklet.

STUDY TOPICS FOR THE NOVICE CLASS AMATEUR RADIO OPERATOR LICENSE EXAMINATION

(Element 2 Syllabus)

A. RULES AND REGULATIONS

Define:

(1) Amateur radio service 97.3(a)
(2) Amateur radio operator 97.3(c)
(3) Amateur radio station 97.3(e)
(4) Amateur radio communications 97.3(b)
(5) Operator license 97.3(d)
(6) Station license 97.3(d)
(7) Control operator 97.3(o)
(8) Third party traffic 97.3(v)

Novice Class Operator Privileges:

(9) Authorized frequency bands 97.7(e)
(10) Authorized emission (A1) 97.7(e)

Prohibited Practices:

(11) Unidentified communications 97.123
(12) Intentional interference 97.125
(13) False signals 97.121
(14) Communication for hire 97.112(a)

Basis and Purpose of the Amateur Radio Service Rules and Regulations:

(15) To recognize and enhance the value of the Amateur radio service to the public as a voluntary, non-commercial communication service, particularly with respect to providing emergency communications. 97.1(a)
(16) To continue and extend the Amateur radio operators' proven ability to contribute to the advancement of the radio art. 97.1(b)
(17) To encourage and improve the Amateur radio service by providing for advancing skills in both the communication and technical phases. 97.1(c)
(18) To expand the existing reservoir within the Amateur radio service of trained operators, technicians, and electronics experts. 97.1(d)
(19) To continue and extend the radio Amateurs' unique ability to enhance international good will. 97.1(e)

Operating Rules:

(20) U.S. Amateur radio station call signs 2.302 and FCC Public Notice
(21) Permissible points of communications 97.89(a)(1)
(22) Station logbook, logging requirements 97.103(a), (b); 97.105
(23) Station identification 97.84(a)
(24) Novice band transmitter power limitation 97.67(b), (d)
(25) Necessary procedure in response to an official notice of violation 97.137
(26) Control operator requirements 97.79(a), (b)

B. OPERATING PROCEDURES

(1) R-S-T signal reporting system
(2) Choice of telegraphy speed
(3) Zero-beating received signal
(4) Transmitter tune-up procedure
(5) Use of common and internationally recognized telegraphy abbreviations, including: CQ, DE, K, SK, R, AR, 73, QRS, QRZ, QTH, QSL, QRM, QRN

C. RADIO WAVE PROPAGATION

(1) Sky wave; "skip"
(2) Ground wave

D. AMATEUR RADIO PRACTICE

(1) Measures to prevent use of Amateur radio station equipment by unauthorized persons

Safety Precautions:

(2) Lightning protection for antenna system
(3) Ground system
(4) Antenna installation safety procedures

Electromagnetic compatability — identify and suggest cure:

(5) Overload of consumer electronic products by strong radio frequency fields
(6) Interference to consumer electronic products caused by radiated harmonics

Interpretation of S.W.R. readings as related to faults in antenna system:

(7) Acceptable readings
(8) Possible causes of unacceptable readings

E. ELECTRICAL PRINCIPLES

Concepts:

(1) Voltage
(2) Alternating current, direct current
(3) Conductor, insulator
(4) Open circuit, short circuit
(5) Energy, power
(6) Frequency, wavelength
(7) Radio frequency
(8) Audio frequency

Electrical Units:

(9) Volt
(10) Ampere
(11) Watt
(12) Hertz
(13) Metric prefixes, mega, kilo, centi, milli, micro, pico

F. CIRCUIT COMPONENTS

Physical appearance, applications, and schematic symbols of:

(1) Quartz crystals
(2) Meters (D'Arsonval movement)
(3) Vacuum tubes
(4) Fuses

G. PRACTICAL CIRCUITS

Block Diagrams:

(1) The stages in a simple telegraphy (A1) transmitter

(2) The stages in a simple receiver capable of telegraphy (A1) reception

(3) The functional layout of novice station equipment, including transmitter, receiver, antenna switching, antenna feedline, antenna, and telegraph key

H. SIGNALS AND EMISSIONS

(1) Emission type A1

Cause and cure:

(2) Backwave
(3) Key clicks
(4) Chirp
(5) Superimposed hum
(6) Undesirable harmonic emissions
(7) Spurious emissions

I. ANTENNAS AND FEEDLINES

Necessary physical dimensions of these popular high frequency antennas for resonance on amateur radio frequencies:

(1) A half-wave dipole
(2) A quarter-wave vertical

Common types of feedlines used at Amateur radio stations

(3) Coaxial cable
(4) Parallel conductor line

STUDY TOPICS FOR THE TECHNICIAN/GENERAL CLASS AMATEUR RADIO OPERATOR LICENSE EXAMINATION

(Element 3 Syllabus)

A. RULES AND REGULATIONS

(1) Control point 97.3(p)
(2) Emergency communications 97.3(w); 97.107
(3) Amateur radio transmitter power limitations 97.67
(4) Station identification requirements 97.84(b), (f), (g); 97.79(c)
(5) Third party participation in Amateur radio communications 97.79(d)
(6) Domestic and international third party traffic 97.114; Appendix 2, Art. 41, Sec. 2
(7) Permissible one-way transmissions 97.91
(8) Frequency bands available to the technician class 97.7(d)
(9) Frequency bands available to the general class 97.7(b)
(10) Limitations on use of Amateur radio frequencies 97.61
(11) Selection and use of frequencies 97.63
(12) Radio controlled model crafts and vehicles 97.65(a); 97.99
(13) Radioteleprinter emissions 97.69

Prohibited practices:

(14) Broadcasting 97.113
(15) Music 97.115
(16) Codes and ciphers 97.117
(17) Obscenity, indecency, profanity 97.119

B. OPERATING PROCEDURES

(1) Radiotelephony
(2) Radio teleprinting
(3) Use of repeaters
(4) Vox transmitter control
(5) Full break-in telegraphy
(6) Operating courtesy
(7) Antenna orientation
(8) International communication
(9) Emergency preparedness drills

C. RADIO WAVE PROPAGATION

(1) Ionospheric layers; D, E, F1, F2
(2) Absorption
(3) Maximum usable frequency
(4) Regular daily variations
(5) Sudden ionospheric disturbance
(6) Scatter
(7) Sunspot cycle
(8) Line-of-sight
(9) Ducting, tropospheric bending

D. AMATEUR RADIO PRACTICE

Safety precautions:

(1) Household ac supply and electrical wiring safety
(2) Dangerous voltages in equipment made inaccessible to accidental contact

Transmitter performance:

(3) Two tone test
(4) Neutralizing final amplifier
(5) Power measurement

Use of test equipment:

(6) Oscilloscope
(7) Multimeter
(8) Signal generators
(9) Signal tracer

Electromagnetic compatibility; identify and suggest cure:

(10) Disturbance in consumer electronic products caused by audio rectification

Proper use of the following station components and accessories:

(11) Reflectometer (VSWR meter)
(12) Speech processor — RF and AF
(13) Electronic T-R switch
(14) Antenna tuning unit; matching network

(15) Monitoring oscilloscope
(16) Non-radiating load; "dummy antenna"
(17) Field strength meter; S-meter
(18) Wattmeter

E. ELECTRICAL PRINCIPLES

Concepts:

(1) Impedance (4) Inductance
(2) Resistance (5) Capacitance
(3) Reactance (6) Impedance matching

Electrical units:

(7) Ohm
(8) Microfarad, picofarad
(9) Henry, millihenry, microhenry
(10) Decibel

Mathematical relationships:

(11) Ohm's law
(12) Current and voltage dividers
(13) Electrical power calculations
(14) Series and parallel combinations; of resistors, of capacitors, of inductors
(15) Turns ratio; voltage, current, and impedance transformation
(16) Root mean square value of a sine wave alternating current

F. CIRCUIT COMPONENTS

Physical appearance, types, characteristics, applications, and schematic symbols for:

(1) Resistors
(2) Capacitors
(3) Inductors
(4) Transformers
(5) Power supply type diode rectifiers

G. PRACTICAL CIRCUITS

(1) Power supplies
(2) High-pass, low-pass, and band-pass filters
(3) Block diagrams showing the stages in complete am, ssb, and fm transmitters and receivers

H. SIGNALS AND EMISSIONS

(1) Emission types AØ, A3, F1, F2, F3
(2) Signal; information
(3) Amplitude modulation
(4) Double sideband
(5) Single sideband
(6) Frequency modulation
(7) Phase modulation
(8) Carrier
(9) Sidebands
(10) Bandwidth
(11) Envelope
(12) Deviation
(13) Overmodulation
(14) Splatter
(15) Frequency translation; mixing, multiplication
(16) Radioteleprinting; audio frequency shift keying, mark, space, shift

I. ANTENNAS AND FEEDLINES

Popular Amateur radio antennas and their characteristics:

(1) Yagi antenna
(2) Quad antenna
(3) Physical dimensions
(4) Vertical and horizontal polarization
(5) Feedpoint impedance of half-wave dipole, quarter wave vertical
(6) Radiation patterns; directivity, major lobes

Characteristics of popular Amateur radio antenna feedlines; related concepts:

(7) Characteristic impedance
(8) Standing waves
(9) Standing wave ratio; significance of
(10) Balanced, unbalanced
(11) Attenuation
(12) Antenna-feedline mismatch

STUDY TOPICS FOR THE ADVANCED CLASS AMATEUR RADIO OPERATOR LICENSE EXAMINATION

(Element 4A Syllabus)

