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• rf power meter . . . . . . 55
Ever since we made our first Amateur amplifier almost 20 years ago, our goal has been to make the finest, most rugged and reliable amplifier possible. Now with the 3K Classic we have accomplished this. It contains all of the famous Henry amplifier features plus the magnificent 8877 tube, rugged heavy duty power supply components and advanced antenna switch relay for semi break-in on CW. This is the amplifier of every Amateur’s dreams! The 3K Classic/X with heavy duty power supply and 10 meter operation is available for sale outside the USA where FCC type acceptance is not required.

The 2K Classic

The 2K Classic represents the culmination of years of experience in developing, manufacturing and improving the 2K series. It remains as always a “workhorse”, engineered and built to loaf along at full legal power for days or weeks without rest. A look inside shows why! It is truly a “Classic” amateur amplifier. Heavy duty, top quality components along with its rugged construction assures you trouble free operation. It will put your signal on the air with greater strength and clarity than you ever dreamed possible. The 2K Classic operates on all Amateur bands, 80 through 15 meters (export models include 10 meters). Price $1295.00

The 1KD-5

...Another fine member of the famous Henry Radio family of superior amplifiers. And we're still convinced that it's the world's finest linear in its class. The 1KD-5 was designed for the amateur who wants the quality and dependability of the 2KD-5 and 2K-4, who may prefer the smaller size, lighter weight and lower price and who will settle for a little less power. But make no mistake, the 1KD-5 is no slouch, its 1200 watt PEP input (700 watt PEP nominal output) along with its superb operating characteristics will still punch out clean powerful signals...signals you'll be proud of. Compare its specifications, its features and its fine components and we're sure you will agree that the 1KD-5 is a superb value at only $695.

The 2KD-5

We have been suggesting that you look inside any amplifier before you buy it. We hope that you will. If you “lift the lid” on a 2KD-5 you will see only the highest quality, heavy duty components and careful workmanship...attributes that promise a long life of continuous operation in any mode at full legal power. The 2KD-5 is a 2000 watt PEP input (1200 watt PEP nominal output) RF linear amplifier, covering the 80, 40, 20, and 15 meter amateur bands. It operates with two Elmac 3-500Z glass envelope triodes and a Pi-L plate circuit with a rotary silver plated tank coil. Price $945.

Henry amateur amplifiers are available from select dealers throughout the U.S. And don’t forget the rest of the Henry family of amateur amplifiers...the Tempo 2002 high power VHF amplifier and the broad line of top quality solid state amplifiers. Henry Radio also offers the 4K-Ultra and 3K Classic/X superb high power H.F. amplifiers and a broad line of commercial FCC type accepted amplifiers for two way FM communications covering the range to 500MHz.
The right design — for all the right reasons. In setting forth design parameters for ARGOSY, Ten-Tec engineers pursued the goal of giving amateurs a rig with the right features at a price that stops the amateur radio price spiral.

The result is a unique new transceiver with selectable power levels (convertible from 10 watts to 100 watts at the flick of a switch), a rig with the right bands (80 through 10 meters including the new 30 meter band), a rig with all the right operational features and the right price for today's economy — just $549.

Low power or high power, ARGOSY has it. Now you can enjoy the sport and challenge of QRP operating, and, when you need it, the power to stand up to the crowds in QRM and poor band conditions. Just flip a switch to move from true QRP power with the correct bias voltages to a full 100 watt input.

New analog readout design. Fast, easy, reliable, and efficient. The modern new readout on the ARGOSY is a mechanical design that instantly gives you all significant figures of any frequency. Right down to five figures (± 2 kHz). The band switch indicates the first two figures (MHz), the linear scale with lighted red bar-pointer indicates the third figure (hundreds) and the tuning knob skirt gives you the fourth and fifth figures (tens and units). Easy and efficient — so battery operation is easily achieved.

The right receiver features. Sensitivity of 0.3 μV for 10 dB S+N/N. Selectivity: the standard 4-pole crystal filter has 2.5 kHz bandwidth and a 2.7:1 shape factor at 6/50 dB. Other cw and sb filters are available as options, see below. I-f frequency is 9 MHz, i-f rejection 60 dB. Offset tuning is ± 3 kHz with a detent zero position in the center. Built-in notch filter has a better than 50 dB rejection notch, tunable from 200 Hz to 3.5 kHz. An optional noise blanker of

Here's a Concept You Haven't Seen In Amateur Radio For A Long Time—Low Price.

New TEN-TEC Argosy

$549

the i-f type has 50 dB blanking range. Built-in speaker is powered by low-distortion audio (less than 2% THD)

The right transmitter features. Frequency coverage from 80 through 10 meters, including the new 30 meter band, in nine 500 kHz segments (four segments for 10 meters), with approximately 40 kHz VFO overrun on each band edge. Convertible power: 100 or 10 watts input with 100% duty cycle for up to 20 minutes on all bands. 3-function meter shows forward peak power on transmit, SWR, and received signal strength. PTT on sb, full break-in on cw. PIN diode antenna switch. Built-in cw sidetone with variable pitch and volume. ALC control on "high" power only where needed, with LED indicator. Automatic normal sideband selection plus reverse. Normal 12-14V dc operation plus ac operation with optional power supply.

