SPECIAL ISSUE

DECEMBER 1978 / $1.25

HAM RADIO HORIZONS

1979 Amateur Equipment Roundup

Drake offers 7-line accessories for maximum performance of your TR-7 station

DRAKE WH-7 Directional Rf Wattmeter

- **Remote coupler**
- **New 0-20 watt scale for low power enthusiasts in addition to 200-2000 watt scales**
- **New direct-reading VSWR scale**

The Drake WH-7 is designed for user convenience and high accuracy. This instrument includes three calibrated scales for rf power to satisfy applications from QRP to high power (0-20, 0-200 and 0-2000 watts full scale). A fourth calibrated scale provides direct reading VSWR information, and is switch selected from front panel. This wattmeter makes possible quick, accurate adjustments of antenna resonance and impedance match, when placed between transmitter and matching network. The WH-7 is styled to match the 7-line.

WH-7 SPECIFICATIONS

• **Frequency Coverage**— 1.8-30 MHz • **Line Impedance**— 50 ohm resistive • **Power Capability**— 2000 watts continuous • **Jacks, Removable Coupler**— Two SO239 input and output connectors • **Semiconductors**— Two 1N295 power meter rectifiers • **Accuracy**— ± (5% of reading + 1% of scale) • **VSWR Insertion** — Insertion of wattmeter in line changes VSWR no more than 1.05:1 • **Dimensions**— 4.6"H x 6.9"W x 7.5"D (11.6 x 17.5 x 19 cm) • **Shipping Weight**— 3 lbs. (1.4 kg) **$89.00**

DRAKE MN-7 Antenna Matching Network

- **160-10 meters, 250 watts continuous rf output**
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- **Built-in rf antenna switch allows unit to be by-passed regardless of antenna in use. No need to disconnect feedlines. Switch also permits front panel selection of various antennas.**
- **Built-in rf wattmeter/VSWR bridge**

MN-7 SPECIFICATIONS

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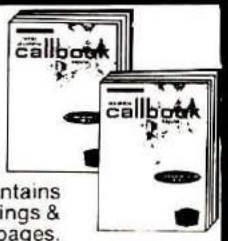

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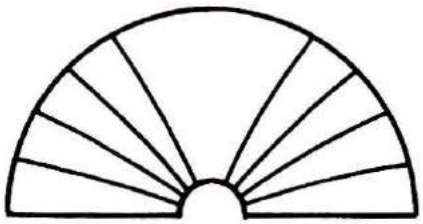
THIS MONTHS



HORIZONS

An Expert's Observations On Antennas

You've heard the story about the cowboy who invested in a $100 saddle and a $10 horse. An analogy often prevalent in Amateur Radio is the ham who invests in a $1000 station but uses a compromise antenna and wonders why he doesn't "get out". Author N1RM offers an interview with an expert on radio antennas, Dr. John Kraus, W8JK. Dr. Kraus invented the first beam antenna with close-spaced elements, the 8JK. It was extremely popular with hams in the 1930s. We also take a look at Dr. Kraus's contributions to radio astronomy with a description of the Big Ear, a radio telescope at Ohio State University that takes up as much space as three football fields.

Equipment Roundup

It's always fun to go shopping this time of year, and Amateur Radio equipment is certainly at the top of everyone's list. Here's a selection of transmitters, receivers, transceivers, and accessories you can thumb through while planning your station. You'll see some new things, some not so new, and some addresses to write to when you get ideas or want to ask questions.

Camouflage Your 2-Meter Antenna

Are you hampered by local restrictions against radio antennas? Author W6DHX has come up with a novel design to fool your neighbors and landlord — it's an efficient quarter-wave ground-plane antenna for two meters, disguised as a weather vane. If you like to build your own gear, you can easily duplicate this design. It has eye appeal and works well.

Looking East

Many countries welcome visiting amateurs with open arms and make it easy to join in the fun on the ham bands while you are there. The Federal Republic of Germany is one of these, so be prepared to add the pleasure of amateur radio to your vacation or business trip. AB4Y/DA1NR knows the ropes, and gives you a few hints about what it's like to enjoy amateur radio in his part of the world.

Golden Years

To a beginning amateur, accustomed to the finicky and cantankerous regenerative receiver of the late 1920s and early 1930s, a massive new superheterodyne receiver must have seemed the answer to all his prayers. The sensitivity and "battleship" stability were awe-inspiring to say the least. Author Orr tells you about his first impressions of a receiver that was, perhaps, the forerunner of later technology.