A. RULES AND REGULATIONS

(1) Frequency bands available to the advanced class Amateur radio operator and limitations on use 97.7(a); 97.61
(2) Automatic retransmission of Amateur radio signals and signals from other radio services 97.3(x); 97.113; 97.126
(3) Amateur radio stations in repeater operation 97.3(1); 97.85; 97.61(c)
(4) Amateur radio stations in auxiliary operation 97.3(1); 97.86; 97.61(d)
(5) Remote control of Amateur radio stations 97.3(m)(2); 97.88
(6) Automatic control of Amateur radio stations 97.3(m)(3)
(7) Control link 97.3(n)
(8) System network diagram 97.3(u)
(9) Station identification 97.84(c), (d), (e)
(10) Station log requirements 97.103(c), (d), (e), (f), (g)
(11) Height limitations for Amateur radio station antenna structures, including FAA notification criteria, and calculation of height above average terrain 97.45; 97.67(c); Appendix 5

B. OPERATING PROCEDURES

(1) Facsimile transmission
(2) Slow-scan television transmission

C. RADIO WAVE PROPAGATION

(1) Sporadic-E
(2) Selective fading
(3) Auroral propagation
(4) Radio-path horizon

D. AMATEUR RADIO PRACTICE

Use of test equipment:

(1) Frequency measurement devices
(2) Grid-dip meter; solid state dip meter
(3) Performance limitations of oscilloscopes, meters, frequency counters; accuracy, frequency response, stability

Electromagnetic compatibility:

(4) Intermodulation interference
(5) Receiver desensitizing
(6) Cross modulation interference
(7) Capture effect

E. ELECTRICAL PRINCIPLES

Concepts:

(1) Reactive power
(2) Series and parallel resonance
(3) Skin effect
(4) Fields, energy storage, electrostatic, electromagnetic

Mathematical relationships:

(5) Resonant frequency, bandwidth, and "Q" of R-L-C circuits, given component values
(6) Phase angle between voltage and current, given resistance and reactance
(7) Power factor, given phase angle
(8) Effective radiated power, given system gains and losses
(9) Replacement of voltage source and resistive voltage divider with equivalent circuit consisting of a voltage source and one resistor (an application of Thevenin's theorem, used to predict the current supplied by a voltage divider to a known load)

F. CIRCUIT COMPONENTS

Physical appearance, types, characteristics, applications, and schematic symbols for the following:

(1) Diodes; zener, tunnel, varactor, hot-carrier, junction, point contact, pin
(2) Transistors; NPN, PNP, junction, unijunction, power, germanium, silicon
(3) Silicon controlled rectifier, triac
(4) Light emitting diode, neon lamp
(5) Crystal lattice ssb filters

G. PRACTICAL CIRCUITS

(1) Voltage regulator circuits; discrete and integrated
(2) Amplifiers; Class A, AB, B, C; characteristics of each type
(3) Impedance matching networks; PI, L, PI-L
(4) Filters; constant K, M-derived, band-stop, notch, modern-network-theory, pi-section, T-section, L-section (not necessary to memorize design equations; know general description, characteristics, responses, and applications of these filters)
(5) Oscillators; various types and their applications; stability

Transmitter and receiver circuits — know purpose of each, and how, basically, each functions:

(6) Modulators; am, fm, balanced
(7) Transmitter final amplifiers
(8) Detectors, mixer stages
(9) RF and IF amplifier stages

Calculation of voltages, currents, and power in common Amateur radio oriented circuits:

(10) Common emitter class A transistor amplifier; bias network, signal gain, input and output impedances
(11) Common collector class A transistor amplifier; bias network, signal gain, input and output impedances

Circuit design; selection of circuit component values:

(12) Voltage regulator with pass transistor and zener diode to produce given output voltage
(13) Select coil and capacitor to resonate at given frequency

H. SIGNALS AND EMISSIONS

(1) Emission types A4, A5, F4, F5
(2) Modulation methods
(3) Deviation ratio
(4) Modulation index
(5) Electromagnetic radiation
(6) Wave polarization
(7) Sine, square, sawtooth waveforms
(8) Root mean square value
(9) Peak envelope power relative to average
(10) Signal to noise ratio

I. ANTENNAS AND FEEDLINES

(1) Antenna gain, beamwidth
(2) Trap antennas
(3) Parasitic elements
(4) Radiation resistance
(5) Driven elements
(6) Efficiency of antenna
(7) Folded, multiple wire dipoles
(8) Velocity factor
(9) Electrical length of a feedline
(10) Voltage and current nodes
(11) Mobile antennas
(12) Loading coil; base, center, top

STUDY TOPICS FOR THE AMATEUR EXTRA CLASS AMATEUR RADIO OPERATOR LICENSE EXAMINATION

(Element 4B Syllabus)

A. RULES AND REGULATIONS

(1) Frequency bands available to the U.S. Amateur radio operator and limitations on their use including variations for regions 1 and 3 97.61; 97.95
(2) Space Amateur radio stations 97.3(i)
(3) Purity of emissions 97.73
(4) Mobile operation aboard ships or aircraft 97.101
(5) Races operation Part 97, Subpart F
(6) Points of communications 97.89

B. OPERATING PROCEDURES

(1) Use of Amateur radio satellite
(2) Amateur fast-scan television

C. RADIO WAVE PROPAGATION

(1) EME; "moonbounce"
(2) Meteor burst
(3) Trans-equatorial

D. AMATEUR RADIO PRACTICE

Use of test equipment:

(1) Spectrum analyzer; interpret display; display of transmitter output spectrum, such as commonly found in new product review articles in Amateur radio magazines
(2) Logic probe; indication of high or low state, pulsing state

Electromagnetic compatibility:

(3) Vehicle noise suppression; ignition noise, alternator whine, static
(4) Direction finding techniques; methods for location of source of radio signals

E. ELECTRICAL PRINCIPLES

Concepts:

(1) Photoconductive effect
(2) Exponential charge/discharge

Mathematical relationships; calculations:

(3) Time constant for R-C and R-L circuits (including circuits with more than one resistor, capacitor or inductor)
(4) Impedance diagrams; basic principles of Smith chart
(5) Impedance of R-L-C networks at a specified frequency
(6) Algebraic operations using complex numbers; real, imaginary, magnitude, angle

F. CIRCUIT COMPONENTS

Physical appearance, types, characteristics, applications, and schematic symbols for:

(1) Field effect transistors; enhancement, depletion, MOS, CMOS, N-channel, P-channel
(2) Operational amplifier and phase-locked loop integrated circuits
(3) 7400 series TTL digital integrated circuits
(4) 4000 series CMOS digital integrated circuits
(5) Vidicon; cathode ray tube

G. PRACTICAL CIRCUITS

(1) Digital logic circuits; flip-flop, multivibrator, and/or/nand/nor/gates
(2) Digital frequency divider circuits; crystal marker, counters
(3) Active audio filters using integrated operational amplifiers

High performance receiver characteristics

(4) Noise figure, sensitivity
(5) Selectivity
(6) Dynamic range

Calculation of voltages, currents, and power in common amateur radio oriented circuits:

(7) Integrated operational amplifier; voltage gain, frequency response
(8) F.E.T. common source amplifier; input impedance

Circuit design; selection of circuit component values:

(9) L-C preselector with fixed and variable capacitors to tune a given frequency range
(10) Single stage amplifier to have desired frequency response by proper selection of bypass and coupling capacitors

H. SIGNALS AND EMISSIONS

(1) Pulse modulation; position, width
(2) Digital signals
(3) Narrow band voice modulation
(4) Information rate vs. bandwidth
(5) Peak amplitude of a signal
(6) Peak-to-peak values of a signal

I. ANTENNAS AND FEEDLINES

(1) Antennas for space radio communications; gain, beamwidth, tracking
(2) Isotropic radiator; use as a standard of comparison
(3) Phased vertical antennas; resultant patterns, spacing in wavelengths
(4) Rhombic antennas; advantages, disadvantages
(5) Matching antenna to feedline; delta, gamma, stub
(6) Properties of 1/8, 1/4, 3/8, and 1/2 wavelength sections of feedlines; shorted, open

ham radio

More Details? CHECK—OFF Page 94

WILSON SYSTEMS TOWERS

— IN STOCK —

FACTORY DIRECT 949^{95}

NEW

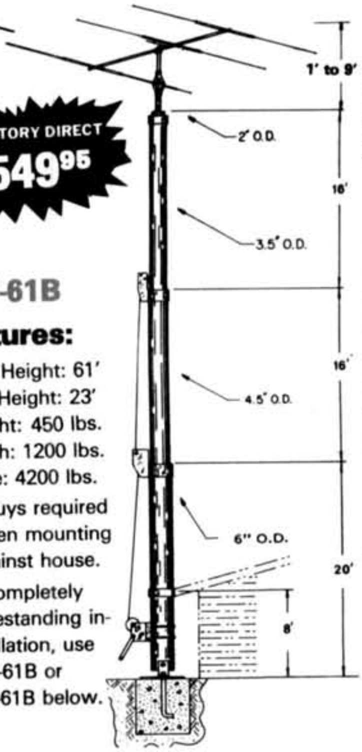
ST-77B

Features:

Max. Height: 77'
Min. Height: 24'
Weight: 700 lbs.
Winch: 1500 lbs.
Cable: 6400 lbs.
Requires FB-77B or RB-77B
Totally Freestanding with Bases below

(Shown with FB-77B)

IN STOCK

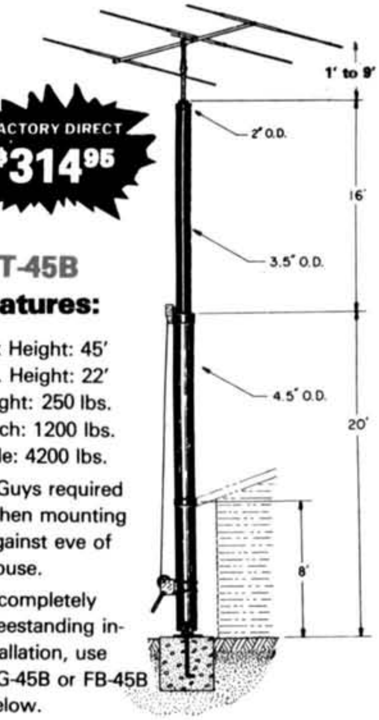


FACTORY DIRECT 549^{95}

MT-61B

Features:

Max. Height: 61'
Min. Height: 23'
Weight: 450 lbs.
Winch: 1200 lbs.
Cable: 4200 lbs.
No Guys required when mounting against house.
For completely freestanding installation, use RB-61B or FB-61B below.



