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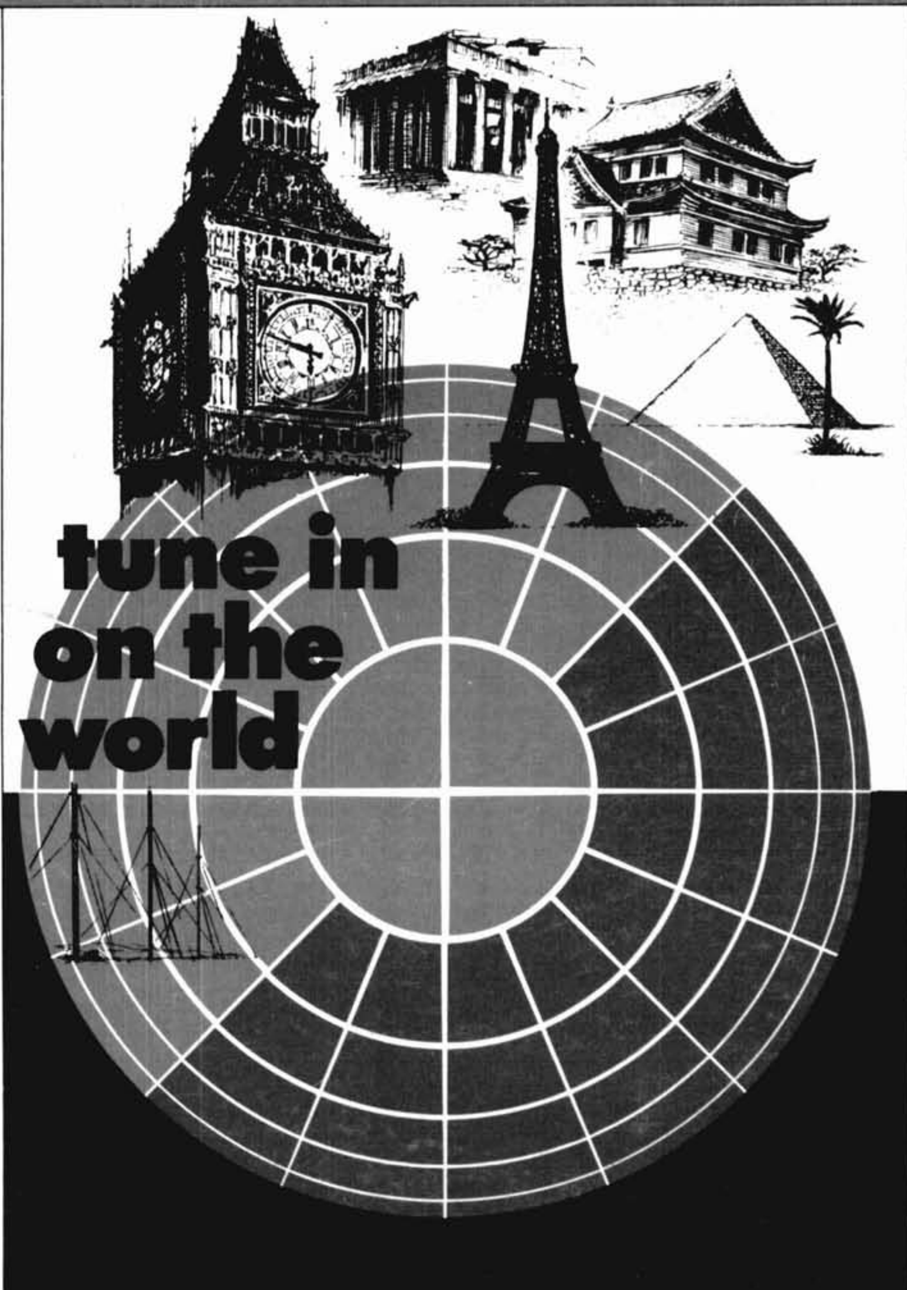

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3K Classic

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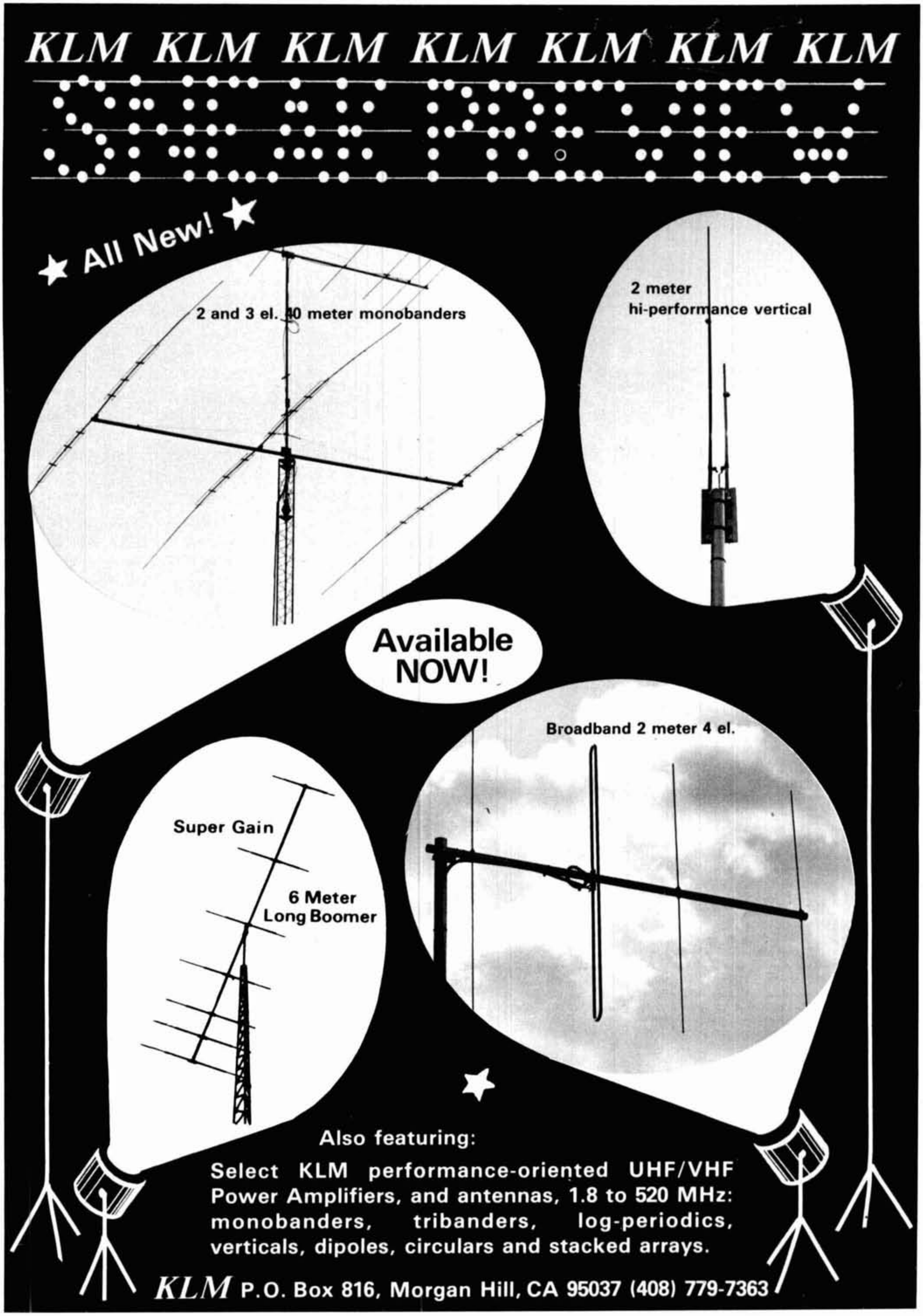
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HAM RADIO HORIZONS

JUNE 1981

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contents

Observation & Opinion

Have you ever wondered how a magazine works? What makes it tick? I'm not talking about just *any magazine — I'm talking about ham radio*. When you remove the current issue of *ham radio* from your mailbox, you're looking at the culmination of many months of work by a lot of dedicated professionals: editors, graphics specialists, typists, advertising people, circulation people, and many others. It's a team effort, and each member is an expert. Each is responsible in some way for the magazine that you've been waiting for.

It seems to be a fact of life in the magazine business that the advertising and editorial people are extremely competitive. Traditionally, these two camps are at odds. The ad people want X number of ad pages, and the editorial types want Y pages of articles. As the publication deadline approaches, this dilemma can cause problems. The editorial people understand that ads pay the bills, and the ad people understand that, without good articles, the magazine won't work. At *ham radio*, a compromise is struck using cooperation and teamwork. It works.

We've received some complaints that *ham radio* has too much advertising. If you count the pages of ads in any of our issues, you'll find that we're giving you a 50-50 mix of ads to editorial content, regardless of the size of the issue. So if we have a larger magazine, yes there will be more ads, but there will also be more articles.

These articles can't come to you unless there's some way to pay the printing bill. Sure, you pay for a subscription, but that barely begins to cover the cost of putting *ham radio* together every month. We must pay for the articles, the editing, the typesetting, re-editing, paste-up, printer, and postage — not to mention all the overhead costs.

So where does the bulk of the money come from? Advertising. Without advertising, there would be no magazine. ARRL would find itself totally incapable of giving you the membership services it now does without ads in *QST*. The *National Geographic* would probably be printed on newsprint with black and white photos.

As I mentioned earlier, occasionally I find myself at odds with the gang down at advertising. Sometimes they want a special favor for one of their accounts. We editorial types try our best to accommodate the ad people. But sometimes there's something we don't like about an ad, or it's too late to break up that part of the magazine to fit the ad people's needs. In any event, we always manage to get the problem ironed out despite gnashed teeth and upset tempers.

We must be doing something right. While most of the rest of the industry has either decreased the number of ad pages or maintained status quo, the combined *ham radio/HORIZONS* is running about 20 percent ahead of last year in number of ad pages sold. This means that we are able to give you a better value for the dollars you spend for subscriptions.

I felt that this little discussion was important, because some of your letters have indicated that there's something less than complete understanding in the relationship between you, the reader, and our advertising and editorial departments.

Elsewhere in this issue you'll find a very important survey that we'd like you to fill out and return to us. I need it to find out what kind of job I'm doing as editor of *ham radio*. Advertising needs it for demographic studies and readership profiles. It's your chance to voice your opinion. Can we please hear from you?

Alf Wilson, W6NIF
Editor

comments

80-meter receiver

Dear HR:

I have received many calls of congratulations on the experimenter's 80-meter receiver published in the February, 1981, issue of *ham radio*. Here are some suggestions from readers, and a correction.

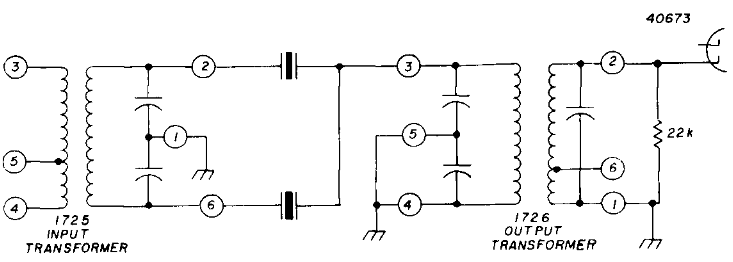
The change shown in the schematic will give a sharper response and more gain. Experimenters have suggested that J.W. Miller part 12-C30, if properly connected, can replace the 1726 transformer if the latter is not available. Note that pins 4-5 of the 1726 transformer are connected together to make a single-tuned circuit. Also note that the secondary pin 2 is connected directly to pin 1 of the 40673, and a 22k resistor is placed across the coil to ground.

The J.W. Miller coil 4515 mentioned in the article (page 25) is now coil 4514 in their new catalog.

One builder found he got better results by shielding the i-f board; alternatively, it can be mounted on aluminum. The leads should be kept short to prevent broadcast-station pickup.

The power supply (page 26 of the article) shows resistor symbols for the capacitors on each side of the LM340 regulator. These obviously should be capacitor symbols.

Ed Marriner, W6XM
La Jolla, California



Suggested mods for the 80-meter receiver.

electrolytic capacitors

Dear HR:

In reference to the article on capacitance measurements by Hemmye, KP4DIF, on page 24 of the September issue, I think this is a good technique, and it is certainly cheaper than getting a meter to measure capacitance. However, it is most likely to be used on inexpensive surplus capacitors. Because those capacitors are often old and leaky electrically (that is, they allow too much dc to pass through), the technique should be modified. I suggest the following: first, connect a milliammeter in series with the capacitor under test and gradually increase the voltage across the capacitor to near the rated voltage. A variac in the primary circuit, or potentiometer in the secondary, is handy for this.

Remember that the capacitor "looks like" a dead short until it is charged, and without a way to increase the voltage slowly you are likely to damage the meter. After the capacitor is charged, you will see (if the capacitor is not shorted inside) that the leakage current will fall slowly. It will take from a few minutes to an hour for the current to stabilize; leakage current will take longer to stabilize the longer the capacitor has been without a charge on it. Electrolytic capacitors last longer if they are used occasionally.

After the current has become reasonably constant, you should do two things, particularly if the capacitor is surplus. First, figure out how much power is being dissipated in it. If it is much more than a watt or so, throw the capacitor away. Leaky electrolytic capacitors get hot and blow up — you haven't lived until you have cleaned up the mess they make when they go. Next, calculate the leakage or shunt resistance of the capacitor. For example, say you have 300 volts across your capacitor and it is leaking 3 mA. This electrolytic looks like a perfect capacitor in parallel with 100 kilohms. If you're using KP4DIF's technique, it's important that the resistance you put in parallel with this capacitor be low in relation to this 100 kilohms or your results will be off. A good rule of thumb would be to have one tenth or less of the leakage resistance, the less the better, within the constraint of not having the RC combination discharge too fast. You can figure in the leakage resistance if you want, but the matter is complicated by the fact that the leakage resistance is something of a function of the voltage across the capacitor. This is another good reason for the resistance you put in shunt with the cap to "swamp" the leakage resistance.

Eugene W. May, Jr., WB8MKU
Ann Arbor, Michigan

slow ASCII

Dear HR:

Since the long-heralded advent of ASCII on the Amateur bands, there has been a singular absence of its use. Therefore, now that the cheering about FCC approval is over, may I suggest taking another look?

With the sophistication of upper and lower case letters, numerous symbols and commands, one might have anticipated a wide-spread adoption of eight-level ASCII over the older five-level Baudot, which is naturally limited. But instead, the solid-state

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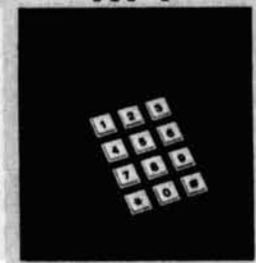

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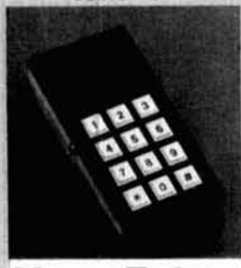

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Message Partitioning	Soft			Soft		Hard	Hard	Hard	
Automatic Contest Serial Number	Yes			Yes		No	No	No	
Selectable Dot and Dash Memory	Yes	Yes		Yes	Yes	No	No	No	No
Independent Dot & Dash (Full) Weighting	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Calibrated Speed, 1 WPM Resolution	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No
Calibrated Beacon Mode	Yes			No		No	No	No	
Repeat Message Mode	Yes			No		Yes	Yes	Yes	
Front Panel Variable Monitor Frequency	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Message Resume After Paddle Interrupt	Yes			Yes		No	No	Yes	
Semi-Automatic (Bug) Mode	Yes	Yes		Yes	Yes	No	No	No	No
Real-Time Memory Loading Mode	Yes			Yes		Yes	Yes	No	
Automatic Word Space Memory Load	Yes			Yes		No	No	Yes	
Instant Start From Memory	Yes			Yes		No	No	Yes	
Message Editing	Yes			Yes		No	No	No	
Automatic Stepped Variable Speed	No	No	No	Yes	No	No	No	No	No
2 Presettable Speeds, Instant Recall	No	No	No	Yes	No	No	No	No	No
Automatic Trainer Speed Increase	Yes	Yes	Yes						No
Five Letter or Random Word Length	Yes	Yes	Yes						No
Test Mode With Answers	Yes	Yes	Yes						No
Random Practice Mode	Yes	Yes	Yes						Yes
Standard Letters, Numbers, Punctuation	Yes	Yes	Yes						Yes
All Morse Characters	Yes	Yes	Yes						No
Advertised Price	$199.95	$129.95	$99.95	$129.95	$79.95	$139.95	$ 99.50/ $139.50	$229.00	$129.95

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More Details? CHECK—OFF Page 98

comments

segment of the RTTY community (which is increasing as older equipment is replaced) has been notably indifferent, even dismissing ASCII as not suited for the high-frequency bands because of its theoretically greater information loss in QRN. Is it possible that this criticism, though *reasonable*, is misplaced, and the real reason is ASCII's lowest speed begins at 110 baud and is too fast for the "real world" of RTTY where hand-typing at 45 baud predominates and is evidently preferred?

It would be unfortunate not to see this elegant code used as Baudot is now used, despite its origin in computer applications. Therefore, I propose that speeds of 45, 50, and 56 baud be added to those now available for ASCII in future RTTY gear and update mods. "Slow ASCII" can help keep Amateur Radio abreast of computer techniques.

Albert F. Storz, W3FVC
Pottstown, Pennsylvania

computer rfi

Dear HR:

I, like many other radio and computer hobbyists, am having trouble with RFI from my TRS-80 computer. I have noticed, however, that when I have my computer turned on, my fifteen-year-old Admiral table model a-m radio with tubes has good audio without any hint of RFI. Yet on the same table the noise level is quite high coming through a new Drake TR7 transceiver and a Bearcat scanner. The old tube radio plays away as if there were no problems. Do you think the old superheterodyne circuitry holds a solution to this perplexing problem? I would be interested in hearing from anyone else with this particular problem or possible solutions.

John J. Watermeier, KA5HJI
New Orleans, Louisiana

Heath HW-2036 mods

Dear HR:

I read with interest the HW-2036 modification article by Tom French, WA4BZP, (November, 1980, *ham radio*), but I felt that two things should be brought to your readers' attention.

First, the Heath Company offers a modification for the older Micoder™, HD-1982 models, to convert them to crystal control. This is part number 830-30 and can be ordered from our parts department for $8.95 plus 90 cents postage.

Second, and more noteworthy, we have serviced one HW-2036 with Tom's "2036-MB" board installed. This unit was returned for service because the receiver seemed to drift erratically. In troubleshooting the unit, we noted a very high noise level on the VCO tune line at TP-401, which caused the condition. This noise was traced to the new encoder board. The receiver was stabilized by disconnecting the board's 5-volt line from the HW-2036 5-volt source.

Since the replacement board was not a Heath product, we did not investigate further. Readers considering this modification should take this into account, as well as the Heath Company's service policy regarding modifications. Any problems encountered with these modifications should be brought to my attention.

E.A. Mosher, Service Supervisor
Amateur Radio & R.C. Products
Heath Company
Benton Harbor, Michigan 49022

novice roundup

Dear HR:

I just completed my third (and I hope my last) Novice Roundup, and I would like to submit a couple of comments. I know that all of the Novices and Technicians who participated thank the higher-class hams who were there with us to give out that point or needed state or section. The DX stations were also there. FB to all from my QTH.

Not so fine business to those with higher-class licenses taking a frequency and sending CQ NR, their call, and /G or /A or /E. The Generals and above have contests almost all year long; surely they get enough CQ sending practice in them. The Novice Roundup is our only contest and we need room. There are a multitude of us Novices and Techs who would be more than happy to make contact with Generals and above. But please, let the main participants have the air, and most of all, the enjoyment. Final comment: it sure would be nice if the Novices and Techs could have more than one contest a year.

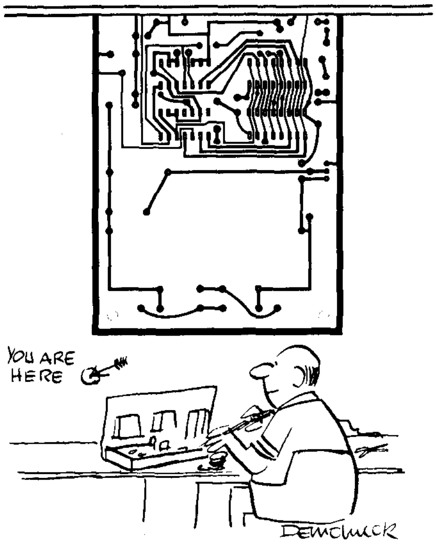
Rich Lawson, KA9AZY
Bloomington, Illinois

thanks

Dear HR:

Thank you very much for a very good radio magazine.

Carl Amberg, SM0GPC
Lidingo, Sweden



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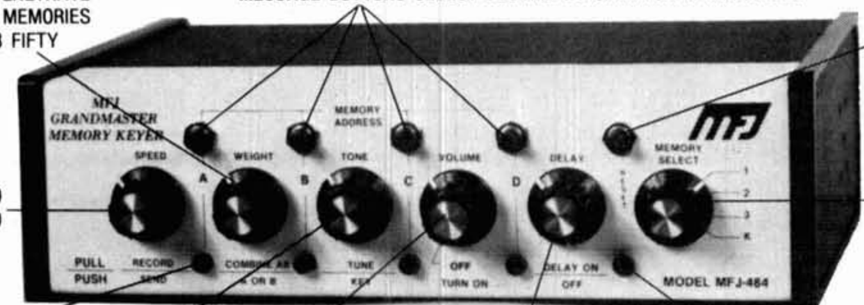

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You can repeat any message continuously and even leave a pause between repeats (up to 2 minutes). **Example:** Call CQ. Pause. Listen. If no answer, it repeats CQ again. To answer simply start sending. LED indicates Delay Repeat Mode.

Instantly insert or make changes in any playing message by simply sending. Continue by touching another button.

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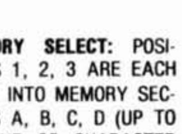

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More Details? CHECK—OFF Page 98

presstop

K2AHL'S RFI PROBLEMS, which he reported had resulted in a judge ordering him off the air and threatening his license, have now taken a somewhat different turn. On April 11, 1978, on the advice of his attorney, K2AHL voluntarily signed an agreement that he'd eliminate all interference to his neighbor's equipment. This in effect gave the state jurisdiction over his operating (with respect to interference), even though the ARRL's legal packet—which he'd requested and received—makes the point that an FCC license pre-empts local control of transmissions.

He Went Back On The Air after clean-up efforts only partially solved the RFI problems, so they took him back to court on several occasions for violating his 1978 agreement. At the last December hearing the attorneys proposed quiet hours, but instead K2AHL made a new agreement to shut down completely since his father (who was attending for him) indicated he'd find it "demoralizing" to observe quiet hours. Later, however, he claimed that this new agreement had been made under duress.

Under The Circumstances, the problems of the position he's put himself into cannot be resolved the way K2AHL now wishes, with or without the support of the Amateur community. It's certainly a classic example of how not to resolve an RFI complaint, and not one that should be considered to set any precedents.

A RECALL PETITION FOR CENTRAL DIVISION Director Ed Metzger, W9PRN, was circulated at Dayton by Amateurs representing the Indiana Radio Club Council. The group, principally from the Indianapolis area, is reported to be seeking the director's recall on the grounds that the League's failure to count the Central Division ballots for director in last fall's election deprived them of their votes. After former director W9NTP resigned late in that hard-fought campaign, W9PRN was declared the only eligible candidate and thus elected without ballot.

No Complaints About W9PRN's performance or competence are cited in the recall petition, which simply asks the League to "hold, as soon as is practical, a recall election to determine whether or not the current director...shall be recalled." The petition's supporters seemed principally concerned with the election process, claiming that W9NTP's resignation had been made "under duress."

A NEW BILL STRONGLY SUPPORTING Amateur Radio was introduced in the U.S. Senate on Wednesday, April 8, by Sen. Barry Goldwater, K7UGA. The bill, S 929, would provide for point-of-sale control of transmitting equipment, extend the term of an Amateur license to 10 years, and—like the old Vanik bill—give the FCC authority to set RFI standards for receiving equipment.

Volunteer Aid From Amateurs could be sought by the FCC for both exam giving and enforcement, as has been proposed in Rep. Dannemeyer's HR 2203, along with lifting of the secrecy provision of Section 605 of the Communications Act.

Sen. Goldwater Is Now Chairman of the communications subcommittee of the Senate Commerce Committee, and most of the members of the subcommittee joined him in co-sponsoring S 929.

30TH ANNIVERSARY DAYTON HAMVENTION drew over 20,000 the last weekend in April, with 185 exhibitors and a filled 1500-space flea market. Business was excellent both inside and outside throughout the long weekend. Some 1400 attended Saturday night's banquet honoring the Amateur of the Year, W9CI, and Specific Achievement Award winners WA6ITF and KH6IAF. W8WY won the complete TS-130S station door prize. Winner of the Drake "7-Line" complete station Hamvention door prize was YL N8AIM; runner-up W9CJW took home a TR-9000, and N8BLX a J.W. Miller AT-2050 automatic antenna tuner. K3KE and Ham Radio's W6NIF shared top honors in the CW competition at 40 WPM plus, while W8AU managed 18 WPM solid copy through QRM.

A 40-METER BROADCASTER operating from southern Florida, shut down twice by the FCC, went free recently after U.S. Attorney Atlee W. Wampler III requested the charges be dropped. Jose Gonzoles had freely admitted his regular anti-Castro broadcasts on 40 with a kilowatt, but despite that illegal operation and considerable FCC enforcement effort, he avoided trial. It now seems likely that other Florida illegal broadcasters, some also using the Amateur bands, will continue operating.

MENTAL INCOMPETENCE IS GROUNDS for a license denial, FCC's Chief Administrative Law Judge Lenore Ehrig has ruled in a review of K6EOA's case. K6EOA is the Los Angeles Amateur who was arrested and jailed after threating the lives of two FCC engineers who attempted to inspect his station during a jamming investigation in 1979. Federal charges were later dropped after he was judged mentally incompetent, and he later pled guilty to state charges resulting from the incident.

This Latest Decision came during a hearing on K6EOA's license. The judge also ruled that an applicant for an Amateur license does agree to abide by applicable regulations, including those that concern prohibited communications.

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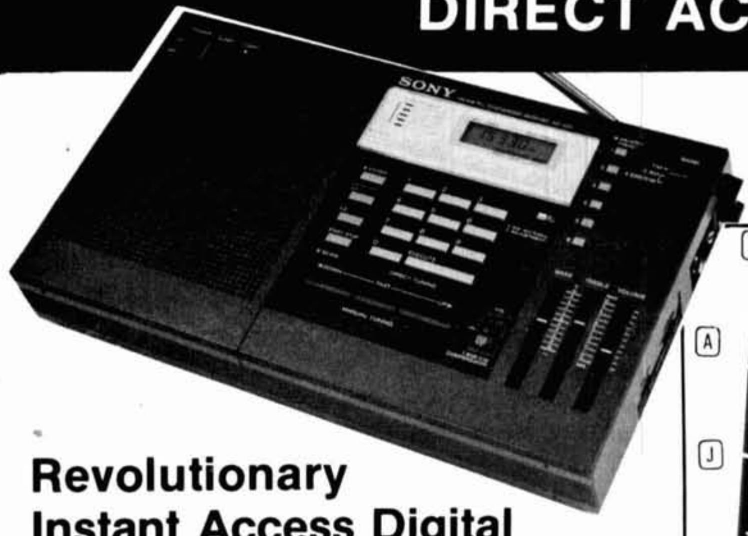

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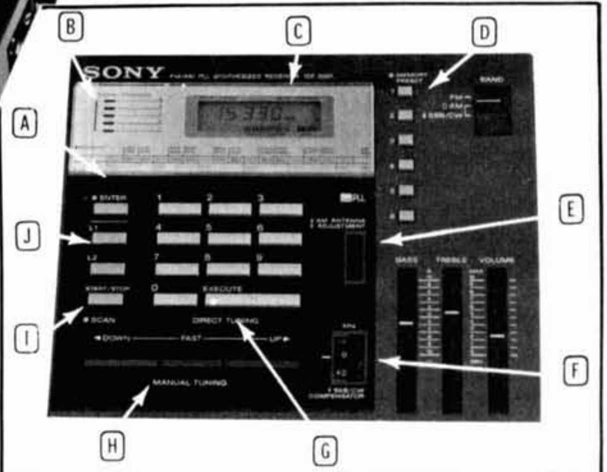

A Enter Button
B Signal Strength Indicator
C Liquid Crystal Display
D Memory Preset Buttons
E Antenna Adjustment Dial
F SSB/CW Compensator
G Execute Bar
H Manual Tuning Buttons
I Scan Button
J High/Low Limit Buttons

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Compare the following features against any receiver currently available and you will have to agree that the Sony ICF 2001 is the best value in shortwave receivers today:

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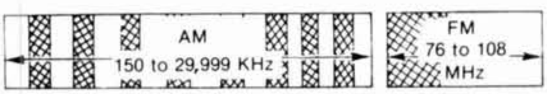

OPERATIONAL FEATURES

INSTANT FINGERTIP TUNING with the calculator-type key board enables the operator to have instant access to any frequency in the LW, MW, SW, and FM bands. And the LCD digital frequency display confirms the exact, drift-free signal being received. **AUTOMATIC SCANNING** of the above bands. Continuous scanning of any desired portion of the band is achieved by setting the "L_1" and "L_2" keys to define the range to be scanned. The scanner can stop automatically on strong signals, or it can be done manually. **MANUAL SEARCH** is similar to the manual scan mode and is useful for quick signal searching. The "UP" and "DOWN" keys let the tuner search for you. The "FAST" key increases the search rate for faster signal detection. **MEMORY PRESETS.** Six memory keys hold desired stations for instant one-key tuning in any mode (AM, SSB/CW, and FM), and also, the "L_1" and "L_2" keys can give you two more memory slots when not used for scanning. **OTHER FEATURES:** Local, normal, DX sensitivity selector for AM; SSB/CW compensator; 90 min. sleep timer; AM Ant. Adjust.

SPECIFICATIONS

CIRCUIT SYSTEM: Fm Superheterodyne; AM Dual conversion superheterodyne. **SIGNAL CIRCUITRY:** 4 IC's, 11 FET's, 23 Transistors, 16 Diodes. **AUXILIARY CIRCUITRY:** 5 IC's, 1 LSI, 5 LED's, 25 Transistors, 9 Diodes. **FREQUENCY RANGE:** FM 76-108 MHz; AM 150-29,999 KHz. **INTERMEDIATE FREQUENCY:** FM 10.7 MHz.; AM 1st 66.35 MHz., 2nd 10.7 MHz. **ANTENNAS:** FM telescopic, ext. ant. terminal; AM telescopic, built-in ferrite bar, ext. ant. terminal. **POWER:** 4.5 VDC/120 VAC **DIMENSIONS:** 12¼ (W) X 2¼ (H) X 6¾ (D). **WEIGHT:** 3 lb. 15 oz. (1.8 kg)

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tune in on the world

Tips to get you started in shortwave listening

Shortwave and scanner receivers adorn the listening post of Bill Rutherford, Bardstown, Kentucky.

Most of us can remember our first exposure to shortwave radio. It might have been at the invitation of a local Amateur Radio operator. Perhaps a gift of a receiver opened our eyes to the hobby. Or did a shortwave listening (SWL) hobbyist let you hear things that fertilized your imagination?

Just a few short years ago simple shortwave receivers abounded; tube-operated sets tuned in on Radio Moscow, the BBC, and other shortwave broadcasters worldwide. But with the radio bands more congested now, simple radios are no longer capable of discriminating among the multitude of signals packed together throughout that busy portion of the electromagnetic spectrum.

the market changes

By the close of the 1960s, venerable names like Hallicrafters, National, Hammarlund, RME, Gonset, and others had disappeared from the shortwave receiver marketplace. A new hobby, CB radio, had begun to emerge as the nation's new gadgetry obsession. By the mid 1970s, good shortwave receivers at a reasonable price were unavailable. A few off-shore brands were on discount house shelves as portables, but not worthy of attention. Serious hobbyists were forced to shop around for military and commerical surplus. Tube-type receivers such as the R-388, R-390, and other salvageable radios became prime items.

And then an unexpected series of CB spinoffs shaped the destiny of consumer radios. Innovative technology, which developed competitive, low-cost CB transceivers, went to work for the shortwave hobbyist. Large-scale integration of complex circuitry into tiny chips of silicon greatly cut costs while increasing dependability and performance. Frequency synthesis and phase-locked-loop oscillator circuitry proved to have enormous potential in general coverage receivers for the shortwave spectrum. A South African firm produced the Barlow-Wadley portable, an outstanding shortwave receiver featuring the Wadley loop. Other manufacturers followed the trend.

The market is burgeoning with merchandise of outstanding quality at reasonable prices, prices far lower than equivalent performance would have cost just a few short years ago. Inexpensive beginners' radios are also plentiful for less critical listening.

what should I look for?

Along with the wide selection of modern receivers comes the bewilderment of trying to make the right decision. Which radio will suit my needs? Are there any real lemons? Does price dictate the quality? How can I be sure to pick the right radio?

Fortunately, there is considerable variety in both quality and price. Unfortunately, price does not always dictate quality! Let's take a close look at some of the characteristics that must be considered in making a choice.

selectivity

Unquestionably, the ability to discriminate among closely packed stations for single-signal reception is a prime requirement (**fig. 1**). Good receivers will have a switchable option — "selectable selectivity," if you will — to choose the degree of selectivity required for different listening challenges. Musical programs with little adjacent interference may justify wide selectivity, while Morse code and single-sideband voice reception in the crowded ham bands will require the use of sharp or narrow selectivity.