Writing For Amateur-Radio Magazines

Surely you have some ideas that you'd like to share with other hams. Have you thought about writing down these ideas and submitting them to the Amateur-Radio magazines for publication? Are you concerned about how to present your idea? In this month's *Horizons* we offer some advice by *HRH* assistant editor Alf Wilson, W6NIF, on how to break into the publications game.

Buy For Less

It's an old ham custom to dicker for best price when you shop at flea markets and club sales and auctions. Did you ever think of asking for the best price on new gear? It works more often than you would think, and K4SDS tells you how to start shopping. At today's prices, you can save a bundle.

Soldering

Anyone who wants to build electronic equipment, either kits or from scratch, will run into the essential part of construction called soldering. It's an easy operation to perform, yet thousands of poorly soldered connections cause equipment failure every year. W8FX takes you beyond the heated iron and melting alloy, to explain what goes on in the process of bonding two or more wires or parts together. Read, then practice a bit; you can turn out equipment that you'll be proud of.

The Cover

All of us here at *Ham Radio Horizons* take this opportunity to wish you a very enjoyable holiday season as Santa checks his list, his helpers wrap the latest in equipment and accessories for delivery, and his station in the background keeps tabs on the great world of Amateur Radio and the wonderful people in it. Original painting by Tom Broscius, WA2RWA.

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This NEW MFJ Versa Tuner II . . .

has SWR and dual range wattmeter, antenna switch, efficient airwound inductor, built in balun. Up to 300 watts RF output. Matches everything from 1.8 thru 30 MHz: dipoles, inverted vees, random wires, verticals, mobile whips, beams, balanced lines, coax lines.

BRAND NEW

NEW, IMPROVED MFJ-941B HAS . . .
- More inductance for wider matching range
- More flexible antenna switch
- More sensitive meter for SWR measurements down to 5 watts output

$89.95

Transmitter matching capacitor. 208 pf. 1000 volt spacing.

Sets power range, 300 and 30 watts. Pull for SWR.

Meter reads SWR and RF watts in 2 ranges.

Efficient airwound inductor gives more watts out and less losses.

Antenna matching capacitor. 208 pf. 1000 volt spacing.

Only MFJ gives you this MFJ-941B Versa Tuner II with all these features at this price:

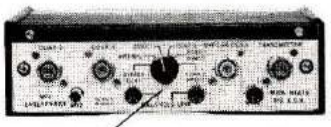
A SWR and dual range wattmeter (300 and 30 watts full scale) lets you measure RF power output for simplified tuning.

An antenna switch lets you select 2 coax lines direct or thru tuner, random wire/balanced line, and tuner bypass for dummy load.

A new efficient airwound inductor (12 positions) gives you less losses than a tapped toroid for more watts out.

A 1:4 balun for balanced lines. 1000 volt capacitor spacing. Mounting brackets for mobile installations (not shown).

With the NEW MFJ Versa Tuner II you can run your full transceiver power output — up to 300 watts RF power output — and match your transmitter to **any** feedline from 160 thru 10 Meters whether you have coax cable, balanced line, or random wire.



ANTENNA SWITCH lets you select 2 coax lines direct or thru tuner, wire/balanced line, dummy load.

You can tune out the SWR on your dipole, inverted vee, random wire, vertical, mobile whip, beam, quad, or whatever you have.

You can even operate all bands with just one existing antenna. No need to put up separate antennas for each band.

Increase the usable bandwidth of your mobile whip by tuning out the SWR **from inside your car.** Works great with all solid state rigs (like the Atlas) and with all tube type rigs.

It travels well, too. Its ultra compact size 8x2x6 inches fits easily in a small corner of your suitcase.

This beautiful little tuner is housed in a deluxe eggshell white Ten-Tec enclosure with walnut grain sides.

SO-239 coax connectors are provided for transmitter input and coax fed antennas. Quality five way binding posts are used for the balanced line inputs (2), random wire input (1), and ground (1).

NEW 300 WATT MFJ VERSA TUNER II'S: SELECT FEATURES YOU NEED.

NEW MFJ-945 HAS SWR AND DUAL RANGE WATTMETER.

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NEW MFJ-944 HAS 6 POSITION ANTENNA SWITCH ON FRONT PANEL.

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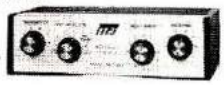

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NEW MFJ-943 MATCHES ALMOST ANYTHING FROM 1.8 THRU 30 MHz.