FACTORY DIRECT 314^{95}

TT-45B

Features:

Max Height: 45'
Min. Height: 22'
Weight: 250 lbs.
Winch: 1200 lbs.
Cable: 4200 lbs.
No Guys required when mounting against eve of house.
For completely freestanding installation, use RG-45B or FB-45B below.

WIND LOADING			
Tower	Height	Sq. Ft.	
ST-77B	69	18	Square Footage Based on 50 MPH Wind
	77	12	
MT-61B	53	18	
	61	12	
TT-45B	37	18	
	45	12	

BASE CHART		
TOWER	WIDTH	DEPTH
TT-45B	12" x 12"	30"
FB-45B	30" x 30"	4½'
RB-45B	30" x 30"	4½'
MT-61B	18" x 18"	4'
FB-61B	3' x 3'	5½'
RB-61B	3' x 3'	5½'
ST-77B	See Below	Bases
FB-77B	3½' x 3½'	6'
RB-77B	3½' x 3½'	6'

Wilson Systems uses a new high strength carbon steel tube manufactured especially for Wilson Systems. It is 25% stronger than conventional pipe or tubing. The tubing size used is: 2" & 3½"-.095; 4½" & 6"-.125, 8"-.134. All tubing is hot dip galvanized. Top section is 2" O.D. for proper rotor and antenna mounting.

The TT-45B and MT-61B come complete with house bracket and hinged base plate for against-house mounting. For totally freestanding installation, use either of the tilt-over bases shown below.

The ST-77B can not be mounted against the house and must be used with the tilt-over base FB-77B or RB-77B shown below.

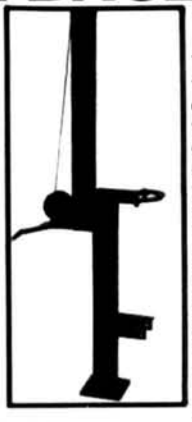
All three towers above are able to handle large arrays of up to 20 sq. ft. at 80 mph WHEN GUYED with one set of 4-point Guys at the top of the 3½" section. Guying Kits are available at the following prices: GK-45B—$59.95; GK-61B—$79.95; GK-77B—$99.95. When using the Guy System with RB Series Rotating Base, an additional thrust bearing at the top is required. The WTB-1 is available for $49.95.

TILT-OVER BASES FOR TOWERS

FIXED BASE

The FB Series was designed to provide an economical method of moving the tower away from the house. It will support the tower in a completely free-standing vertical position, while also having the capabilities of tilting the tower over to provide an easy access to the antenna. The rotor mounts at the top of the tower in the conventional manner, and will not rotate the complete tower.

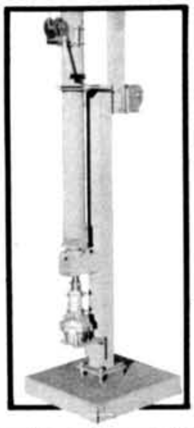
FB-45B... 112 lbs... $154.95
FB-61B... 169 lbs... 214.95
FB-77B... 250 lbs... 299.95



ROTATING BASE

The RB Series was designed for the Amateur who wants the added convenience of being able to work on the rotor from the ground position. This series of bases will give that ease plus rotate the complete tower and antenna system by the use of a heavy duty thrust bearing at the base of the tower mounting position, while still being able to tilt the tower over when desiring to make changes on the antenna system.

RB-45B... 144 lbs... $219.95
RB-61B... 229 lbs... 299.95
RB-77B... 300 lbs... 449.95



Tilting the tower over is a one-man task with the Wilson bases. (Shown above is the RB-61B. Rotor is not included.)

ORDER
FACTORY DIRECT
1-800-634-6898

WSI WILSON SYSTEMS, INC.

4286 S. Polaris Ave., Las Vegas, Nevada 89103

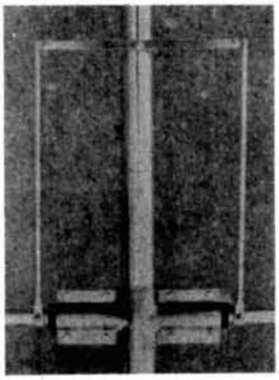
More Details? CHECK—OFF Page 94

WILSON MONO-BAND BEAMS

M520A
THE ALL NEW 5 ELEMENT 20 METER BEAM

At last, the antennas that you have been waiting for are here! The top quality, optimum spaced, and newest designed monobanders. The Wilson System's new Monoband beams are the latest in modern design and incorporate the latest in design principles utilizing some of the strongest materials available. Through the select use of the current production of aluminum and the new boom-to-element plates, the Wilson Systems' antennas will stay up when others are falling down due to heavy ice loading or strong winds. Note the following features:

1. **Taper Swaged Elements** – The taper swaged elements provide strength where it counts and lowers the wind loading more efficiently than the conventional method of telescoping elements of different sizes.
2. **Mounting Plates – Element to Boom** – The new formed aluminum plates provide the strongest method of mounting the elements to the boom that is available in the entire market today. No longer will the elements tilt out of line if a bird should land on one end of the element.
3. **Mounting Plates – Boom to Mast** – Rugged 1/4" thick aluminum plates are used in combination with sturdy U-bolts and saddles for superior clamping power.
4. **Holes** – There are no holes drilled in the elements of the Wilson HF Monobanders. The careful attention given to the design has made it possible to eliminate this requirement as the use of holes adds an unnecessary weak point to the antenna boom.



Wilson's Beta match offers maximum power transfer.

With the Wilson Beta-match method, it is a "set it and forget it" process. You can now assemble the antenna on the ground, and using the guide-lines from the detailed instruction manual, adjust the tuning of the Beta-match so that it will remain set when raised to the top of the tower.

The Wilson Beta-match offers the ability to adjust the terminating impedance that is far superior to the other matching methods including the Gamma match and other Beta matches. As this method of matching requires a balanced line it will be necessary to use a 1:1 balun, or RF choke, for the most efficient use of the HF Monobanders.

The Wilson Monobanders are the perfect answer to the Ham who wants to stack antennas for maximum utilization of space and gain. They offer the most economical method to have more antenna for less money with better gain and maximum strength. Order yours today and see why the serious DXers are running up that impressive score in contests and number of countries worked.

SPECIFICATIONS

Model	Band Mtrs	Gain dBd	F/B Ratio	[illegible]	VSWR @ Resonance	Impedance	Matching	Elements	Longest Element	Boom O.D.	Boom Length	Turning Radius	Surface Area (Sq.Ft.)	Windload @ 80 mph (Lbs.)	Maximum Mast	Assembled Weight (Lbs.)
M520A	20	11.5	25 dB	500 KHz	1.1:1	50 Ω	Beta	5	36'6"	2"	34'2½"	25'1"	8.9	227	2"	68
M420A	20	10.0	25 dB	500 KHz	1.1:1	50 Ω	Beta	4	36'6"	2"	26'0"	22'6"	7.6	189	2"	50
M515A	15	12.0	25 dB	400 KHz	1.1:1	50 Ω	Beta	5	25'3"	2"	26'0"	17'6"	4.2	107	2"	41
M415A	15	10.0	25 dB	400 KHz	1.1:1	50 Ω	Beta	4	24'2½"	2"	17'0"	14'11"	3.1	54	2"	25
M510A	10	12.0	25 dB	1.5 MHz	1.1:1	50 Ω	Beta	5	18'6"	2"	26'0"	16'0"	2.8	72	2"	36
M410A	10	10.0	25 dB	1.5 MHz	1.1:1	50 Ω	Beta	4	18'3"	2"	12'11"	11'3"	1.4	36	2"	20

WILSON SYSTEMS, INC. – 4286 S. Polaris
Las Vegas, NV 89103 – (702) 739-7401

FACTORY DIRECT ORDER BLANK

Toll-Free Order Number
1-800-634-6898

WILSON SYSTEMS ANTENNAS

Qty	Model	Description	Shipping	Price
	SY40	10 Ele. Tribander for 10, 15, 20 Mtrs.	UPS	274.95
	SY36	6 Ele. Tribander for 10, 15, 20 Mtrs.	UPS	199.95
	SY33	3 Ele. Tribander for 10, 15, 20 Mtrs.	UPS	149.95
	33-6 MK	40 Mtr. Mod Kit for SY33 & SY36	UPS	49.95
	WV-1A	Trap Vertical for 10, 15, 20, 40 Mtrs.	UPS	49.95
	GR-1	Ground Radials for WV-1A	UPS	12.95
	M-520A	5 Elements on 20 Mtrs.	TRUCK	229.95
	M-420A	4 Elements on 20 Mtrs.	UPS	159.95
	M-515A	5 Elements on 15 Mtrs.	UPS	129.95
	M-415A	4 Elements on 15 Mtrs.	UPS	84.95
	M-510A	5 Elements on 10 Mtrs.	UPS	84.95
	M-410A	4 Elements on 10 Mtrs.	UPS	69.95
		ACCESSORIES		
	T²X	Tail Twister Rotor	UPS	199.95
	HD-73	Alliance Heavy Duty Rotor	UPS	109.95
	RC-8C	8/C Rotor Cable	UPS	.12/ft.
	RG-8U	RG-8U Foam-Ultra Flexible Coaxial Cable. 38 strand center conductor, 11 guage	UPS	.21/ft.