The right styling, the right size. Easy-to-use controls, fast-action push buttons, all located on raised front panel sections. New meter with lighted, easy-to-read scales. Rigid steel chassis, molded front panel with matching aluminum top, bottom and back. Stainless steel tilt-up bail. And it's only 4" high by 9½" wide by 12" deep (ball not extended) to go anywhere, fit anywhere at home, in the field, car, plane or boat.

The right accessories — all front-panel switchable.

Model 220 2.4 kHz 8-pole sb filter $55; Model 218 1.8 kHz 8-pole sb filter $55; Model 217 500 Hz cw filter $55; Model 219 250 Hz cw filter $55; Model 224 Audio cw filter $34; Model 223 Noise blanker $34; Model 226 Internal Calibrator $39; Model 325 DC Circuit breaker $10; Model 225 117/230V ac power supply $129; Model 222 mobile mount, $25; Model 1126 linear switching kit, $15.

Model 525 ARGOSY — $549. Make the right choice, ARGOSY — for the right reasons and low price. See your TEN-TEC dealer or write.
All New!

2 and 3 el. 30 meter monobanders

Available NOW!

2 meter hi-performance vertical

Super Gain

6 Meter Long Boomer

Broadband 2 meter 4 el.

Also featuring:
Select KLM performance-oriented UHF/VHF Power Amplifiers, and antennas, 1.8 to 520 MHz: monobanders, tribanders, log-periodics, verticals, dipoles, circulars and stacked arrays.

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editor

treasurer

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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
Multi mode operation includes CW/AM/SSB/RTTY — Normally used side band selected automatically.

Continuously variable power from 10W to full power — speech processor — LDA channeling module included provides auto band changing capability when increasing your power using the IC-2KL broadband solid state linear.

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Simple to use Dual VFO’s standard Data transfer button for marking a frequency of interest and storing it in unused VFO.

Broadbanded solid state transceiver operation on the 9 amateur HF bands — Readout of mode in use and VFO — Status LEDs for push button functions.

Use of RF/ALC switch in conjunction with the internal top hatch cover switches allows monitoring relative RF Out, SWR, collector current and ALC.

The ICOM HF System. We Have You Covered.
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

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
# More Keyer Features for Less Cost

AEA Invites You to Compare the AEA Keyer Features to Other Popular Keyers on the Market.

<table>
<thead>
<tr>
<th>Keyer</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM-1</td>
<td>MorseMatic™</td>
</tr>
<tr>
<td>KT-1</td>
<td>Keyer Trainer</td>
</tr>
<tr>
<td>MT-1</td>
<td>Morse Trainer</td>
</tr>
<tr>
<td>CK-1</td>
<td>Contest Keyer</td>
</tr>
<tr>
<td>MK-1</td>
<td>Morse Keyer</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Feature</th>
<th>AEA MM-1</th>
<th>AEA KT-1</th>
<th>AEA MT-1</th>
<th>AEA CK-1</th>
<th>AEA MK-1</th>
<th>AEA</th>
<th>COMPETITOR</th>
<th>B</th>
<th>C</th>
<th>D</th>
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<tbody>
<tr>
<td>Speed Range (WPM)</td>
<td>2-99</td>
<td>1-99</td>
<td>1-99</td>
<td>1-99</td>
<td>2-99</td>
<td>8-50</td>
<td>5-50+</td>
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<td>8-50</td>
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<td>Memory Capacity (Total Characters)</td>
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<td>500</td>
<td>400</td>
<td>400</td>
<td>100/400</td>
<td>400</td>
<td>400</td>
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<td>Message Partitioning</td>
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<td>No</td>
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<td>No</td>
<td>No</td>
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<td>Independent Dot &amp; Dash (Full) Weighting</td>
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<td>Calibrated Speed, 1 WPM Resolution</td>
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<td>Repeat Message Mode</td>
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<td>Semi-Automatic (Bug) Mode</td>
<td>Yes</td>
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<td>Yes</td>
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<td>No</td>
<td>No</td>
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<td>Yes</td>
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<td>No</td>
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<tr>
<td>Instant Start From Memory</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Message Editing</td>
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<td>Automatic Stepped Variable Speed</td>
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<td>2 Presettable Speeds, Instant Recall</td>
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<td>No</td>
<td>No</td>
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<td>No</td>
<td>No</td>
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<td>Automatic Trainer Speed Increase</td>
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<td>No</td>
<td>No</td>
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<tr>
<td>Five Letter or Random Word Length</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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<td>Test Mode With Answers</td>
<td>Yes</td>
<td>Yes</td>
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<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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<td>Random Practice Mode</td>
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<td>No</td>
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<td>Standard Letters, Numbers, Punctuation</td>
<td>Yes</td>
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<td>Yes</td>
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<td>No</td>
<td>No</td>
<td>No</td>
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<tr>
<td>All Morse Characters</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
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</table>