By Bob Grove, WA4PYQ, Route 1, Box 240, Brasstown, North Carolina 28902

sensitivity

There is little real difference among most modern receivers in their ability to detect weak signals, although a high noise figure can reduce apparent sensitivity. It's what the receivers do with the signals *after* they hear them that separates the wheat from the chaff! The day of the 500-foot antenna is gone; modern shortwave receivers work fine with wire antennas anywhere from 25 to 100 feet in length, so long as they are high, free of metallic obstructions, and away from electrically noisy power lines.

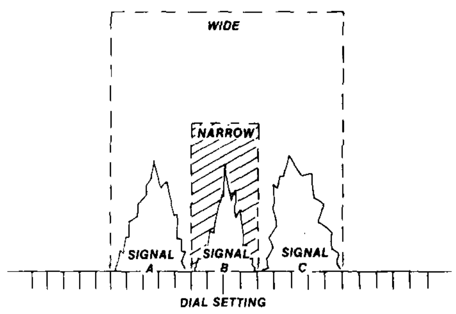

fig. 1. Selectivity is the ability of a receiver to reject adjacent signals.

stability

The ability of a receiver to remain on the frequency to which it is tuned is important when listening to amplitude-modulated signals; it is vital when listening to CW (Morse code) or SSB (single-sideband voice).

Stability comes in two varieties: thermal and mechanical. Thermal stability refers to the behavior of electronic components as they change temperature. If frequency-determining components change value as they change temperature, they have the annoying effect of shifting the received frequency.

To check a receiver for thermal drift, turn it on and tune in a shortwave broadcast station with the beat-frequency oscillator (BFO) on so that a low-pitched tone is heard. If the tone slowly changes pitch, the receiver suffers from thermal instability. A good receiver will settle down in a couple of minutes, but some receivers will drift continuously. Such receivers are virtually worthless for CW, SSB, or radioteletype (RTTY) reception.

Mechanical stability is a measure of the sturdiness of construction. As in the previous test, tune in a station with the BFO turned on. A modest rap on the side of the cabinet will betray the presence of mechanical instability by causing the note to warble or shift suddenly.

Another sign of mechanical instability is displayed as dial backlash; if there seems to be play in the dial when tuning in a station, backlash is present, making precise dial settings difficult.

frequency range

Most general-coverage receivers tune continuously from the standard broadcast band (0.54-1.6 MHz) through 30 MHz; some start even lower in frequency to include the European 1600-400 kHz broadcast band. A few begin at radio's basement: 10 kHz!

Years ago, many general-coverage receivers offered considerable frequency range, often ascending far above 30 MHz. Such receivers compromised performance for frequency coverage.

Ham-band-only receivers, which cover spaced-frequency segments (3.5-4.0, 7.0-7.3 MHz, etc.) omit the majority of the shortwave spectrum. While these receivers are of good quality, they restrict listening to Amateur communications only.

spurious response

Strong signals have an annoying habit of being heard at more than one place on the dial. Some of these phantom signals result from the inability of receivers to suppress unwanted signals of formidable strength. A good test of spurious response may be made by tuning the receiver slowly through an extremely active band of frequencies, listening for whistles to change pitch while you tune *without* the BFO turned on.

frequency readout

The close spacing of signals throughout the shortwave band demands accurate frequency readout. It is often futile to look for a station even when you know its frequency if your dial reading is inaccurate. Similarly, if you happen to stumble across an intriguing transmission which doesn't identify itself, there is no way to nail it down without knowing what frequency it's on.

Frequency displays may be analog (the continuous frequency spread is printed on a scale through which a pointer gradually moves) or digital (only the numerical characters that indicate the present setting of the receiver frequency are displayed.) Digital frequency readout is clearly the winner, taking over printed dials in all but the least expensive radios.

where to buy?

Many prominent manufacturers advertise their consumer-grade communications receivers in hobby magazines such as *ham radio*. Most Amateur Radio retail stores stock general-coverage receivers for shortwave listeners.

table 1. Typical shortwave block assignments in North America (partial list).

frequency (kHz)	class of service
3500-4000	Amateur
4000-4063	fixed
4063-4438	maritime/mobile
4438-4650	fixed, aero mobile
4650-4750	aero mobile
4750-4850	fixed
4850-5000	fixed/mobile
5000-5250	fixed
5250-5450	fixed/mobile
5450-5730	aero mobile
5730-5950	fixed
5950-6200	international broadcasting

table 2. International broadcasting frequency bands.

frequency (kHz)	meter band
2,300- 2,500	120
3,200- 3,400	90
3,900- 4,000	75
4,750- 5,060	60
5,950- 6,200	49
7,100- 7,300	41
9,500- 9,775	31
11,700-11,975	25
15,100-15,450	19
17,700-17,900	16
21,450-21,750	13
25,600-26,100	11

table 3. The most intriguing portions of the shortwave spectrum.

frequency (kHz)
4,750- 5,300
5,300- 5,950
6,500- 7,000
7,300- 8,000
8,800- 9,100
11,100-11,700
13,100-14,000
14,400-15,100
17,400-18,100

listening in — "Utes" or broadcasters?

Most shortwave devotees classify their listening thrusts into two categories: utilities (two-way communications such as military, ship-to-shore) and broadcasters (Radio Peking, Voice of the Andes). While many enthusiasts share their listening time between the services, most eventually find one of the facets of listening of greater personal interest and challenge.

the delicate art of listening

Spinning the receiver dial through its tuning range is like shooting at ducks in a fog; a good hit is pure luck! Successful listeners employ one or more tricks to guarantee results. First, it is a good idea to know what the frequency allocations are. **Table 1** gives a sample of how assignments are made in North America. Note that assignments are not based on the identities of users, but on their class of operation (fixed, mobile, maritime). A more detailed chart is published in the Federal Frequency Directory (see publications elsewhere in this article.)

Another trick of the trade is knowing *when* to listen. Shortwave signals propagate (travel) over vast distances, and just because it is 2 PM in your home town doesn't mean that daily activities are bustling in Tokyo! A world time chart can give you an edge for some types of listening.

Our sun plays a vital role in propagation of radio waves. Its intense radiation has profound effects on reflection and absorption of radio waves in our atmosphere. At night, listen to frequencies below 12 MHz, while during the daylight hours, signals above 8 MHz will be favored. Frequencies between 8 and 12 MHz are usually good around the clock.

international broadcasting

One of the major thrusts for propaganda by any nation is its radio contact with the world. Thousands of transmissions are beamed daily from virtually every point on the globe to every other point. Pro-American, anti-American, pro-Communist, anti-Communist — it's all there and makes for some fascinating listening. **Table 2** shows the target areas to tune your receiver for these broadcasts. However, not all countries subscribe to this fixed band plan. You are likely to intercept broadcasting stations throughout the shortwave spectrum; broadcasters occasionally choose to go on their own without international cooperation regarding treaty matters concerning frequencies and schedules.

table 4. Listening intrigue (all frequencies in kilohertz).

Navy	
radioteletype	14.160
Atlantic fleet	6,697; 8,972
Guantanamo Bay telephone	10,222.5
war games	9,259
Air Force	
MacGill AFB	5,683; 8,993 11,246
SAC	6,761; 9,027 11,243; 13,241
TAC	8,964
MAC	11,182
hurricane hunters	5,683; 8,993 11,232
Andrews AFB	13,247
Cape Kennedy	10,780; 20,390
NORAD	14,894
MARS	4,580; 4,885 7,324; 7,540 13,977
CAP	4,467.5 4,585; 7,635
"Spy" Numbers Stations	3,060; 3,090 5,812; 6,772 8,418
Travelers Info Service	530; 1,610
Canadian Air Force	11,233
Coast Guard	
ship-to-shore	5,680; 5,696 11,201
emergency (CW)	500
AMVER	6,506.4; 8,765 13,113
Embassies	
State Dept. CW marker (KKN50)	6,925; 23,975
worldwide pool	10,640; 13,626 14,355
South/Central America (military attaches)	7,430; 13,950
Aeronautical	
FAA regional net	7,475
VOLMET	3,001; 5,652 8,868; 13,272
ARINC	13,320; 13,328 13,356; 17,941
Russian Aeroflot	11,312; 17,936
Maritime	
simplex	4,125; 4,143.6 6,218.6; 6,221.6 8,790
calling/emergency	2,182
Great Lakes	6,516
inland waterways	6,519; 6,522
Petroleum Network	4,634.5; 4,637.5
Smugglers	7,400-7,500 14,400-14,500
Pirate Broadcasters	6,235-6,280 7,325-7,370
Clandestine Broadcasters	
Radio Free Grenada	15,045
anti-Castro	7,030-7,090

the hot spots

Intrigue permeates the shortwave bands. Smugglers, spies, undercover communications, tactical military operations and other activities never cease to pique the imaginations of hobby listeners.

Where are such transmissions to be found? Virtually anywhere. But before dismissing such catches as unpredictable, let's do a little planning. First, low-power communications cannot compete with high-power broadcasters, so that eliminates some frequency ranges. Second, time of day dictates the most likely portion of the spectrum to be in use, with the lower frequencies primarily in use at night.

Experience has shown a few key segments of the high-frequency spectrum to be favored for two-way communications by the most interesting targets of the "utilities DXers," those relentless hobbyists who pursue things that they are not supposed to hear. For a close look at those more productive hunting grounds, consult **table 3**.

try this sampling

Most of us enjoy the cookbook approach to listening: look up a listing in a frequency directory and dial it up. Some of the more interesting stations can be tuned in by this straightforward approach. Let's take a look at a few listings (**table 4**). Most transmissions are SSB. Perhaps something here may capture your interest!

listeners' clubs

A number of clubs exist for the pleasure of serious shortwave hobbyists. For information about these clubs, enclose a self-addressed envelope along with your request to: ANARC (Association of North American Radio Clubs), 409 Laconia Lane, Schaumburg, Illinois 60193.

publications

Several outstanding publications are available to assist the SWL enthusiast. Among them are: *Federal Frequency Directory, Communications Monitoring, Radio Communications Guide, World Radio TV Handbook, Confidential Frequency List*, and the *Sounds of Shortwave* cassette.*

a final word

Listening in is an American privilege. Perhaps nowhere else in the world are laws regarding the interception of private correspondence so lenient. But there are regulations, and listeners should be apprised of their obligations.

*Available from Ham Radio's Bookstore, Greenville, New Hampshire 03048 or Grove Enterprises, Incorporated, Brasstown, North Carolina 28902. An interesting catalog may be obtained from Grove Enterprises, Incorporated.

Yaesu FRG-7

Kenwood R-1000

Drake R7

Radio Shack DX-302

Radio Shack DX-200

At left, a few of the receivers suitable for shortwave listening that are currently on the market. Shortwave listening is often the first step to an Amateur license, and many active Amateurs are also confirmed SWL enthusiasts.

Section 605 of the *1934 Communications Act* specifically prohibits the divulgence to another person the nature of a communication which you heard that was not directed toward you. Nor are you allowed to make use of that information for your own gain. The act is enforced by the FBI. Hobby radio listening is educational recreation; but only the information transmitted by broadcasting stations is intended to be repeated.

The hobby of shortwave listening is at a level greater than ever before in history, and its ranks are growing. Tune in on the action. There's a world of listening out there!

reference

1. Bob Grove, WA4PYQ, "Shortwave Listening, a World of Intrigue," *Ham Radio HORIZONS*, November, 1980, page 13.

ham radio

DX=

The Cubic 103. If you're looking for DX, the Cubic 103 is the rig you should be looking at. Because it's all solid state, state-of-the-art design and construction, with all bands, 160-10 Meters (including the WARC bands) installed and operating. With Dual PTO's dual 8-pole filters (1.4:1 shape factor), true passband tuning, speech processor, 235 watts input and RF/IF gain controls, the 103 has the performance that's necessary for exeptional operation under the high cross modulation conditions found on today's crowded bands.

If you're lookin for DX, look no further. DX is the new Cubic 103.

The suggest retail price of the Cubic 103 is $1395.00. But a lower quote is just a phone call away.

The Specs: Solid State Construction, Dual PTO's for split frequency operation. All bands installed and operating, 160-10 Meters, including the 3 new WARC bands. 235 watts input. Fast break in (QSK). RTTY. VOX. Jack for separate receive antenna. Fully variable, AGC delay. Dual, 8-pole filters with 1.4:1 shape factor, −6 to −100 dB. Soft or hard CW out put pulse shaping. Sophisticated noise blanker. Exceptional dynamics: Noise floor −132 dBm; 3rd order intercept +15 dBm.

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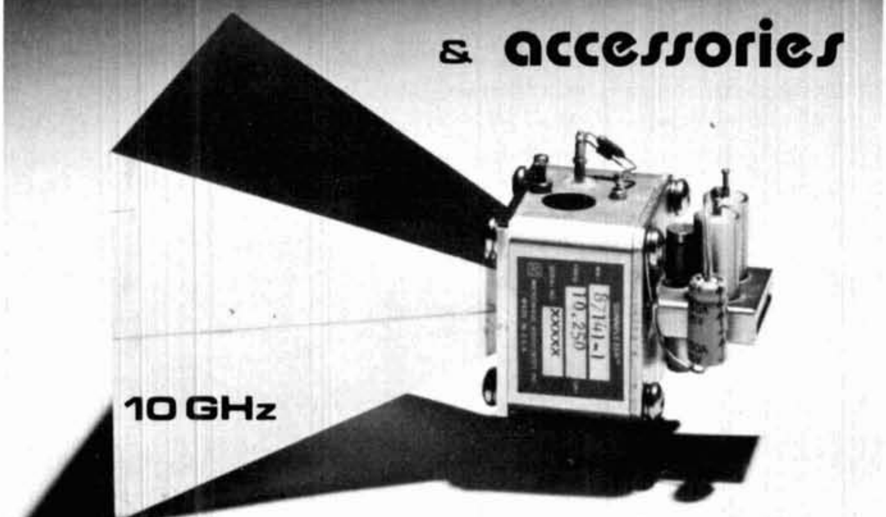

ARR is proud to offer the complete Microwave Associates Gunnplexer and accessory line. Two of the Gunnplexer transceivers shown here (the MA87141-1, at only $239.95 per pair) can form the heart of a 10 GHz communications system for voice, cw, video or data transmission, not to mention mountaintop DXing! ARR sells a line of necessary support equipment such as power supply/modulator and receiver boards. Write or call for additional information.

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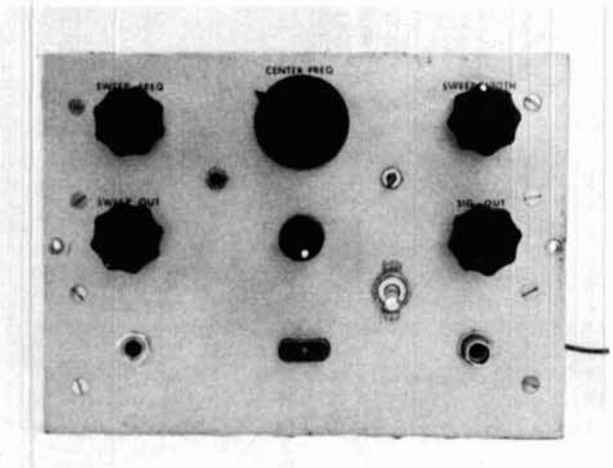
A useful instrument
for testing
multipole filters

stable wideband sweep generator

Several articles have appeared recently in the Amateur literature describing crystal ladder filters. I've been interested in selective filters for many years, and after reading an article by G3JIR,[1] I decided to try building a ladder filter.

It soon became apparent that it would be difficult to adjust a multipole filter (I had chosen an eight-pole filter) without a sweep generator and oscilloscope to produce a pattern of the filter's passband.

I didn't have a sweep generator, so I decided to build one. After trying the RC oscillator circuit suggested by K6DYX,[2] I was convinced that a more stable oscillator was needed when working with a highly selective filter in the 9-10 MHz range. The circuit I chose uses frequency conversion, thereby making it possible to set up any frequency from 10 kHz to about 150 MHz. By subtracting the two oscillator frequencies (sweep oscillator and crystal oscillator), it's possible to produce a frequency-modulated signal as low as 10 kHz. By adding the two frequencies, usable signals can be produced well into the VHF ranges.



Front panel of author's homebrew sweep generator.

typical test setup

The sawtooth generator (**fig. 1**) provides a linear sweep signal to the sweep oscillator as well as a ramp for the oscilloscope. The frequency-modulated signal from the sweep oscillator is mixed with the crystal-oscillator signal in the balanced modulator to provide an amplified signal to the filter under test. (The filter

By Harry Sievers, W7BAR, 2725 North Five-Mile Road, SP100, Boise, Idaho 83704

should be terminated with the proper impedances while the alignment is being made.)

I used modular construction on homemade PC boards. Most of the construction is not very critical, but special attention should be paid to keep the sweep oscillator as stable as possible and to keep leads *short* if VHF operation is intended.

the circuit

Fig. 2 is a schematic diagram of the wideband sweep generator. The circuits are mounted on individual PC boards (indicated by dashed lines). Operation of the essential circuits is as follows.

Sawtooth generator. R3 controls bias to Q1, which, in conjunction with C2, sets the sweep frequency at about 30 Hz. Q1 drives Q2, which in turn drives the noninverting input of the 741 op amp. The dc voltage at the output of the 741 is balanced by R2.

Sweep oscillator. The sweep oscillator is a grounded-drain Hartley circuit. It drives Q4, a source follower, which is direct-coupled to Q5. The output from Q5 is fed to one input port of the double-balanced mixer. The slug in L1 tunes the oscillator over about a 1-MHz range (4.5-5.5 MHz), and C1 provides fine tuning of about 10 kHz to provide easy adjustment of the center frequency. The signal from the sawtooth generator is applied to tuning diode CR1 to frequency modulate the sweep oscillator.

Crystal oscillator. This is a Pierce oscillator, which allows a wide selection of oscillator frequencies for various output-frequency requirements. It is buffered by Q7 and Q8, and the output is fed to the balanced mixer to be mixed with the output of the sweep generator.

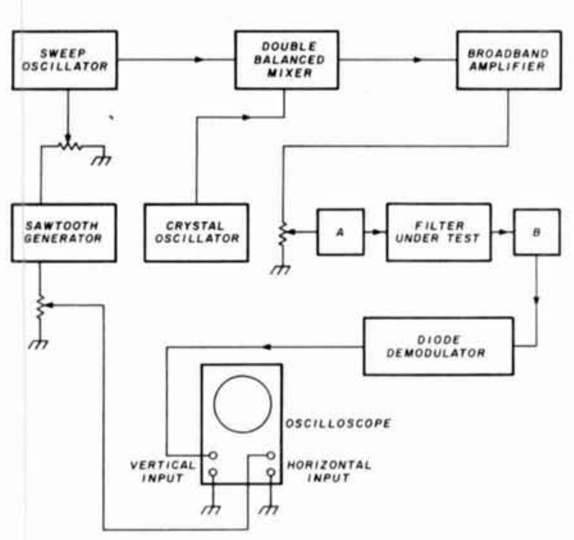
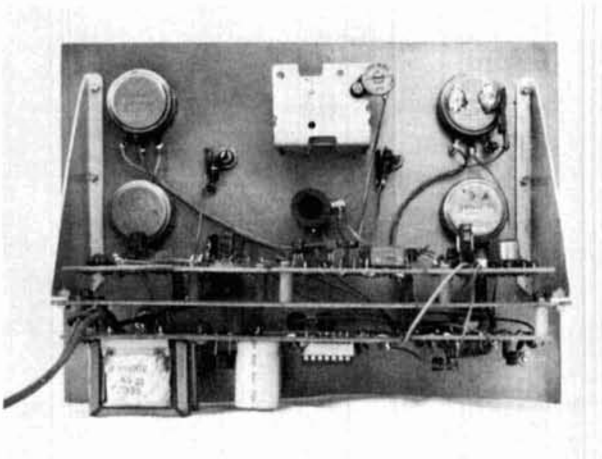
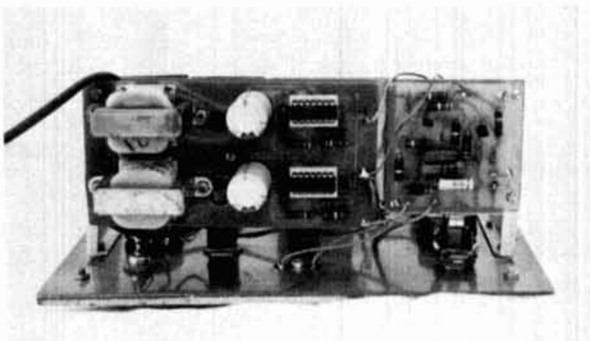


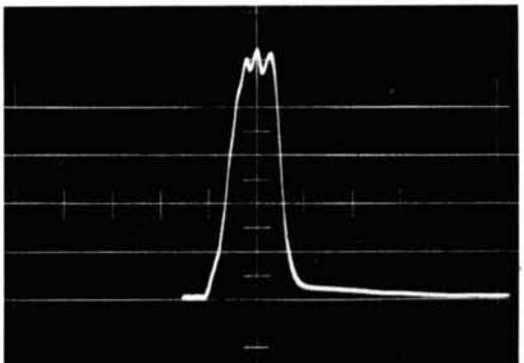
fig. 1. Test setup for checking filters with the wideband sweep generator. Blocks *A* and *B* are impedance-matching networks or amplifiers.



Rear view of panel showing construction of the sweep generator. Upper left is the sweep-width control; center, center-frequency control; right, sweep-frequency control. At lower left is the signal-output control; center, dc-balance control, and lower right is the sweep-output control. Power supply and crystal oscillator are mounted on the bottom circuit board.

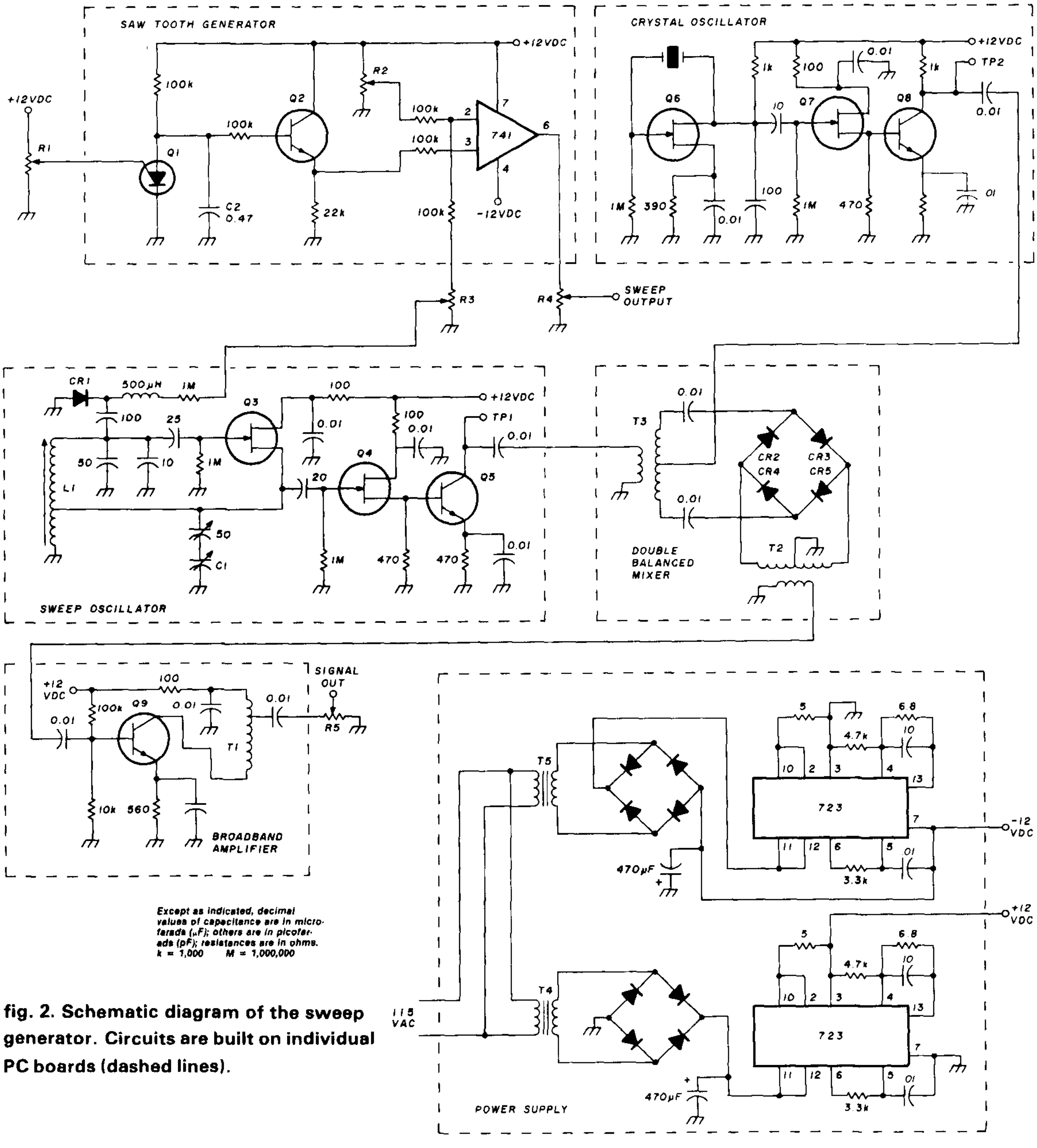


Under-chassis view showing the power supply (left) and crystal oscillator.



Oscillogram showing the passband of an eight-pole filter.

C1	25-pF variable mounted on panel (center frequency control)
C2	0.47-pF low-leakage capacitor
CR1	tuning diode (MV2203)
CR2-CR5	1N914 or equivalent
L1	36 turns No. 26 (0.4 mm) tapped at 12 turns, 1/2" (25.4 mm) diameter slug-tuned form mounted on panel
Q1	unijunction transistor, Radio Shack #276-2029
Q2	2N2222
Q3	MPF 102
Q4	MPF 102
Q5	2N2222
Q6	MPF 102
Q7	MPF 102
Q8	2N2222
Q9	2N2222
R1	25k pot mounted on panel (sweep frequency)
R2	25k trimpot (dc balance on sweep output)
R3	25k pot mounted on panel (sweep width)
R4	25k pot mounted on panel (sweep output)
R5	10k pot mounted on panel (signal out)
T1	12 turns No. 30 (0.25 mm) Trifilar wound on Amidon T50-72 core (4:1 ratio)
T2,T3	12 turns No. 30 (0.25 mm) Trifilar wound on Amidon T50-72 core
T4,T5	12V 300 mA Radio Shack #273-1385



Except as indicated, decimal values of capacitance are in microfarads (μF); others are in picofarads (pF); resistances are in ohms. k = 1,000 M = 1,000,000

fig. 2. Schematic diagram of the sweep generator. Circuits are built on individual PC boards (dashed lines).

Broadband amplifier. The output of the balanced mixer is amplified by Q9 to a level of about 2 volts. This voltage is more than adequate for checking filters or aligning receivers and will usually be enough to allow using an oscilloscope of lower sensitivity.

A diode demodulator (**fig. 3**) converts the rf signal from the filter to dc, thereby eliminating the need for a high-frequency oscilloscope.

During adjustment of a filter, I recommend that the sweep width be reduced as far as possible while still allowing you to see the ripple on the nose of the pattern. This makes it much easier to note changes as adjustments are made.

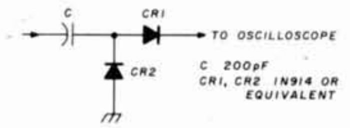


fig. 3. Schematic diagram of a diode demodulator, which converts the rf signal from the filter under test to dc.

measurements

Measuring the bandwidth and the nose ripple of a filter can be made by plotting the passband response. To do this, connect the output of the diode demodulator to a low-scale VTVM and reduce the sweep width to zero. Connect a frequency counter to the output of the signal generator. Slowly tune the generator through the passband of the filter and note the meter reading and the frequency as indicated on the counter. By plotting meter readings versus frequency a pattern of the filter passband will be produced. Following are the characteristics of a filter I recently constructed from surplus CB crystals:

center frequency	9.565 MHz
6-dB bandwidth	2.3 kHz
60-dB bandwidth	3.9 kHz
80-dB bandwidth	4.7 kHz
nose ripple	1.5 dB
insertion loss	10 dB

acknowledgments

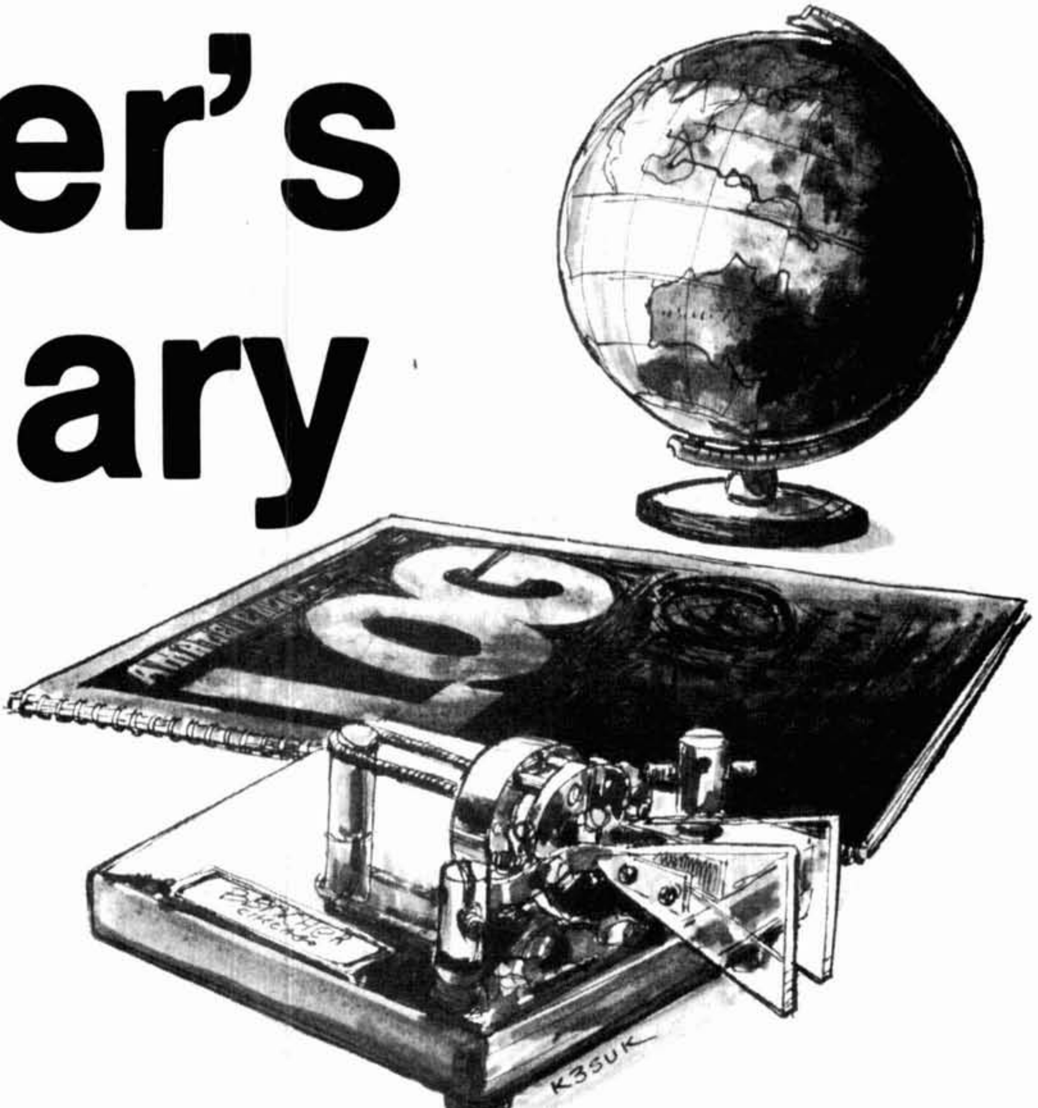
I'd like to acknowledge suggestions from W7NO and W7BZ during the development of this project.

references

1. J.A. Hardcastle, G3JIR, "Some Experiments With High-Frequency Ladder Crystal Filters," *QST*, December, 1978, page 22.
2. W.C. Smith, K6DYX, "An Inexpensive Sweep Generator," *QST*, October, 1976, page 17.

ham radio

DXer's diary



By Bob Locher W9KNI

It's been a beautiful June day, one of those rare jewels that only late May and early June can deliver to the Midwest. Seventy degrees, dry with low humidity, a gentle breeze, altogether a perfect day.

Thoughts of any kind of useful work were cast aside early, like those of the Mole about doing his spring cleaning in *The Wind in the Willows*. A Saturday like this just can't be wasted, and I didn't.

A long bicycle ride in the country, hamburgers charcoaled on the grill; a perfect day. Now it's time for a look around the bands. The high-pressure cell sprawled across the Midwest certainly will keep thunderstorms away; the bands should be relatively quiet and free of QRN.

I ease into the operating chair with a bit of a wince; perhaps I did overdo it for the first long ride of the season. But I'm glad I did, even if I'll pay with sore muscles tomorrow. I flip the master safety switch on, and settle the headphones over my head as the receiver comes to life.

Let's see here, it's 0130 Zulu, 8:30 PM Central Daylight Time. Fifteen ought to be in pretty decent shape. I flip the bandswitch, and start tuning the dial. Yes, there are lots of signals. That's fine; the band is obviously pretty wide open.