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Same as MFJ-941B, less SWR/Wattmeter, antenna switch, mounting bracket. 7x2x6 in.

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HAM RADIO HORIZONS

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If you're like many readers of *Ham Radio Horizons*, you've just received your Novice license after a great deal of study and work learning the Morse code. Now you can operate your station and talk to other amateurs on the air. While you were preparing for your license, you've probably assembled your radio station — receiver, transmitter, sending key, and antenna; perhaps an antenna tuner and some accessories. You've made some tests to make sure everything is in working order; now the great moment has arrived. What next?

Let's say your station is designed for 7 MHz (the amateur 40-meter band). This band is right smack in the middle of the amateur high-frequency band allocations; not too high in frequency and not too low — just about right for your first attempt at ham-radio communications. Antennas are easy to get going, low transmitter power does a good job in working other stations out to about 500 miles or so, and the band is generally open around the clock.

So now that you have your new Novice ticket you're ready to try your luck — what can you expect? When you tune across the band, early or late in the day, you'll hear many stations talking to each other, but you'll also hear many stations endlessly sending CQ. Obviously the stations who established contact did so because one of them called CQ. So the question is, "Should I call CQ for my first contact, or shall I call another station who is already calling CQ?" (Remember, this is your first attempt as an Amateur Radio operator to establish radio contact with another station.)

The key to good operating practice is to *listen*; almost certainly you will hear several Novice stations calling CQ — some will be practically on top of one another. If one of those stations had listened before he sent his CQ he could have immediately established contact without polluting the air waves with an unnecessary radio transmission. The first rule of a good operator, then, whether an old timer or a newcomer, is to listen before you transmit.

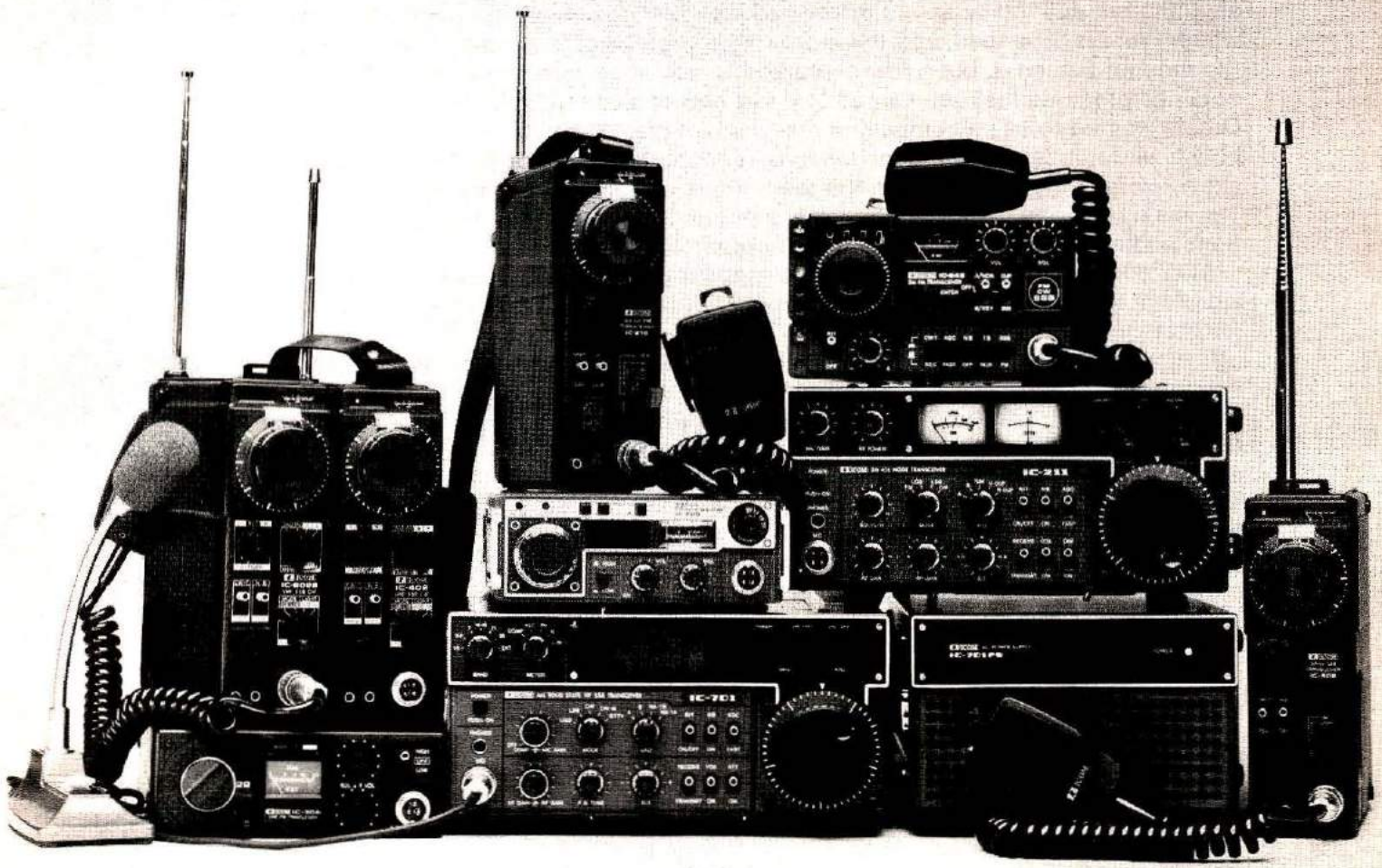
Spend some time tuning around the band to see what stations are on the air and where the strongest signals are coming from; the best propagation may be from close in or from several hundred miles away. Pick out the station you're interested in talking to; if he has a loud signal and your equipment is working properly, give him a call. His callsign sent three times, followed by DE and your call three times is the best approach. Take it slow and easy, then wait. Chances are that your first on-the-air call as an Amateur will result in a good, solid contact. If you don't get any response, don't start calling CQ, but *listen*, *listen*, *listen*! That's the name of the game.