**Advertised Price**

<table>
<thead>
<tr>
<th>Options</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-1P (portable version of MT-1) with batteries, charger, earphone</td>
<td>$139.95</td>
</tr>
<tr>
<td>ME-1 2000 character plug-in memory expansion for MM-1</td>
<td>$59.95</td>
</tr>
<tr>
<td>AC-1 600 Ma. 12 Volt wall adapter for MM-1 with ME-1</td>
<td>$14.95</td>
</tr>
<tr>
<td>AC-2 350 Ma. 12 Volt wall adapter for all AEA keyer and trainer products except MM-1 w/ ME-1</td>
<td>$9.95</td>
</tr>
<tr>
<td>DC-1 Cigarette lighter cord for all AEA keyers and trainers except MT-1P</td>
<td>$5.95</td>
</tr>
<tr>
<td>MT-1K Factory conversion of MT-1 to KT-1</td>
<td>$40.00</td>
</tr>
</tbody>
</table>

**OPTIONS:**

All our keyers (except the MT-1) will operate with any popular single lever or lamplow squeeze paddle and will key any type of modern amateur transmitter with no external circuitry required. AEA keyers are as easy to operate as a four function calculator. The internal AEA computers are all pre-programmed for the features shown above. Each AEA product is fully RF protected and receives a complete elevated temperature burn-in and test before it is shipped from the factory.

Ask a friend how he likes his AEA keyer compared to anything else he has ever tried, then JUDGE FOR YOURSELF. See the AEA keyer and trainer family at your favorite dealer.

Advanced Electronic Applications, Inc., P.O. Box 2160, Lynnwood, WA 98036. Call 206/775-7373

**AEA Brings you the Breakthrough!**

June 1981
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

---

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 MicoderTM, 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

---

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

---

thanks

Dear HR:

Thank you very much for a very good radio magazine.

Carl Amberg, SM6GPC
Lidingo, Sweden
MFJ-484 “Grandmaster” Memory Keyer, $139.95 (+$4)

So easy to use you can probably use all its features without reading the instruction manual. Has all the features you'll ever need.

**WEIGHT CONTROL TO PENETRATE ORM. PULL TO COMBINE MEMORIES A AND B FOR 1, 2, OR 3 FIFTY CHARACTER MESSAGES.**

**MESSAGE BUTTONS SELECT DESIRED 25 CHARACTER MESSAGES.**

**RESETS MEMORY IN USE TO BEGINNING.**

**MEMORY SELECT: POSITIONS 1, 2, 3 ARE EACH SPLIT INTO MEMORY SECTIONS A, B, C, D (UP TO TWELVE 25 CHARACTER MESSAGES). SWiCH COMBINES A AND B. POSITION K GIVES YOU 100, 75, 50, OR 25 CHARACTERS BY PRESSING BUTTONS A, B, C, OR D.**

**SPEED CONTROL, 8 TO 50 WPM. PULL TO RECORD.**

LEDs (4) show which memory is in use and when it ends.

**MESSAGE BUTTONS SELECT DESIRED 25 CHARACTER MESSAGES.**

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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.

The Attorney, attempting to inspect his station during a jamming investigation in 1979. Federal charges were dropped. Jose Gonzoles that an applicant for an Amateur license does agree to abide by applicable regulations, and some also using the Amateur bands, will continue operating.

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, K7UCA. 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 1600 attended Saturday night's banquet honoring the Amateur of the Year, W9C1, and Specific Achievement Award winners W9ITF and K6LAK. W9WW won the complete TS-130S station door prize. Winner of the Drake '7-Line' complete station Hamvention door prize was YL N8IAIM; runner-up W9C1W 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 threatening 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.
Revolutionary Instant Access Digital Shortwave Scanner

- Continuous Scanning of LW, MW, SW, & FM Bands
- Instant Fingertip Tuning—No More Knobs!
- 6 Memories for Any Mode (AM, SSB/CW, & FM)
- Dual PLL Frequency Synthesized—No Drift!

A WHOLE NEW BREED OF RADIO IS HERE NOW! No other short wave receiver combines so many advanced features for both operating convenience and high performance as does the new Sony ICF-2001. Once you have operated this exciting new radio, you'll be spoiled forever! Direct access tuning eliminates conventional tuning knobs and dials with a convenient digital keyboard and Liquid Crystal Display (LCD) for accurate frequency readout to within 1 KHz. Instant fingertip tuning, up to 8 memory presets, and continuous scanning features make the ICF-2001 the ultimate in convenience.

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:

DUAL PLL SYNTHESIZER CIRCUITRY covers entire 150 KHz to 29.999 MHz band. PLL circuit has 100 KHz step while PLL2 handles 1 KHz step, both of which are controlled by separate quartz crystal oscillators for precise, no-drift tuning. DUAL CONVERSION SUPERHETERODYNE circuitry assures superior AM reception and high image rejection characteristics. The 10.7 MHz IF of the FM band is utilized as the 2nd IF of the AM band. A new type of crystal filter made especially for this purpose realizes clearer reception than commonly used ceramic filters. ALL FET FRONT END for high sensitivity and interference rejection. Intermodulation, cross modulation, and spurious interference are effectively rejected. FET RF AMP contributes to superior image rejection, high sensitivity, and good signal to noise ratio. Both strong and weak stations are received with minimal distortion.

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 “L1” and “L2” 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 “L1,” and “L2” 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. AM 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 6¼ (D). WEIGHT: 3 lb. 15 oz. (1.8 kg)
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.