What direction shall I point my antenna? The band could still be open to Europe, but so what if it is? I have everything in Europe except Albania and Mount Athos, and I'm sure not likely to hear one of them. Besides, they'll all be in bed.

If conditions are good, the band is probably open over the polar regions, with deep Asian Soviet, Indian, and Sri Lanka stations possible. It's morning in those parts. But those stations tend to stay on 20 meters, rather than on 15, and I want to try 15 for a while tonight. Still, it's a thought; some of them may well be on the band.

I could point east into Africa. At this time of year, central and southern Africa ought to be a lead-pipe cinch for propagation on 15 at this time of day. But equally, it's too early, and they are most likely all in bed, even though conditions are fine. Still, the path into the Indian Ocean may be open, and it's morning there.

I could point the antenna south-south east, good for Central and South America and Antarctic continent. I don't need anything on the South American continent, but sure could use both the South Orkney Islands and the South Sandwich Islands. The path should be wide open, and it's not too late for them to be up. It's definitely a possibility.

I could go southwest, across the fabled isles of the South Pacific, and on into Australia and New Zealand. Visions of swaying palm trees and pounding surf on coral reefs cross my mind; but heck, it can't be any nicer anywhere than it was here today. It's mostly afternoon across that path, Saturday afternoon east of the date line, Sunday west of the line. Either way, a weekend with good chances of activity from stations in that area. I wonder if VK9NV works 15?

There's always the northwest bearing, to Japan, Guam, the North Pacific and Southeast Asia. I could certainly use a couple of those places, but there are two chances of snagging one of them — slim and none. Like Cambodia, Burma, or Laos.

Anyhow, I decide on my plan of action. I'll start looking north, across the transpolar paths. I'll have a good look around, then turn the antenna east-northeast to bisect the great-circle path between Europe and most of Africa. Then, after another good snoop around, I'll rotate the antenna into the southeast, and have a look for those Antarctic islands.

If I fail to find anything of interest there, we'll try that shot across the wide Pacific, aiming west-southwest. And if that path is really good, we might get a long path peak into the Middle East and Northwest Africa. When I've milked that path dry, we'll haul round to the northwest, and have a look at the Orient and Southeast Asia. Then, I'll back the antenna round to north, and start all over again.

I move the receiver dial to 21,000 kHz and begin tuning up the band, with the antenna due north. The band is definitely quieter with the antenna north, but that certainly doesn't mean it's dead. I hear a lot of signals, most of them pretty weak. I listen to call signs; they're from all over. There's a GM, Aberdeen, Scotland. And there's an OH, a Finn. OK, not all Europeans are in bed. And of

course, it's the weekend for them, too. I keep tuning.

There's a signal with just a touch of chirp; nice fist, "CQ CQ DE AP2BQ AP2BQ AR." I pick up my 2-meter mike, and call it in on our DX channel, "AP2BQ, that's Alpha Poppa Two Bravo Quebec, twenty one oh one nine, twenty one oh one nine, from W9KNI." I wait a moment. No one asks for a repeat, so I begin tuning again. Pakistan is always an interesting catch, but I have it, so I keep on tuning.

Hmmm. The band is full of signals. There's a JA — pretty decent signal, too, considering that the antenna isn't on him. There's a raspy signal calling CQ. OK, it's UL7BDG. Gosh, the band seems to be as nice as the weather is.

I continue tuning higher up the band, getting a feel for it, tasting its flavor. Even with my antenna north, I hear a lot of stations from other parts of the world that come in on other bearings. What's that — a loud station with lots of backscatter, obviously a W or a VE, calling VP8AI. I grab my note card on VP8s — there's VP8AI listed. Faulkland Islands. OK, I don't need that one.

I keep a note card on the Antarctic stations because their prefixes are not clear indicators of their DXCC country status. For example, a VP8 could be Antarctica, the Faulkland Islands, the South Shetlands, South Georgia, the South Orkneys, or the South Sandwich Islands. Since I need several of these, I always listen to VP8 call signs, and I keep a list made up of who is known to be where. Knowing that VP8AI is in the Faulklands saves wear and tear on the finals, not to mention the operator.

The other Antarctic area prefixes are easier that the VP8s. The Argentines have their own system. If the first letter after the number is a *Z*, the station is Antarctic. The second letter, the letter after the *Z*, will tell you which island. Hence, LU1ZA is South Orkneys; the *Z* for Antarctica, the *A* for South Orkneys. LU3ZY is the rare South-Sandwich station, while LU4ZS is South Shetland. LU3ZC is Antarctica.

The Antarctic Russian stations all have 4K1 prefixes and all are on the relatively common Antarctic continent, except for one station, 4K1F, who is in the South Shetlands.

The Chileans use CE9 for Antarctic stations, with CE9AA to CE9AM call signs used by stations on the Antarctic continent, and stations on the South Shetlands using CE9AN through CE9AZ calls — not that there are that many calls issued and in use.

I must keep all this in mind, knowing that we have propagation into that part of the world. VP8AI won't do me any good, but maybe on the next kHz...

But my antenna is still north, and I'm wool gathering entirely too much. It's deep Asia we're looking for on this pass. I keep tuning the receiver.

There's a signal with the marks of a long propagation path to it. He's calling CQ. Let's see who it is. OK, it's UH8HGB. I've worked four or five, but I still don't have a QSL, so I'd better give him a call. He's strong enough; maybe I can do this one barefoot, without turning on the linear. He signs, and I call, "UH8HGB UH8HGB DE W9KNI W9KNI W9KNI AR." I use the longish call, because from the sound of his fist he may well be a rather new operator. Ah, he comes right back...

He keeps the contact brief, and that's fine with me. He definitely appears to be a new operator; that's to my advantage, as he's more likely to QSL. We sign clear, and I start my tuning-up-the-band bit again.

There's a signal: "1RT AR," with the marks of another Asian signal impressed from the transpolar path. Hey! Could it be? *Naw, not a chance.* Still, it could be. *Naw, he's never been reported on 15.* Hey, what the heck! No one's calling him, give a call. *Naw, it's a waste of time.* Oh go ahead, you have nothing to lose. *What the heck, see if I care.*

Having settled my internal debate, I bring the VFO up, and try to zero the frequency where I heard the tail end of that station.

"1RT? 1RT? DE W9KNI W9KNI AR K."

"W9KNI W9KNI DE A51RT A51RT GM OM ES TNX CALL..."

I'm in shock. My heart instantly switches into high gear. My hand trembles. I feel like my first oil well came in as an exploding gusher. It's *BHUTAN!* Exotic fastness of the High Himalaya, the land of the Dragon, the land of the Druk, rarest of the rare..."NAME HR RANDHU RANDHU HW COPY? W9KNI DE A51RT KN."

My fingers feel like a funny combination of lead and rubber, but my trusty Bencher paddle picks up, "R A51RT DE W9KNI R TNX RANDHU FOR QSO ES VY PSED QSO RST569 569 QTH HR CHICAGO CHICAGO ES NAME BOB BOB PSE UR QSL FOR NEW COUNTRY HW CPY A51RT DE W9KNI AR KN."

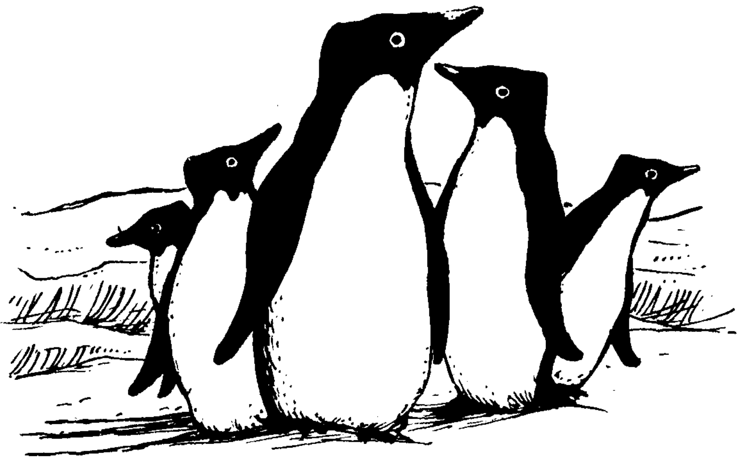
"R W9KNI DE A51RT FB BOB ES TNX RPT FM CHICAGO..."

I pick up my 2-meter microphone, "Hey, I got a good one. It's A51RT, Bhutan, that's A51RT, twenty one oh sixty seven, Alpha Five One Radio Tango, twenty one oh sixty seven, I'm in QSO, from W9KNI."

"...QSL SURE 73 ES GOOD DX FROM THIMPU BOB W9KNI DE A51RT SK."

"R FB RANDHU BEST 73 ES TNX QSL SURE A51RT DE W9KNI SK EE."

I sit there in shock. I can breathe now. There are about a dozen stations calling him. From the sound of it they are mostly locals alerted by my 2-meter call. Got to get the log straight.



I look at my calendar watch; OK it's the 6th. But GMT date would be the 7th, because it's past midnight in Zulu time. I already had the time in the log — 0206 Zulu. I write in the date: A51RT, 21 MHz, 569 X 579, 150 watts.

Hah! That's right, I worked him barefoot. Had I known that he was going to be there, I certainly would have had the linear on and running. I never run the linear until I need it. New finals cost too much to be idly wasting filament time. Besides, my 3-500Z can be fully operational from a cold start in under 10 seconds flat. But I never needed it for this one.

Bhutan! The number of hours I've spent looking for him on 20 meters. Then I nearly break my leg tripping over him on 15. Ah well, as they say, it's not how you get them but how many you get. But you've got to know that I'm going to brag about working Bhutan barefoot.

I listen to the frequency again. Yep, he's still in there...

"TNX JIM FOR QSO ES QSL SURE BK 73 ES DX FM THIMPU MUST QRT NW QRL W9WU DE A51RT SK CL EE."

The 2-meter radio pipes up: "Hey, W9KNI, here's W9WU. Thanks, Bob. For that one I owe you a case of Augsburg, my man!"

You know you've snagged a rare one indeed when WU offers such bestowments.

I listen on to the chatter on 2 meters a couple more minutes. WU certainly is catching a lot of good-natured static about his luck, lack of operating skills, and so forth, from the fellows that came up short when the A51 pulled the switch. WU is thoroughly enjoying it, and, of course, so am I.

But with the band open like this, I ought to keep tuning. I resettle the earphones and begin turning the knob again. I find a couple Siberians, and one UL7, but it becomes obvious that I've milked the path for all it's worth. And its worth was high. The A51 is, and probably always will be, one of the rarest. And I got him barefoot! That's one I'll always remember, I know.

I consider my plan of attack. It's 0220 Z, 9:20 PM Central Daylight Time. And it's 3:20 AM in Western Europe. They're all in bed. I was going to try the African path next, but it's really too early for those fellows to be up; and hearing people calling VP8AI has turned my attention to the far, frozen Antarctic.

I pull the antenna around to 160 degrees, the bearing that my *Second Op* tells me is for the South Orkneys. That's close enough for any of the Antarctic islands. I run the receiver back down to 21,000 kHz and start my hunt back up the band.

I immediately rediscover the problem with tuning this path — very loud South-American stations. First it's LU8DZ, doing a drumbeat on my ears. Then it's PY7RO. But it's natural; the band is obviously wide open, and I'm looking down the jaws of their arrays as they look down mine. No wonder they are 30 and 40 dB over S-9.

There's a CP5; not very common, especially on CW, but I have it, in the log and on the wall. I call it in on 2 meters, and keep tuning.

Suddenly, I find myself in a mini pile-up; perhaps a dozen stations intently signing their calls. Wonder who they're onto? I bring my VFO up quickly. Never hurts to be ready. There. They've all stopped calling now; and yes there's someone coming back.

"589 589 HR BK NAME IS ROGER ROGER ES QTH PORT STANLEY PORT..." OK, it's a VP8 in the Faulkland Islands. Wait, he's signing his call; let's see who he is. OK, it's VP8TN. H'mm. Check my laundry list of VP8s. He's not on it, so let's get him added. There, VP8TN — Faulkland. I won't need to waste time on him in the future trying to crack a pile-up for one I don't need.

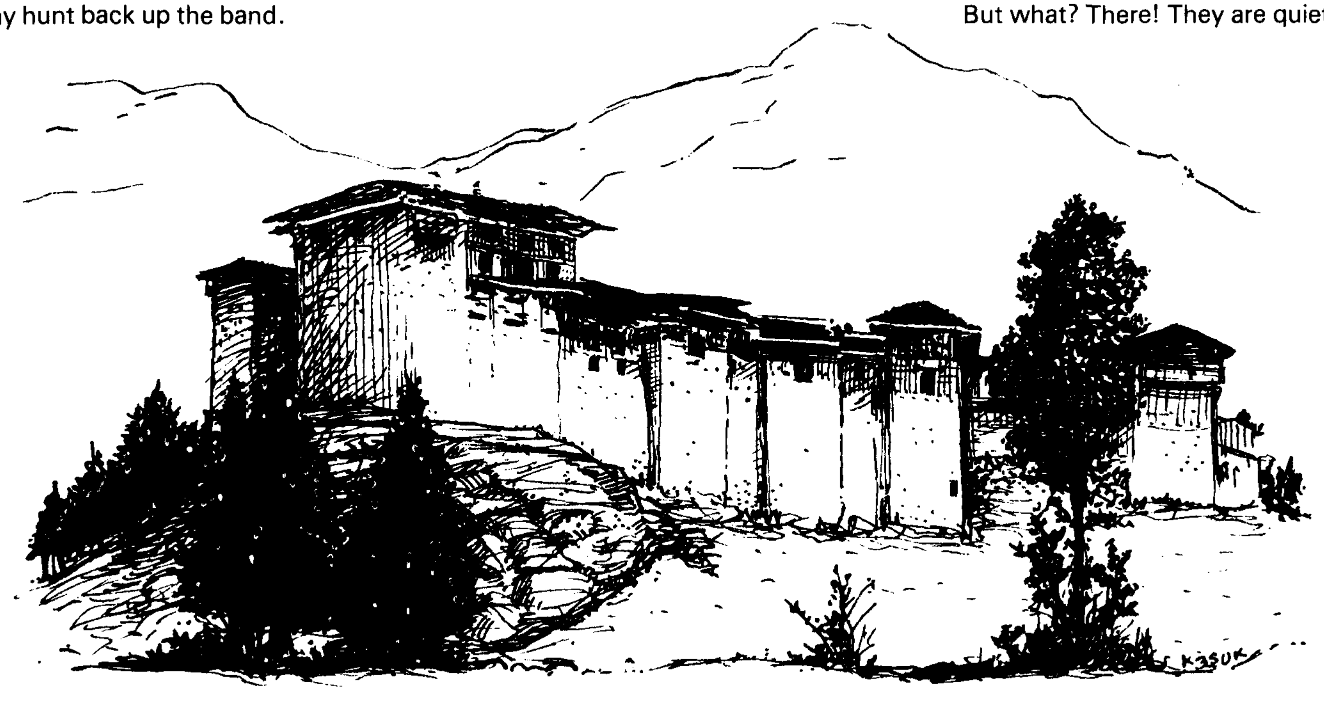
Listen to that crowd call! They sure do seem intent tonight. That's not very nice — he hasn't finished his last QSO. Yeah, there he is. Wait; he's calling QRZ, and yet people all around him keep signing their calls. He's not that weak.

Hey, wait a minute. They're not calling him at all. They are all calling someone else, and from the sounds of it rather frantically. Who?

I wait. The pile-up dies down, and I tune carefully through it looking for their prey. Not a whisper do I hear. Nothing... I run the gain up. Nil. Oh oh. Should I turn my antenna? Where? The side nulls cross, roughly, the path to Europe on the one side, and the path to New Zealand on the other. If the station that the pile-up is after is on frequency and I'm not hearing him, it's a pretty safe bet that he's buried in the side null of my antenna. Otherwise, I should hear something, even if very weakly.

Hey, they're calling again, and there are more of them. There's W3KT. And N4WW. And K5LM. This ain't no Sunday School picnic — the heavies are out in force. As I recognize their calls, and the sense of urgency they display, I myself get hyped.

But what? There! They are quieting



down again. Whomever they are chasing must be back to someone. I hit the antenna rotor, and swing the antenna around to the southwest. Maybe there's something on in the Pacific.

Once again, I strain my ears as the antenna rotor responds to my command. I'm almost crawling into my headphones trying to wring out information. Then I hear, "R LU3ZY DE W3KT R TNX ISIDRO UR 589 589 QTH PA PA NAME HR JESSE JESSE HW COPY? LU3ZY DE W3KT KN." As 3KT signs, a bunch of fellows drop tail end calls.

It's the South Sandwich isles — the rarest of the Antarctic group. Until LU3ZY started up recently, the Islands had been off the air for over ten years. There had been recent reports of activity, but only on Spanish phone, and outside the U.S. phone bands. But now, they apparently are on CW. Hot Dog!

But where is he? I turn the antenna hurriedly back to 160 degrees. That, at least, is one dilemma I'm done with now. He must be working split frequency. Let's start looking lower for him.

I find him almost immediately, as he comes back to someone. Nice signal, too. A clean, honest 579, with a trace of a chirp, probably due to a weak main supply.

No wonder I was confused. The LU3 is listening up five, putting his pile-up squarely on top of the VP8. What a mess. But the LU3 is pretty well in the clear, so we have a good shot at him.

This time I quickly turn the final on. A quick touch up on the tuning after presetting the knobs, and I'm ready. OK, let's see who he's working now. I want to be ready.

"OK JIM ES TNX QSO MUST QRT FOR WATCH DUTY 73 W9VNE DE LU3ZY SK CL."

Agggghhh!

Oh well, I look at the clock, and make note to transfer to my blackboard. OK, it's 0258 Zulu. His watch duty must start at 0300 Zulu. I note the frequency, 21,063. If he's keeping watches, there's a very good chance that he'll be on again tomorrow. And I'll be there. And so will a bunch of others. But that's OK. When I took up DXing nobody promised me a rose garden.

Well, you win a few, you lose a few. But you sure aren't going to get a complaint from me. Bhutan! Wow! I'm still riding high.

I've done enough for one day, a really super day. I turn the rig off, ground the antenna, and head up the stairs. I can just catch the ten o'clock news. Bhutan! Wow!

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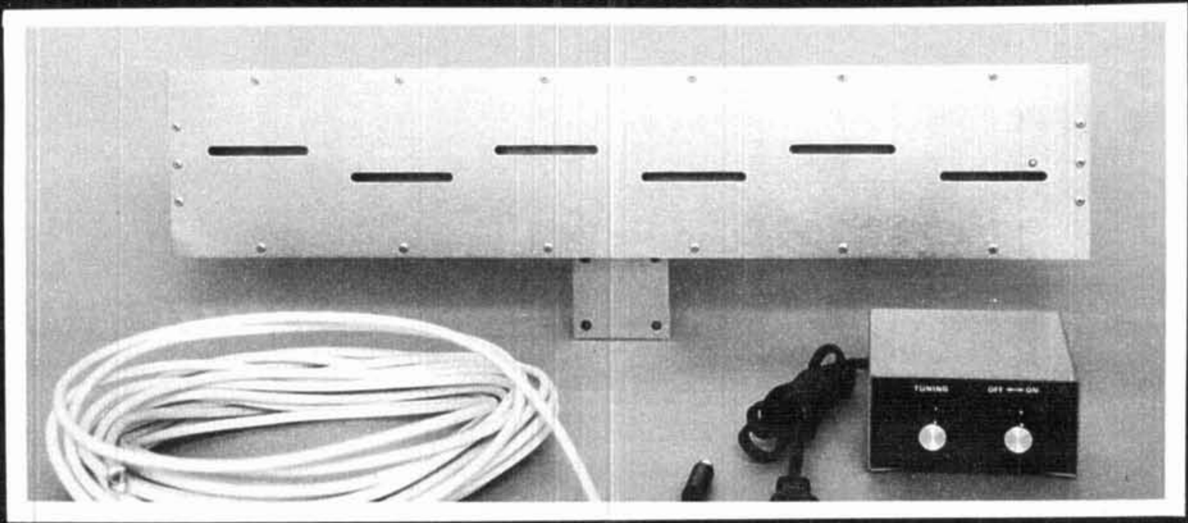

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Fortunately, the simplest remotely operated antenna matcher/tuner for high-frequency mobile operation also just happens to be highly efficient, very effective, and ridiculously easy to operate. It consists of just *one lonely variable capacitor in the car trunk,* tunable from the driver's seat. In my case, this is accomplished using a *limber* 1/4-inch (6.5 mm) plastic rod.

In a typical two-door sedan it's easy to rotate the *capacitor manually from the driver's seat.* With this simple arrangement one can move from 7150 to 7300 kHz with a VSWR not exceeding approximately 1.1. On 75 meters, the VSWR is less than 1.2 over most of the 3800-4000 kHz band; it increases rapidly to about 1.5 at the phone-band edges. The exact numbers will vary slightly with antenna mounting, arrangement, car size, and road surface.

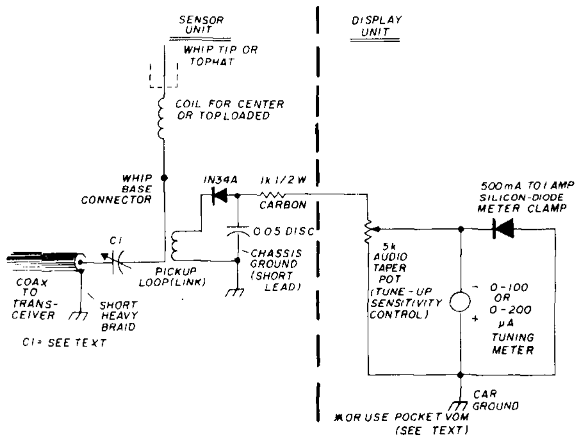


fig. 1. The "Simplest Remote Mobile Antenna Matcher" consists of a sensor and display unit. Mechanical parts consist of a tuning capacitor and a drive shaft, appropriately supported between driver's compartment and antenna.

By Woodrow Smith, W6BCX, 2117 Elden Avenue, Apt. 20, Costa Mesa, California 92627

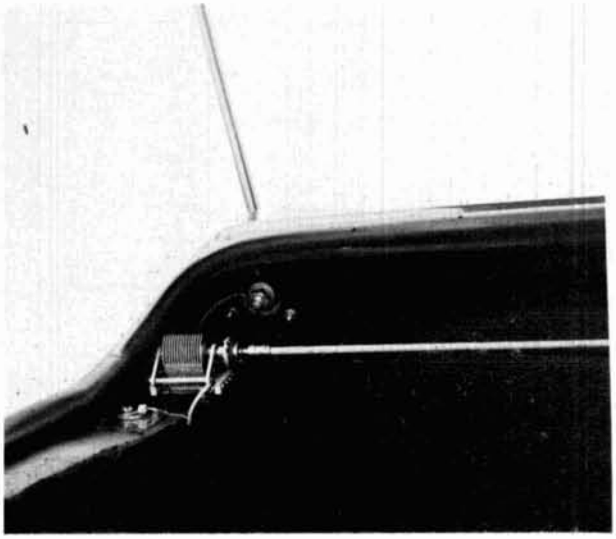
typical application

In my two-door sedan, the limber shaft drives a planetary gear arrangement attached to the capacitor frame. Unfortunately, this method doesn't lend itself too well to a four-door sedan configuration, although it can be done if you're willing to go to the trouble of running the shaft through the passenger compartment at floor level — not an easy trick but still feasible on many four-doors. In this case, the driver reaches down instead of left and over to change frequency.

My Mercury Monarch is probably typical of most compact and intermediate two-door sedans of domestic manufacture circa 1970-80. The limber shaft terminates at a small knob located at the forward edge of the left-quarter plastic trim panel (to the rear of the door frame), slightly above the armrest. The shaft runs snugly against the trim panel and is rarely noticed by passengers. Its height is such that it's possible to reach it briefly without interfering with normal driving tasks. The best height seemed to be about flush with the back of the seat (not the headrest).

Once the antenna for a particular band has been trimmed for equal VSWR at the band edges, it's not necessary to touch the antenna again. Just rotate the capacitor for maximum *radiated* power. (I

Tuning capacitor and limber shaft mounted in author's car. Planetary drive at capacitor prevents backlash and wind-up "hop" by reducing torque at capacitor.



Another view of the tuning capacitor and coupling assembly installed in the author's car trunk.

assume the rig is an all-solid-state transceiver with untuned 50-ohm output).

circuit

One arrangement I've used successfully is shown in **fig. 1**. A small, imported, illuminated tuning meter of questionable ancestry is mounted on the back side of the sun visor (to be at eye level and close enough for easy reading while driving). Voltage to actuate the meter is derived from a 1N34A diode inductively (link) coupled to the lead between the capacitor and the antenna base connection. (Before I found the tuning meter I used a pocket multimeter placed on the seat. It had the advantage of sensitivity selection for tune up, but had the disadvantage of not being at eye level.)

The word *limber* is appropriate in describing the drive shaft because, unlike a flexible shaft with an outer sheath, the limber shaft is simply a 1/4-inch (6.5-mm) shaft stiff enough to avoid objectionable wind-up yet flexible enough to allow for some misalignment, or change in direction.

The limber shaft is made to behave by supporting it in guides spaced at appropriate points (photo). Loose-fitting cable clamps act as shaft guides. The use of the planetary drive unit eliminates backlash and wind-up hop by reducing the torque that the shaft must deliver. At the same time, it acts as a friction brake to discourage the inherently unbalanced capacitor rotor from being vulnerable to shock and vibration.

The planetary drive I used has a ratio of 6.5 to 1, table 1. Readings and observations, 40 meters.

initial conditions		
"High power" 40-meter Hustler resonator (coil and tip) RM-40-S. (Standard resonator RM-40 gave readings nearly identical.)		
obervations		
best VSWR with no shunt or series C		1.15
best VSWR with optimized shunt C (≈260 pF) and tip lengthened accordingly		1.0
best VSWR with optimized series C (≈75 pF) and tip lengthened accordingly		1.0
1.5-VSWR bandwidth; no tuning or adjustments. *(1) no C, (2) optimum shunt C, and (3) optimum* series C		
all three configurations		≈58 kHz
While shunt or series C was required to bring the VSWR below 1.15, the 1.5-VSWR bandwidth with *fixed tuning* is not changed significantly.		
While optimum shunt C can reduce VSWR to approximately 1.0, there's no reactance compensating effect if shunt is optimized as frequency is increased or decreased. Therefore, to make the tunable capacitor effective over as wide a frequency range as possible, it must be in *series*.		
VSWR obtained with resonator tip optimized for 40-meter phone and tuning only with series capacitor	7150 kHz	1.1
	7300 kHz	1.1
VSWR with resonator tip optimized for entire 40-meter band	7000 kHz	1.22
	7300 kHz	1.24

which appears to be about optimum — but anything between 5 to 1 and 10 to 1 should be satisfactory.

A few electronic parts stores carry planetary drives (such as the British-made Jackson Bros.). But if you have trouble locating one, note that they are available as replacement parts for a number of ham transceivers.

My original plan was to rig up a motor-driven mechanism using the actuator from a remotely operated telescoping auto-radio antenna obtained from an auto parts junk yard. However, obtaining and assembling the stuff turned out to be a more formidable task than expected. So I made a lashup using manual drive through the limber shaft. It has been so satisfactory that, nearly three years later, the motor-driven project still is awaiting development.

typical installation

I use two separate and considerably different high-frequency mobile-antenna installations above the same ball mount. The first is a standard Hustler installation and is normally used around town because with it it's easy getting in and out of the garage and driving up to canopied gas pumps (and along residential streets with low telephone lines) without having to worry about the antenna hitting something. The other antenna is much more elaborate and is used only on out-of-town trips.

results

Because the matcher/tuner works equally well with both systems, and because so many Hustler installations are already in use, the VSWR figures (**tables 1** and **2**) are actual readings taken with the standard Hustler installation, and with the car in a vacant parking lot on asphalt paving. Tuner performance isn't significantly different on other paved surfaces or with other top or center-loaded antennas.

To minimize interference and avoid spurious VSWR readings as a result of harmonic output, all readings were made with the smallest amount of drive to my 350-XL final amplifier that would produce usable readings with the VSWR meter set for maximum sensitivity. After all VSWR measurements were completed, the meter made an unofficial visit to a calibration lab, where it was checked for accuracy. Readings below 2.0 on the meter turned out to be sufficiently accurate on the bands of interest that application of a correction factor was not necessary.

table 2. Readings and observations, 75 meters.

initial conditions		
Standard 75 meter Hustler resonator RM-75		
observations		
best VSWR with no shunt or series C, tip length optimized for F		1.4
best VSWR with optimum shunt C (≈600 pF) at center of phone band and tip *lengthened* accordingly		1.0
best VSWR with optimum series C (≈240 pF) at center of phone band and tip *lengthened* accordingly		1.0
1.5-VSWR bandwidth; no tuning or adjustments.		
no shunt or series C (VSWR 1.4 at resonance)		spot frequency only
with optimum shunt or series C at center frequency		≈19 kHz
To stay below 1.5 VSWR, only spot (fixed) frequency operation is possible without shunt or series C.		
Even with optimum shunt or series C at center frequency, it isn't possible to move F very far when tip length and C are fixed.		
VSWR obtained with resonator tip optimized for 75-meter phone band and tuning only with series capacitor	3800 kHz	1.5
	4000 kHz	1.55
Over most of band	better than	1.2

other bands

No readings are shown for 20, 15, and 10 meters because, on those bands, the VSWR will be reasonably low if the capacitor is simply tuned near maximum capacitance once and the antenna pruned as though the capacitor were not in use. If you want to go to the trouble of making the adjustments, though, the VSWR can be reduced to approximately 1.0 over these three bands by making use of the capacitor, as on 40 and 75 meters.

initial adjustments

The initial adjustment that has to be made only once (for each band on which you'll want to take advantage of the capabilities of the capacitor) is simple. It involves trimming the resonator whip length (in the case of a Hustler) or top hat capacitance to the value that gives equal VSWR readings at the band edges when the capacitor is rotated for minimum VSWR. With the 40-meter Hustler resonator, for example, this will involve lengthening the whip perhaps 3 inches (7.6 cm) from the normal midband setting. Once this is done, a VSWR meter is no longer essential, as long as you stay within the band limits, because proper setting of the capacitor can be made simply by tuning for maximum output, as noted elsewhere.

On 75 meters, my 75-meter Hustler resonator "just barely got there" before running out of resonator tip. So I attached a miniature hose clamp above the coil to the top of the fat part of the top section, with the free end of the clamp (about 1-1/2 inches, or 3.8 cm) providing some additional capacitance. While minor adjustments may have to be made to accommodate the variable capacitor, planetary drive, and the limber shaft to a particular car, the considerations will be generally the same.

The best place for the antenna is as *far back* on the left rear fender as possible; or, if you don't want to drill a hole for the ball mount, place it on the left side of the bumper using a bumper mount.

precautions

It's extremely important that a bumper mount be jumpered as directly as possible to the sheet metal of the car body with two separate, flat braids at least 1/2 inch (12.7 mm) wide, terminating at points about 12 inches (30 cm) apart. Drill pilot holes for sheet-metal screws if there are no suitable points of attachment. This is especially important with the new bumpers, like those on my car.

The ball mount (or bumper mount and braid terminations), the tuning capacitor, and the planetary drive unit must *all* be clustered close together, with minimum bend in the limber shaft drive. Some bending of the shaft can be tolerated, as long as it doesn't make too sharp a bend radius anywhere along its length. In my car, the capacitor is mounted on a horizontal and flat section of the fiberboard trunk liner, where it houses the connections to the left-hand stop, turn, tail, and back-up lights. Capacitor frame must be floated.

some final observations

Tuning for maximum power output with a VSWR box is simple if you're parked. But reaching around to tweak the tuning knob, while mentally subtracting the reflected power reading from the forward power reading, is definitely not recommended as something to be accomplished while in traffic. Tuning for maximum output on a single meter at eye level is much quicker and safer. However, you should first make sure that the MAX INDICATOR peak correlates reasonably well with maximum *radiated* power.

In a mobile installation there often are strange currents flowing in the car metal. "Wattless" displacement currents that unintentionally get coupled into a sampling antenna or pickup loop can upset the accuracy of the reading insofar as correlation with the actual radiation well beyond the induction field. At first I obtained an appreciable discrepancy when tuning for maximum "net" power on the VSWR box then peaking the reading obtained with the 1N34 sampler previously described. I found that very effective rf filtering was required on the wire bringing the rectified dc to the driver's position. Also, correlation was better when the very small pickup loop was placed right against the lead between the tuning capacitor and antenna base, rather than the lead between the coax and the capacitor. A larger link spaced from the lead caused some problems with stray fields.

To make absolutely sure that the maximum "net" reading on the VSWR box correlated with maximum *radiated* power, I took field-strength readings at 75 feet (23 meters) through a target spotting scope. The car was parked in a vacant parking lot, with no wires between the field-strength meter and the car.

Correlation between field-strength peak readings and readings on the tune-for-max indicator was, for practical purposes, 100 percent after changes were made in the sampling loop (link) position; one side of the link was grounded *at the link* and filtering of the 1N34A dc lead was improved.

When you get your "world's simplest mobile antenna tuner" installed and ready to go, first make sure your "output power peaker" (if you use one) correlates reasonably well with the *net* readings of the forward and reverse power readings on a VSWR meter. Then you can forget the entire VSWR hassle and tune for MAX, which is more fun than tuning for a dip.