NOTE:
On Coaxial and Rotor Cable, minimum order is 100' and 50' multiples.
Prices and specifications subject to change without notice.
Ninety (90) Day Limited Warranty – All Products FOB Las Vegas, Nevada

WILSON SYSTEMS TOWERS

Qty.	Model	Description	Shipping	Price
	TT-45B	Freestanding 45' Tubular Tower	TRUCK	314.95
	RB-45B	Rotating Base for TT-45B w/tilt over feature	TRUCK	219.95
	FB-45B	Fixed Base for TT-45 B w/tilt over feature	TRUCK	154.95
	MT-61B	Freestanding 61' Tubular Tower	TRUCK	549.95
	RB-61B	Rotating Base for MT-61B w/tilt over feature	TRUCK	299.95
	FB-61B	Fixed Base for MT-61B w/tilt over feature	TRUCK	214.95
	ST-77B	Freestanding 77' Tubular Tower	TRUCK	949.95
	RB-77B	Rotating Base for ST-77B w/tilt over feature	TRUCK	449.95
	FB-77B	Fixed Base for ST-77B w/tilt over feature	TRUCK	299.95
	GK-45B	Guying Kit for TT-45B	UPS	59.95
	GK-61B	Guying Kit for MT-61B	UPS	79.95
	GK-77B	Guying Kit for ST-77B	UPS	99.95
	WTB-1	Thrust Bearing for Top of Tower	UPS	49.95

Prices Effective April 1-30, 1980 Nevada Residents add Sales Tax

Ship C.O.D. ☐ Check enclosed ☐ Charge to VISA ☐ MasterCharge ☐

Card No.________________ Expires________

Bank No.________________ Signature________

Name________________ Phone________

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City________________ State________ Zip________

Prices and specifications subject to change without notice.

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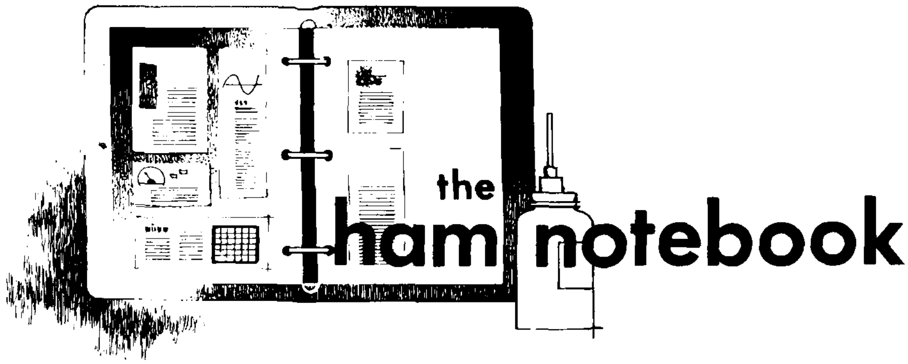

counter control pulses

In a counter, the necessary control pulses can be generated from the crystal-controlled clock train without much additional circuitry. The most difficult problem is to find a suitable time into which the strobe and reset pulses can be inserted after the count enable pulse.

By inverting the 2-Hz output from the divide-by-five section, the divide-by-two section of the 7490 is triggered 0.1 second earlier, thus creating a 0.1 second blanking pulse by the difference in time between the negative and positive edges of the 2-Hz pulse. The 7421 quad-AND gate, shown in **fig. 1**, is wired to combine the appropriate pulses for the 50 ms strobe and reset pulses, after the 1.0 second count enable pulse and in the alternate second of the counting sequence. The frequencies shown are for a one-second count, one-second strobe and reset, but the principle can be used for most counting sequences.

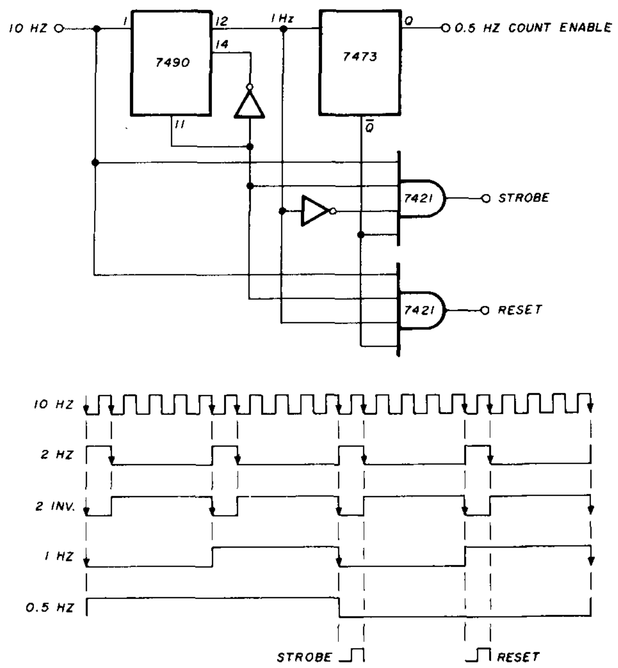

fig. 1. Schematic and timing diagram that shows the generation of the strobe and reset pulses.

R. S. Naslund, W9LL

dc-dc converter increases Gunnplexer frequency swing

Microwave Associates' Gunnplexers are easily tuned if a varying dc voltage of 5-20 volts is applied to the varactor tuning diode. Field operation from a 12-volt battery limits tuning range somewhat. The circuit in **fig. 2** allows maximum use of the tuning varactor.

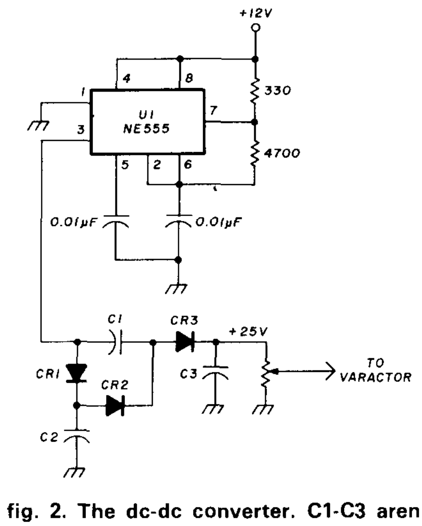

fig. 2. The dc-dc converter. C1-C3 aren't critical; values from 0.47 to 1μF were successfully tested. CR1-CR3 are 1N4148 diodes or equivalent.

U1 generates a high-frequency ac voltage, which is rectified by a voltage-tripling circuit composed of C1-C3 and CR1-CR3. Output voltage is approximately 25 volts.

Jim Kearman, W1XZ

noise figure relationships

In my radio class the question of noise figure and its relationship to noise temperature and sensitivity comes up time after time. Confronting the Amateur are terms such as:

1. Noise figure of a receiver in dB.

2. Receiver sensitivity in microvolts to produce a given signal-plus-to-noise ratio (usually 10 dB).

3. The dBm at different bandwidths ($B\ kHz$).

4. The equivalent noise temperature (T_e in degrees Kelvin).

Without going into their theory or derivation, the following formulas provide a convenient way to determine the relationship between these terms.

1. The input noise power at a standard temperature of $T_0 = 290\ K$ and a bandwidth of 1 kHz is 4×10^{-18} watt.

2. $NF = 10 \log \dfrac{e^2 \times 10^6}{4RB}$ **(1)**

where $e = \mu V$ to produce the desired

$$\frac{S\&N}{N}\ ratio$$

R = input resistance
B = bandwidth in kHz

example: $e = 0.3\ \mu V$
$R = 50\ ohms$
$B = 2.7\ kHz$

$$NF = 10 \log \frac{(0.3)^2 \times 10^6}{4 \times 50 \times 2.7} = 22\ dB \quad \textbf{(2)}$$

3. Given the NF in dB, B in kHz and the input resistance, R, the μV sensitivity can be determined by

$$e = \sqrt{\frac{10^{\frac{NF}{10}} \times 4RB}{10^6}}\ \mu V \quad \textbf{(3)}$$

example: $NF = 21\ dB$
$B = 2\ MHz$
$R = 50\ ohms$

$$e = \sqrt{\frac{10^{2.1} \times 4 \times 50 \times 2000}{10^6}} = 7\ \mu V$$

4. The equivalent noise temperature, T_e, is more convenient to use with receivers having a very low NF:

$$T_e = (F-1)\ 290\ K$$

$F = 10^{\frac{NF}{10}}$, where NF is in dB **(4)**

example:
$NF = 1.95\ dB$ or
$F = 10^{0.195} = 1.567$

$$T_e = (10^{0.195} - 1)\ 290 = 164.4K$$

5. Given the T_e of a receiver, NF may be determined as follows:

$$NF = 10 \log \frac{T_e + T_0}{T_0} \quad \textbf{(5)}$$

example: $T_e = 190\ K$
$T_0 = 290\ K$ standard

$$NF = 10 \log \frac{190 + 290}{290} = 2.19\ dB$$

6. At $T_0 = 290\ K$, the noise power in dBm (dB below 1 milliwatt) is

$$dBm = 10 \log \frac{1 \times 10^{-3}}{4 \times 10^{-21}} = 174\ dBm \quad \textbf{(6)}$$

at a B of 1 Hz

To determine dBm at the desired bandwidth, B, in kHz

$$dBm = 144 - 10 \log B \quad \textbf{(7)}$$

example: $B = 3\ kHz$

$$dBm = 144 - 10 \log 3$$
$$= 144 - 4.77$$
$$= 139.2\ dBm$$

I.L. McNally, K6WX

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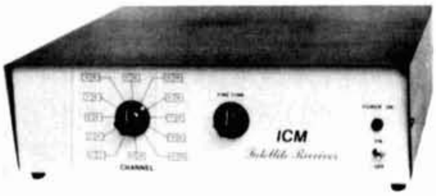
NEW products

ground station satellite receiver



A new satellite receiver, covering 3.7-4 GHz, is available from International Crystal Mfg. Co., Inc.