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.

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).

<table>
<thead>
<tr>
<th>frequency (kHz)</th>
<th>class of service</th>
</tr>
</thead>
<tbody>
<tr>
<td>3500-4000</td>
<td>Amateur</td>
</tr>
<tr>
<td>4000-4063</td>
<td>fixed</td>
</tr>
<tr>
<td>4063-4438</td>
<td>maritime/mobile</td>
</tr>
<tr>
<td>4439-4650</td>
<td>fixed, aero mobile</td>
</tr>
<tr>
<td>4650-4750</td>
<td>aero mobile</td>
</tr>
<tr>
<td>4750-4850</td>
<td>fixed</td>
</tr>
<tr>
<td>4850-5000</td>
<td>fixed/mobile</td>
</tr>
<tr>
<td>5000-5250</td>
<td>fixed</td>
</tr>
<tr>
<td>5250-5450</td>
<td>fixed/mobile</td>
</tr>
<tr>
<td>5450-5730</td>
<td>aero mobile</td>
</tr>
<tr>
<td>5730-5950</td>
<td>fixed</td>
</tr>
<tr>
<td>5950-6200</td>
<td>international broadcasting</td>
</tr>
</tbody>
</table>

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.
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.
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

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Radio Shack DX-302

Radio Shack DX-200
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 exception operation under the high cross modulation conditions found on today's crowded bands.

If you're looking for DX, look no further. DX is the new Cubic 103. The suggested 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 output pulse shaping. Sophisticated noise blanker. Exceptional dynamics: Noise floor -132 dBm; 3rd order intercept +15 dBm.

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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, 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, 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.

**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.**
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.

**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 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.](image)

**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**


---

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**Dipoles**

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<th>PRICE WITH HI-Q BALUN</th>
<th>WITH HI-Q CENTER INSULATOR</th>
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<td>130'</td>
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**Ham radio**

June 1981
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 leadpipe 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. Falkland 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 Falkland 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 Falklands 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. LU3ZC 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
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 TXN 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 TXN 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 TXN 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, W9WU, 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.
foot! 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 Falkland 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 — Falkland. 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 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.

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...
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 QST MUST QRT FOR WATCH DUTY 73 W9VNE DE LU3ZY SK CL."

Aggggghh!

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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Are you frustrated because you can't move up and down the 40- and 75-meter bands while driving down the freeway? The stumbling block, of course, is the narrow bandwidth of the antenna system on these bands, particularly on 75 meters. The higher the antenna $Q$, the worse the situation.

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.

By Woodrow Smith, W6BCX, 2117 Eelden 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 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 linked 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,
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>
<thead>
<tr>
<th>table 1. Readings and observations, 40 meters.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>initial conditions</strong></td>
</tr>
<tr>
<td>“High power” 40-meter Hustler resonator (coil and tip)</td>
</tr>
<tr>
<td><strong>observations</strong></td>
</tr>
<tr>
<td>best VSWR with no shunt or series C</td>
</tr>
<tr>
<td>best VSWR with optimized shunt C (~ 260 pF) and tip lengthened accordingly</td>
</tr>
<tr>
<td>best VSWR with optimized series C (~ 75 pF) and tip lengthened accordingly</td>
</tr>
<tr>
<td>1.5-VSWR bandwidth; no tuning or adjustments.</td>
</tr>
<tr>
<td>all three configurations</td>
</tr>
<tr>
<td>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.</td>
</tr>
<tr>
<td>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.</td>
</tr>
<tr>
<td>VSWR obtained with resonator tip optimized for 40-meter phone and tuning only with series capacitor</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>VSWR with resonator tip optimized for entire 40-meter band</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>table 2. Readings and observations, 75 meters.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>initial conditions</strong></td>
</tr>
<tr>
<td>Standard 75 meter Hustler resonator RM-75</td>
</tr>
<tr>
<td><strong>observations</strong></td>
</tr>
<tr>
<td>best VSWR with no shunt or series C, tip length optimized for F</td>
</tr>
<tr>
<td>best VSWR with optimized shunt C (~ 600 pF) at center of phone band and tip lengthened accordingly</td>
</tr>
<tr>
<td>best VSWR with optimum series C (~ 240 pF) at center of phone band and tip lengthened accordingly</td>
</tr>
<tr>
<td>1.5-VSWR bandwidth; no tuning or adjustments.</td>
</tr>
<tr>
<td>no shunt or series C (VSWR 1.4 at resonance) with optimum shunt or series C at center frequency</td>
</tr>
<tr>
<td>To stay below 1.5 VSWR, only spot (fixed) frequency operation is possible without shunt or series C.</td>
</tr>
<tr>
<td>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.</td>
</tr>
<tr>
<td>VSWR obtained with resonator tip optimized for 75-meter phone band and tuning only with series capacitor</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Over most of band</td>
</tr>
</tbody>
</table>
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 1N34A 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 peakere" (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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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>
<thead>
<tr>
<th>element</th>
<th>amateur band (MHz)</th>
<th>28</th>
<th>21</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>single resonator at end of antenna, inches (mm)</td>
<td>7-5/16 (186)</td>
<td>8 (203)</td>
<td>14 (356)</td>
</tr>
<tr>
<td></td>
<td>three resonators mounted for three-band operation, inches (mm)</td>
<td>6-1/2 (165)</td>
<td>7-5/8 (194)</td>
<td>13 (330)</td>
</tr>
</tbody>
</table>

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

![Diagram of three-band mobile antenna showing adapter bracket to hold three resonators to the antenna rod (whip) of fig. 1.](image-url)
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 FT101-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).
I wish all of you happy mobiling! At least five bands are available by the flip of the radio's band-switch.