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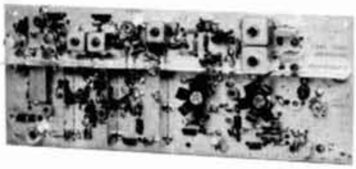

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CA146	146-148	28-30
CA220	220-222	28-30
CA220-2	220-224	144-148
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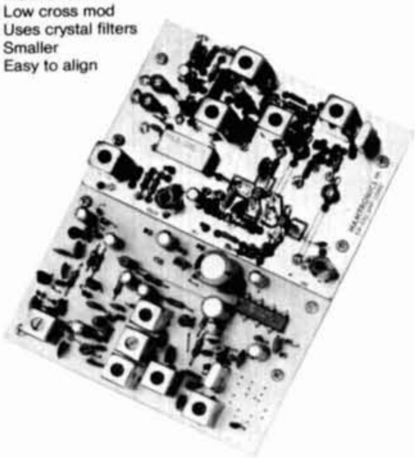

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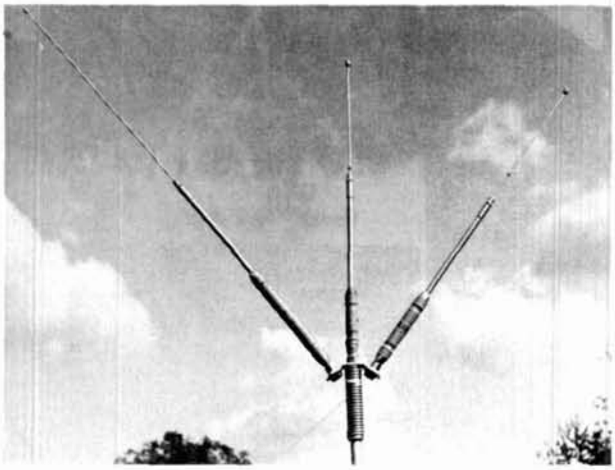
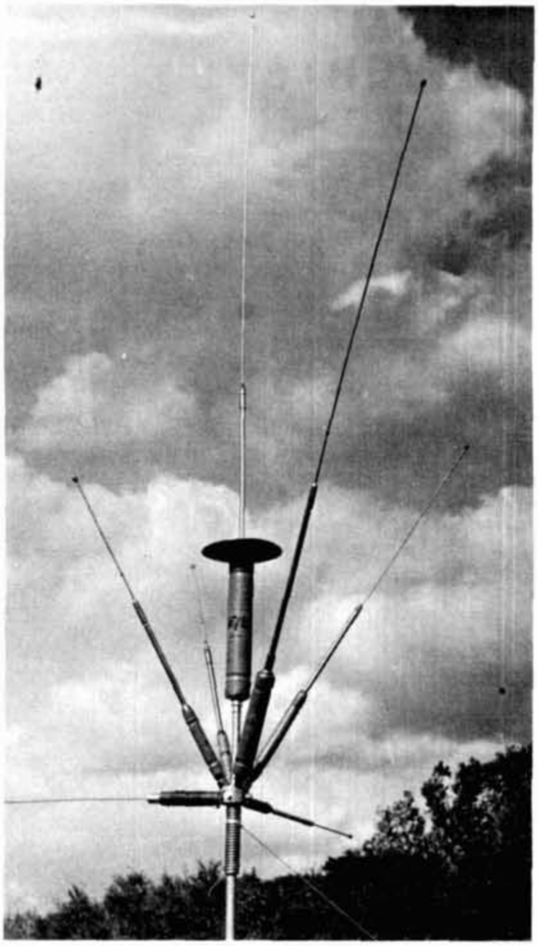
More Details? CHECK—OFF Page 98

Modifications to a popular mobile antenna for multiband operation

Nine-resonator antenna with seven resonators in place (right). Those for 10, 15, 20, 40, and 80 meters are pointing upward. The two horizontal elements are for the new WARC 10-18 MHz bands. Below, complete assembly of the three-band antenna.





refinements to a mobile high-frequency antenna

Ten months to retirement! During the countdown, all my free time was devoted to getting a mobile CW station working in my car. No way would I go on an extended trip without ham radio. An FT 101-B would be my transceiver, and for the radiator I chose the Hustler mobile antenna. I had been going to roll my own, but time was running out.

At first I purchased only the 40-meter resonator with the antenna and mount. This gave me a chance to run some tests and determine the capabilities of such a short antenna mounted on the bumper of the car. **Fig. 1** shows the original installation. The results amazed me! In a few days I worked WAC on 7 MHz from the highways in eastern Pennsylvania. This mobile operating opened up a new dimension for me. I then purchased the four other resonators, tuned them up, and off we went on a two-week trip to Florida. I had more fun working mobile than sightseeing.

During a memorable QSO on 21 MHz, the DX station informed me that 28 MHz was wide open, and he asked me to change frequency, as we needed to make contact only on 10 to complete a five-band exchange. This band change required stopping the

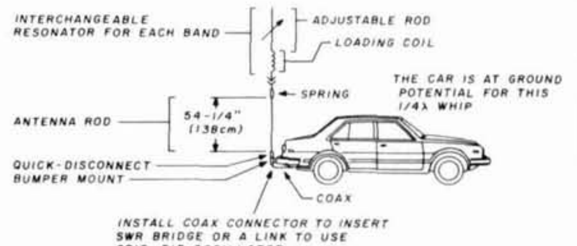
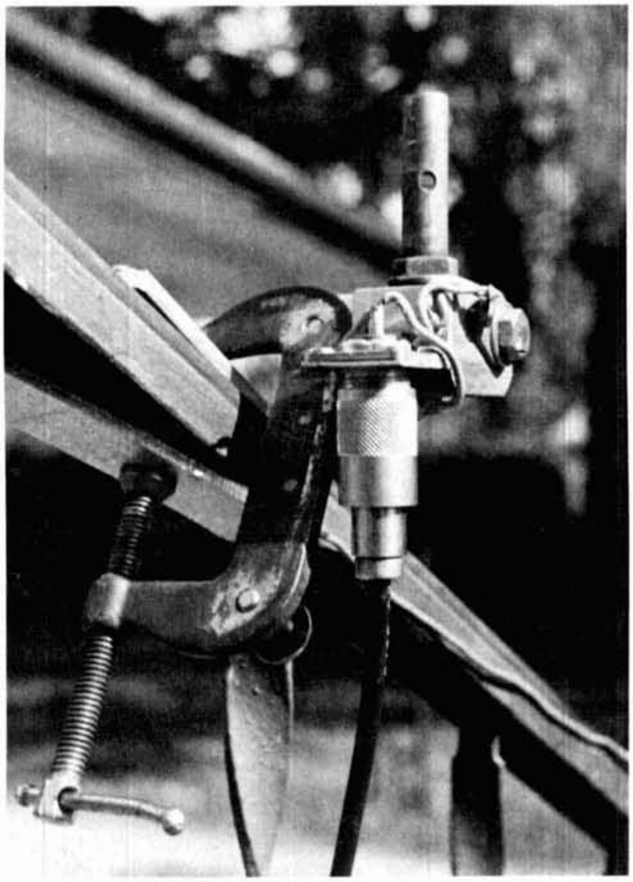


fig. 1. Author's original mobile installation showing bumper-mounted Hustler antenna. Quick disconnect allows easy insertion of test equipment.

By Frederick Hauff, W3NZ, 437 South Lewis Road, Royersford, Pennsylvania 19468



Universal C-clamp mount for the nine-resonator mobile antenna. (The male half of a quick disconnect points up.) Small aluminum pads 1/8-inch (3-mm) thick are installed on each side of railing. Screws in C clamp are for connecting radials.

car, unscrewing the 15-meter resonator, and putting the 10-meter resonator in place. It's not much of an operation, but it was raining. Full of true ham spirit, I made the band change. The contact was completed on 10 meters, which gave me great satisfaction.

This one band change convinced me that all was not ideal with the original setup. Some changes would have to be made if I were to come up with a mobile multiband antenna. This could be a nifty retirement project. I had a feeling that several resonators could be connected together at the bottom end. Here's how I did it.

three-band design

Fig. 2 shows a small bracket that holds three resonators at the same time and reduces their mutual inductive coupling. The 15/10/20 meter resonators were assembled as shown. A Jones Micromatch (SWR bridge) was installed into the feed line. Only a slight adjustment was needed to bring the SWR on the three bands to 1.1 or better. **Table 1** shows the

table 1. Lengths of elements for the three high-frequency bands measured from element end to locking nut.

	amateur band (MHz)		
	28	**21**	**14**
single resonator at end of antenna, inches (mm)	7-5/16 (186)	8 (203)	14 (356)
three resonators mounted for three-band operation, inches (mm)	6-1/2 (165)	7-5/8 (194)	13 (330)

length of the tuning stubs measured from the very end to the end of the locking nut.

I made field-strength measurements on 28 MHz with all three resonators in place, then with only the 28-MHz resonator in place. I detected no change in field strength. But then a friend asked, "What are you going to do about 40 and 80, and what about the new WARC bands?"

nine-resonator design

After a few days in my workshop I came up with a new creation. **Fig. 3** shows the details of a new, lightweight, low-profile adapter that will accept a total of nine resonators. It was made up by using only a small bench lathe and a drill press.

Fig. 4 shows the arrangement of the resonators, including the change in length of the tuning stub. I omitted the 80-meter setup since I could purchase

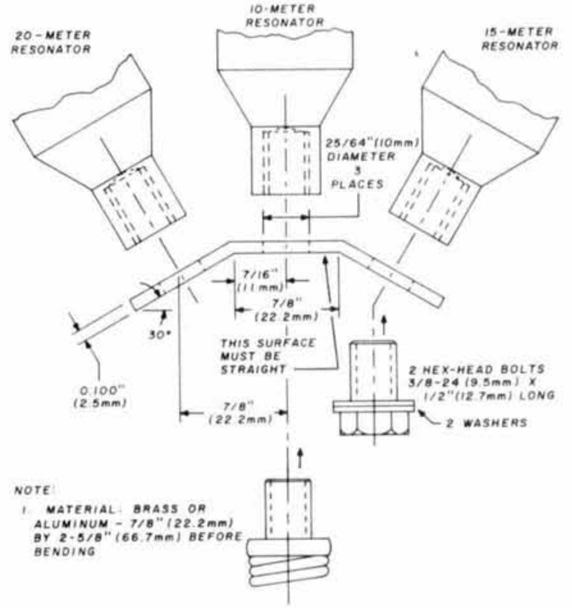


fig. 2. Three-band mobile antenna showing adapter bracket to hold three resonators to the antenna rod (whip) of *fig. 1*.

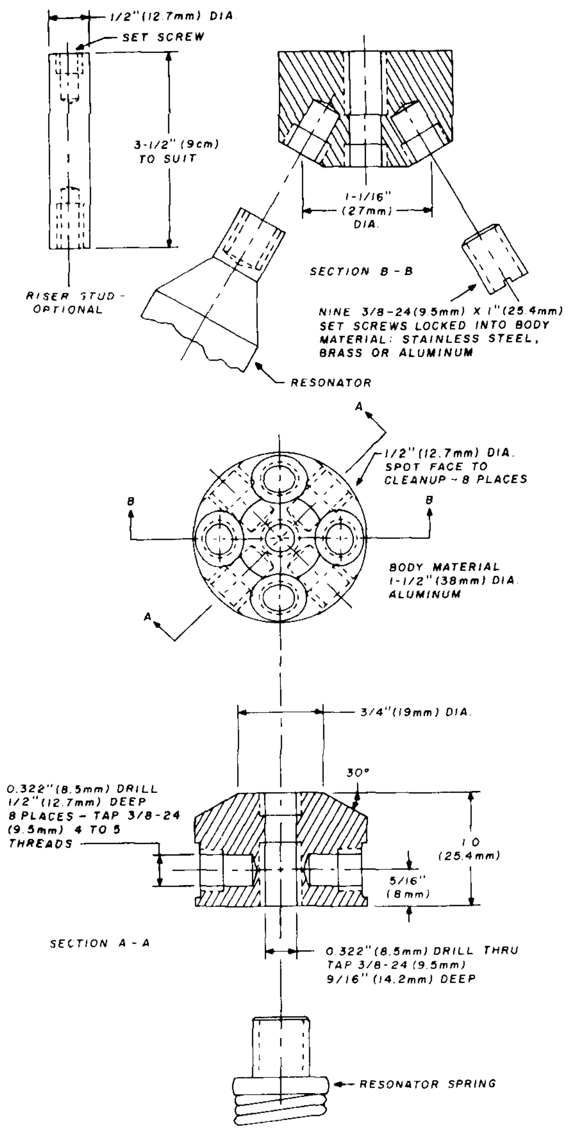
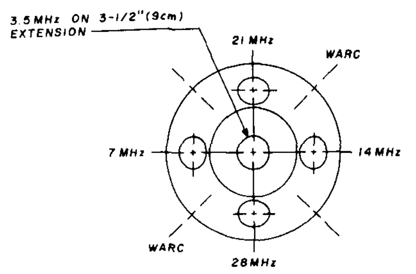


fig. 3. Mechanical details for constructing a nine-resonator adapter.



	AMATEUR BAND (MHz)			
	28	21	14	7
SINGLE RESONATOR, INCHES (mm)	7-5/16 (186)	8 (203)	14 (356)	23-1/2 (597)
FIVE RESONATORS ON ADAPTER, INCHES (mm)	6-1/2 (165)	7-1/2 (190)	12-3/4 (324)	20-5/8 (324)

fig. 4. Arrangement of the different resonators. Table shows lengths of the elements when using a single resonator and when using the resonators and the adapter.

only the resonator for the 75-meter phone band and had to improvise to work on the low end of 80 meters to bring the resonator to frequency. I also installed a disk 4 inches (10 cm) in diameter above the 80-meter loading coil to improve the SWR and also to reduce the length of the tuning stub. The SWR for all five bands is better than 1.15:1.

There is no guarantee that the resonators for the new bands will perform in conjunction with the present-band resonators. There might be too much interaction between some of the loading coils. At one time, I installed two 40-meter resonators. I wanted one tuned to 7025 kHz and the other to 7225 kHz. However, I never was able to accomplish this.

160-meter mobile antenna

It was impossible for me to purchase a resonator for the 160-meter band. I either had to make one myself or just forget about 160-meter operation from the car. I not only wanted to work 160, but was also curious to see what could be done on that band while rolling along. **Fig. 5** shows the details of my 160-meter loading coil. Many experts will have misgivings about using PVC tubing. Since I had nothing else, I tried it, and it has been working just great with the FT 101-B; no breakdowns!

An old telescoping automobile antenna serves as tuning stub, with an aluminum disk 7 inches (18 cm) in diameter between the tuning stub and loading coil.

The adjustment on 160 meters must be precise: usable bandwidth is only 6 kHz. For 1805 kHz, my tuning stub is adjusted to a length of 44-1/8 inches (112 cm) from the coil to the end of the stub.

notes on the directivity of the antenna

While in Florida, I had biweekly schedules with N3WW (distance 1,000 miles). I always had the rear of the car facing toward Pennsylvania. (The antenna is mounted on the rear bumper). We always managed our CW contacts, but at times copy was marginal. One morning a side road was blocked off and I had to

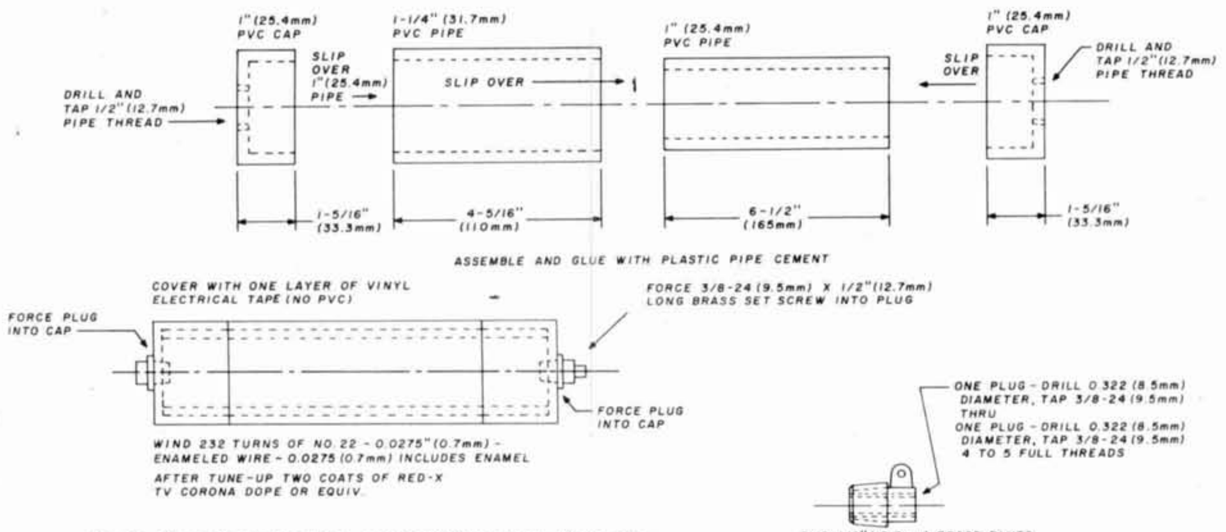


fig. 5. Homebrew loading coil for 160 meters. Note the PVC tubing, which may break down at high rf voltages. This tubing worked well, however, in this installation.

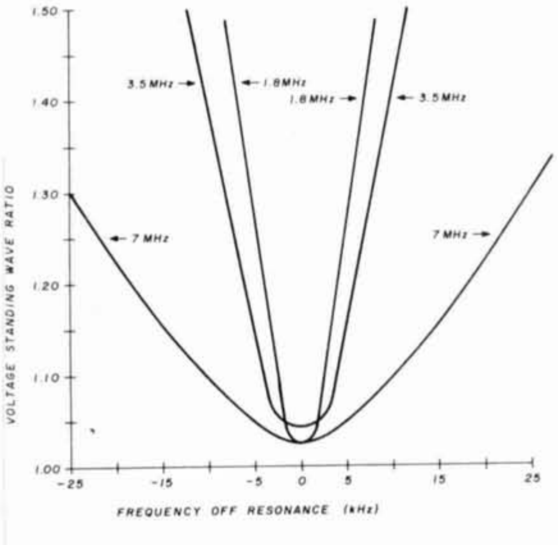
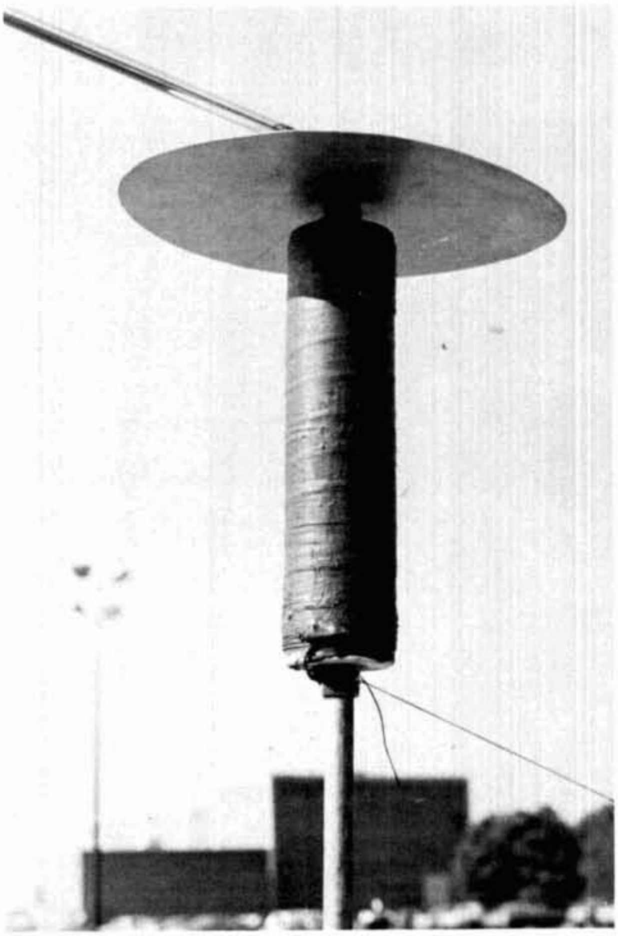
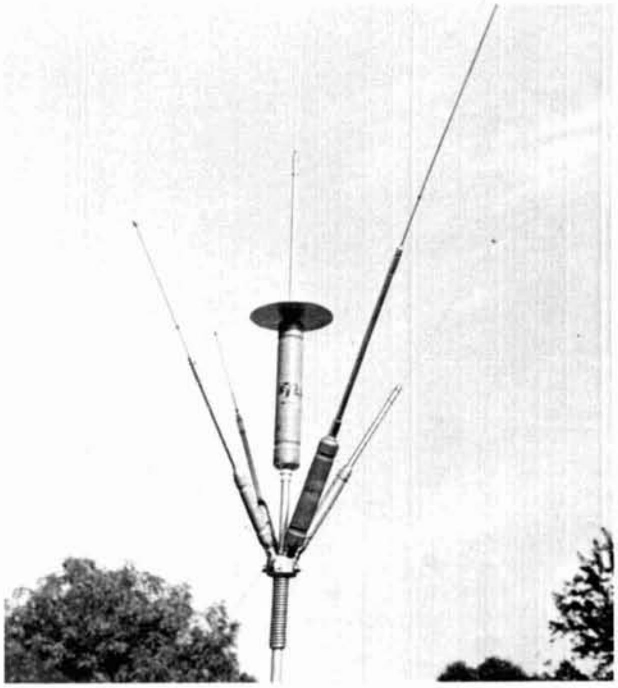


fig. 6. Plot of standing-wave ratio as a function of off-resonance frequency for three bands. Plot for the 160-meter antenna was made separately. Not bad considering the mechanical constraints involved.

make a U turn. I was amazed! The signal from N3WW went from S5 to 20 dB over S9. N3WW started to ask questions about the tremendous increase in signal strength. I made a few more circles with the car. The results were always the same: maximum signal when the front of the car was facing in the direction I was working.



The 160-meter loading coil with 7-inch (18-cm) diameter disk. Tuning stub at top of disk is used to reduce the total height of the antenna to 10 feet (3 meters).



Ready to roll with the five-band mobile antenna. (All resonators tuned to 25 kHz from the low ends of the bands: 10, 15, 20, 40, and 80 meters.)

We made the same tests on 21 MHz. The results were more pronounced: from S5 to 30 dB over S9.

The very same evening we met on 7 MHz and obtained similar results. However, the difference in signal strength was only 2-1/2 S units, and on 80 meters the difference was 1 S unit.

I ran a few tests with some DX stations (3000+ miles). The difference in signal strength was not nearly as spectacular, but a difference was noted.

Every time I now work mobile I feel that I am sitting inside a good beam antenna. I hope I never get carried away and make a U turn on a freeway.

Can anything be worked mobiling on 160? During the 160-meter ARRL contest I was on the beach at Daytona Beach, Florida. In 45 minutes I worked 35 stations. Enough said!

Fig. 6 shows SWR versus frequency for three bands. I had no desire to try the 160-meter antenna in conjunction with any of the others; it's big enough by itself!

No one should have to stay off the air for lack of an antenna. The photo shows a forged C clamp that can be used in various places and situations; for example, on a railing, picnic table, fire escape, rain gutter. However, an effective ground should be provided.

I wish all of you happy mobiling! At least five bands are available by the flip of the radio's bandswitch.

ham radio

ham radio TECHNIQUES

Bill Orr W6SAI

One-sixty meters is Amateur Radio's grandpa band. This band is where it all started after the experts said that wavelengths below the broadcast band (short waves) were useless for radio communications. But the hams proved otherwise. And now, many years after Amateur Radio pioneered shortwave communications, 160 meters is still flourishing. It is the *elite* ham band. Working on 160 meters requires a special kind of discipline. And there's a gentleman's agreement about operating practices that's not evident in the higher-frequency (shorter wavelength) Amateur bands. Operating on "top band" is a real challenge.

In this month's article, pioneer Bill Orr tells how to make a simple but effective transmitter for 160 meters that will provide many hours of enjoyment — easy to build and easy to get going. **Editor**

The year 1933 was a harsh one for most Americans. The economy was in a shambles. The discredited Administration had been swept out of office in the 1932 election landslide, and there was an ominous pause in the heartbeat of America before the new President took office in March of 1933. The economic clock of the country had run down.

Between the crash of 1929 and the new year of 1933, the economy had gone from bad to worse. Business was at a standstill. Unemployment ran as high as sixty percent in some cities. Hordes of men and boys roamed the countryside, looking for work or a handout. The Southern Pacific Railroad testified before Congress that it had thrown more than 680,000 vagrants off freight trains during 1932.

Those lucky enough to have a job during these hard times had little, if any, money left over for pleasure or amusement. Jobs were scarce and low paying. An offer of 20 dollars a week, or even 30 cents an hour, was enough to create a long line of job hunters. Lucky kids got an allowance of ten cents a week. Apartments rented for 20 dollars a month, movie admission was 15 to 25 cents, with kids at 10 cents. And a good hotel room was $4.50 a day.

Viewed by today's standards, 1933 was a very different time. There were no copying machines, clock radios, ball-point pens, televisions, automatic dishwashers, or zip codes — and only a few electric refrigerators. Amateur Radio was blissfully unaware of single sideband, SWR meters, DXCC, slow-scan television, transceivers, beam antennas, and all the other goodies of modern communications that we take for granted today.

It wasn't easy to buy ham gear in 1933. The market was small, and not many stores or manufacturers catered to Amateur Radio enthusiasts. The prices of receivers and components were astronomical despite the depression. Bearing in mind that the 1933 dollar had about ten times the purchasing power of today's dollar, prices of ham equipment were staggering, especially to the unemployed Amateur.

getting on the air in 1933

Many hams were not on the air, because it was an expensive and time-consuming chore. Paradoxically, this was a period of great growth in Amateur Radio. The number of licensed Amateurs exploded, almost doubling between 1932 and 1934. Perhaps this was a result of there being many people with plenty of time on their hands, or a result of the demise of the broadcast-receiver-building boom, which all but ended with the introduction of the all-ac-operated receiver — who knows? In any event, the pressing problem was how to get on the air with a thin purse.

Other factors complicated the problem. Buying on credit was almost unknown. Radio equipment was sold strictly on a cash-and-carry basis. There were no credit cards, no 800 phone numbers, and little manufactured ham gear. Amateurs, in fact, took pride in homemade stations; and the rare, affluent Amateur with "store bought" equipment was viewed as something of an eccentric.

Nevertheless, by the time his ham license came in the mail from the Federal Radio Commission (the grandfather of the FCC), the would-be Amateur probably had a two-tube regenerative receiver set ready to go for ham work. The transmitter, unfortunately, was more of a problem.

The solution was to build a simple transmitter out of readily available parts from defunct battery-radio receivers. Old five-tube, battery-operated, receiver chassis could be obtained on "radio row" in most cities for twenty-five or fifty cents, often complete with tubes. Armed with one or two old receivers, the new ham was ready to begin building a transmitter from the components. If the components were not just right, he could swap them with other money-short Amateurs to try and get what he needed.

what to build? what band to choose?

Once a junkbox of parts was at hand, the next problem was to determine the band of operation and the transmitter circuit. Bandswitching transmitters were unknown, and band changing, attempted by the more sophisticated Amateurs, required a basket-full of plug-in coils. Most Amateurs stayed on one band for a long period of time because economics forced them to do it. These fellows depended on *QST* for ideas.

Ten meters was an unknown quantity; fifteen meters did not exist. It was difficult to get a transmitter to work on a frequency as high as 20 meters, and many would-be DXers gave up in disgust. *QRM* was heavy on 40 meters (strictly a CW band — no phone allowed). And 80 meters was chock full of traffic nets. Indeed, the greatest portion of Amateur activity was on the 80-meter band.

That left 160 meters. And this was *the* popular beginner's band and the home of the inexpensive, home-built station. Many beginners opted for 160 meters, and spent their formative years on this band.

The CW portion of the 160-meter band extended from 1715 kHz to 1800 kHz. Canadian phones occupied the portion from about 1770 kHz to 1800 kHz, and that left a nice, 55-kHz-wide band segment open to CW operation, with little QRM. And on a good night, contacts up to 500 miles or more were possible.

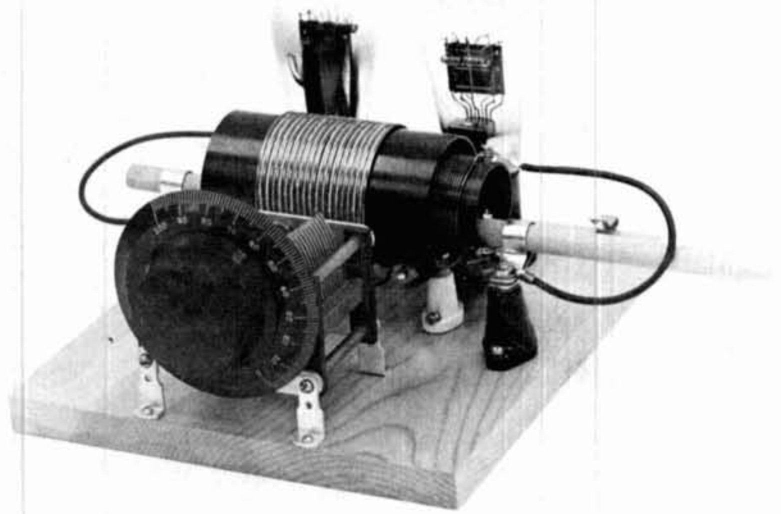


fig. 1. A 1981 replica of a 1933 transmitter. This little 40-watt oscillator provides a clean CW signal for 160-meter operation. It is built upon a "breadboard" in the true tradition of yesterday. The frequency-setting capacitor and dial are in the foreground; the oscillator tank coil is directly behind it. This coil is wound with enamel wire, slightly spaced by winding string between the turns. The coil is given a spray coat of air-dry plastic cement. Note that the string is left in the winding.

The antenna coil is wound on a smaller-diameter Bakelite (phenolic) tube attached to a dowel rod. The rod is mounted in clamps affixed to insulators. This arrangement permits the coupling between the coils to be adjusted for best oscillator performance. Tube sockets and grid capacitors are mounted to the rear of the breadboard.

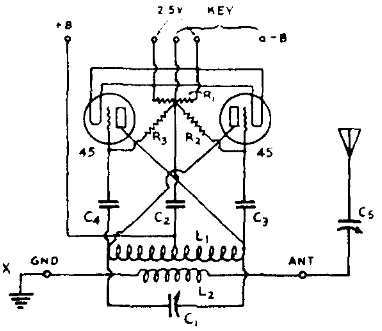
let's build a replica transmitter

Several circuits were at hand that would work. The proven Hartley, and the TNT (tuned, not tuned) circuits were good ones. But a newer, more simplified design was gaining popularity: the unity-coupled Hartley oscillator (**fig. 1**). This simple circuit used two receiving-type tubes in push-pull and two or three fixed capacitors and resistors. The whole works could be built on a breadboard in a few hours. The two 245 receiving tubes* could be operated at up to 400 volts at 100 milliamperes, providing a respectable 40 watts input and an output of about 20 watts. That's plenty of power to work a lot of DX.

Construction information on this interesting transmitter appeared in the August, 1933, issue of *QST* magazine. Since most new hams didn't have the $2.50 for an ARRL membership (which included *QST*), they either bought a copy (25 cents) at the local magazine and cigar store or got a penciled sketch of the schematic from a friend.

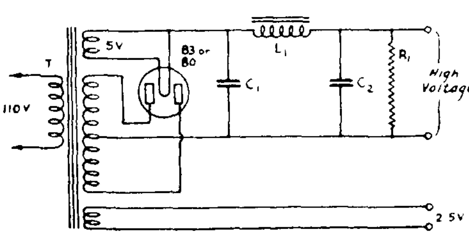
The transmitter is built on a breadboard measuring 9 inches wide and 10 inches deep (23 × 25 cm). Since breadboards, as such, are now nearly defunct, you can build your replica on a piece of plywood or shelving. The

*The UX245 triode was used in the audio amplifier circuit of many broadcast receivers. They provided the nucleus of many early Amateur shortwave transmitters. If you were able to scrounge a type UX210, then your ham rig could run even higher power — provided you had higher plate voltage. **Editor**



— *THE PUSH-PULL SERIES FEED HARTLEY CIRCUIT USED IN THE 1750-KC. TRANSMITTER*

C_1 — *500-μμfd. variable condenser (Cardwell 123-B).*
C_2 — *.002-μfd. mica condenser (Aerovox Type 1450).*
C_3, C_4 — *.0001-μfd. mica condensers (Aerovox Type 1450).*
C_5 — *250-500-μμfd. variable condenser, any type.*
R_1 — *20-ohm center-tapped resistor.*
R_2, R_3 — *100,000-ohm, 2 watt resistors, non-inductive (I.R.C.).*
L_1 — *22 turns No. 12 enamelled wire on 2½ inch bakelite tube; turns spaced with string to make length of winding 2½ inches.*
L_2 — *20 turns No. 16 enamelled wire on 1½-inch bakelite tube; no spacing between turns.*



— SUGGESTED POWER SUPPLY CIRCUIT

T — *Receiver power pack transformer delivering 2.5 volts at 3 or more amps., 5 volts for rectifier tube, and having a high-voltage winding for 350 volts each side center tap.*
L_1 — *30-henry, 100-ma. filter choke.*
C_1, C_2 — *8-μfd. 500-volt electrolytic condensers.*
R_1 — *25,000-ohm, 25-watt resistor.*

fig. 2. Schematic diagrams of the original 1933 transmitter. The 1981 version has only 18 turns in the tank coil to move the operating frequency from 1750 kHz to 1800 kHz. A regulated power supply is suggested instead of the capacitor-input supply shown. (Circuits from *QST* magazine.)

board is given a few coats of shellac or varnish before work is started.