The TV 4200 receiver is fully tunable and provides standard dual audio outputs of 6.2 and 6.8 MHz, with other outputs available. The receiver has a built-in LNA power supply and output levels are compatible with video monitor or VTR input. It's priced at $1,995.

For more information, write International Crystal Mfg. Co., Inc., 10 North Lee, Oklahoma City, Oklahoma 73102.

Bird rf power analyzer

A new era in rf power measurement was announced by THRULINE® Wattmeter designer, Bird Electronic Corp., with the introduction of the new series 4380 RF Power Analyst™. First of the series, the portable model 4381 is a multi-purpose, digital, directional rf wattmeter for power levels from 1/10 watt to 10,000 watts, and from ½ to 2300 MHz. CW or fm power in both forward or reflected directions is displayed in watts or dBm at the push of a button. VSWR is calculated continuously, and indicated through a fifth button, as is dB return loss. Button seven and eight are for peak envelope power (as in SSB transmissions) in watts, and the ninth button calls up per cent modulation. The final set of three buttons make tuning a transmitter, matching an antenna or tweaking rf components a fast and simple task. A delta (Δ) function identifies either rise or fall in displayed values, while a minimum or maximum memory recalls optimum conditions during adjustments. Other models in the 4380 series measure to 250 kW, or are panel mounted.

This new generation of rf wattmeters with nine-mode system versatility was designed around existing Bird Plug-in Elements, which determine full-scale power and frequency range. Once a set of two elements is chosen (for incident and reflected power), the large LED display correctly places the decimal point, making mental notes of multipliers unnecessary. Overranging of up to 120 per cent in watts, and 400 per cent in dBm, often obviates changing to a higher-power element, and retains "up-scale" accuracy.

The RF Power Analyst™ is the first uniquely different directional rf wattmeter system for gauging and analyzing rf power since the Bird THRULINE® model 43 was designed 25 years ago. It calculates parameter products that formerly required consulting a graph or chart, reveals whether an undesirable hum is present and — if so — how much, and permits minimum/maximum power searches even with closed eyes. Accuracy of model 4381 is ± 5 per cent of nominal full scale and VSWR is a low 1.05 max to 1 GHz in 50-ohm systems.

Price of Model 4381 RF Power Analyst is $590. Delivery is 90 days after receipt of order, from Bird Electronic Corporation, 30303 Aurora Road, Cleveland (Solon), Ohio 44139.

mobile rapid charger

DebTed Engineering introduces a line of 12-volt operated rapid chargers for Amateur and commercial use, available exclusively through Debco Electronics. The rapid chargers come with a cigarette lighter plug on the input side and the appropriate charging plug on the output side. Models are currently available for the Tempo S1, Wilson Mark II, and Wilson Mark IV with direct plug-in capabilities. Units are also available for other transceivers.

A fully discharged battery can be recharged in 4-6 hours and the unit can be used during transmit, receive, and off periods. It will not damage batteries if left connected for prolonged periods of time, due to automatic shut-off circuitry. Cord lengths will allow convenient use of radio while charging. Further applications include rapid charging from 12-volt power supplies in motor homes and during emergencies.

Price of the rapid charger is $29.95. For more information, write Debco Electronics, P.O. Box 9169, Cincinnati, Ohio 45209.

Hamtronics 1980 catalog

Hamtronics, Inc., has announced a new 1980 catalog, which is yours for the asking. The 24-page catalog features many types of kits for the Radio Amateur or two-way shop. Exciting new products in the catalog include a 435-MHz transmitting converter, a new uhf-fm receiver, an a-m receiver for aircraft and DX warning, a weather-tone-alert receiver module, a new low-noise vhf converter, and several new linear power amplifiers for vhf and uhf. These new products follow in the tradition of other fine Hamtronics kits, including their famous vhf and uhf converters and preamps, and fm transmitters and receivers.

For your free copy of this informative catalog, call (716) 392-9430 or write Hamtronics, Inc., 65F Maul Road, Hilton, New York 14468. (For overseas airmail delivery, please send four IRCs.)

Amateur Radio computer packages from Snow Micro Systems, Inc.

Snow Micro Systems, Inc., provides low-cost hardware and software for the personal-computer user. The diversified line of hardware is designed for club or group construction projects, such as the AMSAT-GOLEM-80 Project. Our expanding line of software is designed and priced for the low-budget, personal-computer user.

Our bare boards are sold with schematics, layout drawings, and component lists only, so that schools, Amateur Radio or computer clubs, and other technically competent individuals can save money by assembling the boards themselves. Snow Micro Systems, Inc., warrants that the PC boards are free from physical defects and circuit errors.

All assembled and tested boards are covered by a standard 90-day warranty.

The AMSAT Telemetry-Range Card (TM .01) contains a bi-directional synchronous/asynchronous serial port (8251A), at 400 bauds AMSAT Phase III serial TT&C standard. Other rates are available using software-settable counter-timer (8253), audible tone output circuit for bell or CW monitor, Vector Interrupt circuitry (8214/8212), and two programmable 8-bit i/o ports (8255).

It is S-100 bus interfaced, using standard IC's (8095, 8216 and 8131). Operation of the card is controlled by an 82S23 PROM and jumpers.

This is the S-100 card for reception of the AMSAT Phase III spacecraft telemetry, and for Synchronous Communications. Note that additional external demodulator circuitry will be required to interface this card to a 145-MHz Amateur Radio receiver for AMSAT Phase III satellite reception.

This card is suitable for interfacing most synchronous and packet-data formats to the S-100 bus, provided that any necessary software drivers and modem circuits are part of the system.

Delivery of TM .01 (assembled version), configured for AMSAT Phase III, will be approximately March-June, 1980, to ensure compatability with the spacecraft.

The Amateur Radio Logging Package (Ham .001) contains commands to allow logs to be created, examined, edited, and printed. The contents of the logs can be examined by prefix (G, G3, G3Z, G3ZC, and G3ZCZ are all valid prefixes) or by dates, or between dates. Output can be routed to any of the seven devices supported by NORTHSTAR. QSL cards can be printed on label stock, based on log entry information. A separate WAS set of commands allows WAS records to be kept for single-multiple band or modes. (Commands are written in NORTHSTAR Basic.)

The Amateur Radio Contest Package (Ham .002) contains contest programs for the ARRL Sweepstakes as well as a general contest program. The calls of stations worked (check list) are saved in memory, while the log entries are written to the disk in the same format as the log data files in the LOG package. (Commands are written in NORTHSTAR Basic.)

For more information, write Snow Micro Systems, Inc., P.O. Box 1704, Silver Spring, Maryland 20902.

keyer add-on provides practice and memory

An add-on accessory provides both random code practice and message storage for the Curtis Electro Devices EK-480 series keyers. Called the IM-480, this device will automatically send Morse code in random groups, at speeds from 6 to 50 WPM. It allows variable extra spacing between letters and groups to allow slow-speed copy with letters being formed at higher speed. This feature enhances learning in the 6 to 10 WPM range. A meter display of code speed allows accurate setting.

The IM-480 also includes a message-memory function, storing four messages of approximately 32 characters each, with an automatic repeat function. The messages are programmable from the paddle key.

The IM-480 is the same size as the EK-480 — 18 × 11 × 6 cm (7 × 4½ × 2½ inches), and the two units connect via a short length of ribbon cable and plug. Use of the Curtis 8046 and 8047 LSI ICs allows the compact packaging. The IM-480 is priced at $179.95.

A code-practice-function-only model, called the I-480 (Instructo-Mate) is available at $124.95. Similarly, the M-480 (Message-Mate) containing only the message storage function, is available at $124.95.

For further information, contact Curtis Electro Devices, Inc., Box 4090, Mountain View, California 94040.

uhf glass-mounted antennas

As part of their technically advanced "on-glass" design series, Avanti Research and Development, Inc., of Addison, Illinois, is now offering Amateur Radio operators a new 5-dB gain, superior-performance uhf mobile antenna.

Called the AH450.5G, it's a ¾-meter, 440-450 MHz (tunable 406-512 MHz) antenna that features an exclusive, dual-phased design, and is especially sensitive in fringe areas. It also has the ability to reach distant repeaters, and has a more uniform pattern than a ground plane.

Avanti's unique on-glass design eliminates the need for external electrical connections — thus preventing coax cable deterioration caused by corrosion and water seepage.

A patented "High-Q" impedance coupling unit, with built-in Ritter noise reduction system, mounts inside the vehicle to insure maximum performance throughout the 440-450 MHz band. Because the antenna transmits and receives through glass, there are no holes to drill and no car patching at resale time.

AH450.5G also features an exclusive Horizontal Phasing Loop which links two separate antenna systems, creating a lower, more effective take-off angle and higher gain.

The sleek antenna mount is securely locked to the window by a new aerospace adhesive that has greater strength than a ¼-inch bolt. The whip is easily removed for storage, car wash, or theft protection, and guaranteed to hold securely under even abnormal weather conditions and extreme vibrations.

In addition to the AH450.5G, Avanti also makes 3-dB gain, on-glass antennas for Amateur Radio operators in 144-174 MHz and 220-225 MHz models, plus trunk-mounted mobile antennas for 144-148 MHz and 440-450 MHz. Especially for Amateurs, Avanti also offers a 10-meter dual-polarity beam (AH-028.9B), which is the original polarity diversity loop antenna.