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Tell 'em you saw it in HAM RADIO!
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.

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 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.

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.

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 x 25 cm). Since breadboards, as such, are 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 circuit is push-pull, with the grids 2) the other. Since the 245 triode tubes the peak grid voltage of one tube will the rear. The schematic diagram two tubes mounted immediately to board is given a few coats of shellac or varnish before work is started. The components are cross-connected to the plates of each 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 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.

**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.

*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.)*
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.

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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.

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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 __________
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   d) $20,000-$29,999 __________
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15. What bands do you work regularly?
   ________________________________
   ________________________________
   ________________________________

16. What modes do you work regularly?
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   ________________________________
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17. How much per year do you usually spend on Amateur Radio equipment and Amateur Radio related activities?
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- Advanced single-conversion PLL system Improved overall stability and improved transmit and receive spurious characteristics.

- Adjustable noise-blanker level Pulse-type (such as ignition) noise is eliminated by built-in noise blanker, with front-panel threshold level control.

- RF attenuator The 20-0 dB RF attenuator may be switched in for rejecting IMD from extremely strong signals.

- Optional VFOs for flexibility VFO-240 allows split-frequency operation and other applications. VFO-230 digital VFO operates in 20-Hz steps and includes five memories and a digital display.

- RIT/XIT Front-panel RIT (receiver incremental tuning) shifts only the receiver frequency, for tuning in stations slightly off frequency. XIT (transmitter incremental tuning) shifts only the transmitter frequency, for calling a DX station listening.

Matching accessories for fixed-station operation:
- SP-230 external speaker with selectable audio filters
- VFO-240 remote VFO

Other accessories not shown:
- VFO-230 remote digital VFO with 20-Hz steps, five memories, digital display
- TL-922A linear amplifier
- SM-220 Station Monitor
- KH-1 deluxe VFO knob
- PC-1 phone patch
- HS-5 and HS-4 headphones
- AT-230 antenna tuner
- SWR and power meter
- MC-50 desk microphone

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

Miniaturized, 5 memories, memory/band scan

TR-7730
The TR-7730 is an incredibly compact, reasonably priced, 25-watt, 2-meter FM mobile transceiver with five memories, memory scan, automatic band scan, UP/DOWN manual scan from the microphone, and other convenient operating features.

TR-7730 FEATURES:
- Smallest ever Kenwood mobile
  Measures only 5-3/4 inches wide, 2 inches high, and 7-3/4 inches deep, and weighs only 3.5 pounds. Mounts even in the smallest subcompact car, and is an ideal combination with the equally compact TR-8400 synthesized 70-cm FM mobile transceiver.
- 25 watts RF output power
  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 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.

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.
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 (no 6-meter, F-region) and also by openings from sporadic-E. Sporadic-E openings often occur around the 6th and 18th. The first week of the month if the thunderstorms on the lower-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
*Look at next higher band for possible openings.*
Part 2: Measurements and measurement accessories

Part 1 of this article addressed the construction of an rf power meter capable of measuring amplitudes between $-60 \text{ dBm}$ and $+20 \text{ dBm}$ 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 $+10 \text{ dBm}$ (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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Accessories for use with the rf power meter.
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, \( \sigma \); reflection coefficient, \( \rho \); 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:

\[
\rho = 10^{-\frac{RL}{20}}
\]

and

\[
\sigma = \frac{1 + \rho}{1 - \rho}
\]

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 \( \sigma \) 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 \( \sigma \), 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.

**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 \( \infty \), 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. 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.
With the antenna connected to the unknown port, a value is now measured that, when compared to the calibration level, $-6\,\text{dBm}$, represents the return loss of the antenna in dB. If the power-meter reading were $-15.6\,\text{dBm}$, for example, this would correspond to a $9.6\,\text{dB}\,\text{RL}$; $9.6\,\text{dB}\,\text{RL}$ converts to a VSWR of 2.0, using the conversion equations. By tuning the source across the band you could then plot $\text{RL}$ versus frequency and determine the $\text{VSWR} = 3.0$ 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 $-34\,\text{dBm}$ and still measure a $1.2\,\text{VSWR}$ ($20\,\text{dB}\,\text{RL}$).

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.
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 (Z₀) 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, 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.

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 measuring 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 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
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 \(f_1\) 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:

\[
HD,\text{dBc (nominal drive level)} = HD,\text{dBc (meas)} + (N - 1) \times \text{(change in drive level)} (3)
\]

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 \(n\)th-order distortion as well: changing the drive level by 1 dB causes the \(n\)th-order distortion product to change by \(n\times1\) 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.