The tuning capacitor and tank coil, the heart of the oscillator, are mounted at the center of the board, with the two tubes mounted immediately to the rear. The schematic diagram (**fig. 2**) is arranged somewhat in the same manner in which the components are mounted to the board. Notice that the circuit is push-pull, with the grids cross-connected to the plates of each tube. When the circuit is oscillating, the peak grid voltage of one tube will be equal to the peak plate voltage of the other. Since the 245 triode tubes have a very low amplification factor (3.5), this provides just about the right arrangement for Class-C service — the grid swing being equal to the plate swing over the operating cycle.

Grid excitation is controlled to a degree by the small size of the grid-coupling capacitors, which form an rf voltage divider when considered in conjunction with the grid resistors. In any event, it all works smoothly, and the circuit is a steady, reliable oscillator.

the tank coil

The tank coil is wound with No. 12 (2.1 mm) wire, as it carries high circulating current in this high-C oscillator circuit. The antenna coil, which is somewhat smaller in diameter, slides in and out of the tank coil, supported on a wooden dowel rod affixed to two standoff insulators.

Variable coupling is achieved by sliding the antenna coil back and forth until proper antenna loading is achieved, in the manner of the pre-World War I "loose couplers." The dowel rod slides back and forth in small clamps made from thin aluminum stock; the clamps are bolted to the authentic, brown standoff insulators. The antenna coil is bolted to the dowel rod, and connections between the coil and the insulators (which also serve as connections for antenna and ground) are made with flexible wire, normally used for test leads.

the antenna — tuning up

The 1933-type antenna works just as well today as it did then — a simple Marconi of about 120 feet (37 meters) working against a good ground.

To get things going, the transmitter requires a filament supply of 2.5 volts ac at 3 amperes. The plate supply may be anything between 300 and 400 volts dc at 100 mA, well regulated. A voltage-regulated supply will be helpful in obtaining a good CW note from this simple transmitter.

The frequency is set within the band with the aid of an external monitor receiver, with the plate-tank tuning capacitor being about 75 percent meshed. Antenna coupling is loose; that is, the coil is pulled out as far as it will go. The antenna is then tuned to resonance, as noted by 1) a change in oscillator plate current (which is running quite low), and 2) a change in frequency, as noted in the monitor receiver. Antenna coupling is increased (with a corresponding increase in plate current) to provide the greatest power output consistent with good frequency stability under keying. It's not hard to reach a compromise, with plate current running 80 to 100 mA.

One point should be noted: the oscillator is directly coupled to the antenna and an antenna swinging in the breeze will cause the note of the little transmitter to waver a bit. Loose coupling to the antenna helps eliminate this annoying problem.

getting on the air

Now that you have built your replica of the 1933 transmitter what can you do with it? Easy! Work stations! The CW segment of the 160-meter band runs from 1800 kHz to about 1820 kHz, with some CW activity in other portions of the band, depending upon the geographical division of the band: see the *ARRL Handbook* for details. Operation close to a band edge *is not* recommended unless the frequency is *carefully monitored*.

But you can work plenty of stations with this midget transmitter. Most modern hams will express a sense of awe and amazement at working a 1933-style, breadboard transmitter. But not one in ten will guess it from the CW note this little transmitter puts out. And, even if you don't put it on the air, it certainly is an interesting conversation piece, worthy of a place of honor in your radio shack!

old-time radio equipment

A growing number of today's Amateurs are taking a great interest in old-time Amateur gear. Old radio magazines are a treasure trove of circuits and information. Old tubes and components (while not available at the corner *Radio Shack*) can usually be picked up at flea markets and from older Amateurs who still maintain a junkbox. Compared with today's equipment, the old circuits are simple and straightforward.

It's fun to build up the old gear and get it on the air, and various contests take place from time to time based on the use of home-built replicas of yesterday's equipment.

Want more information? I suggest you write to the Antique Wireless Association for details: Bruce Kelley, W2ICE, Holcomb, New York 14469.

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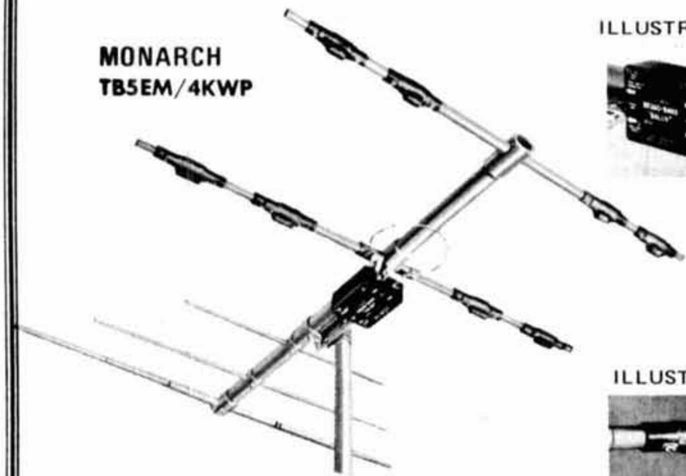

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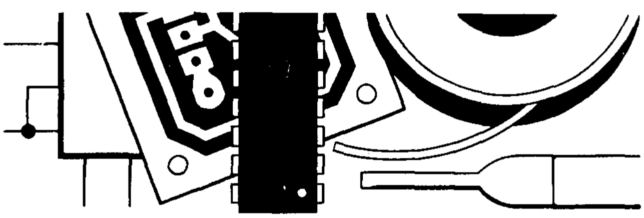

stabilizing the DenTron 160XV transverter

My DenTron 160XV Transverter sat quietly unused in a corner of the station for many months after I had bought it for a standby rig. One fine day I was conned into a 160-meter schedule without my main rig for 160, since it had been borrowed by the ham who made the schedule. On tuneup, the DenTron had a plate current peak instead of the traditional dip (anyone remember tubes?). Worse, severe distortion showed on the scope and on the air. When the set was in the bypass position and the relay keyed, even with no drive applied, bright arcs flew across the plate tuning capacitor. These are all symptoms of self-oscillation – positive feedback.

I had noticed similar symptoms some years ago with another 160XV. A call to the factory implicated C15 and C16, 0.01-μF and 150-pF capacitors respectively, as occasionally subject to breakdown. These two large disc ceramic capacitors, which couple the output of the 6146B to the pi network, are located on the printed circuit board just about under the large air-wound coil, L9, and just to the left of two runs of small coaxial cable, when looking at the set with the front panel facing you. Replacing these didn't solve my problem, but it's worth a try, as failure of the capacitors could cause stability problems.

By Peter Ferrand, WB2QLL, 355 Lake Street, Nashua, New Hampshire 03060

A close inspection of the physical layout of the output circuit proved more rewarding. From the top of the 6146B plate choke the output rf is carried down a piece of bare wire to the circuit board, where it runs on a trace to C15 and the pi network. The problem is that this trace is less than 0.1 inch (3 mm) away from the grid-circuit trace. It turns out that coupling occurs across the two nearly parallel traces, with a consequent tendency toward self-oscillation.

The fix is very simple. Unsolder the circuit board end of the vertical bare wire next to the 6146B (and its plate choke) and swing the free end around the choke in a counter clockwise direction, until it is between C15 and C16. Then remove C15, the 0.15-μF, 1.6-kV capacitor, and solder one end of it *above the board* to the same side of C16, the 150-pF, 4-kV capacitor to which it had been connected below the board. Then solder the free end of C15 to the free end of the bare wire you unsoldered previously. What you have achieved is to redirect the rf output away from the grid circuit around the 6146B socket; the circuit itself remains unchanged.

Next we go back to the bottom of the board, to the trace to which C15 had been connected, and tie it to ground as a partial shield. Solder a wire from the trace (identified on my unit with a "J") to the nearest handy ground, pin 2 of the 6146B. While we're at the 6146 note that the tube's filament is not bypassed. I didn't notice any difference, but on general principles connect a 0.01-μF capacitor from pin 7 to the ground foil.

That's about all there is to it. The transverter will now put out its 70 watts. Turning the plate tuning control will produce a plate current dip simultaneously with output power peak, with no arcs or sparks. You have created stability in an unstable world.

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ham radio readers' survey

Here's your chance to get into the act and help shape the destiny of *ham radio* magazine. It's been six months since we started publishing the new *ham radio* incorporating Ham Radio HORIZONS. We've made a lot of changes. How do you like them?

We've made these changes in an effort to satisfy our former HORIZONS readers and also to include suggestions we've received in recent years from our *ham radio* readers. We've read your letters and talked to hundreds of you at various hamfests. Are we heading in the right direction? We think so, but we must know for sure. So here's a little questionnaire that will give you a chance to tell us what you like, and dislike, about the new *ham radio*.

It's not often you get a chance to tell magazine folks what they're doing right and what they're doing wrong. So please take a few minutes and fill out the questionnaire. If you'd rather not remove a page from your magazine, just send us an SASE and we'll ship you a page by return mail.

We've been doing our best to bring you the very finest magazine in its field. Now it's your turn to tell us what *you* think. If you'd like to add your own comments, just jot them down on a separate sheet of paper and send them in.

1. Before the merging of Ham Radio HORIZONS, which were you?

a) *ham radio* reader only ____
b) Ham Radio HORIZONS reader only ____
c) A reader of both magazines ____
d) A reader of neither magazine ____

2. Where do you get your copy of *ham radio* each month?

a) I am a subscriber ____
b) Buy it in a store ____
c) Read a friend's copy ____
d) Read it in a library ____

3. How do you feel about the content of the new *ham radio*?

a) Better ____
b) As good ____
c) Not as good ____

4. How do you feel about the appearance of the new *ham radio*?

a) Better ____
b) As good ____
c) Not as good ____

5. What are your three favorite types of articles in *ham radio*? (List the ones you like the most first.)

a) ____
b) ____
c) ____

6. What types of articles do you like the least in *ham radio*? (List the ones you dislike the most first.)

a) ____
b) ____
c) ____

7. Please list, in order of your preference, the Amateur magazines that you read regularly. Do not include those you do not see most months. Just put the name of the publication next to the number.

1st ____
2nd ____
3rd ____
4th ____
5th ____

8. What features (if any) would you like to see added to *ham radio*?

____
____
____

9. How much of your equipment do you build?

a) 100% ____
b) 50% ____
c) 25% ____
d) 10% ____
e) none ____

10. What is your license class? ____

11. How many years have you been licensed? ____

12. What is your age? ____

13. What is your occupation? ____

14. What is your income bracket?

a) Under $8,000 ____
b) $8,000-$12,999 ____
c) $13,000-$19,999 ____
d) $20,000-$29,999 ____
e) $30,000-$49,999 ____
f) $50,000 and over ____

15. What bands do you work regularly?

____
____

16. What modes do you work regularly?

____

17. How much per year do you usually spend on Amateur Radio equipment and Amateur Radio related activities?

a) Under $500 ____
b) $500-$999 ____
c) $1,000-$1,999 ____
d) Over ____

ham radio

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  Even though the TR-7730 is so compact, it still produces 25 watts output for reliable mobile communications. HI/LOW power switch selects 25-W or 5-W output.
- **Five memories**
  May be operated in simplex mode or repeater mode with the transmit frequency offset ±600 kHz. The fifth memory stores both receive and transmit frequency independently, to allow operation on repeaters with nonstandard splits. Memory backup terminal on rear panel.
- **Memory scan**
  Automatically locks on busy memory channel and resumes when signal disappears or when SCAN switch is pushed. Scan HOLD or microphone PTT switch cancels scan.
- **Extended frequency coverage**
  Covers 143.900-148.995 MHz in switchable 5-kHz or 10-kHz steps, allowing simplex and repeater operation on some MARS and CAP frequencies.
- **Automatic band scan**
  Scans entire band in 5-kHz or 10-kHz steps and locks on busy channel. Scan resumes when signal disappears or when SCAN switch is pushed. Scan HOLD or microphone PTT switch cancels scan.
- **UP/DOWN manual scan**
  With UP/DOWN microphone provided, manually scans entire band in 5-kHz or 10-kHz steps.
- **Offset switch**
  Allows VFO and four of five memory frequencies to be offset ±600 kHz for repeater access (or to be operated simplex) during transmit mode.
- **Four-digit LED frequency display**
  Indicates receive and transmit frequency during simplex or repeater-offset operation.
- **S/RF bar meter and LED indicators**
  Bar meter of multicolor LEDs shows relative receive and transmit signal levels. Other LEDs indicate BUSY, ON AIR, and REPEATER offset.
- **Tone switch**
  Activates internal subaudible tone encoder (not Kenwood-supplied).

Optional accessories:

- **MC-46** 16-button autopatch (DTMF) UP/DOWN microphone
- **SP-40** compact mobile speaker
- **KPS-7** fixed-station power supply

More information on the TR-7730 and TR-8400 is available from all authorized dealers of Trio-Kenwood Communications, Inc., 1111 West Walnut Street, Compton, California 90220.

TR-7730 is subject to FCC approval.

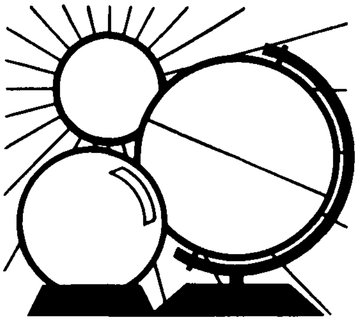
KENWOOD
...pacesetter in amateur radio

Synthesized 70-cm FM mobile rig

TR-8400

- **Synthesized coverage of 440-450 MHz**
  Covers upper 10 MHz of 70-cm band in 25-kHz steps, with two VFOs.
- **Offset switch**
  For ±5 MHz transmit offset on both VFOs and four of five memories, as well as simplex operation. Fifth memory allows any other offset by memorizing receive and transmit frequencies independently.
- **HI/LOW RF output power switch**
  Selects 10 watts or 1 watt output.
- **DTMF autopatch terminal**
  On rear panel, for connecting DTMF (dual-tone multifrequency) touch pad (for accessing autopatches) or other tone-signaling device.
- **Virtually same size as TR-7730**
  Perfect companion for TR-7730 in a compact mobile arrangement.
- **Other features similar to TR-7730**
  Five memories, memory scan, automatic band scan (in 25-kHz steps), UP/DOWN manual scan, four-digit LED receive frequency display (also shows transmit frequency in memory 5), S/RF bar meter and LED indicators, tone switch, DTMF autopatch terminal, and same optional accessories.

Specifications and prices are subject to change without notice or obligation.



DX FORECASTER

Garth Stonehocker, KØRYW

last-minute forecast

The lower-frequency bands are expected to be favored for DX during the first week of the month if the summer QRN isn't too bad by then. DX conditions for the higher-frequency bands should improve by mid month, decrease until about the 24th, then increase somewhat toward the end of the month in time for field day. Propagation disturbances are expected around the 6th and 18th. The first disturbance may bring DX from unusual locations on the lower frequencies in east-west directions, while the latter disturbance may show good one-hop trans-equatorial openings on the higher bands.

Lunar perigee comes twice this month, on the 2nd and 30th, and the full moon on the 17th. The longest day of the year, summer solstice, is on the 21st at 1145 GMT and begins our summer season. It also ushers in the sporadic-E season in full swing to make the short-skip openings the rule rather than the exception (see last month's DX Forecaster).

DX conditions during summer are usually not as good as those during other seasons of the year because of propagated static noise from evening thunderstorms on the lower-frequency bands. The higher-frequency bands have lower maximum usable frequencies (no 6-meter, F-region-propagated openings). This is somewhat compensated for by having more hours for operating becoming available because of longer daylight, and also by openings from sporadic-E. Sporadic-E openings often occur on 6 meters and once in a while on 2 meters. This keeps life interesting.

some shop talk

The accuracy of forecasting and predictions is inversely related to the length of time in advance that the forecast or prediction is made or desired. Those that are made a long time in advance are generally known as predictions and are based on a reasonably accurate sunspot number for the year and season. They are usually made with the help of a computer. This enables one to sample the stored ionospheric information to find the maximum usable frequencies and propagated signal strengths by use of simplified radio-wave tracing techniques. The time scale here is on the order of months or years in advance, and the data are used mainly by engineers to design equipment and antennas for transmitting between two points. The prediction tables and graphs in the ham magazines are usually done this way because of the long publication lead times. For more detailed information see *ham radio* for April and September 1979.

Forecasting techniques are more akin to weather forecasting. They run from the present into the next few hours or days in advance. Forecasting is a way of updating the prediction method in a day-by-day or even hour-by-hour dynamic fashion for better accuracy. More on this technique later.

band-by-band summary

Ten and fifteen meters should give excellent daytime openings to most worldwide locations on both F-region long skip to 2500 miles (4000 km) and sporadic-E short skip to 1200 miles (2000 km) or multiples thereof on many days of the month. Don't expect as much one-hop trans-equatorial DX during disturbed periods this time of the year. June, July, and August are off-months for the F-region ionization to pile up on either side of the magnetic equator as it does from equinox through the winter to equinox. The ionization is down in the E region, making sporadic-E layers in the summer.

Twenty meters will be open to some area of the world for nearly all hours of the day and night. Sporadic-E propagation will fill in the pre-sunrise dip in usable frequencies during many mornings to make round-the-clock openings possible. The direction of the openings will not be much different than usual, and the openings will be extended in time.

Forty meters will give the best DX during the night from sunset until just after sunrise. Static levels may be high at times. Watch for local storm passages and operate near sporadic-E peaks around sunrise and sunset (particularly sunrise, when fewer thunderstorms have built up).

Eighty meters on some nights (during hours of darkness until sunrise) can have DX openings to areas of interest. Static from thunderstorm activity, long distance and local, may limit working the rare ones when propagation is otherwise right. Coastal stations usually have more favorable propagation geometry under summer conditions for working the rare DX than inland stations. Sporadic-E propagation around sunrise and sunset is good for this band also. Daytime work will be limited to within about 200 miles (360 km).

One-sixty-meter DX activities really require a lot of work this time of year. During hours of darkness between storm-front passages, you may work 1000 miles (1600 km) if your ears hold up. DX takes on a new meaning here unless you're really lucky. Nevertheless, you may want to give it a try.

ham radio

JUNE

WESTERN USA

GMT	PDT	N ASIA FAR EAST	NE EUROPE	E S. AFRICA	SE S. AMERICA	S ANTARCTICA	SW NEW ZEALAND	W OCEANIA AUSTRALIA	NW JAPAN
0000	5:00	—	20*	20	15	15	10	10	—
0100	6:00	—	20	20	15	15	10	10	—
0200	7:00	—	20	20	15	15	10	10	15
0300	8:00	15	20	—	15*	15	10	10	15
0400	9:00	15	20	—	10	20	10	10	15
0500	10:00	15	20	—	15	20	15*	15	—
0600	11:00	—	20	20	15	20	15*	15	—
0700	12:00	—	20	20	20*	20	15	15	—
0800	1:00	20	—	20	20	20	15	15	20
0900	2:00	20	—	—	40*	20	15	15	20
1000	3:00	20	—	—	40*	40*	15	15	20
1100	4:00	20	—	—	40*	40	20	20	20
1200	5:00	20	—	—	—	40	20	20	—
1300	6:00	20	20	—	—	—	40*	20	—
1400	7:00	20	20	20	—	—	40*	20	—
1500	8:00	20	20	20	—	—	40*	—	—
1600	9:00	15	20	20*	—	—	40	—	20
1700	10:00	15	20	15	—	—	40	—	20
1800	11:00	15	20	15	15*	—	20	—	15
1900	12:00	15	20*	15	10	—	20	15	15
2000	1:00	15	15	15	10	—	20	15	15
2100	2:00	—	15	15	10	20	15	15	20
2200	3:00	—	15	15	15	20	10	10	20
2300	4:00	—	20*	15	15	15	10	10	20

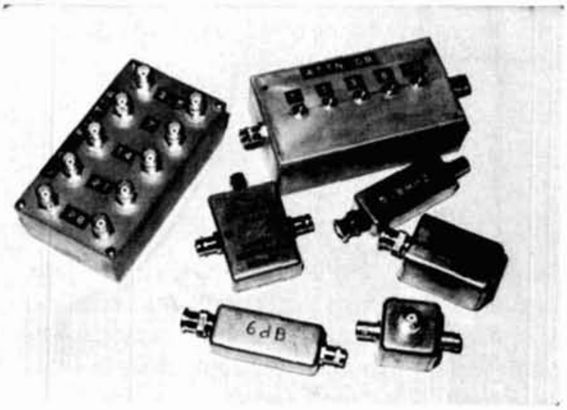
MID USA

GMT	MDT	CDT	N ASIA FAR EAST	NE EUROPE	E S. AFRICA	SE S. AMERICA	S ANTARCTICA	SW NEW ZEALAND	W OCEANIA AUSTRALIA	NW JAPAN
0000	6:00	7:00	15	15	15	15	15	10	15*	15
0100	7:00	8:00	15	20*	20*	15	15	10	15*	15
0200	8:00	9:00	15	20	20	15	20	10	15*	15
0300	9:00	10:00	15	20	—	15	20	15*	15	15
0400	10:00	11:00	20*	20	—	15	20	15	15	20*
0500	11:00	12:00	20	20	40	15	20	15	15	20*
0600	12:00	1:00	20	20	20	20	20	15	15	20
0700	1:00	2:00	20	20	20	20	20	15	20	—
0800	2:00	3:00	—	—	20	20	20	15	20	—
0900	3:00	4:00	—	—	—	40*	40	15	20	—
1000	4:00	5:00	—	—	—	40	40	15	20	40*
1100	5:00	6:00	—	20	—	40	40	20	40*	40*
1200	6:00	7:00	—	20	15	20	—	20	40*	40
1300	7:00	8:00	20	20	15	20	—	40*	20	40*
1400	8:00	9:00	20	20	15	20	—	40*	20	20
1500	9:00	10:00	20	—	15	20	—	—	—	20
1600	10:00	11:00	20	—	15	15	—	—	—	20
1700	11:00	12:00	20	—	15	15	—	—	—	20
1800	12:00	1:00	20	—	15	15*	20	15	—	20
1900	1:00	2:00	15	15	15	10	20	15*	10	—
2000	2:00	3:00	15	15	15	10	20	10	15*	—
2100	3:00	4:00	15	15	15	10	20	10	15*	—
2200	4:00	5:00	—	15	15	10	15	10	15*	15
2300	5:00	6:00	—	15	15	15	15	10	15*	15

EASTERN USA

GMT	EDT	N ASIA FAR EAST	NE EUROPE	E S. AFRICA	SE CARIBBEAN S. AMERICA	S ANTARCTICA	SW NEW ZEALAND	W OCEANIA AUSTRALIA	NW JAPAN
0000	8:00	15	20*	20	10	20	15*	15	20*
0100	9:00	15	20	40	15	20	15*	15	20*
0200	10:00	15	20	40	15	20	15*	15	20*
0300	11:00	20*	20	40	20*	20	15	15	20
0400	12:00	20	20	—	20*	15	15	15	20*
0500	1:00	20	40*	—	20	20	15	15	20
0600	2:00	20	40*	20	20	40*	15	20	20
0700	3:00	—	40*	20	20	40*	15	20	20
0800	4:00	—	40*	20	40*	40*	20	40*	40*
0900	5:00	—	20	20	40*	40*	20	40*	40*
1000	6:00	—	20	—	40	40	20	40*	40*
1100	7:00	20	20	—	40	40	20	40*	20
1200	8:00	20	15	—	20	—	20	20	20
1300	9:00	20	15	15	15	—	20	20	20
1400	10:00	20	15	15	15	—	40*	20	—
1500	11:00	20	20	15	15	—	40*	—	—
1600	12:00	20	20	15*	15*	—	—	—	—
1700	1:00	20	20	15*	15*	—	—	—	20
1800	2:00	15	15	15	10	20	15	15	20
1900	3:00	15	15	15	10	20	15	15	20
2000	4:00	20*	15	15	10	15	15	15	20
2100	5:00	20*	15	15	15*	15	15	15	15
2200	6:00	20*	15	15	15*	20	15	15	15
2300	7:00	15	15	15*	15*	20	15	15	15

*Look at next **higher** band for possible openings.



Accessories for use with the rf power meter.

rf power meter

Part 2: Measurements and measurement accessories

Part 1 of this article addressed the construction of an rf power meter capable of measuring amplitudes between −60 dBm and +20 dBm from 3.5 to 30 MHz. This rf power meter is the basis of a measurement system that can be used to make many useful network measurements, as explained in part 1. Some of these measurements are described in detail here.

accessories

Depending upon the measurement, various accessories are required, some of which you may have. Construction of others is covered in other literature sources, such as the *ARRL Handbook*[1] and *Solid-State Design for the Radio Amateur.*[2] I will list only the system components required to make the measurement and will describe the measurement itself. The photo shows accessories that I have built and found useful.

One accessory required for reflection measurements, as in measuring antenna VSWR and amplifier input VSWR, is a *directional bridge*. Hayward[2] briefly mentions the usefulness of such a device, but I haven't found many references that provide details on how to use it or what the limitations are in its use.

One of the advantages in using the bridge described here, as opposed to other "signal-separation" devices, is its simplicity, which results in the fact that it doesn't have to handle large amounts of transmitter power as in other coupler circuits found in SWR meters. This bridge is designed to be used with a low-level signal generator, VFO, or other oscillators delivering less than about +10 dBm (10 mV). Higher power will cause damage or may generate distortion, which could adversely affect the measurement.

directional bridge

The bridge is shown in **fig. 1**. Basically, it's a Wheatstone impedance bridge circuit with an unbalanced output to drive the power meter. Construction is uncomplicated. It should perform well up to and beyond 30 MHz with no adjustment or calibration. If your interests are limited to 30 MHz, no construction points are critical: simply use a reasonably close parts placement, high-quality components (small ¼-watt, film-type, 1 percent or better resistors preferred), and you should have no problems. If you anticipate working above 30 MHz, up to approximately 150 MHz, the bridge can be modified slightly to extend its range.

what's a network measurement?

Don't be concerned. You've probably been making them for a long time already but have been using other names such as VSWR or gain measurements. There are two basic types of network measurements that are made: transmission measurements and reflection measurements.

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In simple terms, we apply a stimulus signal, generally a low-level sine wave, sometimes swept, to the input of a one-port (antenna) or a two-port (amplifier) device, then we take measurements to see what is reflected from the input (reflection measurement), or what comes out of the output (transmission measurement).

Network measurements are, strictly speaking, linear measurements. That is, we measure the output at frequencies corresponding to the input frequency only. In many cases, however, we can look at nonlinear effects by changing our test procedure slightly and do things such as making an harmonic analysis of an amplifier. **Fig. 2** shows the two types of basic network measurements that can be made with the power meter and accessories. First, let's look at reflection measurements.

reflection measurements

The objective of a reflection measurement is to measure the amount of power reflected from a device, as shown in **fig. 3**. The reflected power is usually referenced to the incident power, and the ratio is expressed as VSWR, σ; reflection coefficient, ρ; or return loss, RL. These three quantities are all different ways of expressing the same thing; that is, how well the device is matched to the transmission line carrying the power. All three are scalar values; that is, magnitude only without phase angle. Any one of the three can be converted to the others using the expressions:

$$\rho = 10^{-\left(\frac{RL}{20}\right)} \qquad (1)$$

and

$$\sigma = \frac{1+\rho}{1-\rho} \qquad (2)$$

These equations are important since, as you will find, the measurement system described here measures directly in dB of return loss (the advantages will be discussed), which can then be converted to other units as desired. Antenna measurements, for example, are measured in return loss values, dB, which can then be converted into σ values to put them into a form in which they are usually expressed.

Most of us are used to thinking in terms of VSWR and will want to do this in other measurements as well. While you might object to the bother of converting from RL to σ, especially since SWR meters give this information directly, you'll find that the advantages of measuring RL far outweigh the minor inconveniences of conversion. And who knows, once you adapt to thinking in terms of RL, you may want to forget VSWR.

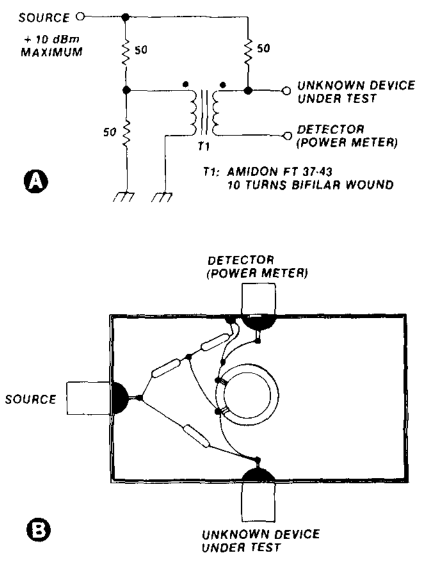


fig. 1. Directional bridge. The circuit (A) is basically a Wheatstone impedance bridge with an unbalanced output to drive the power meter. A suggested parts layout is shown in (B). Construction tips are given in the text.

making a return-loss (RL) measurement

A return-loss (RL) measurement is made in two steps: calibration and measurement. This measurement is analogous to an SWR meter measurement in which the meter sensitivity is adjusted to give a full-scale reading of the forward power (calibration), then switching to read the reverse power as a function of the forward power (the measurement) with a meter readout directly in VSWR.

As a specific example, suppose we want to measure the VSWR and bandwidth at the *VSWR = 3.0* points of our antenna. This measurement system is shown in **fig. 3**. Calibration is performed by connecting a standard (a known VSWR) to the unknown port of the directional bridge to establish the 0-dB relative reference level on the power meter. The absolute power is unimportant; it serves only as a level with which the subsequent measurement is compared.

The standard used is an open circuit with a VSWR of ∞, corresponding to a perfect reflection where all of the forward going power is reflected. (We would thus say that the open circuit had a 0-dB RL). Assuming that we had 0-dBm forward power, we would measure −6 dBm at the "detector" port of the bridge, corresponding to a 6-dB loss of the reverse power as it passed through the bridge to the "detector" port. A value of −6 dBm would then be our calibration value and should be logged or otherwise remembered.

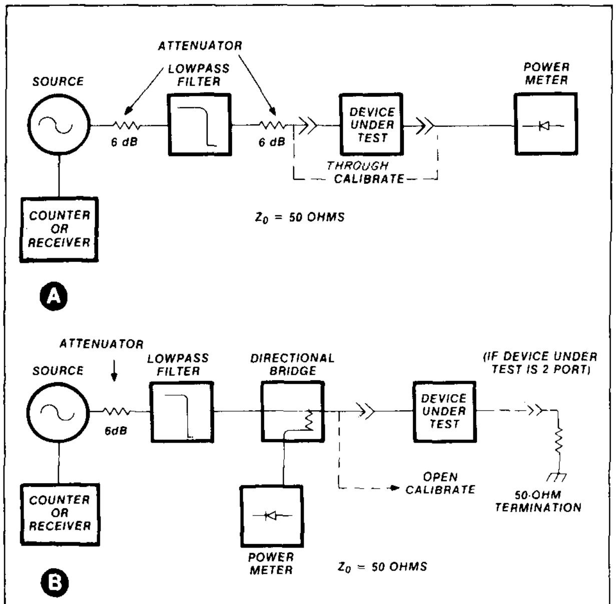


fig. 2. Instrumentation for basic network measurements. Transmission measurement setup is shown in (A); (B) shows instrumentation for reflection measurements.

With the antenna connected to the unknown port, a value is now measured that, when compared to the calibration level, −6 dBm, represents the return loss of the antenna in dB. If the power-meter reading were −15.6 dBm, for example, this would correspond to a 9.6 dB *RL*; 9.6 dB *RL* converts to a VSWR of 2.0, using the conversion equations. By tuning the source across the band you could then plot *RL* versus frequency and determine the *VSWR = 3.0* frequencies. Assuming the source were reasonably flat as you tuned, the calibration would remain good across the band.

why measure *RL* instead of VSWR directly?

There are three important reasons: resolution, accuracy and sensitivity.

Accuracy is determined to a large extent by how well you can read the meter or indicator, (scale resolution), and how well the directional bridge does its job (there are some other accuracy considerations that will be covered later). SWR meters, like the system described here, use some kind of signal-separation device (bridge, monimatch coupler). Therefore, other things being equal, they perform equally well in this respect. SWR meter resolution, however, is very poor at low values of VSWR below, say, 1.5, where the meter is at 20 percent of full scale. Below 1.5 the meter scale is compressed so much that about the best you can do when adjusting the match is to tune for a null. Dynamic range of the SWR meter (without "expanded" scales) is thus not much greater than about 10 dB with good resolution.

Return loss measurements using the power meter, however, do not suffer from a lack of resolution, even at extremely low values of VSWR (<1.01) because of the increased dynamic range of the power meter, 80 dB. And to make a point, resolution is sufficient so that we could theoretically measure VSWRs of 1.0002 with the system described here if we were not limited by the directional bridge.

Admittedly, while there are few of us who really need to measure antenna VSWRs below, say, 1.5 or so, there are other reflection measurements which can't be made with most SWR meters because of their lack of sensitivity. Input VSWR of small-signal amplifiers, for example, will not admit the power levels necessary to make most SWR meters operate. Due to the increased sensitivity of the power meter, you can drive small-signal amplifiers with as little as −34 dBm and still measure a 1.2 VSWR (20 dB *RL*).

So while the SWR meter is an extremely useful device for continuous monitoring of VSWR under actual transmit conditions (something this system can't do), initial evaluation of antennas, amplifiers, and other devices can best be done with the power meter and bridge.