For more information, contact Avanti Research and Development, Inc., 340 Stewart Avenue, Addison, Illinois 60101.

MFJ hybrid phone patches

The MFJ-624 Telepatch II hybrid phone patch delivers clean, hum-free audio. It features a VU meter for monitoring the telephone line level to prevent crosstalk between telephone channels, and a null control allows adjustment of the null depth for maximum isolation between receiver and transmitter.

The MFJ-624 has separate transmitter and receiver gain controls that eliminates readjusting the rig's controls after patching. All controls for the patch are on the front panel: receiver gain; on, off, null switch; null adjustment, and transmitter gain.

The connections to the Telepatch II are four phono connectors between receiver and speaker, and transmitter and microphone, and a two-screw terminal strip for connection to the phone lines. Simple patch-in/patch-out connection can be made to rigs with phone patch input and output connectors.

The cabinet is eggshell white with walnut sides and measures 8 × 2 × 6 inches. The Telepatch II costs $59.95.

The MFG-620 Telepatch is a less

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expensive version of the MFJ-624. It is the same unit minus the meter. This phone patch is available for $49.95.

For more information, contact MFJ Enterprises, Inc., P.O. Box 494, Mississippi State, Mississippi 39762.

new 1980 Radio Shack catalog

Radio Shack's new 176-page 1980 catalog is now available free on request from more than 6,000 participating stores and dealers nationwide. The catalog has 120 full-color pages and features the latest in everything electronic — from computers and stereo components to toys, parts, and accessories for home entertainment, hobbyists, and experimenters.

Among the products being offered for the first time are an a-m/fm stereo receiver with microprocessor control and digital readout, a 7-inch open-reel tape deck with full logic control, and a cordless extension telephone for only $219.95.

Radio Shack has also expanded their line of telephone products and security devices, and is offering a complete selection of radio-controlled vehicles.

The new catalog includes the company's world-famous TRS-80 microcomputer system, the new Model II business microcomputer, and the complete line of Realistic stereo components, CB equipment, radios, tape recorders, Archer antennas, Micronta test instruments, and ArcherKit and Science Fair hobby kits.

In addition, Radio Shack's catalog lists an extensive selection of specialized electronics items, tools, tubes, transistors, ICs, parts, plugs, cables, and more.

test encoder

The new Communications Specialists TE-64 Test Encoder will provide a total of sixty-four audible and subaudible tone frequencies for test purposes. Measuring 5.25 by 3.3 by 1.7 inches, it is ideal for shop or service truck use. With the addition of a 9-volt transistor radio battery, it can be made completely self-contained. Mounting brackets are included for permanent installation.

Frequencies available include all thirty-two standard EIA sub-audible, and nineteen burst-tone frequencies beginning with 1600 Hz and increasing in 50-Hz increments to 2550 Hz, eight touch-tone frequencies and five test frequencies including 700, 1000, 1500, 2175, and 2805 Hz.

This unit provides a low-impedance, low-distortion adjustable sine wave output at 5 volts p-p, and may be operated from any external dc voltage from 6 to 30 volts. Although primarily designed for test purposes, this unit may be permanently installed for mobile use as a universal encoder.

The output level is flat to within ±1.5 dB over the entire range selected and separate level adjustment controls and output connections are provided for each tone group. There is an OFF position for no tone output.

No counter or other test equipment is required to set frequencies. A calibrated dial on the front panel allows selection of the desired frequency.

The TE-64 is totally immune to rf and has built-in polarity protection. External connections are made to an internal terminal block.

A full one-year warranty is provided for factory repair. Price of the TE-64 is $79.95, wired, tested, and with complete instructions.

For more information, write Communications Specialists, 426 West Taft Avenue, Orange, California 92667.

Anteck MT-1 mobile antenna

The MT-1 is a manually tuned antenna which covers 3.5 to 30 MHz. It is center loaded on all frequencies except 10 meters, where it works like a half-wave vertical.

The MT-1 is constructed of a fiberglass loading coil wound with No. 20 AWG (0.8-mm) wire and conformed

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in its construction so that contact with the coil is internal through silver-plated, beryllium-copper contacts. This results in low contact resistance between each turn of the coil and the whip assembly. The coil is tuned from the base of the antenna using a non-inductive plastic rod that is attached to the base of the whip assembly and extends down into the bottom mast section.

Positive lock is provided by the close tolerance fit of the tuning rod and middle bushing, and by the friction lock at the knurled nut. The base section is steel with a heavy-duty paint finish to withstand the elements in all climates.

For more information, contact Anteck, Inc., P.O. Box 415, Route 1, Hansen, Idaho 83334.

uhf amateur TV transceiver from Science Workshop

Science Workshop in Bethpage, New York, has just introduced a new, compact ham TV transceiver, the SE-1. It is designed to transmit and receive live, fast-scan, high-resolution black-and-white or color-TV pictures and sound. The SE-1 transceiver measures only 9½ × 5½ × 2½ inches, including knobs and heat-sink. Its weight is less than 3 pounds.

The receiver section uses a three-transistor, four-varactor-tuned uhf converter which covers the Amateur 440-MHz band. Its i-f output signal is on vhf-TV channels 2 or 3. A two-stage uhf pre-amp using two high-gain, low-noise FETs, precedes the converter, providing 18-22 dB gain. A front panel RCVR GAIN control provides full rf gain control. Any TV set can be used for high-detail, black-and-white (or color) pictures. The receiver tuning control, labeled RCVR FREQ on the front panel, tunes the converter over the 420-450 MHz range. With the switch to the left of the illuminated meter set to the RCVR position, the meter reads the varactor tuning voltage, providing an electronic tuning (logging) scale. A green LED in the upper right-hand corner of the front panel is illuminated, indicating that the transceiver is in the "receive" mode.

The transmitter section delivers 10 watts (peak), wide-band (adequate for color) video power into 50 ohms. A BNC connector on the front panel accepts the standard 1-1.5 volt camera video signal. A 439.25-MHz transmit crystal is supplied (installed) as standard equipment. A four-pin microphone connector is supplied, which provides "push-to-talk" operation. The XMIT/PTT switch on the right hand side of the front panel overrides the "push-to-talk" switch on the microphone, allowing the transmitter to stay on for longer periods of time, for testing or long transmissions.

With the meter AMP/RCVR switch in the AMP position, the meter reads the current drawn by the transmitter. The VIDEO GAIN control adjusts the video modulation level. A toggle switch on the rear selects whether the fm audio will be carrier or subcarrier modulation (as in commercial TV). The transceiver is supplied with power plug and cable (to operate mobile off the 12-volt car battery or base power supply), mobile mounting bracket, and microphone connector.

It is available from Science Workshop, Box 393, Bethpage, New York 11714. The price is $349.95 plus $3.50 shipping and handling.

digitally compensated crystal oscillator

A digitally compensated crystal oscillator, the model D-100, is now available from Greenray Industries. The use of digital compensation achieves "oven" stability of $\pm 5 \times 10^{-8}$ over a temperature range of 0° to +70° C while consuming only 500 mW of dc power. Ten-, five-, and one-MHz outputs are provided to drive TTL logic.

The D-100 occupies only 8 cubic inches and "warms up" in less than 5 seconds. It offers a great number of uses where size, power consumption, and stability are important. Price of the D-100 is approximately $850.00 in small quantities.

For more information, write Greenray Industries, 840 West Church Road, Mechanicsburg, Pennsylvania 17055.

microminiature encoder-decoder

Communications Specialists announces the addition of a new encoder-decoder to their present line of tone products.

The new TS-32 is a binary-coded, field-programmable encoder-decoder which does not require the use of any counter or other test equipment for setting frequency. This unit is capable of producing any one of the thirty-two standard EIA sub-audible frequencies upon adjustment of a dip switch. A remote-mounted rotary switch may be purchased to allow selection of all thirty-two tone frequencies for both encode and decode functions.

Measuring just 1.25 by 2.0 by 0.40 inches, this unit is adaptable to all mobiles, base stations, and many portables, and will operate on any dc voltage from 6 to 30 volts. It is completely immune to rf, and reverse-polarity protection is built-in.

A high-pass tone rejection filter for removing tone from received audio is included on the board. All connections are made with push-on connectors; color-coded wires and mounting hardware are supplied.

The encoder section provides a low-impedance, low-distortion adjustable sine wave output with a frequency accuracy of ±0.1 Hz maximum from −40° C to +85° C. The output level is 5 volts peak-to-peak. The encoder function is continuous and operates simultaneously during decode, independent of mike hang-up.

The decoder is driven directly from the discriminator, input impedance is

More Details? CHECK—OFF Page 94

1 meg. The sensitivity is better than 10 mV rms with a bandwidth of ±1.5 Hz maximum, limited. The response time is 200 ms, drop-off time is 200 ms. Receiver muting is all solid-state with automatic monitoring.

The high-pass filter is automatically muted by the decoder, if desired; no extra wire is needed to mute receiver. Input impedance to the filter is 100 k, output impedance is 2.5 k. The attenuation at 100 Hz is 38 dB and roll-off is 24 dB/octave.

A full one-year warranty is provided if the unit is returned to the factory for repair. Price of the TS-32 is $59.95, wired, tested, and with complete instructions.

For more information write Communications Specialists, 426 West Taft Avenue, Orange, California 92667.

mobile charger/ amplifier

Trilectric, Inc., Van Nuys, California, announces the introduction of the mobile charger amplifiers for the Wilson Mark Series and Yaesu's FT-202R 2-meter hand-held transceivers.