**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 \(f_1\) and \(f_2\) and pass the third-order distortion products at \(2f_2 + f_1\) or \(2f_1 + f_2\). 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. 7. Effect of drive level on amplifier harmonic distortion at 2f1. (A) and (B) respectively show drive at -30 dBm and -20 dBm.](image)

![fig. 8. Test setup for measuring intermodulation distortion.](image)
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:

\[
\text{IMD}_{\text{dBc (nominal drive level)}} = \text{IMD}_{\text{dBc (meas)}} + 2(\text{change in drive level, dB})
\]

and the output TOI can be computed from

\[
\text{TOI} = \frac{\Delta}{2} + P_{\text{out}}
\]

where \(\Delta = \text{IMD level in dBC relative to the fundamental (one tone), and } P_{\text{out}} \text{ 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, \(\Delta\), when plugged into the equation below, will
yield the modulation percentage to within a few percent, depending on how carefully you measure \( \Delta \).

\[
\text{modulation percentage} = \frac{170 \sqrt{10^{(\Delta/10)} - 1}}{100}
\]  

(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.

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**

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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 QRN.

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

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 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.
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 $2.2 \times 10^7$ 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
<table>
<thead>
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<th>VALUE</th>
<th>1/4W</th>
<th>1/2W</th>
<th>1W</th>
<th>2W</th>
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Table 1. (left) Program listing for sorting and inventory of resistors. Below is an abbreviated example of program output.
Mast lock installed on author's tower.

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.

beam antenna mast lock

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

fig. 2. Isometric view of the mast lock.
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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.

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
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, W9MLH
Shipping and Handling Cost:
Receiver Kits add $1.50, Power Supply add $2.00, Antenna add $5.00, Option 1/2 add $3.00, For complete system add $7.50.

INTRODUCING THE HOWARD/COLEMAN TVRO CIRCUIT BOARDS

DUAL CONVERSION BOARD
This board provides conversion from the 3.7-4.2 band first to 900 MHz where gain and bandpass filtering are provided and, second, to 70 MHz. The board contains both local oscillators, one fixed and the other variable, and the second mixer. Construction is greatly simplified by the use of Hybrid IC amplifiers for the gain stages.

47 pF CHIP CAPACITORS
For use with dual conversion board. Consists of 6 - 47 pF.

70 MHz IF BOARD
This circuit provides about 43 dB gain with 50 ohm input and output impedance. It is designed to drive the HOWARD/COLEMAN TVRO Demodulator. The on-board band pass filter can be tuned for bandwidths between 20 and 35 MHz with a passband ripple of less than ½ dB. Hybrid ICs are used for the gain stages.

.01 pF CHIP CAPACITORS
For use with 70 MHz IF Board. Consists of 7 - .01 pF.

DEMODULATOR BOARD
This circuit takes the 70 MHz center frequency satellite TV signals in the 10 to 200 millivolt range, detects them using a phase locked loop, de-emphasizes and filters the result and amplifies the result to produce standard NTSC video. Other outputs include the audio subcarrier, a DC voltage proportional to the strength of the 70 MHz signal, and AFC voltage centered at about 2 volts DC.

SINGLE AUDIO
Duplicated of the single audio but also carries the 6.2 range.

DUAL AUDIO
Duplicated of the single audio but also carries the 6.2 range.

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More Details? CHECK — OFF Page 98
MRF454  $21.83
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- designed for power amplifier applications in industrial, commercial and amateur radio equipment to 30 MHz.
  - Specified 12.5 Volt, 30 MHz Characteristics
    Output Power = 80 Watts
    Minimum Gain = 12 dB
    Efficiency = 50%
  
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NPN SILICON RF POWER TRANSISTOR
designed primarily for use in large-signal output amplifier stages, intended for use in Citizen Band communications equipment operating at 27 MHz. High breakdown voltages allow a high percentage of up-modulation in AM circuits.
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    Power Output = 4.0 Watts
    Power Gain = 10 dB Minimum
    Efficiency = 65% Typical

MRF475  $5.00
NPN SILICON RF POWER TRANSISTOR
- designed primarily for use in single sideband linear amplifier output applications in citizens band and other communications equipment operating to 30 MHz.
  - Characterized for Single Sideband and Large Signal Amplifier Applications Utilizing Low Level Modulation.
  - Specified 13.6 V, 30 MHz Characteristics –
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    Minimum Efficiency = 40% (SSB)
    Output Power = 4.0 W (CW)
    Minimum Efficiency = 50% (CW)
    Minimum Power Gain = 10 dB (PEP & CW)
  - Common Collector Characterization

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    Minimum Gain = 19 dB
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<td>2416</td>
<td>Variable Attenuator</td>
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<td>3614-60</td>
<td>Variable Attenuator 0 to 60 dB</td>
<td>75.00</td>
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<tr>
<td>4658-20C</td>
<td>Variable Attenuator 18 to 25 GHz</td>
<td>100.00</td>
</tr>
<tr>
<td>6684-20F</td>
<td>Variable Attenuator 0 to 180 dB</td>
<td>100.00</td>
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**PRD**

| U101 | 12.4 to 18 GHz Variable Attenuator 0 to 60 dB | 300.00 |
| X160 | 8.2 to 12 GHz Variable Attenuator 0 to 60 dB | 200.00 |
| C101 | Variable Attenuator 0 to 60 dB | 200.00 |
| 2054B7 | Slotted Waveguide Type N Adapter | 100.00 |
| 195B | 8.2 to 12 GHz Variable Attenuator 0 to 50 dB | 100.00 |
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| 1985 | 8.2 to 12 GHz Variable Attenuator 0 to 40 dB | 100.00 |
| 170B | 3.9 to 5.85 GHz Variable Attenuator 0 to 45 dB | 100.00 |
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| 1091U | Fixed Attenuators | 25.00 |
| WIEINSCHEN ENG. | 2692 Variable Attenuator + 30 to 60 dB | 100.00 |