Don't be discouraged if you don't make it the first time around, or even the second or third. Propagation conditions (especially nowadays) are chancy; one day you'll hear signals from many miles away — tomorrow you may not hear anything. Sometimes a band will go completely dead without warning. Perhaps the other operator blew the fuse in his transmitter; maybe his antenna blew down — stranger things have been known to happen. If you don't score the first time, listen and try again. Just be patient and don't give up. After a few hours of operating you'll be chatting with other hams all across the country.

We need more Amateur Radio stations; your first Novice attempts will help to increase the Amateur Radio population in this country. Experience has shown that more listening and less CQing is less frustrating and results in a great many more successful contacts. CQ is the "Call of the Wild;" it doesn't do much but create pollution.

Jim Fisk, W1HR
editor-in-chief

ICOM stacks it all in your favor.



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FOCUS & COMMENT

Can another year have slipped by so easily? Gosh, it seems as though I've just turned my back on 1977 and here it is the end of 1978. Just as I predicted, this year has been anything but dull. Many of you expressed your feelings about the beginner's transmitter which W8YFB described, and the letters were gratifying. Most applauded the rig and the thought behind it, but a few deplored the use of vacuum tubes. Many builders obtained great results, but wanted to know how to add the higher bands to the rig. Others wanted to see a companion receiver. I'm glad to say that we have the receiver in house, and it'll be appearing in *Horizons* very shortly. It's a transistorized job, so I'll expect some letters applauding that and others asking what we have against tubes. There's a receiving converter for the higher bands as part of the story, and modifications and accessories for the transmitter are in the works.

Also, I've been taken to task for talking about obsolete CB rigs. Many of the letter writers hold both Amateur and CB licenses, which indicates an interesting trend. Let me state, in self-defense, that the word came from a person in an FCC Washington office, and I'm now trying to find out exactly where he got his information. (Did you ever try to do push-ups on a water-bed?)

Amateur Radio saw some exciting moments during the past year — A Clipperton DXpedition, meetings to finalize our expectations for WARC-79, crossing the Atlantic in a balloon, a new uhf contest, a new EME (earth-moon-earth) contest, 10-meter linears banned, a new OSCAR in orbit, and a five-year term for Novice licenses — to name a few.

With things like that happening in Amateur Radio, you'd have to work at it to be bored or disinterested in our hobby. In fact, it's a pretty good guess that frustration will set in because everything you want to do has a First-class priority!