The MAC440H and MAC480H have 40- or 90-watt rf power output capability respectively with 4 watts drive. An MC101 charger is also available separately. Additional features are a built-in 5-watt audio amplifier for an external speaker, automatic regular or trickle charger, an optional front-panel mounted Touch-Tone® pad which allows generation of DTMF tones while the hand-held is in the case, over or under mounting bracket, for under dash, floor mounting, or base station use, and a locking feature for portable security.

In addition to mobile operation, the Trilectric MAC440H and MAC480H can be used to allow a hand-held to function as a high-power base station by using a 110 Vac to 13.8 Vdc power supply.

For more information, write to Trilectric, Inc., 6725 DeCellis Place, Van Nuys, California 91406.

spectrum chart

A unique radio chart called "Worldwide Listeners Guide to the Radio Spectrum" is available from Radio Publication Co., Lake Geneva, Wisconsin. The chart covers the radio spectrum from 10 kHz to 30 GHz with sample listings of stations found on particular frequencies. For example, on 16.7155 MHz (high frequency), the chart lists the Queen Elizabeth II (inter-ship communications). Over five hundred listings across the spectrum appear on the chart.

Laid out as outer and inner circles, this is a quick and easy reference chart for hams, short-wave listeners, and scanner owners. The chart is printed in full color on high-quality paper and resembles the rainbow spectrum. It measures 80 × 63 cm (35 inches × 25 inches). This new chart is available from Radio Publication Co., P.O. Box 28, Lake Geneva, Wisconsin 53147. The price is $4.50 postpaid in a special mailing tube.

short circuit

CMOS synthesizer

In the construction article for the 144-MHz CMOS synthesizer in the December, 1979, issue of *ham radio* (page 14), author K9LHZ has pointed out several drawing errors in the component placement on the printed-circuit board (**fig. 7**). The 22-pF capacitor next to Q6 should be C36 *not* C26; resistor R25 has a value of 820 ohms. J1 and J2 should go to pin 13 of U6, not pin 12. T1 is a tapped coil with the tap going to C16 (cold end of T1 goes to ground). U4 is a CD4060 *not* CD4046, and the collector of Q13 is +8 TX *not* +8 RX; diodes D5, D6, D17, D26, and D27 are backwards. Finally, switch labeling should be 100 *kHz*.

For those of you interested in the math equations given in the **appendix**, the quantity on the left side of the fourth equation should be a lower case c. This fits the modified binomial solution in line 2.

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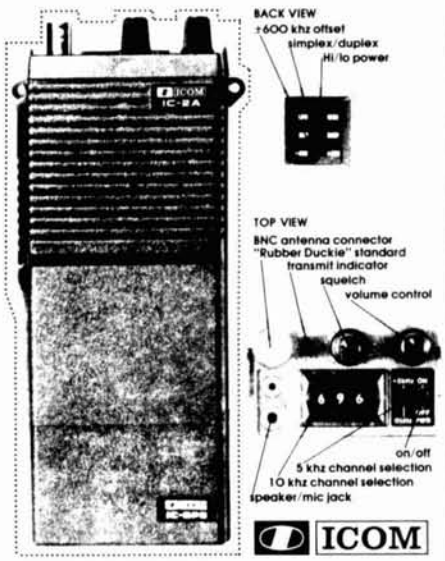

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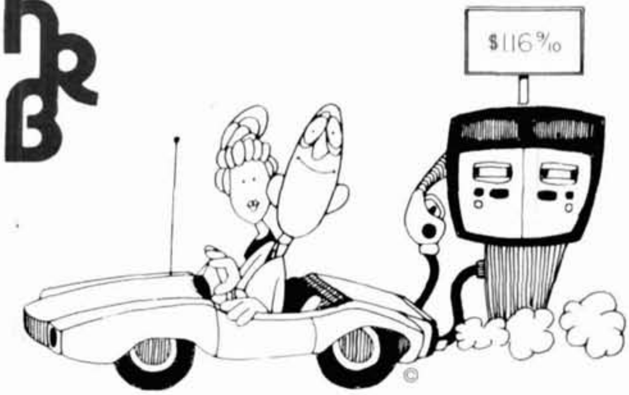

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Coming Events

DX YL to NORTH AMERICA YL. Phone starts Tuesday, April 8 at 1800 UTC, ends Wednesday, April 9 at 1800 UTC. CW starts Tuesday, April 15 at 1800 UTC ends Wednesday, April 16. All licensed YL operators throughout the world are invited to participate. OM contacts do not count. W/VE YLs call "CQ DX YL", DX YLs call "CQ W/VE YL". All bands 160-10 meters. Cross band operation not permitted. Logs must be postmarked no later than May 3, 1980 and received no later than May 17, 1980 by the YLRL Vice President.

MISSOURI: The Missouri Valley Amateur Radio Club, Inc. proudly announces its second annual Pony Express Days from the original stables in St. Joseph, April 5 and 6. Operating time 1000 CST to 1900 CST both days. Anyone making contact with the club station will receive the Pony Express Award. Send legal-size SASE along with personal QSL card to: Missouri Valley ARC, 401 North 12th Street, St. Joseph, MO 64501. Certificate will be stamped with original seal of the Pony Express. Operating frequencies will be 28.575 and 10 kc's from the bottom of the General phone band on the other bands — 15 through 75. CW bands will be 28.150, 21.150 and 7.125. Listen for WØNH from the home of the Pony Express.

OHIO: Dayton Hamvention, April 25, 26, 27, 1980 at the Hara Arena and Exhibition Center. Exhibits and Flea Market open Friday noon. Usual gatherings, forums, lectures, meetings. Banquet speaker: Senator Barry Goldwater, K7UGA. Special awards, prizes, including 26th annual "Ham of the Year" award. Nominations to be sent to Awards Chairman, Box 44, Dayton, Ohio 45401. Flea Market hours are: Friday 1200 to 1800; Saturday 0600 to 1700; and Sunday 0600 to 1600. *No self-contained vehicles may enter the flea market area.* Space: $11 advance, $13 gate; maximum four spaces. Those with permits may enter 0800 Friday AM. All persons entering the Flea Market area must have valid registration to Hamvention. For more information, reservations, etc., telephone (513) 296-1165, or write Box 44, Dayton, Ohio 45401.

NEW YORK: Southern Tier Amateur Radio Club's 21st annual Hamfest, Saturday, May 3. NEW LOCATION: Owego Treadway Inn, Rte. 17, Exit 65, Owego. Flea market, tech. talks. Buffet dinner tickets and general admission $8.00. Reservations received after April 20 will be held at door. Admission only, $2.00. STARC has use of all public rooms of Treadway for that day, all on ground level. For hotel accommodations at the Treadway contact: Debbie Chambers, 607-687-4500. For information, ticket reservations contact: STARC, PO Box 11, Endicott, NY 13760.

MASSACHUSETTS: The Central Massachusetts Amateur Radio Association will be holding a ham radio auction on April 25th at 7:30 pm (doors open at 6:00 pm) at the Main South American Legion Post No. 341, Worcester. Flea market table, door prizes, refreshments. Talk-in on 37-97; 52-52. For more information call: Rene Brodeur, WA1LEA, 617-753-7480.

ILLINOIS: Kishwaukee Radio Club & DeKalb County Amateur Repeater Club's 22nd annual indoor/outdoor hamfest, Sunday, May 4, 8 a.m. to 3 p.m., Notre Dame School (3 miles south of DeKalb between hwy. 23 and South 1st St. on Curler Rd.) Tickets, $1.50 advance, $2.00 at door. Indoor tables available. Own table, set-up free. For tickets & directions SASE to: Howard, WA9TXW, Box 349, Sycamore, IL 60178.

NEW JERSEY: The Fifth Trenton Computer Festival will be held on April 19th, 10 a.m.-6 p.m., April 20th 10 a.m.-4 p.m., at the Trenton State College, Trenton. Outdoor flea market, indoor commercial exhibit area, forums, talks, seminars, door prizes, banquet Saturday night (tickets $10 for banquet). Admission $5, students $2 — tickets available only at door. Free parking. For more information call: 609-771-2487 or write: Dr. Allen Katz, Trenton State College, Hillwood Lakes, Box 940, Trenton, NJ 08625.

ONTARIO: Lake Simcoe Hamfest, June 13th, 14th and 15th, at Molson's Park, Barrie, Ontario, Canada. Registration: $4 by mail, $5 at gate. Children under 18 admitted free. Doors open at 12:00 noon on Friday the 13th, with talk-in on VE3LSR 146.25/.85 and 146.52 simplex, or 3780 kHz SSB. For information, reservations, or tickets, write to Lake Simcoe Hamfest, P.O. Box 2283, Orillia, Ontario L3V 6S1, Canada.

More Details? CHECK—OFF Page 94

PUERTO RICO: Puerto Rico Amateur Radio Club's 1980 Convention and Hamfest, April 26th & 27th, Montemar Inn, Aguadilla. For additional information and reservations contact: P.R.A.R.C, GPO Box 693, San Juan, PR 00936.

NEW JERSEY: Delaware Valley Radio Association & Lawrenceville Amateur Repeater Group will hold their annual flea market, Sunday, April 20th, 8 a.m.-4 p.m., at the New Jersey National Guard 112th Field Artillery Armory, Eggerts Crossing Rd., Lawrence Township. Advance registration $2.00, $2.50 at door. Indoor and outdoor flea market area, door prizes, raffles, refreshments, FCC examinations. Sellers bring own tables. Talk-in on 146.52, 146.07-67, 147.84-24. For further information write: D.V.R.A., P.O. Box 7024, West Trenton, NJ 08628.

MICHIGAN: South Eastern Michigan Amateur Radio Association's 22nd Annual Hamfest on April 13th, 8 a.m.-3 p.m. EST at South Lake High School, 21900 E. Nine Mile Road (at Mack Ave.), St. Clair Shores, MI.