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<td>2708</td>
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<td>1K Static RAM 450ns</td>
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<td>3K x 4 Dynamic RAM</td>
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<td>2111A/21011</td>
<td>256 x 4 Static RAM</td>
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<tr>
<td>2115A</td>
<td>1K x 1 Static RAM 55ns</td>
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<tr>
<td>6160A 21404</td>
<td>4K x 1 Static RAM 320ns</td>
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<tr>
<td>714-1</td>
<td>4K x 1 Static RAM 200ns</td>
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<tr>
<td>7131-4</td>
<td>4K x 2 Static RAM 300ns</td>
</tr>
<tr>
<td>9131-4</td>
<td>1K x 1 Static RAM 300ns</td>
</tr>
</tbody>
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**C.P.U.'s ETC.**

| MC6800L | Microprocessor | 13.90 |
| MC6801AP | 128 x 8 Static RAM 450ns | 3.99 |
| MC68051AP | 128 x 8 Static RAM 360ns | 4.99 |
| MC6820P | 128 x 8 Static RAM 250ns | 6.99 |
| MC6820L | 5 Volt | 8.99 |
| MC6821P | 5 Volt | 9.99 |
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| B228 | 8 Bit Input/Output Port | 5.00 |
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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 Staten Island Ferry 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 146.25/52 and 146.52. More info: S.A. S.E. to WAZAMJ, P.O. Box 456, 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. Admission is $3.00 per person, registration for prices: $3.00 per person (top price is a TR-520 SE). No admission charge. Talk-in on 146.25/88, 147.70/15, 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 Nimsllinch Grange, 6641 Easton St., Cincinnati. Giant flea market, dealers, food, XVII activities, CW contest, super awards, and more. $1.50 advanced and $2.00 at the door. Vendor tables: $3.00. Bid table available this year. Talk-in on 146.52 simplex and Hi-Point repeater. More info: WB6FJ, John L. Wentz, Box 102, West Liberty, OH 43357 or W8OHE, Paul F. Merine, Box 185, West Mansfield, OH 43358.

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. Vendor tables: $3.00. Bid table available this year. Talk-in on 146.52 simplex and Hi-Point repeater. More info: WB6FJ, John L. Wentz, Box 102, West Liberty, OH 43357 or W8OHE, 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. K6TH talk-in on 52. Tickets are $1.50 in advance and $2.00 at the door. Write to: Eric Wimmer, 14118 Bishop Rd., Bowling Green, OH 43402. Advance table rental to dealers only: $3.00 per table, payable in advance. Saturday setup available. Send check for tables to: Bill Wilkins, 16220 Portage Rd., Bowling Green, OH 43402.

OHIO: The Northern Ohio Amateur Radio Society's "Norasfest" on July 25th at the Lorain County Fairgrounds in Wellington. Over 100 tables, free market, parking available, large indoor exhibit hall, refreshments, overnight camping (no hookups), plus much more. Admission: $2.50 advanced and $3.00 at the gate. Dealer tables: $5.00 each. Talk-in on 146.10/70 or 146.52 simplex. Tickets or info: S.A.S.E. to Norasfest, P.O. Box 364, Lorain, Ohio 44052. Dealers: John Morningstar, WB9AM, 168 Glenview Dr., Avon Lake, Ohio 44012. (216) 933-3641.

OHIO: The Lancaster and Fairfield County A.R.C.'s annual family hamfest on June 21st at The F & F Party Barn, 4 miles west of Lancaster off of R R 189. Overnight camping and many, many activities for the family. Starts at 9:00 AM. Admission: tickets only: $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 146.52 simplex. More info: C. Ted Riley, W8BQA, P.O. Box 3, Lancaster, Ohio 43130 or call (614) 653-8222.

OKLAHOMA: The West Gulf Division ARRL Convention and famous "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 Amateur Radio Amateurs, the program will include forums, technical talks, a QCW breakfast, a full ladies program, many prizes, plus much more. Pre-register by July 7th for $6.00 or at the door for $7.00 after the 13th. Admission includes guided in-door exhibitor and swapfest are available. Tables free to non-commercial registrants. More info: CQRA, P.O. Box 21518, Oklahoma City, OK 73120.

Pennsylvania: Harrisburg RAC Annual Firecracker Hamfest on Saturday, July 4th at the Shellville VFW picnic grounds. Exit #27 off I-81, north one mile off exit. Parking for 1000 cars. Shade trees with pavilion. Food available. Talk-in on 52. and 16.76. Admission is $2.00, tailgating is $1.50. XYL and children free.