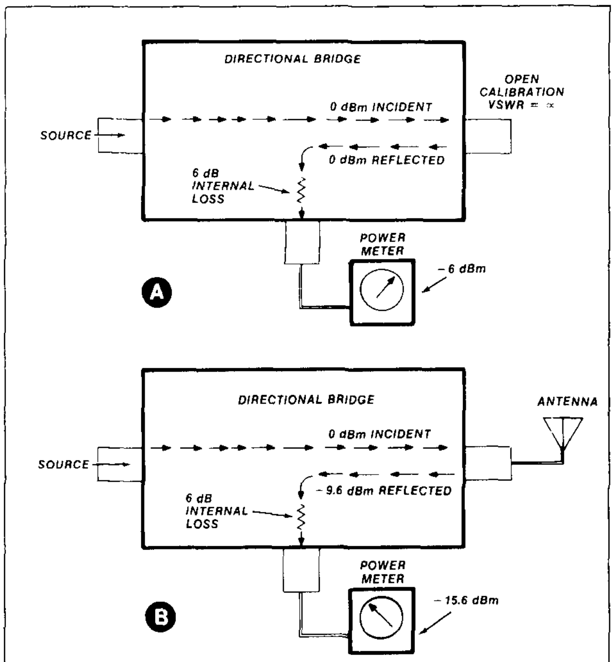


fig. 3. Setup for measuring antenna voltage standing-wave ratio. Reflection calibration is shown in (A); reflection measurement in (B).

how accurate is the measurement?

A detailed analysis of the accuracy of this measurement is not within the scope of this article. However, some general guidelines are given to make sure you make the best measurement possible.

There are two main sources of error in the return loss measurement described: source match and bridge directivity. These errors are limitations on all reflection measurements, whether with an SWR meter or the system described here; see **fig. 4**.

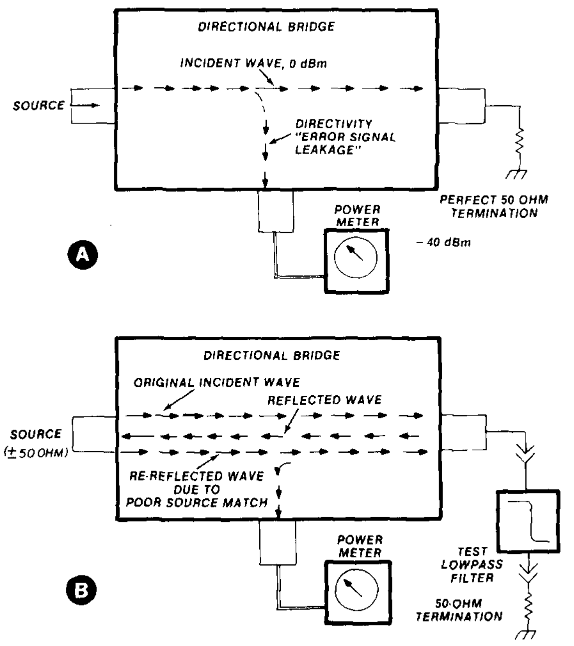


fig. 4. Reflection-measurement errors. The bridge directivity error is depicted in (A); (B) shows the source-match error.

Bridge directivity is a measure of how well the directional bridge separates the forward- and reverse-going waves. It is generally specified in dB. As an example, assume the directivity of the bridge is 40 dB. Practically speaking, this means that if our device under test (the antenna) were a perfect 50-ohm antenna with an infinite RL, we would still measure approximately 40 dB RL, even though there were no reflected waves traveling along the transmission line. Consequently the percentage errors in the measurement become increasingly large as the device RL approaches the bridge directivity. In this example any return loss measurements greater than approximately 35 dB would be unreliable. Fortunately, a 35-dB RL (VSWR 1.03) is usually well beyond the practical requirements of most measurements. The directivity of the bridge described here is greater than 40 dB up to 30 MHz.

The other source of error in reflection measurements is *source-match error*. Source match is essentially a measure of how close the output impedance of the source is to the characteristic impedance of the transmission line (50 ohms). Its importance becomes apparent when you consider the effect of any reflected energy traveling back to the source only to be reflected from the source, becoming part of the new forward-going wave. The forward-going wave now consists of two components (an infinite number if we count the re-reflections) to create an uncertainty in establishing the forward-going power in the calibration step. If the device we are measuring accepts most of the forward-going power (VSWR is low or RL is high), then this source of error becomes negligible.

If, on the other hand, the device has a reasonably high VSWR (a low RL), then source match error becomes appreciable. A source with a VSWR of 2.0, for example, used in the measurement of a device with an actual VSWR of 4.0 would yield a measured VSWR lying between 2.8 and 6.0. The value you would measure depends on the relative phasing of the component waves. When measuring the VSWR of reflective devices such as filters (outside of the passband), source match errors become significant. Ideally, then, the source used to make the measurement should have a 50-ohm (Z_0) output impedance to reduce source-match errors.

Fortunately, there are simple fixes to improve the source match of a given source. Simply adding a 6- or 10-dB attenuator at the output of the source brings the effective output impedance of the source/attenuator combination closer to 50 ohms. In the above example adding a 6-dB attenuator to the 2.0 VSWR source improves the effective source match to 1.4, reducing the uncertain window to 3.4-4.8 in a $VSWR = 4.0$ measurement.

The directional bridge has 6 dB of attenuation built in by design and satisfies this requirement on its own. However, when making transmission measurements remember to add 6 or 10 dB attenuation following the output of your source/filter, particularly when measuring large VSWRs (small RL). More about this later.

other notes on reflection measurements

As mentioned in part 1, the power meter is a broadband detector, one which responds equally well to the stimulus frequency, f_0, coming from the source or to any of the harmonics of the source or the device being tested. Because of this, harmonic filtering of the source is a must, and suitable lowpass or highpass filters must be added to attenuate the source's harmonics adequately. Lowpass filters are recommended because of their relative ease of construction.

The skirt attenuation of the filters outside the passband should be sufficient to reject unwanted harmonic frequencies. The actual value of attenuation required will depend on the dynamic range required in the measurement, although 40 dB or greater harmonic rejection is usually enough, depending on the harmonic content of the source itself. In my system I use seven-pole LC lowpass filters with cutoffs at 5.8, 9.6, 15. 7, 23.1, and 30.4 MHz following my tunable generator to cover the high-frequency bands. These, combined with the inherent harmonic content of the oscillator itself, yield a source with a minimum −50 dBc harmonic content, sufficient for most of my measurements. LC lowpass filter construction is covered in detail in the *ARRL Handbook.*[1]

The attenuators shown surrounding the filters absorb the multiple reflections that result from out-of-band energy reflected from the filters and provide a proper termination for the filters and test amplifier. They should not be omitted from the circuit.

transmission measurements

The other type of measurement that can be made with the power meter is the transmission measurement. As the name implies, it is simply a measurement of the amount of signal power transmitted by a device under test. The measurement can be as simple as measuring the passband ripple and the stopband rejection of a filter, or as complex as meauring the gain, compression level, harmonics, intermodulation distortion (IMD) and third order intercept (TOI) of a small-signal amplifier.

A basic transmission measurement is shown in **fig. 2.** This setup would be suitable for characterizing a filter, for example, and the details of this measurement should be evident. The measurement of a small-signal amplifier's characteristics can be more involved and, therefore, will be discussed as an example of the measurement procedure. This measurement is shown in **fig. 5.** Note the liberal use of attenuators to buffer multiple reflections from the reactive filters, improve the effective source match, and provide a proper termination for the filters and test device.

calibration

Calibration consists of simply bypassing the test device (amplifier) with a through connection and noting the power level on the power meter. This should

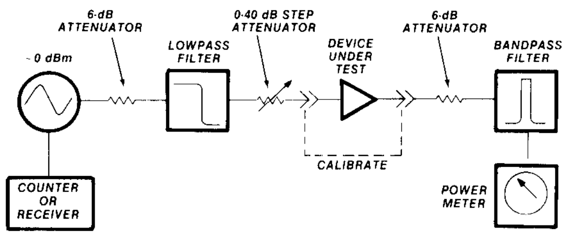


fig. 5. Instrumentation for small-signal amplifier gain, compression, and harmonic-distortion test.

be done with the 0-40-dB step attenuator adjusted to set the input power level low enough to prevent overdriving the amplifier.

measurement

Gain is measured by connecting the test amplifier and comparing the output power level with the calibration value (the input power level). In cases where the harmonics are known to be more than 10 dB below the fundamental level, the filter following the test amplifier can be omitted without serious errors in the gain measurement. If, for example, the harmonic power were 10 dB below the fundamental level, the error resulting from omission of the filter would be only 0.4 dB in the gain measurement.

The 1-dB gain compression level can be determined by increasing the drive to the test amplifier to a point where the gain, as measured in the preceding step, decreases by 1 dB. At this point the test amplifier is entering the nonlinear region and is generating enough distortion so that by choosing an appropriate bandpass filter we can measure the harmonic distortion. Back off on the drive a bit, however, since the measurement should be made with the amplifier operating in the linear mode and not near gain compression.

Measurement of *nth*-order harmonic distortion required choosing a bandpass filter that will attenuate the fundamental to a level at least 10 dB below that of the harmonic to be measured, as shown in **fig. 6.** We could not expect to be able to measure harmonic

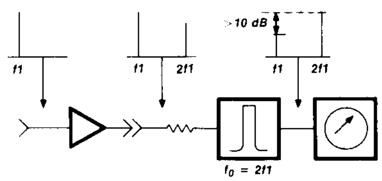


fig. 6. Attenuating the fundamental signal, f1, with a bandpass filter.

distortion 50 dB below the fundamental using a bandpass filter with only 30 dB of rejection of the fundamental, for example. Conventional Butterworth designs using from three to five poles as described in the *Handbook*[1] will provide sufficient attenuation in most cases.

Generally speaking, extreme bandpass-filter selectivity is not required, even in low-distortion measurements, for testing small-signal amplifiers since we can arbitrarily increase the distortion from the test amplifier by increasing the drive level to the input (but staying away from gain compression). **Fig. 7** illustrates this principle.

Note that in **fig. 7A** at an output level of −10 dBm, for example, the second harmonic is at −50 dBm, or relative to the fundamental at f1 we say that it is −40 dBc. If we increase the drive level to the test amplifier by 10 dB, the fundamental output also increases by 10 dB to 0 dBm as shown in **fig. 7B**.

But note that the second harmonic has increased by 20 dB and is now only −30 dBc relative to the fundamental. So given a three-pole bandpass filter with a 40-dB rejection over one octave of bandwidth, it would not be possible to make an accurate second-harmonic measurement with the drive level set as in **fig. 7A**; but by increasing the drive level as in **fig. 7B** we could make the measurement. Once the distortion has been measured at the artificially high drive level, the distortion at any nominal drive level can be computed from the equation:

$$HD,_{dBc}\ (nominal\ drive\ level) =$$
$$HD,_{dBc}\ (meas) + (N-1) \times (change\ in\ drive\ level) \quad \textbf{(3)}$$

where N is the order of distortion (that is, second, third, etc.). If, for example, the second harmonic were measured to be −40 dBc at a drive level of 0 dBm, it would compute to be −80 dBc at an input drive level of −40 dBm.

Again, stay away from gain-compression levels by at least a few dB, and remember that you can't measure test-amplifier distortion levels less than that generated by the source used and present at the input of the test amplifier. Also remember to take into account any insertion loss of the bandpass filter (it can be measured separately with the power meter) in your measurement of harmonic distortion.

The relationship between the fundamental and second-order harmonic distortion as the drive level is changed can be generalized to *nth*-order distortion as well: changing the drive level by 1 dB causes the *nth*-order distortion product to change by *nx1* dB. This fact is extremely useful in positive identification of the signal you think you are measuring. For example, when measuring the third harmonic, changing the drive by 1 dB should cause a 3-dB change in the power-meter reading.

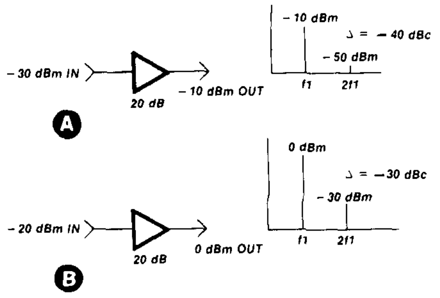


fig. 7. Effect of drive level on amplifier harmonic distortion at 2f1. (A) and (B) respectively show drive at −30 dBm and −20 dBm.

IMD and TOI measurements

IMD measurements follow the same general guidelines established in harmonic distortion measurements. One complication arises in the fact that we must now drive the test amplifier with two equal amplitude rf "tones" and somehow provide filtering to reject the fundamentals at f1 and f2 and pass the third-order distortion products at 2f1 ± f2 or 2f2 ± f1. **Fig. 8** shows the measurement setup.

Ideally we would like to present to the test amplifier two rf signals separated by, say, 10 or 20 kHz and measure the IMD product, which would be separated from the test signals by the same 10 or 20 kHz as

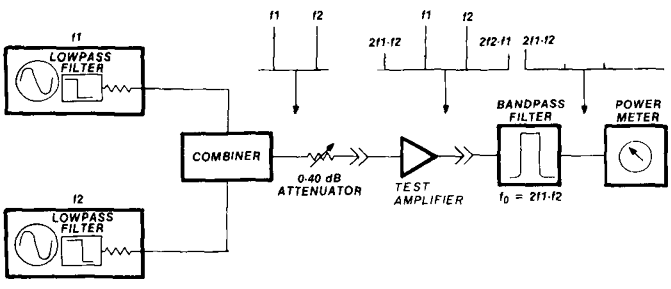
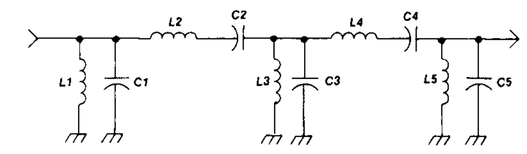


fig. 8. Test setup for measuring intermodulation distortion.



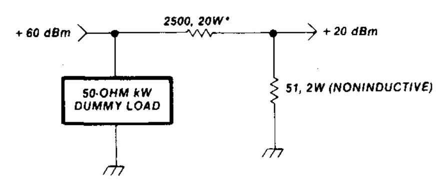
C1(pF)	L1(μH)	C2	L2	C3	L3	C4	L4	C5	L5
1970	0.46	70	12.9	6370	0.14	70	12.9	1970	0.46

fig. 9. A 5.3-MHz Butterworth bandpass filter for testing intermodulation distortion. Filter-component values provide 50-dB attenuation at 7 MHz and above.

shown in **fig. 8**. This tone spacing is desirable since it simulates the situation that exists at the input to a receiver's preselected rf amplifier in crowded band conditions. However, without heterodyning the test amplifier's output to a lower frequency where filtering can be easily accomplished, it becomes necessary to separate the tones by at least a few MHz to allow using LC bandpass filters to select the IMD product and provide attenuation to the fundamentals at f1 and f2. Consequently, the measurement described here is limited to broadband amplifiers or amplifiers with a bandwidth large compared with the tone spacing. Fortunately, tests made with a spectrum analyzer using closely spaced tones show results that agree within a few dB compared with measurements made using tones spaced by a few MHz on broadband test amplifiers.

In my test setup I used two crystal oscillators at 7.0 MHz and 8.7 MHz and measured 2f1 – f2 at 5.3 MHz. **Fig. 9** shows filter component values for a 5.3-MHz bandpass filter that provides 50-dB attenuation at 7.0 MHz and above. As previously stated, the filters and test amplifier must see 50 ohms to provide a good termination. Also remember to verify the test by changing the drive level by a given amount, using the step attenuator, and look for a three times change in the power meter reading.

Once the third-order IMD is measured at the arbitrary drive level, the IMD at a nominal drive level can be computed from:



*TEN 25K, 2-WATT RESISTORS (NONINDUCTIVE) IN PARALLEL

fig. 10. A 40-dB, 1-kW attenuator for making a-m measurements in a high-power transmitter.

$$IMD,_{dBc}\,(nominal\ drive\ level) =$$

$$IMD,_{dBc}\,(meas) + 2(change\ in\ drive\ level,\ dB) \quad \textbf{(4)}$$

and the *output* TOI can be computed from

$$TOI = \frac{\Delta}{2} + P_{out} \quad \textbf{(5)}$$

where $\Delta = IMD$ level in dBc relative to the fundamental (one tone), and P_{out} is the *output* level of *one* of the tones. Input TOI is the output TOI minus the gain of the test amplifier.

Measurement accuracy depends to a large extent on maintaining a 50-ohm impedance within the measurement instrumentation as well as the input and output impedance of the test amplifier itself. The measurement is meaningful only to the extent that the test device matches the impedance of the measurement instrumentation. Hence any networks used for input or output matching should be included as part of the measurement device.

One other comment: beware of IMD generated within the power combiner shown in **fig. 8**.[3] IMD caused by saturation of the toroids used in the combiner frustrated me for some time before I figured out what was going on. This combiner had 0.25-inch (6.35-mm) OD toroids that created their own IMD when driven above about + 10 dBm.

Although the foregoing tests were made on small-signal amplifiers such as those used ahead of a receiver, similar tests for harmonic distortion can be made on a high-power transmitter with the aid of an in-line power sampler such as is used in SWR meters. Examples of such samplers can be found in reference 1. Alternatively, a 40-dB pi attenuator capable of handling 1 kW can be made with the aid of a 1-kW dummy load and some 2-watt resistors. **Fig. 10** shows details. This attenuator will reduce the output of a kilowatt rig to a level that can be handled by the power meter.

measuring amplitude modulation

The power meter can also be used to measure amplitude modulation if the need arises and a scope isn't handy. The measurement is based on calculating the modulation percentage after measuring the power difference between the carrier with and without the modulation applied. A tone generator should be used to modulate the transmitter.

With modulation applied, the power meter (or the transmitter output) is adjusted to place the power meter reading near full scale, where scale resolution is best. Remove the modulation and measure the decrease in the power-meter reading. This difference, Δ, when plugged into the equation below, will yield the modulation percentage to within a few percent, depending on how carefully you measure Δ.

$$modulation\ percentage = 170\sqrt{10^{(\Delta/10)} - 1} \quad \textbf{(6)}$$

A difference of $\Delta = 1\ dB$, for example, would correspond to an 86.5-percent modulation level. This technique will provide good accuracy to about 30-percent modulation, where the power-meter scale resolution becomes marginal (0.2 dB). Results were verified using an HP-8640B calibrated signal generator. Remember to use an attenuator capable of dissipating the total power of the transmitter, or use a circuit similar to that in **fig. 10**.

extending operating frequency of the directional bridge

As mentioned earlier, the directional bridge has a directivity of about 40 dB to 30 MHz, dropping off to less than 10 dB or so at 150 MHz. By adding a 1-5 pF ceramic trimmer as shown in **fig. 11** and by *careful* parts placement, the balance can be improved to yield about 30-dB directivity at 150 MHz, permitting reflection measurements using the detector assembly (which is usable well beyond 150 MHz) and the modified bridge at 2 meters. The dynamic range of the detector assembly alone is about 20 dB (it departs from square-law operation above − 10 dBm, and sensitivity is about − 35 dBm), so the overall return-loss measurement range is about 20 dB, corresponding to a VSWR of 1.2. The VHF return loss adjustment procedure is shown in **fig. 11B**.

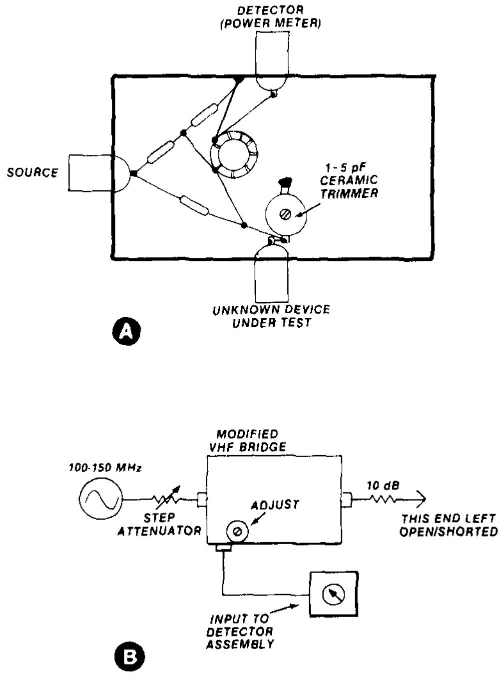


fig. 11. Making reflection measurements at VHF. A modified VHF directional bridge layout is shown in (A); (B) shows how to adjust the modified bridge for best directivity.

Initial adjustment of the modified return loss bridge is rather tedious. For best results it's necessary to adjust the trimmer and tweak the parts placement, particularly the toroid, while observing the return loss of a known device, a 10-dB attenuator connected to the unknown port of the bridge. With the 10-dB attenuator connected, the measured return loss (remember to calibrate with an open circuit first) should be 20 dB, since the signal must make two passes through the attenuator before reaching the bridge. There should be a range of adjustment over which you should measure this value.

A good indication that the bridge has been adjusted for directivity greater than 20 dB is to alternately short and open the open side of the 10-dB attenuator. If the directivity error signal has been nulled satisfactorily, the change in the power meter readings should be small (less than 1 dB). If not, readjust the trimmer capacitor and/or parts placement and try again. At some point the power meter variation as the attenuator is shorted/opened should be small. At this point try the same measurement at a lower frequency, say 50 MHz or 30 MHz, to see that you have not degraded the low-frequency directivity, since adding the capacitance disturbs the circuit balance somewhat.

Once you have adjusted the bridge to your satisfaction, epoxy the toroid in place using a *small* drop of epoxy (avoid coating the windings) to prevent it from moving. The assembly should then be sealed to prevent fingers from touching the insides.

closing remarks

Using this system I've been able to duplicate measurements on many of my homebrew projects that previously required the use of expensive laboratory measurement instrumentation. I can now measure the performance of projects and not wonder what effect a parts substitution had on a particular circuit, or whether adjustments were optimized.

Any questions or comments regarding construction of the power meter or the measurements described are welcome. Please include an SASE. Improvements doubtless can be made.

references

1. *The Radio Amateur's Handbook*, ARRL, Newington, Connecticut 06111, 1980 edition.
2. Wes Hayward, W7ZOI, and Doug DeMaw, W1FB, *Solid State Design for the Radio Amateur*, ARRL, Newington, Connecticut 06111.
3. William R. Hennigan, W3CZ, "Broadband Hybrid Splitters and Summers," *QST*, October, 1979, page 44.

ham radio

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Readers are invited to send a card with the question they feel is most useful that appears in each issue. Each month's winner will receive a prize. We will give a prize for the most popular question of the year. In the case of two or more questions on the same subject, the one arriving the earliest will be used.

Why is it that most Novices operate near the low end of the 21.0-21.2 MHz band? — Walter Legan, KA4KXX.

Perhaps they are trying to avoid interfering with the phone stations, or maybe they simply enjoy the company. The same thing happens on other bands, Novice or otherwise, CW or phone, but there doesn't seem to be good justification for it.

Next time the band is crowded, try calling CQ just below the upper end and see if you can reverse the trend. Certainly you will experience less QRM.

How do you prevent a lightning strike from entering your shack through your rotor wiring? — Ron Ankney, WD5IXP.

Lightning is unpredictable — it can enter your shack by various means, including of course, the rotator wiring. There is no accepted evidence that any form of protection can prevent a stroke (direct hit). It is wise, however, to provide some means of draining away static charges which can accumulate during summer storms and possibly become quite dangerous.

If you inspect the circuit diagram of your rotator, you will notice that the wiring is grounded at some point inside the mechanism. The TR-44, for example, employs a 500-ohm potentiometer inside the aluminum case; the arm of this pot is grounded to the frame. If the rotator is clamped to a grounded metal tower, static charges will drain off to the ground and will not enter the shack. To make sure of this, connect a piece of No. 12 or 14 drawn-copper, copper-clad, or No. 10 gauge aluminum "clothesline" to the rotator housing and run it in as straight a line as possible over the most direct route to a good ground.

If your antenna system is insulated from ground (mounted on top of a wooden tower or the roof), connect a No. 4 or larger wire to the rotator or frame of the system (at some point which will not interfere with operation of the antenna), and run it in a straight line down the tower to a good ground.

Article 810 of the National Electrical Code (NFPA No. 70), which is purely advisory but which is of interest here, recommends using an 8-foot-long galvanized iron pipe 3/4 inch in diameter as an effective ground. A 5/8-inch galvanized rod 8 feet long is also acceptable.

From a lightning protection standpoint, it is desirable to run coaxial cable and control wires directly down the tower and then underground to the shack. It is also a good idea to ground the braid of the coax to a water pipe system at the point of entry into the shack, if possible, using a 1/2-inch or larger copper strap soldered to the braid and clamped to the pipe. If a water pipe system is not available, drive a ground stake into the ground immediately outside the house, at the point of entry, and ground the coax braid to it.

Glass or silk, when rubbed, produce static electricity. Why aren't they good conductors? — Lawrence Emmett.

It is convenient to define two kinds of electricity, positive and negative. The elementary electric charge is the negative electron. To charge a body negatively you add electrons to it; the only way to charge it positively is to take some electrons away from it. Think of the atom as a neutral body under normal conditions. Remove some electrons and it becomes a positively charged ion. Add some electrons and it becomes a negatively charged ion.

In some substances the forces holding the electrons to the atoms are small, and some electrons may become detached temporarily from the atom and wander in the vacant space between the atoms. This is particularly true of the metals, such as silver and copper.

If the electrons are more rigidly bound to the atom, so that they cannot be freed except under the action of very large forces, no free electrons will be found in the empty spaces between atoms. If an electric force is applied to such a substance, it cannot cause the electrons to migrate and there's no flow of electrons (no current flow) from one part of the substance to the other. If an excess number of electrons are placed on one part of such a substance, they remain there. Glass, mica, quartz, wood, and ebonite are examples of such substances, which we know as insulators.

When a glass rod is rubbed with a silk cloth, some electrons pass from the rod to the silk, leaving the rod charged positively and the silk negatively. However, since electrons cannot migrate in these insulators, current won't flow in them.

What do I do in case of an emergency involving the sending or receiving of an SOS? — Steve Reisman, KA6IVE.

If you suddenly find yourself in an emergency, you can call SOS on CW or MAYDAY on phone. Chances are you will receive one or more immediate replies on your frequency requesting your location and details of the emergency. Respond to the strongest signal. Generally, an emergency net will be quickly set up and a net-control station will be selected who will act as the supreme authority in the situation. Listen to him carefully, answer his questions briefly, and do exactly what he tells you to do.

Emergency nets are not pre-arranged — they happen. The reason for this is that many Amateur operators know exactly what to do in an emergency without much thought. They have operated nets before and know how to pass the maximum amount of information with the minimum number of words in a minimum of time. If you aren't familiar with net procedures, listen to them and try getting involved. It may help you or somebody else when a real emergency arises.

On the other hand, if you should hear a distress call, listen for a few seconds to see if somebody else responds. If so, listen carefully but stay off the air unless it becomes clear that there is a specific job to be done that you can handle more efficiently than anyone else.

If nobody else responds, you certainly must do so. Stay calm. Ask the distressed station to provide you with details. Remember that other stations may now be tuned in and assessing the situation, and they may join you. In any event, don't rag-chew.

If it appears that you personally can't be of much help, you can call QST to attract other stations who might be better able to help, and you can call your ARRL Area Emergency Coordinator on the telephone and ask his help. (If you don't know his telephone number, look it up and post it in your shack. Do it now!) Be prepared. You might also want to monitor W1AW transmissions for latest emergency information if you are not directly involved in the emergency.

ham radio

computer program for sorting and inventory of standard resistor values

A useful tool for experimenters with overflowing junkboxes

A friend of mine is in the surplus electronics business. He buys closeouts and overstocks then sorts what he has bought and resells them. Recently he made a large buy on surplus resistors. Most were in plastic bags, but some had been attacked by rats. Thus sorting and inventory wasn't going to be easy. He asked me if my computer could make a list for performing the inventory. **Table 1** is the result of that request. An abbreviated example of the program output is also given.

The idea of using a computer program to generate this list is made practical by the fact that resistor values follow a distinct pattern. There are only 24 possible combinations for the first two digits of a resistor value. These digits are then multiplied by a power of 10 to form all the values. The lowest value is 1.0 ohm and the highest is 2.2×10^7 ohms, or 22 megohms. (This same pattern is followed by capacitor values.)

The program was written in TSC extended BASIC and runs on a Southwest Technical Products (SWTP) computer system.* Lines 50 through 80 establish the standard value table using the DATA statement. The FOR loops at 210, 260, 290, 370, 440, and 490 generate the values by multiplying the table values by various powers of ten.

The entire list could have been generated by a set of nested loops except for formatting the value column. The subroutine at line 600 handles printing the spaces where the values are to be manually entered and also handles page headings. The columns are set up for 1/4-, 1/2-, 1-, and 2-watt resistors. To change this it's only necessary to change lines 610 and 710.

*TRS-80 level-2 BASIC and APPLESOFT BASIC for the APPLE II can be run with no program changes.

By **Phil Hughes, WA6SWR,** Specialized Systems Consultants, P.O. Box 2847, Olympia, Washington 98507

```
 10 REM RESISTOR  4-15-80
 20 REM Specialized Systems Consultants
 30 REM Olympia, WA
 40 REM STANDARD VALUES
 50 DATA 1,1.1,1.2,1.3,1.5,1.6,1.8
 60 DATA 2,2.2,2.4,2.7,3,3.3,3.6,3.9
 70 DATA 4.3,4.7,5.1,5.6,6.2,6.8,7.5
 80 DATA 8.2,9.1
 90 REM
100 PRINT "RESISTOR INVENTORY LIST"
110 INPUT "ENTER TOLERANCE (5 OR 10)",P
120 IF (P<>5) AND (P<>10) THEN 110
130 PRINT "POSITION PAPER TO TOP OF PAGE AND HIT RETURN"
140 A$=INCH$(0)
150 IF A$<>CHR$(13) THEN 140
160 IF P=10 THEN R=12 ELSE R=24
170 IF P=10 THEN R1=5 ELSE R1=9
180 PRINT
190 GOSUB 670
200 REM 1 TO 9.1 OHM
210 FOR J=1 TO R
220 GOSUB 740
230 PRINT USING '#####.#',V;
240 GOSUB 600
250 NEXT J
260 FOR I=1 TO 4
270 REM 10 TO 91000 OHM
280 RESTORE 50
290 FOR J=1 TO R
300 GOSUB 740
310 PRINT USING '###,###',V*10^I;
320 GOSUB 600
330 NEXT J
340 NEXT I
350 REM .1 MEG TO .91 MEG
360 RESTORE 50
370 FOR J=1 TO R
380 GOSUB 740
390 PRINT USING '.##\12\',V/10,' Meg';
400 GOSUB 600
410 NEXT J
420 REM 1 MEG TO 9.1 MEG
430 RESTORE 50
440 FOR J=1 TO R
450 GOSUB 740
460 PRINT USING '#.#\12\',V,' Meg';
470 GOSUB 600
480 NEXT J
490 REM 10 MEG TO 22 MEG
500 RESTORE 50
510 FOR J=1 TO R1
520 GOSUB 740
530 PRINT USING ' ##\12\',V*10,' Meg';
540 GOSUB 600
550 NEXT J
560 FOR I=1 TO 67-LC
570 PRINT
580 NEXT I
590 END
600 REM PRINT END OF LINE
610 PRINT "     ______     ______     ______     ______"
620 LC=LC+1
630 IF LC<60 THEN RETURN
640 FOR K=1 TO 6
650 PRINT
660 NEXT K
670 REM PAGE HEADING AND SET LINE COUNT
680 LC=4
690 PRINT "    RESISTOR INVENTORY LIST FOR ______ ____, 19__"
700 PRINT
710 PRINT "  VALUE    1/4W      1/2W        1W        2W"
720 PRINT
730 RETURN
740 REM READ NEXT VALUE
750 IF P=5 THEN READ V
760 IF P=10 THEN READ V,W
770 RETURN
```

table 1. (left) Program listing for sorting and inventory of resistors. Below is an abbreviated example of program output.

VALUE	1/4W	1/2W	1W	2W
1.0	______	______	______	______
1.2	______	______	______	______
1.5	______	______	______	______
1.8	______	______	______	______
2.2	______	______	______	______
2.7	______	______	______	______
3.3	______	______	______	______
3.9	______	______	______	______
4.7	______	______	______	______
5.6	______	______	______	______
6.8	______	______	______	______
8.2	______	______	______	______
10	______	______	______	______
12	______	______	______	______
15	______	______	______	______
18	______	______	______	______
22	______	______	______	______
27	______	______	______	______
33	______	______	______	______
39	______	______	______	______
47	______	______	______	______
56	______	______	______	______
68	______	______	______	______
82	______	______	______	______
100	______	______	______	______
120	______	______	______	______
150	______	______	______	______
180	______	______	______	______
220	______	______	______	______
270	______	______	______	______
330	______	______	______	______
390	______	______	______	______
470	______	______	______	______
560	______	______	______	______
680	______	______	______	______
820	______	______	______	______
1,000	______	______	______	______
1,200	______	______	______	______
1,500	______	______	______	______
1,800	______	______	______	______
2,200	______	______	______	______
2,700	______	______	______	______
3,300	______	______	______	______
3,900	______	______	______	______
4,700	______	______	______	______
5,600	______	______	______	______
6,800	______	______	______	______
8,200	______	______	______	______
10,000	______	______	______	______
12,000	______	______	______	______
15,000	______	______	______	______
18,000	______	______	______	______
22,000	______	______	______	______
27,000	______	______	______	______
33,000	______	______	______	______
39,000	______	______	______	______

Mast lock installed on author's tower.

beam antenna mast lock

Simple clamp device for preventing windmilling

There are frequent occasions when it's necessary to secure a beam antenna in a fixed position to prevent it from spinning or windmilling, or from changing its vertical position relative to the rotator when the rotator has been removed for maintenance, routine or otherwise. The antenna clamp described here meets that requirement completely. It is not only effective and easy to make, but it even costs less than two dollars for materials. Before going further, I want to explain that the term *mast* is used to denote the pipe to which the antenna is mounted and which is turned by the rotator. It does not refer to the tower structure.

clamp description

Briefly, the clamp consists of a piece of oak or other hardwood 2 × 4 × 13 inches (50.8 × 102 × 330 mm) and a pair of 2 1/2 × 5/16 inch (64 × 8 mm) U bolts. See **fig. 1**. (The lumber dimensions are those that best fitted my EZ-WAY tower installation.) For other towers it may be necessary to change the longer dimensions, making it about 4 inches (102 mm) more than the distance between the legs at the height of the rotator.