MINNESOTA: Rochester Amateur Radio Club and the Rochester Repeater Society will sponsor the Rochester Area Hamfest, Saturday, April 12th, starting at 8:30 a.m. at the St. John's School Gymnasium, Rochester. Large indoor flea market, prize raffles, refreshments, free parking. Talk-in on 146.22/82 MHz. For further information write: RARC, WB0YEE, 2253 Nordic Ct. N.W., Rochester, MN 55901.

CONNECTICUT: Pioneer Valley Repeater Association's 3rd annual Flea Market, April 27th, 10 a.m.-5 p.m., Newington High School, Newington. Capacity 1,000 people; tables, chairs, free parking, food service available. Rent tables $7.50 (3' × 6'). Dealer displays, family activities, door prizes, admission $1. For more information write: Arnie DePascale, K1NFE, P.O. Drawer M, Plainville, CT 06062.

MASSACHUSETTS: Wellesley Amateur Radio Society's annual auction on Saturday, April 12th, starting at 11:00 a.m., Wellesley High School Cafeteria, Wellesley. Talk in on -63:03, -04:64, and 52. Doors open 10 a.m. Contact Kevin P. Kelly, WA1YHV, 7 Lawnwood Place, Charlestown, MA 02129.

MASSACHUSETTS: Framingham Amateur Radio Association's annual Spring Flea Market, April 27th, 10 a.m.-3 p.m., Framingham Police Station Drill Shed, Framingham. Admission $1 — sellers $6/table. Sellers must register in advance. Talk in on 75/15 and 52. Contact: Ron Egalka, K1YHM, F.A.R.A., P.O. Box 3005, Saxonville, MA 01701, 617-877-4520.

MISSOURI: The Missouri Valley Amateur Radio Club's second annual Pony Express Days, April 5th & 6th, 10 a.m.-7 p.m. CST, St. Joseph. Anyone making contact with club station receives Pony Express Award — just send SASE & QSL card to: Missiouri Valley Amateur Radio Club, 401 North 12th St., St. Joseph, MO 64501. Operating frequencies: 10 meters — 28.575, 15 meters — 20 meters — 40 meters — 75 meters — 10kc's from bottom of General Phone Band. CW bands: 10 meters — 28.150, 15 meters — 21.150, 40 meters — 7.125. Listen for W0NH.

INDIANA: Lake County's Amateur Radio Club's 27th annual Herbert S. Brier Memorial Banquet, April 19th, starting at 6 p.m. at the Griffith Knights of Columbus Hall, 1400 S. Broad St., Griffith. Famous surprise speaker, door prizes, awards. Tickets $10 — write: L.C.A.R.C, P.O. Box 1909, Gary, Indiana 46409. No tickets at door.

NORTH CAROLINA: The Azalea Coast Amateur Radio Club (WD4ORA) will be operating from Battleship U.S.S. North Carolina Memorial, Wilmington, April 12 & 13, 9:30 a.m.-7 p.m. EST. Operating frequencies: 25 kHz up from lower edge of General Phone Bands. QSL to: ACARC, P.O. Box 4044, Wilmington, NC 28403. SASE Please.

NEW YORK: Rochester Hamfest & NY State ARRL Convention. May 16-17. Add your name to mailing list. Send QSL to Rochester Hamfest, Box 1388, Rochester, NY 14603. Phone 716-424-1100.

NEW ENGLAND: The Hosstraders net will hold its seventh annual Tailgate Swapfest, Saturday, May 10, at Deerfield N.H. fairgrounds (covered buildings in case of rain.) Admission $1.00, no commission or percentage. Excess revenues benefit Boston Burns Unit of Shriners' Hospital for Crippled Children. Last year we donated $1355.00. Questions about New England's biggest flea market? S.A.S.E to Joe, K1RQG, Star Route Box 56, Bucksport, ME 04416, or Norm, WA11VB, P.O. Box 32, Cornish, ME 04020.

PENNSYLVANIA: Sixth Annual Northwestern Pennsylvania Hamfest. May 3, Crawford County Fairgrounds, Meadville. Note date change. Gates open 8 a.m. Bring your own tables. $5 per table to display inside, $2 per car space outside. $3 admission, children under 12 free. Refreshments. Commerical displays welcome. Talk in 04/64, 81/21, 63/03. Details C.A.R.S, P.O. Box 653, Meadville, PA 16335. Attn: Hamfest Committee.

CALIFORNIA: The Fresno Amateur Radio Club, Inc. presents the 38th Annual Fresno Hamfest May 9 — 11, 1980, at the Hacienda Inn, Clinton and 99, Fresno. Tech talks, QLF contest, Golf tournament, Ladies program, MARS activities, ARRL forum, Prime rib banquet, prizes and more. Talk in on 146.34/94. Full registration $20 advance, $23 at door. Ladies program $7. Advanced registration closes May 2nd. For information write: Fresno Hamfest, Box 783, Fresno, CA 93712.

OHIO: The Ottawa Area Radio Club of Ottawa, announces that their new 2 meter repeater is now operational. Located in Ottawa, the repeater has an input frequency of 144.630, and an output frequency of 145.230. This repeater is carrier operated accessed and operates under K8BNS call sign. All area and visiting hams are invited to make use of their repeater.

ILLINOIS: Rock River Radio Club's 14th Annual Hamfest, April 13th in Lee County 4th Center NR Amboy. (1 mile east of Rte's 52 & 30, south of Dixon, IL). Camping available, all tables furnished at $5 each (open Satruday 1:00 p.m. for early dealer arrivals). Breakfast served 7:30-8:30 a.m. on 13th. Talk-in on 146.52 or 146.37-97 repeater. Advance tickets $1.50, at gate $2. No Firearms Please! For reservations and information contact: Charles Randall, 1414 Ann Ave., Dixon, IL 61021.

PENNSYLVANIA: The Penn Wireless Association will hold its Tradefest '80 on Sunday, April 13th, at the National Guard Armory, Southampton Rd. & Roosevelt Blvd., (Rte. 1) ½ mile south of the PA Turnpike exit 28. Sellers space 6' × 8', $5. Bring tables, limited number of power connections ($3). General admission $3. Prizes, refreshments, rest area, displays, and surprises. Talk-in on 146.715 and 52. For further information contact: Robert L. Daut Jr., WB3KRV, P.O. Box 734, Langhorne, PA 19047.

WISCONSIN: The Madison Area Repeater Association will be sponsoring the 8th Annual Madison Swapfest on Sunday, April 13th at the Dane County Expo Center Forum Building, Madison. Doors open at 9 a.m. — tickets $2.50 in advance, $3.00 at door (children 12 & under free). Tables $4 in advance, $5 at door — reserve early — sell out last year! Dealers and commercial exhibitors, free movies, arts & crafts, all you can eat pancake breakfast and beef bar-b-que luncheon. For information on booths contact: MARA, Box 3403, Madison, WI 53704.

WISCONSIN: The 3-F Amateur Radio Club's Swapfest will be held on Saturday, May 3, from 8 a.m.-3 p.m., at the Neenah Labor Temple, 157 South Green Bay Rd., Neenah. Facilities include large parking area, large indoor and outdoor swap area, free auction. Food and beverage available. Admission $1.50 for tickets and tables in advance; $2 at door for tables and tickets. Talk in on 52/52. For reservations contact: Mark Michel, W9OP, 339 Naymut St., Menasha, WI 54952 or call: 414-722-4034.

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TENNESSEE: Humboldt A.R.C. Hamfest, Sunday, May 18th, at Shady Acres City Park in Trenton. Talk-in on 146.37/.97. Flea market, prizes, ladies' activities, light lunches. More info from Ed Holmes, W4IGW, 501 N. 18th Avenue, Humboldt, Tennessee 38343.

ROHN TOWER: Buy wholesale from worldwide distributor; 20G, $28.44 each; 25G, $37.62 each; 45G, $83.60 each; 48-foot foldover tower, $660, freight paid; BX freestanding tower, $224.02. Hill Radio, 2503 G.E. Road, Box 1405, Bloomington, Illinois 61701. (309) 663-2141.

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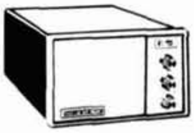

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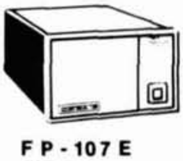

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DenTron

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FT-707 is shown with optional FV-707DM VFO & Scanning Microphone

THE FT-707 "WAYFARER"

The introduction of the "WAYFARER" by Yaesu is the beginning of a new era in compact solid state transceivers. The FT-707 "WAYFARER" offers you a full 100 watts output on 80-10 meters and operates SSB, CW, and AM modes. Don't let the small size fool you! Though it is not much larger than a book, this is a full-featured transceiver which is ideally suited for your home station or as a traveling companion for mobile or portable operation.

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FT-707 with Standard Features

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- Advanced noise blanker
- Built-in calibrator
- WWV/JJY Band
- Bright Digital Readout
- Fixed crystal position
- 2 auxiliary bands for future expansion
- Unique multi-color bar metering—monitors signal strength, power output, and ALC voltage.

FT-707 with Optional FV-707DM & Scanning Microphone

- Choice of 2 rates of scan
- Remote scanning from microphone
- Scans in 10 cycle steps
- Synthesized VFO
- Selection of receiver/transmitter functions from either front panel or external VFO
- "DMS" (Digital Memory Shift)

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For more information on the 1KD-5 amplifier write to Henry Radio, 11240 West Olympic Boulevard, Los Angeles, CA 90064. And for a data sheet on the 3-500Z and more informationon EIMAC power grid tubes, write to Varian, EIMAC Division, 301 Industrial Way, San Carlos, CA 94070. Telephone (415) 592-1221. Or contact the more than 30 Varian Electron Device Group Sales Offices throughout the world.

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