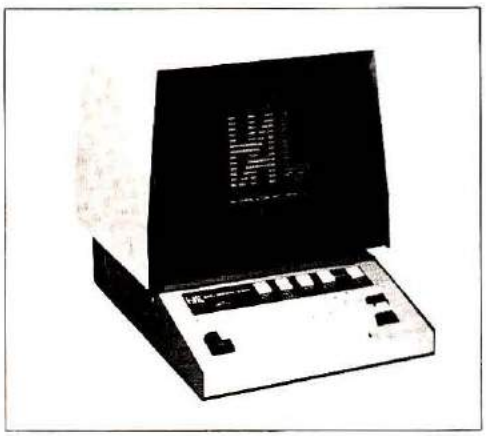
As before, I expect next year to be just as lively, both on the Amateur bands and through the mail and the pages of *Horizons*. So, turn to a new page in your logbook, shine up your microphone or key, and dive in; bring a friend, too.

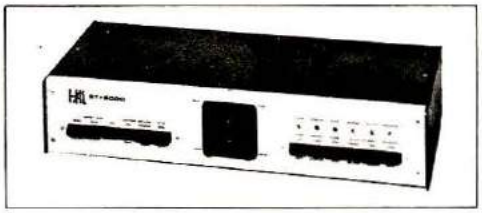
To all of you from the Ham Radio Horizons staff: have a great Holiday season and a terrific new year.

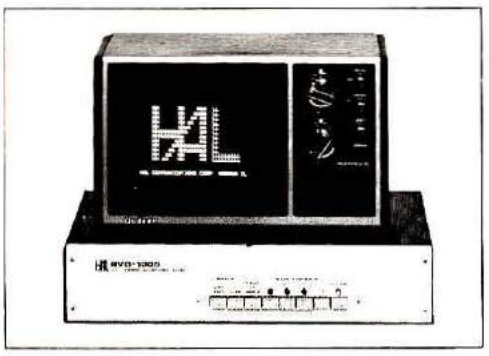
Thomas McMullen, W1SL
Managing Editor

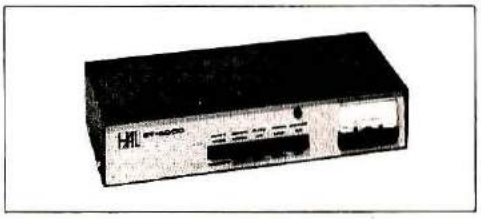
RTTY Can Be Easy!

Have You Wondered . . .
What Owning a RTTY Station Would be Like?
Have You Thought . . .
About Finding Out but Didn't Know Who to Ask?









ASK THE GUYS AT HAL!

Our sales and service staff will be happy to assist you in your choice of RTTY equipment, answer questions about RTTY, and provide assistance if problems do arise. In addition, all HAL amateur RTTY equipment manuals can be purchased for $10.00 each for an advance look (applicable to future purchase of that unit).

Answers to common RTTY questions are featured in the center-fold of our new amateur radio catalog. Such questions as "What do I need?", "How do I hook it up?", and "What frequencies do I use?" are discussed. Technical points concerning RTTY pulses, FSK and AFSK, and high-tones vs low-tones are covered.

Write today for HAL'S new catalog and RTTY guide and discover how much fun RTTY can be.

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Not only is the big move to switch to the Wilson Mark Series of Mini-Hand-Held Radios, but now the switch is on the Mark!

Wilson Electronics, known for setting the pace in 2m FM Hand-Helds, goes one step beyond!

AT NO EXTRA CHARGE: all Mark Series Radios now will include a switch for you to control the power of operation. This will enable you to use the high power when needed, then later switch to low power to conserve battery drain for extended operation.

IN ADDITION: all Mark Series Radios now have an LED Battery Condition Indicator conveniently mounted on the top plate. A quick peek will reassure you of a charged battery in the radio.

– NOW SWITCHABLE –

MARK II: ≃ 1 & 2.5 watts

MARK IV: ≃ 1 & 4.0 watts

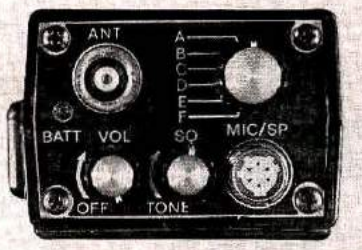
Wilson hand-helds have been known world-wide for exceptional quality and durable performance. That's why they have been the best selling units for years.

Now the Mark Series of miniature sized 2-meter hand-helds offers the same dependability and operation, but in an easier to use, more comfortable to carry size . . . fits conveniently in the palm of your hand.

The small compact size battery pack makes it possible to carry one or more extra packs in your pocket for super extended operation time. No more worry about loose cells shorting out in your pocket, and the economical price makes the extra packs a must.