The device is clamped to the mast by means of the U bolts (**fig. 2**). The 2-by-4 lumber piece should rest on the cross member, which is just above the rotator. It's important that the small backing plates that accompany the U bolts are used so that maximum pressure may be exerted on the wooden member to prevent any slippage between the bolts and the mast. Merely putting washers beneath the nuts *will not* accomplish this. Remember that we're dealing with considerable twisting force on the clamp.

The clamp not only prevents the antenna from turning but also maintains the vertical position relative to the rotator. This can be very critical when the rotator is reinstalled. It may be necessary

By Lefferts A. McClelland, W4KV, 109 Anona Place, Indian Harbour Beach, Florida 32937

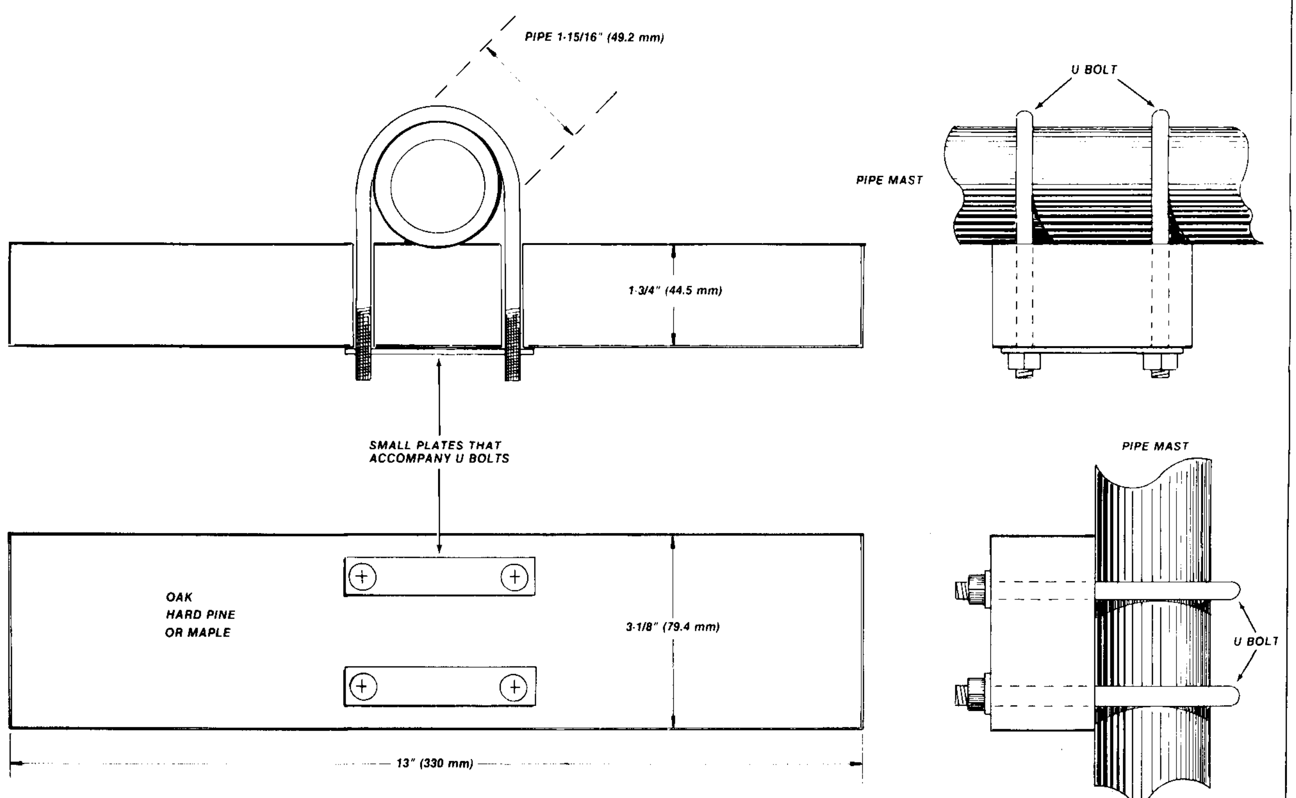


fig. 1. Assembly drawing of the beam antenna mast lock. These dimensions are measured from the clamp. Sizes given in the text are nominal; 2 × 4 lumber varies from 1-1/2 × 3-1/4 to 2 × 4 for unplaned mill material.

to add shims or small wedges between the clamp and the tower legs to obtain a tight lock-up.

With my EZ-WAY foldover tower, I position the beam antenna so that, when lowered, either the reflector or the director lies flat on the ground. This action relieves the strain on the antenna elements when the antenna is down and puts the antenna in a fixed position of reference. In this position, the base casting and rotatable upper casting should be indexed by means of a China marking pencil or a strip of paint. The dial of the control box should be marked to indicate the azimuth of the system before it was lowered. With everything thus marked no further alignment should be necessary after reinstallation of the serviced rotator.

Whenever I leave town for any length of time, I install the clamp to relieve the rotator of torque caused by heavy on-shore winds (my property is very close to the Atlantic Ocean.)

This has been a practical solution to a bothersome problem.

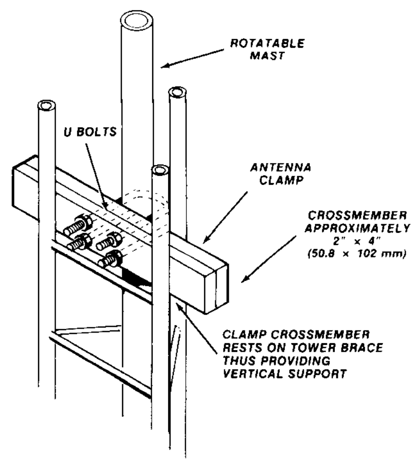
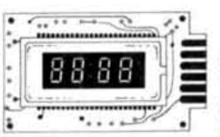


fig. 2. Isometric view of the mast lock.

ham radio

National Semiconductor Clock Modules



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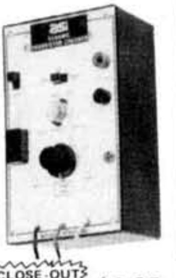

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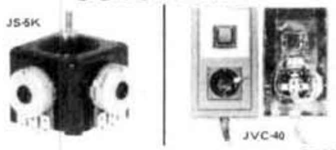

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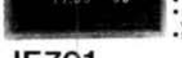

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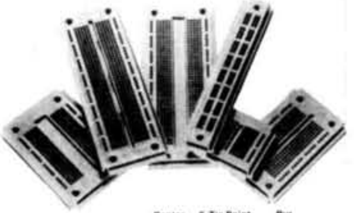

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EXP325	1.8"	2.1"	.3"	22(110)	2(20)	$ 3.50
EXP350	3.6"	2.1"	.3"	46(230)	2(40)	$ 6.75
EXP600	6.0"	2.4"	.6"	94(470)	2(80)	$14.75
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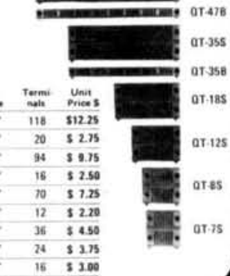

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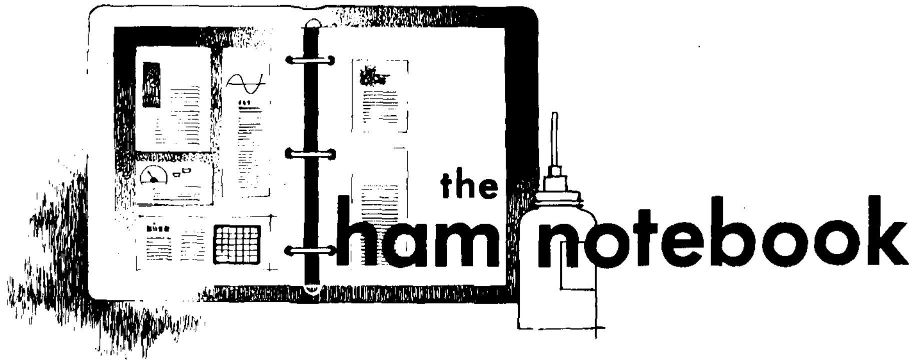
QT-47S	5.3"	5.0"	94	$ 9.75
QT-47B	5.3"	5.0"	16	$ 2.50
QT-35S	4.1"	3.8"	70	$ 7.25
QT-35B	4.1"	3.8"	12	$ 2.20
QT-18S	2.4"	2.1"	36	$ 4.50
QT-12S	1.8"	1.5"	24	$ 3.75
QT-8S	1.4"	1.1"	16	$ 3.00
QT-7S	1.3"	1.0"	14	$ 2.75

More Details? CHECK—OFF Page 98



simple speech amplifier for the SB-400/SB-401

This speech amplifier has no plugs, cables, or interconnections. It turns on and off automatically with the transmitter switch. It's a plug-in module that receives its power from the transmitter, and it doesn't disturb the original design of the SB-400 or SB-401. The amplifier can be plugged in or removed in a few seconds.

The plug-in module was designed to give additional drive power to the triode section of the ring modulator in the SB-400/SB-401. It is inserted between the pentode and triode sections of the 6EA8 tube in the SB-400/SB-401. In these rigs, all audio work is accomplished by the 6EA8. The pentode section of the 6EA8 drives the triode ring-modulator section. It's between these two 6EA8 sections that additional gain is needed to give additional speech amplification.

The plug-in module is simple. It consists of five resistors, two capacitors, a transistor, and a nine-pin test socket with a small circuit board. **Fig. 1** shows the schematic; **fig. 2** gives construction details.

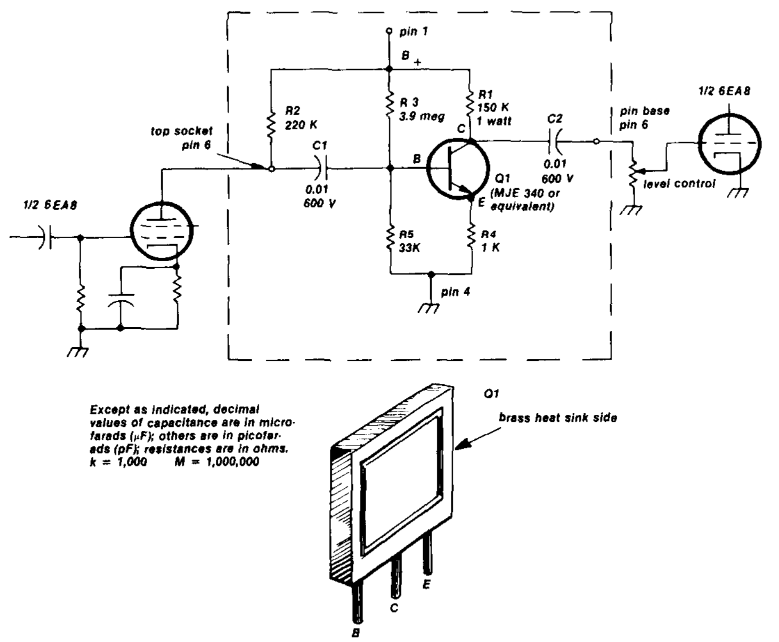


fig. 1. Schematic diagram, plug-in amplifier for Heath SB-400/SB-401 transmitter.

construction

Disassemble the nine-pin test socket by removing the No. 6 terminal pin. Drill a small hole through the side of the test socket one-half inch (12.7 mm) from the pin base at a slight angle. Reinsert the pin through this hole to provide an output and input circuit for the amplifier connection (see **fig. 2**).

Mount the parts on a small circuit board (fiber board is okay). Drill a 3/4-inch (19-mm) hole at one end to accept the nine-pin test socket. Cut a small angle on the board at the right-hand corner for clearance of the capacitor when inserting the module into the 6EA8 socket.

Insert the test socket into the board and cement it with epoxy. Reinsert the pin through the side of the test socket, adjusting the board so that it's parallel with the transformer.

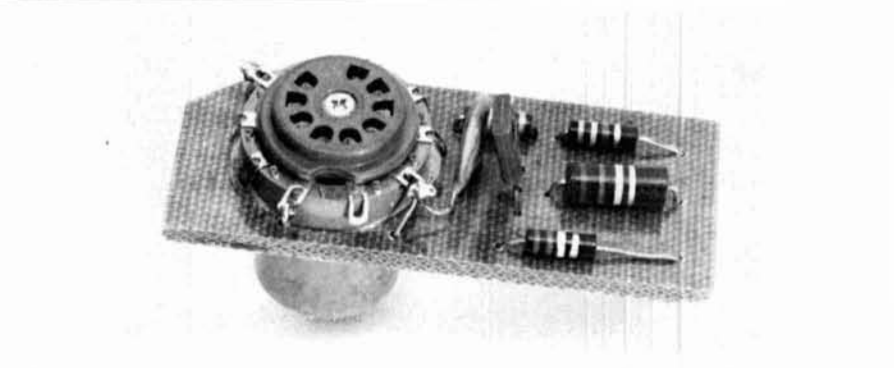
parts

Here's a list of components you'll need:

C1,C2	0.01 µF 600V
Q1	MJE340 (Motorola or equivalent)
nine-pin test socket	
R1	150k 1 watt
R2	220k 1/2 watt
R3	3.9 meg 1/2 watt
R4	1k 1/2 watt
R5	33k 1/2 watt

installation

Simply remove the 6EA8 from the transmitter and insert the 6EA8 into



Completed amplifier module for the SB-400/401 transceiver.

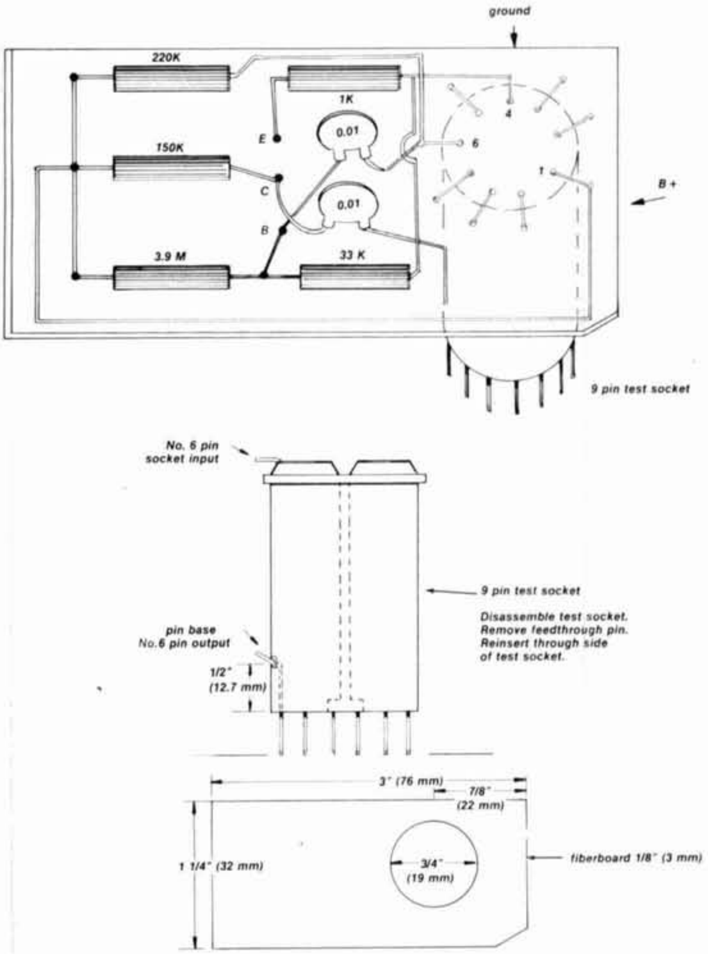


fig. 2. Construction details for the plug-in amplifier module used in the Heath SB-400/SB-401 transmitters.

the amplifier socket. Then insert the amplifier module into the 6EA8 socket. Set the audio level control at 9 o'clock. That's all there is to it. You don't have to use external amplifiers to obtain additional gain. As a matter of fact, such amplifiers, when inserted into the transmitter microphone jack, will overdrive the 6EA8.

Steve Hresko, W8MLH

MHz electronics

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SALE: HW-16, $120.00 — wanted keyer, power meter, 1-50 MHz receiver, KA4EBW.

ETCH IT YOURSELF PRINTED CIRCUIT KIT, Photo-Positive Method — No darkroom required, All the supplies for making your own boards, direct from magazine article in less than 2 hours. Only $24.95, S.A.S.E. for details: Excel Circuits Co., 4412 Fernlee, Royal Oak, MI 48073.

RUBBER STAMPS: 3 lines, $3.25 ppd. Send check or M.O. to G.L. Pierce, 5521 Birkdale Way, San Diego, CA 92117. S.A.S.E. brings information.

HAM RADIO REPAIR — Professional lab, personal service. "Grid" Gridley, W4GJO. April thru October: Rt. 2, Box 138B, Rising Fawn, Georgia 30738. (404) 657-7841. November thru March: 212 Martin Drive, Brooksville, Florida 33512. (904) 799-2769.

SELL: Midland 220 MHF FM transceiver model #13-509. $100.00. WB6NOM, (415) 278-0177, P.O. Box 546, Hayward, CA 94543.

MIRROR-IN-THE-LID, and other pre-1946 television set wanted. Paying 500+ for any complete RCA "TRK" series, or General Electric "HM" series set. Also looking for 12AP4, MW-31-3 picture tubes, parts, literature on pre-war television. Arnold Chase, WA1RYZ, 9 Rushleigh Road, West Hartford, Conn. 06117 (203) 521-5280.

WANTED: R-278B, T-217A, & MD-129A:/GR (GRC-27 units) unit enclosures. C.T. Huth, 146 Schenhardt St., Tiffin, OH 44883.

AMATEUR REPAIR: Professional service, reasonable rates, ALL brands. USA KDK repair center. Amateur Radio Repair Center, 1020 Brookstown Ave., #5, Winston-Salem, NC 27101 (919) 725-7500.

PHASING NETWORKS for single signal direct conversion transceivers. W9NZB, Wayne Openlander, 3132 North Lowell Avenue, Chicago, IL 60641.

QSL's — BE PLEASANTLY SURPRISED! Order our three colored QSL's in all varieties for $8.00 per 100 or $13.00 for 200. Satisfaction guaranteed. Samples $1.00 (refundable). Constantine Press, 1219 Ellington, Myrtle Beach, SC 29577.

WANTED: New 572B tubes. Larry Kleber, K9LKA, Belvidere, IL 61008.

QSLs & RUBBER STAMPS — Top Quality! Card Samples and Stamp Info — 50¢ — Ebbert Graphics 5R, Box 70, Westerville, Ohio 43081.

MUSEUM for radio historians and collectors now open. Free admission. Old amateur (W2AN) and commercial station exhibits, 1925 store and telegraph displays. 15,000 items. Write for details. Antique Wireless Assn., Holcomb, NY 14469.

WANTED: AN-MS connectors, synchros, etc. Send list, Bill Williams, P.O. 7057, Norfolk, Virginia 23509.

WANTED: Micor and Master II base stations, 406-420 MHz. Any solid state 2 and 6 GHz microwave equipment, AK7B, 4 Ajax Place, Berkeley, CA 94708.

WEST COAST BULLETIN, 1st and 3rd Mondays monthly. 8PM PST (0400 UTC), 3540 KCS, A-1, 22 WPM.

FT-101 MKII, double balanced second mixer, other receiver improvements, CW filter, fan, FV101, SP101, microphone $575.00. Steve, WB6RSE (213) 648-0756.

PROM PROGRAMMING, CW-IDers, repeater controllers. S.A.S.E. catalog. W-S Engineering, P.O.B. 58, Pine Hill, NJ 08021.

RIT, DIGITAL READOUT, BEZEL KIT (HW-101) and WWV Kit for HW-101, SB-102, SB-303 and SB-401. Adaptable to other models and brands. Free info. Protronics, Inc., 20 Monte Vista, Buckley, WA 98321. (206) 829-0056.

CRYSTALS FM 2 METERS STILL AVAILABLE! Crystals for equipment on our parts list, $4.50 each. For equipment list, send self addressed stamped envelope. SAVOY ELECTRONICS, P.O. Box 5727, Ft. Lauderdale, FL 33310 — Tel. (305) 563-1333.

SUPER QRP with Direct Conversion's 5 watt transmitter kits. Write Direct Conversion Technique, Box 1001, Dept. 6FM, 535 No. Michigan Ave., Chicago, Illinois 60611.

SHACK CLEANING TIME!! All good condition equipment! Accepting reasonable offers! (2) HW-16 antenna tuner, 2 meter mobile unit "complete", HW-7 QRP rig, more items. S.A.S.E. for details. Jim Howell, KA4EBW, Route 9, Box 251, Salisbury, NC 28144. Would like to do some trading for mint Century 21 rig, if interested in 2 meters swap including 50W amplifier.

SAVE 90%! Build your own minicomputer. Free details. Digatek, 2723 West Butler Drive, Suite K, Phoenix, Arizona 85021.

FOR SALE: Ten-Tec Omni-D, factory mod, ps, mic., phone patch. $600.00 AC1W, (203) 729-0863.

WANTED: Motorola micor base stations. 406-420 MHz. AK7B, 4 Ajax Pl., Berkeley, CA 94708.

THE VHF SHOP — Pennsylvania's only authorized LUNAR dealer has in stock the complete LUNAR Product Line. For your VHF/UHF Preamp, OSCAR, Linear Amplifier, GaAsFet, and transverter needs — call or write: K3MKZ, Box 349, RD #4, Mountaintop, PA 18707. (717) 868-6565.

SATELLITE TELEVISION...HOWARD/COLEMAN boards to build your own receiver. For more information write: Robert Coleman, Rt. 3, Box 58-AHR, Travelers Rest, SC 29690.

HELP! English Amateur desperately needs 1975 fully bound "Ham Radio" to complete library collection. Any reasonable price paid and shipping arranged. Mr. Trevor Campbell Davis, McGraw-Hill Book Co., Ltd., Shoppenhangers Rd., Maiden Head, Berkshire SL6 2QL UK (684) 23431.

MAKE HAM RADIO FUN! Supplement your learning programs with a motivational hypnosis cassette. Tape #3, Learning the Code; Tape #4, Breaking the Speed Barrier; Tape #7, Electronic Theory. Free catalog. For tapes, $10.95 each to Gem Publishing, 3306 North 6th St., Coeur d-Alene, ID 83814.

500 QSL's, $10. Catalogue, 743 Harvard, St. Louis, MO 63130.

VERY in-ter-est-ing! Next 5 issues $2. Ham Trader "Yellow Sheets", POB356, Wheaton, IL 60187.

CB TO 10 METER PROFESSIONALS: Your rig or buy ours — AM/SSB/CW. Certified Communications, 4138 So. Ferris, Fremont, Michigan 49412; (616) 924-4561.

QSL'S: No stock designs! Your art or ours; photos, originals, 50¢ for samples & details (refundable). Certified Communications, 4138 So. Ferris, Fremont, Michigan 49412.

NEED HELP for your Novice or General ticket? Recorded audio-visual theory instruction. No electronic background required. Free information. Amateur License, P.O. Box 6015, Norfolk, VA 23508.

VFO GLOVE 755 wanted with instructions. A.G. Rannie, W2EAI, 2 Farrell St., Newburgh, NY 12550.

CB TO 10-METER CONVERSIONS. SSB/AM/CW. Let a specialist convert your rig, or buy one complete. Write Conversion Engineering, Box 183, Sandwich, Massachusetts 02563.

CASH for December 1915 to June 1920 QST's for personal collection. Kenn Miller, K6IR, 16904 George Washington, Rockville, Maryland 20853 (301) 774-7709.

HAMS FOR CHRIST — Reach other Hams with a Gospel Tract sure to please. Clyde Stanfield, WA6HEG, 1570 N. Albright, Upland, CA 91786.

DISTINCTIVE QSL's — Largest selection, lowest prices, top quality photo and completely customized cards. Make your QSL's truly unique at the same cost as a standard card, and get a better return rate! Free samples, catalogue. Stamps appreciated. Stu Goodman, K2RPZ Print, P.O. Box 412, Rocky Point, NY 11778 (516) 744-6260.

FREE SAMPLE Ham Radio Insider Newsletter! Send large S.A.S.E.. W5YI, Box #10101-H, Dallas, Texas 75207.

MAGAZINE SAMPLES! For a free list of over 135 magazines offering a sample copy, send a stamped, addressed envelope to: Publisher's Exchange, P.O. Box 1368, Dept. 26A, Plainfield, NJ 07061.

MOBILE ANTENNAS 30-50 MHz. Baseloaded hole mount. Four ranges. First quality by Avanti. $15.00 prepaid. H. C. Van Valzah, 1140 Hickory Trail, Downers Grove, IL 60515 (312) 852-0472.

DSI FREQUENCY COUNTER REPAIR: Factory trained personnel, extensive parts inventory, fast turnaround. Write or call for free information package. Bright Electronics Corporation, P.O. Box 76972, Atlanta, GA 30328 (404) 952-0968.

BUY-SELL-TRADE Send $1.00 for catalog. Give name address and call letters. Complete stock of major brands new and reconditioned amateur radio equipment. Call for best deals. We buy Collins, Drake, Swan, etc. Associated Radio, 8012 Conser, Overland Park, KS 66204. (913) 381-5900.

More Details? CHECK—OFF Page 98

Coming Events

ACTIVITIES

"Places to go..."

ILLINOIS: Radio Expo '81 sponsored by the Chicago FM Club will be held, rain or shine, on September 19th and 20th at the Lake County Fair Grounds, routes 45 and 120 in Grayslake. Grayslake is 30 minutes north of Chicago and 45 minutes south of Milwaukee. This year we will have a super large flea market with plenty of indoor and outdoor space, free with a gate ticket. Just bring your own table and chair or tailgate it. Parking is free. We will also have new camping sites complete with power hook-ups. There will be Ham seminars both Saturday and Sunday. YL's have a ladies program and door prizes both days. Only the best manufacturers of Ham and computer equipment and their distributors will be at our huge display building for you to meet and buy from. As in the past, Expo will be giving out thousands of dollars worth of prizes and admission tickets are good for both days. For advanced registration, send $3.00 per person and a #10 S.A.S.E. to Radio Expo Tickets, P.O. Box 1532, Evanston, Illinois. Tickets at the gate are $4.00 each. Kids under seven are free. For more information call (312) BST-EXPO. Talk-in on 146.16/.76, 146.52, and 222.5/224.10.

ILLINOIS: The JAARC wil hold its 16th annual hamfest and flea market on June 21 at the Morgan County Fairgrounds in Jacksonville. Limited free indoor space and large outdoor flea market area. Free coffee and doughnuts from 8 to 9 AM. Food on the grounds. Talk-in on 146.52. Tickets $2.00 or 3/$5.00. See WB9RAL or WD9EBK for more info.

SOUTHERN ILLINOIS: Shawnee Amateur Radio Association's 25th anniversity Silver Jubilee Hamfest will be August 30 at JOHN A. LOGAN College in Cartersville, Illinois. Offerings include Air Conditioned Flea Market — Prizes — Forums — Computers — Food — Refreshments — Contests. For details QSL Bill May, KB9QY, 800 Hilldale, Herrin, IL 62948 or (618) 942-2511 days.

INDIANA: The Lake County A.R.C.'s ninth annual Hamfest on June 21st at the Lake County Fairgrounds in Crown Point. All tickets: $2.00. Talk-in on club repeater 147.84/.24 and 146.52. More info or tickets: S.A.S.E. "Mike" Evanson, KA9COM, 8037 Monaldi Dr., Munster, Indiana 46321.

MARYLAND: The Baltimore Radio Amateur Television Society announces its annual Maryland Hamfest on July 26th at the Howard County Fairgrounds, Route 32, adjacent to Interstate 70, 15 miles west of Baltimore. Tickets: $3.00 (XYL's and children under 12 free), tailgating spaces $2.00, tables $5.00 each. More information: BRATS, Box 5915, Baltimore, MD 21208 or call Mayer, W3GXK (301) 655-7812.

MICHIGAN: The Straits Area Amateur Radio Club's annual hamfest on July 18th at the Harbor Springs High School in Harbor Springs. Doors open for sellers at 8:00 and for the rest at 9:00. Donation: $2.00. Prizes, lunch, overnight parking, shopping nearby for YL's, and much more. Talk-in on .52 simplex and 146.07/.67. More info: Mr. Bernie Slotnick, KB8RE, 630 Ann St., Harbor Springs, MI 49740. (616) 526-5614.

MONTANA: The Great Falls Area A.R.C.'s Glacier-Waterton International Hamfest on July 17th-19th at the Three Forks Campground located between East and West Glacier on Highway 2. Hams from Canada and the Northwestern U.S. will participate in forums, technical presentations, exhibits and demonstrations. Ladies and children will have their own activities including horseback riding. Preregistration: $6.00, after July 7th: $7.00. Campsites with and without hookups available. More info: Glacier-Waterton Hamfest, Shirley Smith, Secretary, 1822 14th Ave. South, Great Falls, Montana 59405. (406) 452-1886.

NEW YORK: The Genesee Radio Amateurs', ARRL approved Batavia Hamfest on July 12th at the Alexander Firemen's Grounds, Route 98, in Alexander. Doors open at 7:00 AM. Advanced admission: $2.00 and $3.00 at the gate. Flea market is $1.00. Prizes, large exhibit area, programs, YL activities, contests, plenty of food, overnight camping, boat anchor auction and much more. Talk-in to W2RCX on 146.04/.64, 144.71/5.31 and .52 simplex. More info and advanced tickets: S.A.S.E. to GRAM, Inc., Box 572, Batavia, NY 14020.

NEW YORK: The Rome Radio Club's 29th annual "Ham Family Days" on June 7th at Beck's Grove, 10 miles west of Rome just off of Route 49. Starts at 9:00. Flea market, displays, and more. Talk-in on 146.28/.88, 146.34/.94 and .52 simplex.

NEW YORK: The Staten Island Amateur Radio Association's flea market on June 13th on the grounds of the All Saints Episcopal Church, Victory Blvd. and Wooley Ave. starting at 9:00 AM. Take interstate 278 to Victory Blvd. exit, then ½ mile east on Victory Blvd. No admission charge for buyers. Sellers: $3.00 and own tables. Talk-in on 146.28/.88 and 146.52. More info: S.A.S.E. to WA2AMJ, P.O. Box 495, Staten Island, NY 10314.

NORTH CAROLINA: The Cary Amateur Radio Club's ninth annual Mid-summer Swapfest on July 18th at the Lions Club Shelter in Cary (near Cary High School). Starts at 9:00 AM. Buying, selling, auction, prizes, and much more. Registration for prizes: $3.00 (top prize is a TS-520 SE). No admission charge. Talk-in on 146.28/.88, 147.75/.15, and 146.52. More info: Cary ARC, P.O. Box 53, Cary, NC 27511.

OHIO: The Tusco A.R.C. and Canton A.R.C.'s seventh annual Hall of Fame Hamfest on July 19th at the Nimishillen Grange, 6461 Easton St., Louisville. Giant flea market, dealers, food, XYL activities, CW contest, super awards, and more. $2.50 advanced and $3.00 at the gate. Tables must be reserved. For reservations, tickets, or more info: WA8SHP, 10877 Hazelview Ave., Alliance, Ohio 44601.

OHIO: The Champaign — Logan A.R.C.'s annual hamfest on June 14th at the Logan County Fairgrounds, S. Main St. and Lake Ave., Bellefontaine. Prizes, free parking, and much more. Admission: $1.50 advanced and $2.00 at the door. Trunk and table sales: $3.00. Bid table available this year. Talk-in on 146.52 simplex and Hi-Point repeater. More info: W8HFK, John L. Wentz, Box 102, West Liberty, OH 43357 or WD8NEB, Paul F. Merine, Box 185, West Mansfield, OH 43358.

OHIO: The 17th annual Wood County Ham-A-Rama on July 19th at the Bowling Green Fairgrounds in Bowling Green. Opens at 10:00 AM. Free admission and parking. Trunk sale space and food available. Prizes. K8TIH talk-in on .52. Tickets are $1.50 in advance and $2.00 at the door. Write to: Eric Willman, 14118 Bishop Rd., Bowling Green, OH 43402. Advance table rental to dealers only: $3.00 per table, payable in advance. Saturday set-up available. Send check for tables to: Bill Wilkins, 16220 Portage Rd., Bowling Green, OH 43402.