Pennsylvania: The Nittany A.R.C.'s annual Mount Nittany Hamfestival on Saturday, 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 9-10 from central Pennsylvania. More info: Mount Nittany Hamfestival, NARC, Box 614, State College, PA 16801 or call Dave Buckwalter, N3BHH at (814) 234-0759.

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Send Check, M/O, or Visa # ______
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CANADA: The Maple Ridge A.R.C. is hosting Hamfest '81 on July 4th and 5th at the Maple Ridge Fairgrounds, 3 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 146.345.4/4 and 146.197.98. More info or advanced registration: Bob Haughton, VETBZH, 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. Activities start at 11:00 AM. 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 146.345.4/4 ODN repeater. ¥6.76. 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, VE7DML, 564 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., WOKEM, 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.

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<th>CW (Hz)</th>
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Kenwood

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## HAM CALENDAR

### June

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<th>Sunday</th>
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<td><strong>WEST COAST BULLETIN</strong></td>
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<td>(8 PM PST: 0400 UTC) 3540 KCS, A-1, 22 WPM 1.</td>
<td>3850 kHz 9:00 PM EDST (0100Z Wednesday Morning)</td>
<td>Ohio State, Cincinnati</td>
<td>Grand Rapids, MI - WDFN/ZKZ 6.</td>
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<td>3850 kHz 9:00 PM COST (0200Z Wednesday Morning)</td>
<td><strong>7th ANNUAL SUMMER SMIRK PARTY CONTEST</strong></td>
<td><strong>YANKIE RADIO CLUB INC.</strong></td>
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<td>3850 kHz 8:00 PM PDST (0300Z Wednesday Morning)</td>
<td>1300 hrs COT Friday 18 June to 1900 hrs. Sunday 21 June - 2200Z 19-21.</td>
<td><strong>COLUMBIA PARK, Dunellen, NJ 20.</strong></td>
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<td><strong>DENATOBIA, MS - WSGAM 7-B.</strong></td>
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### W1AW Schedule

**April 25 - October 25, 1981**

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<th>UTC</th>
<th>Slow Code Practice</th>
<th>Fast Code Practice</th>
<th>CW Bulletins</th>
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<td>MWF: 0200, 1300, 2300</td>
<td>MWF: 0200, TTiSSF: 0200, S: 0200</td>
<td>Dy: 0000, 0300, 2100, MTWTH-F: 1400</td>
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</table>

Code practice and CW bulletins are at 1.838, 3.56, 7.06, 14.06, 21.06, 28.06, 50.06. 147.555 MHz.
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.

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 contest or DXer when used 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 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 on.
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, magnets and other
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multiple signal line protectors
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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 Monroe Drive #205, P.O. Box 20175, Dallas, Texas 75220.

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 inadvertently 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 “PEout” 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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<td>CV31305C</td>
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<td>HMOO-4075-03</td>
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<td>5510-200</td>
<td>5.1 to 40 pF</td>
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<td>3.5 to 15 pF</td>
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<td>.7 to 80 MHz</td>
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**Drake L75**

**1.2kW Linear Amplifier**

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

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- **Antenna/By-Pass Switching:** Allows matching unit by-pass regardless of antenna in use, and selects various antennas.
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- **Power Capability:** 200 watts average continuous duty (0-300W scale).
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- **Weight:** 8 lbs (3.6 kg).

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- **Load Impedance:** 50 ohm coaxial with VSWR of 5:1 or less at any phase angle to 30 MHz.
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- **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.
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- Low impedance, low distortion, adjustable sinewave output, 5v peak-to-peak.
- Instant start-up.

**TE-12PA**

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>Output (dBc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>67.0 XZ</td>
<td>85.4 YA</td>
</tr>
<tr>
<td>71.9 XA</td>
<td>86.5 YB</td>
</tr>
<tr>
<td>74.4 WA</td>
<td>91.5 ZZ</td>
</tr>
<tr>
<td>77.0 XB</td>
<td>94.8 ZA</td>
</tr>
<tr>
<td>79.7 SP</td>
<td>97.4 ZB</td>
</tr>
<tr>
<td>82.5 YZ</td>
<td>100.0 1Z</td>
</tr>
</tbody>
</table>

Output level flat to within 1.5db over entire range selected.

- Frequency accuracy, ±0.1 Hz maximum - 40°C to +85°C
- Frequencies to 250 Hz available on special order.
- Continuous tone

**TE-12PB**

<table>
<thead>
<tr>
<th>TEST-TONES:</th>
<th>TOUCH-TONES:</th>
<th>BURST TONES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>697 1209</td>
<td>1600 1500</td>
</tr>
<tr>
<td>1000</td>
<td>770 1336</td>
<td>1650 1900</td>
</tr>
<tr>
<td>1600</td>
<td>852 1477</td>
<td>1700 1950</td>
</tr>
<tr>
<td>2175</td>
<td>941 1633</td>
<td>1750 2000</td>
</tr>
<tr>
<td>2805</td>
<td>1800 2100</td>
<td>1800 2300</td>
</tr>
</tbody>
</table>

Frequency accuracy, ±0.1 Hz maximum - 40°C to +85°C

- Tone length approximately 300 ms. May be lengthened, shortened or eliminated by changing value of resistor

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