OHIO: The Northern Ohio Amateur Radio Society's "Noarsfest" on July 25th at the Lorain County Fairgrounds in Wellington. Over 100 prizes, flea market, parking available, large indoor exhibit hall, refreshments, overnight camping (no hookups), plus much more. Donations: $2.50 advanced and $3.00 at the gate. Dealer tables: $5.00 each. Talk-in on 146.10/.70 or .52 simplex. Tickets or info: S.A.S.E. to Noarsfest, P.O. Box 354, Lorain, Ohio 44052. Dealers: George Morningstar, W8ANM, 198 Glenview Dr., Avon Lake, Ohio 44012. (216) 933-2841.

OHIO: The Lancaster and Fairfield County A.R.C.'s annual family hamfest on June 21st at The P & R Party Barn, 4 miles west of Lancaster off of Rt. 188. Overnight camping and many, many activities for the family. Starts at 9:00 AM. Advanced tickets are $2.00 and at the door $3.00. Flea market tables are $2.00 and trunk sales are $1.00. Talk-in on 147.63/.03 or .52 simplex. More info: C. Ted Riley, WB8VOA, P.O. Box 3, Lancaster, Ohio 43130 or call (614) 653-8222.

OKLAHOMA: The West Gulf Division ARRL Convention and famed "Ham Holiday" will be held on July 24th - 26th at Oklahoma City's Myriad Convention Center in downtown Oklahoma City. Sponsored by the Central Oklahoma Radio Amateurs, the program will include forums, technical talks, a QCWA breakfast, a full ladies program, many prizes, plus much more. Pre-register by July 7th for $6.00 or pay $7.00 after the 7th. Immense ground-level indoor exhbitor and swapfest are available. Tables free to non-commercial registrants. More info or tickets: CORA, P.O. Box 20118, Oklahoma City, OK 73120.

PENNSYLVANIA: Harrisburg RAC Annual Firecracker Hamfest on Saturday, July 4th at the Shellsville VFW picnic grounds. Exit #27 off I-81, north one mile from exit. Parking for 1000 cars. Shade trees with pavillion. Food available. Talk-in on .52 and .16/.76. Admission is $3.00, tailgating is $1.50. XYL and children free.

PENNSYLVANIA: The Nittany A.R.C.'s annual Mount Nittany Hamfestival on July 11th at the HRB-Singer, Inc. picnic grounds in State College. Flea market, auction, dealers, door prizes and free parking. Refreshments and food available. Also the famous Central Pennsylvania Festival of the Arts on the Penn State University campus. Advanced registration is $2.00 and at the gate is $3.00. XYLs and children free. Flea market space is $3.00 in advance and $5.00 on site. Talk-in from I-80 and other central Pennsylvania routes on .16/.76 and .25/.85, local direction on .52 simplex. More info: Mount Nittany Hamfestival, NARC, Box 614, State College, PA 16801 or call Dave Buckwalter, N3BBH at (814) 234-0759.

More Details? CHECK — OFF Page 98

CANADA: The Maple Ridge A.R.C. is hosting Hamfest '81 on July 4th and 5th at the Maple Ridge Fairgrounds, 30 miles east of Vancouver. Registration: Hams, $4.50, program with draw ticket: $2.50, dinner and dance: $10.00. Non-hams, over twelve: $2.00 under twelve free. Food, prizes, swap & shop, bunny hunt, ladies program and much more. Camper space available (no hook-ups). Talk-in on 146.34/.94 and 146.19/.79. More info or advanced registration: Bob Haughton, VE7BZH, Box 292, Maple Ridge, B.C. V2X 7G2.

CANADA: The Okanagan International Hamfest on July 25th and 26th at the Oliver Centennial Park, Oliver, B.C. Registration: Saturday the 25th at 9:00 AM. Activities start at 1:00 PM. YLs please bring your hobbies. Flea market items for sale/display. Potluck luncheon Sunday noon, entertainment, bunny hunts, etc. Please note change in location of hamfest. Talk-in on .34/.94 OKN repeater .76/.76. First come, first served basis. No reservations at Centennial Park. Info: John Juul-Anderson, VE7DTX, 8802 Lakeview Dr., Vernon, B.C. V1B 1W3 or Lota Harvey, VE7DKL, 584 Heather Rd., Penticton, B.C. V2A 1W8.

OPERATING EVENTS
"Things to do..."

JULY 4th and 5th: The Hannibal A.R.C. will issue a Special Events Certificate from the National Tom Sawyer Days celebration operating from Mark Twain's boyhood home town, Hannibal, Missouri. Hours: 1500-2100 UTC on July 4 and 1700-2100 UTC on July 5. Frequencies: 7.245, 14.290, 21.390 MHz and Novice CW on 7.125 and 21.125 MHz. For certificate, send S.A.S.E. (9" x 12") and your personal QSL card confirming contact to Hannibal A.R.C. Inc., WØKEM, 2108 Orchard Ave., Hannibal, MO 63401.

THE ATLANTA RADIO CLUB announces the third annual competition for two $500 cash scholarships. Each scholarship will go to a licensed amateur entering college in the Fall of 1981. Deadline for completed application is May 31st; request an application from ARC Scholarship, 259 Wetherstone Parkway, Marietta, GA 30067.

HAM CALENDAR June

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	WEST COAST BULLETIN — 8 PM PST (0400 UTC) 3540 KCS, A-1 22 WPM **1**. **1**	**AMSAT** Eastcoast Net 3850 kHz 9:00 PM EDST (0100Z Wednesday Morning) **AMSAT** Mid-Continent Net 3850 kHz 9:00 PM CDST (0200Z Wednesday Morning) **AMSAT** Westcoast Net 3850 kHz 8:00 PM PDST (0300Z Wednesday Morning) **2**	**3**	**4**	**5**	**INDEPENDENT REPEATER ASSOC. — GRAND RAPIDS SPRING SWAP & SHOP** — National Guard Armory, 44th St., Grand Rapids, MI — WD8NZZ **6**. **6**
OLE VIRGINIA HAMS, A.R.C. Inc. — MANASSAS HAMFEST — Prince William County Fairgrounds, Rt. 3, 234 Manassas, VA 22110 **7**. **CHELSEA SWAP & SHOP** — Chelsea Fairgrounds, Chelsea, MI — Wm. Altenberndt, 3132 Timberline, Jackson, MI 49201 **7**. **ROME RADIO CLUB HAM FAMILY DAYS** — Beck's Grove (10 mi. west of Rome off Rt. 49 at Beck's Grove Airport) Rome, NY 13440 — KA2DAI **7**. **7**	**DELTA DIVISION DENATOBIA, MS** — W5GAM **7-8**. **8**	**AMSAT** Eastcoast Net 3850 kHz 9:00 PM EDST (0100Z Wednesday Morning) **AMSAT** Mid-Continent Net 3850 kHz 9:00 PM CDST (0200Z Wednesday Morning) **AMSAT** Westcoast Net 3850 kHz 8:00 PM PDST (0300Z Wednesday Morning) **9**	**10**	**11**	**ARRL CONVENTION** Ohio State, Cincinnati **12-13**. **12**	**STATEN ISLAND AMATEUR RADIO ASSOC. FLEA MARKET**, — St. Episcopal Church, Victory Blvd. & Wooley Ave., Staten Island, NY 10314 — WA2AMJ **13**. **ARRL VHF QSO PARTY 13-14.** **13**
CLINTON & HIGHLAND COUNTY RADIO CLUB ANNUAL HAMFEST & FLEA MARKET — Clinton County Fairgrounds, S.R. 22, Wilmington, OH **14**. **CHAMPAIGN/LOGAN ARC ANNUAL HAMFEST** — Logan County Fairgrounds, S. Main St. & Lake Ave., Bellefontaine, OH 43311 — WD8NEB **14**. **SIX METER CLUB OF CHICAGO 24th ANNUAL HAMFEST** — Santa Fe Park, 91st & Wolf Rd., Willow Springs, IL — WB9SPV **14**. **MILTON ARC 10th ANNUAL MARCH HAMFEST** — Allenwood Fireman's Fairgrounds, U.S. Rt. 15, Milton, PA 17847 — Harold Dennin, POB 235, Milton, PA 17847 **14**. **SATELLITE ARC ANNUAL SANTA MARIA SWAPFEST** — POB 1615, Vandenberg, AFB, CA 93437 **14**.-*JUNE 14 CONT. BOTTOM RIGHT* **14**	**WEST COAST BULLETIN** — 8 PM PST (0400 UTC), 3540 KCS, A-1, 22 WPM **15**. **15**	**AMSAT** Eastcoast Net 3850 kHz 9:00 PM EDST (0100Z Wednesday Morning) **AMSAT** Mid-Continent Net 3850 kHz 9:00 PM CDST (0200Z Wednesday Morning) **AMSAT** Westcoast Net 3850 kHz 8:00 PM PDST (0300Z Wednesday Morning) **16**	**17**	**18**	**SIX-METER INTERNATIONAL RADIO CLUB 7th ANNUAL SUMMER SMIRK PARTY CONTEST** — 1900 hrs. CDT Friday 19 June to 1900 hrs. Sunday 21 June — SB5SND **19-21**. **19**	**YANKEE RADIO CLUB INC.** — Oxford County Fairgrounds, Rt. 26, Oxford, ME **20**. **RARITAN VALLEY RADIO CLUB 10th ANNUAL HAMFEST & FLEA MARKET** — Columbia Park, Dunellen, NJ **20**. **ATLANTA HAM FESTIVAL 1981** — Downtown Marriott Hotel, Atlanta, GA — W4GKF **20-21**. **ARRL CONVENTION** — Georgia State, Atlanta, GA **20-21**. **20**
JACKSONVILLE ARC 16th ANNUAL HAMFEST & FLEA MARKET — Morgan Co. Fair Grounds, Jacksonville, IL — WB9RAL/WD9EBK **21**. **LANCASTER & FAIRFIELD COUNTY ARC 1981 FAMILY HAMFEST** — The P & P Barn 4 miles West of Lancaster off Rt. 188 — WB8VOA **21**. **LAKE COUNTY ARC NINTH ANNUAL HAMFEST** — Lake County Fairgrounds, Crown Point, IN — KA9COM **21**. **21**	**22**	**AMSAT** Eastcoast Net 3850 kHz 9:00 PM EDST (0100Z Wednesday Morning) **AMSAT** Mid-Continent Net 3850 kHz 9:00 PM CDST (0200Z Wednesday Morning) **AMSAT** Westcoast Net 3850 kHz 8:00 PM PDST (0300Z Wednesday Morning) **23**	**24**	**25**	**26**	**ARRL FIELD DAY 27-28.** **27**
W1AW Schedule **April 26-October 25, 1981** UTC Slow Code Practice: MWF: 0200, 1300, 2300; TThSSn: 2000; S: 0200 Fast Code Practice: MWF: 2000; TTh: 0200, 1300; TThSSn: 2300; S: 0200 CW Bulletins: Dy: 0000, 0300, 2100; MTWThF: 1400 Code practice and CW bulletin frequencies: 1.835, 3.58, 7.08, 14.08, 21.08, 28.08, 50.08, 147.555 MHz.	**29**	**AMSAT** Eastcoast Net 3850 kHz 9:00 PM EDST (0100Z Wednesday Morning) **AMSAT** Mid-Continent Net 3850 kHz 9:00 PM CDST (0200Z Wednesday Morning) **AMSAT** Westcoast Net 3850 kHz 8:00 PM PDST (0300Z Wednesday Morning) **30**	**31**			*JUNE 14 CONT. HERE*— **GOODYEAR ARC 14th ANNUAL GOODYEAR ARC HAMFEST** — Goodyear Wingfoot Lake Park, State Rt. 224 & 43, Akron, OH 44316 **14**. **JONES COUNTY ARC SPECIAL EVENT STATION AC0Z**, Grant Wood Festival in Stone City, Iowa. From 1100 to 2300 UTC. Certificate $1.00 to Lawrence Greenawald, AC0Z, 801 S. Haven Dr., Monticello, IA 52310 **14**. **MONROE COUNTY RADIO COMMUNICATIONS HAMFEST** — Monroe Community College, Raisinville Road, Monroe, MI 43161 **14**.

NEW products

MFJ super keyboard

The all-new MFJ Super Keyboard model MFJ-494 is a full-fledged keyboard that sends CW, Baudot, and ASCII with fifty-character text buffer, thirty-character programmable message memory, four automatic messages, two random code practice modes, speed and buffer metering, back-space delete function, and buffer memory hold function. And just plug in your paddle and it's a full-function keyer. Simple one or two keystroke combinations execute all commands.

in conjunction with the four automatic messages contained in the keyboard. The four automatic messages let you call CQ, CQ TEST, QRZ and ID without using all of your programmable memory.

Two code practice modes let you increase your code proficiency. The first mode is pure random code with random length groups. The second mode is five-letter groups with eight separate repeatable lists (with answers) for checking your progress. Space between letters may be expanded to improve recognition in both modes and in the second mode you may select alphabet only or alphanumeric plus punctuation. A meter tells you your sending speed (speed may be set before sending begins) or just push a button and the meter tells you how much buffer you

The 50-character text buffer can be filled prior to sending (pre-programmed), or it can be filled at any given speed if you type faster than the code is being sent. When the buffer approaches full, the side tone pitch changes and a red LED comes on to warn you to slow down typing to prevent buffer overflow.

The thirty-characters of programmable memory provide enough memory for contester or DXer when used

have used and how much you have left.

A lot of thought has gone into human engineering for the super keyboard. For example, all controls and keys are positioned logically and labeled clearly for instant recognition. Pots are used for speed, volume, tone, and weight because they are easier to use than keystroke sequences and they remember your settings even if power is lost or turned off. The MFJ-494 operates on 9-12 Vdc or 110 Vac with optional ac adapter ($7.95). The same ultra reliable keying circuit that MFJ keyers are famous for is used in the MFJ-494. If ordered from MFJ there is a 30-day, money-back trial period. If you are not satisfied, you may return it within 30 days for a full refund (less shipping). MFJ also provides a one-year unconditional warranty. To order call toll free (800) 647-1800, or mail order with a check or money order to MFJ Enterprises, Inc., P.O. Box 494, Mississippi State, Mississippi 39762.

RTTY/ADCII/ Morse reader

Kantronics Mini-Reader is the size of a hand-held calculator (5.75 inches by 3.5 inches by 1 inch). The Mini-Reader reads and displays Morse code, radioteletype (at any shift or standard speed), and ASCII computer language. It computes and displays code speed, automatically tracks Morse code speed from 3 to 80 WPM, maintains lapse or real time on a 24-hour clock, and contains both an audio frequency counter (0-79 kHz) and a 250-Hz audio filter. The Mini-Reader operates on 8 to 18 volts dc.

The Mini-Reader opens a world of Morse conversations, Amateur radioteletype exchanges, UPI and AP news bulletins, official weather bulletins and warnings, ship-to-shore calls, special maritime bulletins, and on-the-air computer exchanges.

The Mini-Reader comes wired, tested and warranted for a full year for only $314.95, suggested retail price. Write to Kantronics, Incorporated, 1202 East 23rd Street, Lawrence, Kansas 66044.

solder repair kit

A line of solder repair kits for making fast, easy repairs on a variety of electrical and electronic connections in the home or workshop is available from Fry Metals, Inc., of Providence, Rhode Island.

Fry Solder Repair kits feature triple-core solder dispensers that ensure continuous flux flow while soldering fine wires and other connections. They are offered in both 60 percent tin/40 percent lead, and 40/60 combination rosin dispensers; also included is a handy pre-mixed solder cream dispenser tube.

Fry Solder Repair kits range in price from $1.30 to $4.50. For more information contact Fry Metals, Inc., 50 Sims Avenue, Providence, Rhode Island 02909.

receiver preamplifier

Palomar Engineers announces a new receiver preamplifier which is continuously tunable and covers the short wave bands from 1.8 to 54 MHz. It provides 20 dB gain with a dual gate FET for low noise figure. The gain and the low noise figure greatly improve reception on most receivers, particularly on the higher frequency bands. The added selectivity reduces image and spurious response.

Gain is continuously variable to prevent overloading the receiver. A step attenuator is also provided along with a selector switch for two antennas. Model P-305 operates from a 9-volt battery and is priced at $99.95. Model P-308 has a built-in 115-volt ac power supply and is priced at $109.95.

For a free descriptive brochure write Palomar Engineers, 1520 G Industrial Avenue, Escondido, California 92025.

aluminum boxes

A new line of precision aluminum boxes for electronic packaging, which can be made in any size with no tooling or set up charges, are available from Nordal. The box and removable cover are made of 0.032 aluminum. These boxes can be used to package RF circuits, amplifiers, filters, oscillators, magnetics and other

NEW products

electronic circuits. The boxes can be used alone or mounted on a PC board to provide a shielded package with a removable cover.

Write Nordal Electronics Company, 9995 Monroe Drive #205, P.O. Box 20175, Dallas, Texas 75220.

multiple signal line protectors

A complete line of signal line protectors has been introduced by MCG Electronics. These devices provide complete interface protection for signal/data/telephone lines; they protect two-wire systems and RS232, RS423, RS422 systems.

Models are available that can protect as few as two independent twisted pairs. Housed in compact low-profile cases, all protectors can be installed by simply using a screwdriver.

Applications include modems, computers, peripheral equipment, semiconductor devices, as well as all other sensitive equipment that interfaces directly with telephone or signal lines.

The units were designed specifically to protect signal/data/telephone lines from transient overvoltages caused by lightning, heavy machinery, elevator motors, and generators. The protectors interface between the signal lines and the sensitive circuit that is to be protected. All protectors recover automatically to standby in preparation for further protection.

Prices start at $59. Write MCG, 160 Brook Avenue, Deer Park, New York 11729.

EZ CORD

Colton Creators, Inc., has developed and patented a product for safely holding electrical cords. EZ CORD CONTROL holds all sizes of extension cords, amplifier cords, and other wires that can become a safety problem. EZ CORD CONTROL eliminates tangles and offers a safe solution to the hazards created by unwound extension cords. It is portable, and can also be mounted for use or storage.

Practical uses include all lawn and garden equipment, power tools and appliances, microphones, battery cables, speaker and amplifier cables, drop light, and pool filter. It is also ideal for holding yarn, clothes lines, Christmas lights, ski tow ropes, mooring lines and anchor lines. Priced under $3.00. Write Colton Creators, Inc., 216 East Second Street, Mineola, New York 11501.

short circuits

satellite bearings

In the article "Geostationary Satellite Bearings with the TI-58/59 Programmable Calculator," which appeared in the April, 1981, issue, the following corrections should be made to the program: Line 028 should be 86 STF and use instructions steps 5 and 7 should display 23.2. Step 6 should display 252.8.

synthesizer

The following corrections should be made to the schematic in the article "Genesis of a Synthesizer," which appeared in the March, 1981, issue: The 2N2369 whose collector is connected to pins 9 and 10 of U15 is Q2; the other transistor inadventently marked "Q2" should be labelled Q3. The collector and base of Q3 should not be connected together. The connections between the 0.1 MHz thumbwheel switch and U10 are as follows: 8 to pin 6; 4 to pin 4; 2 to pin 2; and 1 to pin 14. The input to U8 should be on pin 6, not 8. "PE" of the left half of U4 and "PE_{out}" on the right are connected internally to pin 1 of U4. The input to pin 15 of U15 should be ≈25 MHz.

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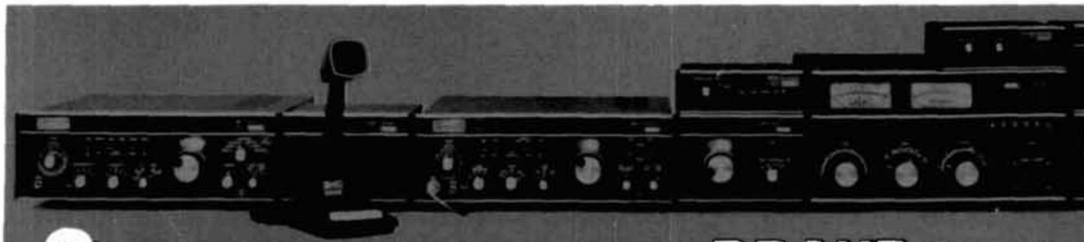

3 recent additions to the DRAKE family

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Model 1554
Drake L75
160-15* Meters

1.2kW Linear Amplifier

1.2kW PEP, ssb continuous, 1kW cw 50% duty cycle.

160-15* meter amateur band coverage, *plus expanded ranges* for any future hf band expansions or additions within FCC rules. These ranges also include increased coverage for MARS, embassy, government, or other such services.

The Drake L75 utilizes an Eimac 3-500 Z triode for rugged use, and lower replacement cost compared to equivalent *ceramic* types.

Built-in relative power reading for output indication.

Temperature controlled two speed fan is a high volume low *noise type and offers optimum* cooling.

Adjustable exciter agc feedback circuitry permits drive power to be automatically controlled at proper levels to prevent peak *clipping and* cw overdrive. Front panel control.

By-pass switching is included for straight through, low power operation without having to turn off amplifier.

Bandpass tuned input *circuitry for low distortion and* 50 ohm input impedance.

Built-in power supply.

Operates from 120/240 V-ac, 50/60 Hz primary line voltage.

Drake L75 Specifications:

• **Frequency Coverage***: Ham bands 160 through 15 *meters**. Non-amateur frequencies between 6.5 and 21.5 MHz may be covered with some modification of the input circuit. • **Plate Power Input:** 1200 watts PEP on ssb and a-m. 1000 watts dc on cw. • **Drive Power Requirements:** 60 watts PEP on ssb and *50 watts on cw, a-m,* RTTY, and SSTV. • **Input Impedance:** 50 ohms. (Bandpass tuned input) • **Output Impedance:** Adjustable pi-network matches *50 ohm line with SWR not* to exceed 2:1. • **Intermodulation Distortion Products:** In excess of −33 dB. • **Power Requirements:** 240 volts 50-60 hertz 10 amperes, or 120 volts 50-60 hertz 20 amperes. • **Tube Complement:** One 3-500Z. • **Dimensions: Amplifier** 13.69"W x 6.75"H x 14.25"D (34.8 x 17.1 x 36.2 cm). • **Weight:** Amplifier 42.2 lbs (19.2 kg), Power Supply 42.5 lbs (19.3 kg).

**Export model includes coverage of the 10-meter Ham Band.*

Model 1540

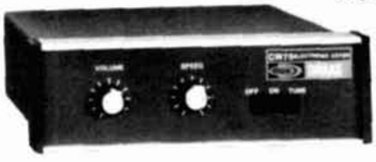
Drake MN75 Matching Network

- **Frequency Coverage:** 1.8 - 30 MHz
- **Antenna Choice:** Matches antennas fed with coax, balanced line, or random wire. (For balanced line use optional B-1000 Balun.)
- **Antenna/By-Pass Switching:** *Allows matching unit by-pass* regardless of antenna in use, and selects various antennas.
- **Extra Harmonic Reduction:** Employs "pi-network" low pass *filter type circuitry for maximum* harmonic rejection.
- **Built-in Metering:** Accurate Rf Wattmeter and VSWR Reading, pushbutton controlled from front panel.
- **Input Impedance:** 50 ohms *(resistive)*.
- **Power Capability:** 200 watts average continuous duty (0-300 W scale).
- **Dimensions:** 13.1"W x 4.53"H x *8.5"D excluding knobs* and connectors (33.26 x 11.5 x 21.6 cm).
- **Weight:** 8 lbs (3.6 kg).

Drake MN75 Specifications:

• **Frequency Coverage:** 1.8 to 30 MHz. • **Input Impedance:** 50 ohms (resistive). • **Load Impedance:** 50 ohm coaxial with VSWR of 5:1 or less at any phase angle to 23 MHz, 4:1 at 23 to 26 MHz, 3:1 at 26 to 30 MHz. 75 ohm coaxial at a lower VSWR can be used. • **Balanced Feedlines:** With the Drake B-1000 accessory balun, which mounts on rear panel, tunes feed point impedances of 40 to 1000 ohms, or 5:1 VSWR referenced to 200 ohms (3:1 on 10 meters). • **Long-Wire Antennas:** Feed point impedances up to 5:1 VSWR referenced to 50 ohms. Also, 5:1 referenced to 200 ohms with the Drake B-1000 accessory balun (3:1 on 10 meters) • **Meter:** Reads VSWR or forward power. • **Wattmeter Accuracy:** ±5% of reading ±1% of full scale. • **Front Panel Controls:** Provide for the adjustment of resistive and reactive tuning, antenna switching, range switching, VSWR calibration, and selection of watts or VSWR calibration, and selection of watts or VSWR functions of the meter. • **Rear Panel Connectors:** The rear panel has four type SO-239 connectors (one for input and 3 for outputs), three screw terminal connections (for long-wire and open-wire feeder systems), and a ground post.

Model 1507 CW75 Keyer



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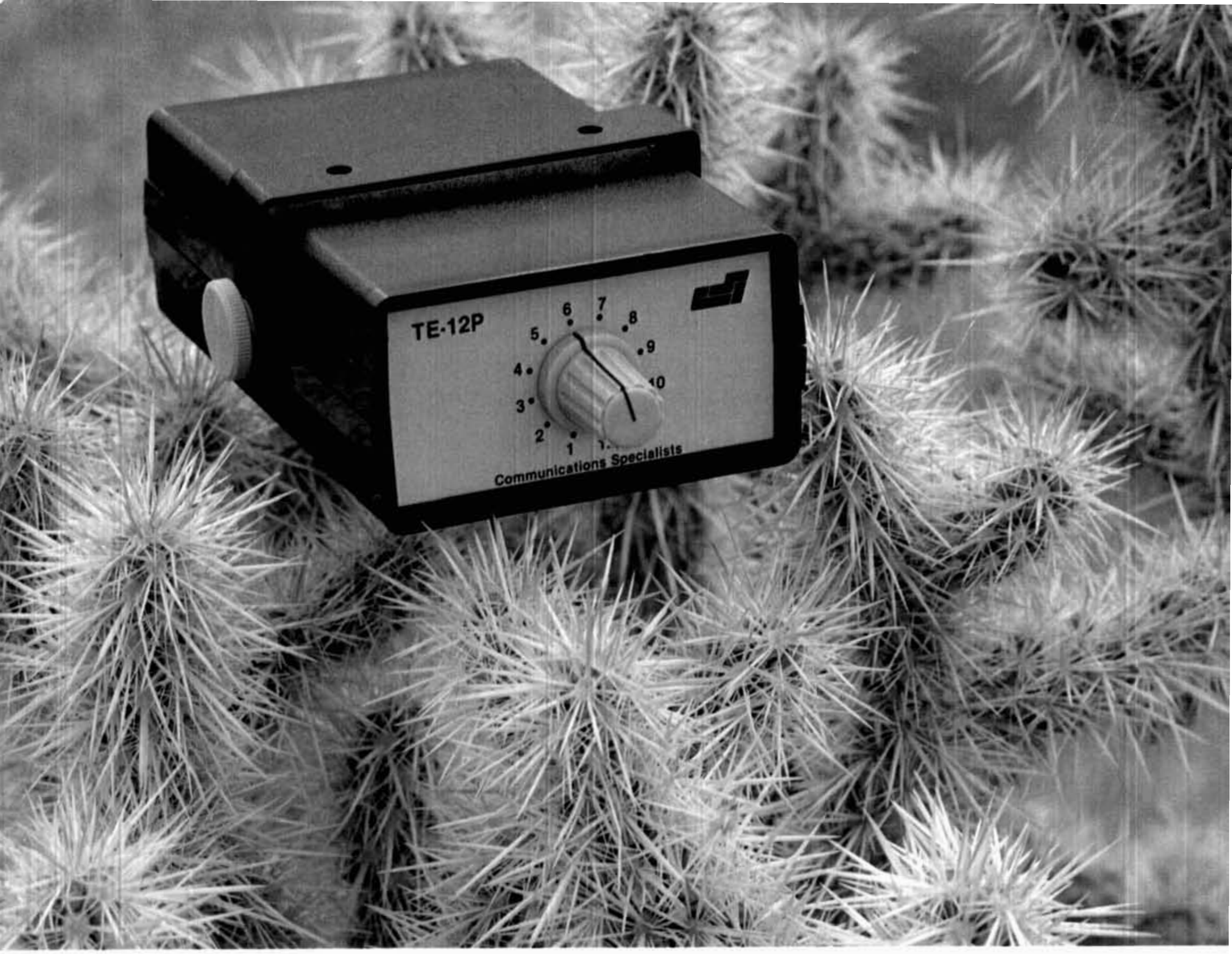

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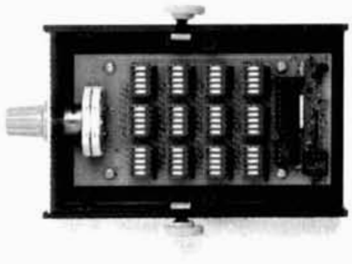

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See your Yaesu dealer for a demonstration of the top performance accessories for the FT-101ZD, such as the FV-101Z External VFO, SP-901P Speaker/Patch, YR-901 CW/RTTY Reader, FC-902 Antenna Tuner, and the FTV-901R VHF/UHF Transverter. Watch for the upcoming FV-101DM Digital Memory VFO, with keyboard frequency entry and scanning in 10 Hz steps!

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Note: A limited quantity of the earlier FT-101ZD (with AM as standard feature) is still available. See your Yaesu dealer. FT-101ZD Mk III designates transceivers bearing serial #240001 and up, with APF/Notch filter built in and AM/FM units optional.

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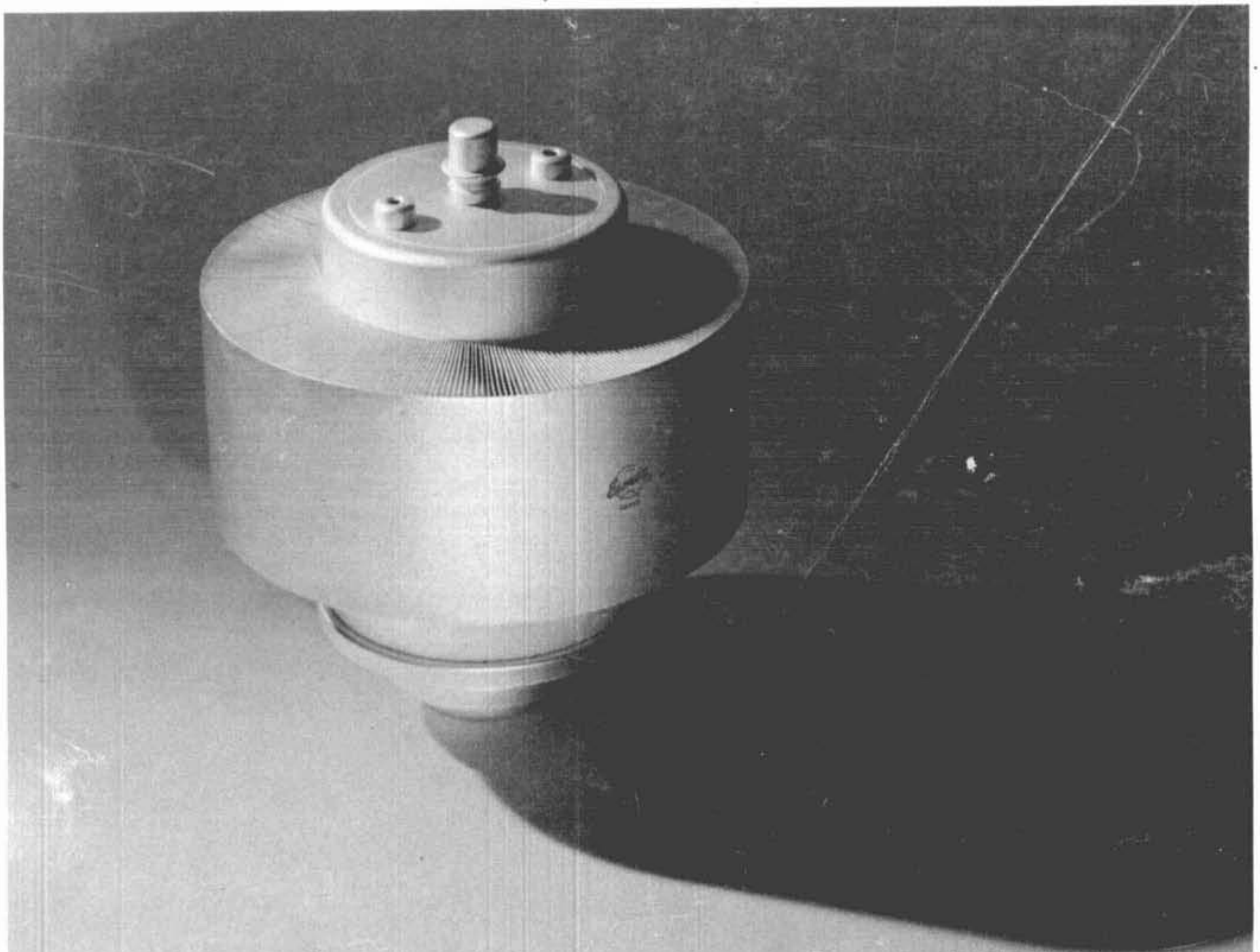

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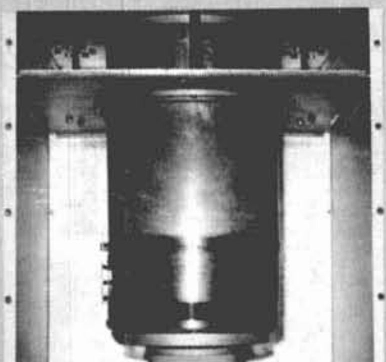

50 kW FM broadcast cavity CV-2200 with 4CX40,000G tetrode.

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