SPECIFICATIONS

- Range: 144-148 MHz
- 6 Channel Operation
- Individual Trimmers on TX and RX Xtals
- Rugged Lexan® outer case
- Current Drain: RX 15 mA
  TX - Mark II: 500 mA
  TX - Mark IV: 900 mA
- 12 KHz Ceramic Filter and 10.7 Monolithic Filter included.
- 10.7 MHz and 455 IKz IF
- Spurious and Harmonics: more than 50 dB below carrier
- BNC Antenna Connector
- .3 Microvolt Sensitivity for 20 dB Quieting
- Uses special rechargeable Ni-Cad Battery Pack
- Rubber Duck and one pair Xtals 52/52 included
- Weight: 19 oz. including batteries
- Size: 6" x 1.770" x 2.440"
- Popular accessories available: Wall Charger, Mobile Charger, Desk Charger, Leather Case, Speaker Mike, Battery Packs, and Touch Tone™ Pad.



Conveniently located on top of the radio are the controls for volume, squelch, accessory speaker mike connector, 6 channel switch, BNC antenna connector and LED battery condition indicator.

Optional Touch Tone™ Pad available.

Illustrated is Wilson's BC-2 Desk Top Battery Charger shown charging the Mark Series Unit or the BC-4 Battery Pack only.

To obtain complete specifications on the Mark II and Mark IV, along with Wilson's other fine products, see your local dealer or write for our Free Amateur Buyer's Guide.

Consumer Products Division

Wilson Electronics Corp.

4288 South Polaris Avenue • P. O. Box 19000 • Las Vegas, Nevada 89119

Telephone (702) 739-1931 • TELEX 684-522

Prices and specifications subject to change without notice.

NEWSLINE

CANADA'S NO-CODE AMATEUR LICENSE went into effect September 30, with the first exams scheduled for November 15. The "Amateur Digital Radio Operator's Certificate" gives the holder operating privileges on 2 meters and up and includes "packet" (computer-to-computer data bursts) and pulse as well as more conventional modulation modes. Though any Canadian licensees will be permitted use of packet radio, passage of an additional test on the relevant portion of the new Amateur Digital Radio Operator's Certificate exam will be required of other licensees who wish to use pulse transmission.

Holders Of The New no-code Canadian certificate may upgrade to the Canadian "Advanced" certificate simply by passing a 15 WPM code test, but must wait one year after initial licensing before becoming eligible to do so. Canadian Amateurs may now also retain credit for passing a CW test for up to one year after it's taken, even though the written test was failed. Amateur exams will now be given four times annually, in January, April, July, and October.

Details Of These Significant Changes in Canada's Amateur licensing regulations are contained in DoC bulletins TRC-24 and TRC-25.

ITU REGION 3 WARC PREPARATIONS were covered in detail during the Fourth General Assembly of the IARU Association in Bangkok October 7-10. Eighty delegates, observers, and guests representing ten Region-3 nations attended the meeting, which was convened by Thai Deputy Undersecretary of State Sribhoom Suknetr, while Radio Amateur Society of Thailand President Kamhai Chotikul, HS1WR, was the Honorary Presiding Officer. Fred Luan, HS1ABD, was elected conference chairman.

The Assembly Revised Far East WARC preparation country by country, reaffirmed support for the frequency formula (including satellite needs) to be sought in Geneva next year, and was unanimous in opposing changes in Article 41 of the ITU Radio Regulations. Article 41 is the section defining and governing Amateurs.

THE FCC'S FEE REFUND PROGRAM is supposed to get under way by the first of the year, with FCC licensees who paid more than $20 for their licenses first in line for reimbursement. Details of how all this is to be done have yet to be worked out, as the amount to be repaid is to be the fee less the license's "value" to the applicant (how much is a 2-letter call worth?). A Notice of Inquiry, soliciting comments on how such values can be derived, and other aspects of the program, will come out first. About all that seems certain at this time is that Amateurs who paid $25 for a special callsign are due to receive something back, and they'll be in the first group to be repaid.

Refunds To Those Who Paid $20 Or Less, including refunds on CB license fees, are to be made later this year.

FCC Commissioner Margita White's term on the FCC has expired, and President Carter has nominated Ann P. Jones of Arlington, Massachusetts, to replace Mrs. White. Miss Jones has been general counsel to the Federal Home Loan Bank since last January.

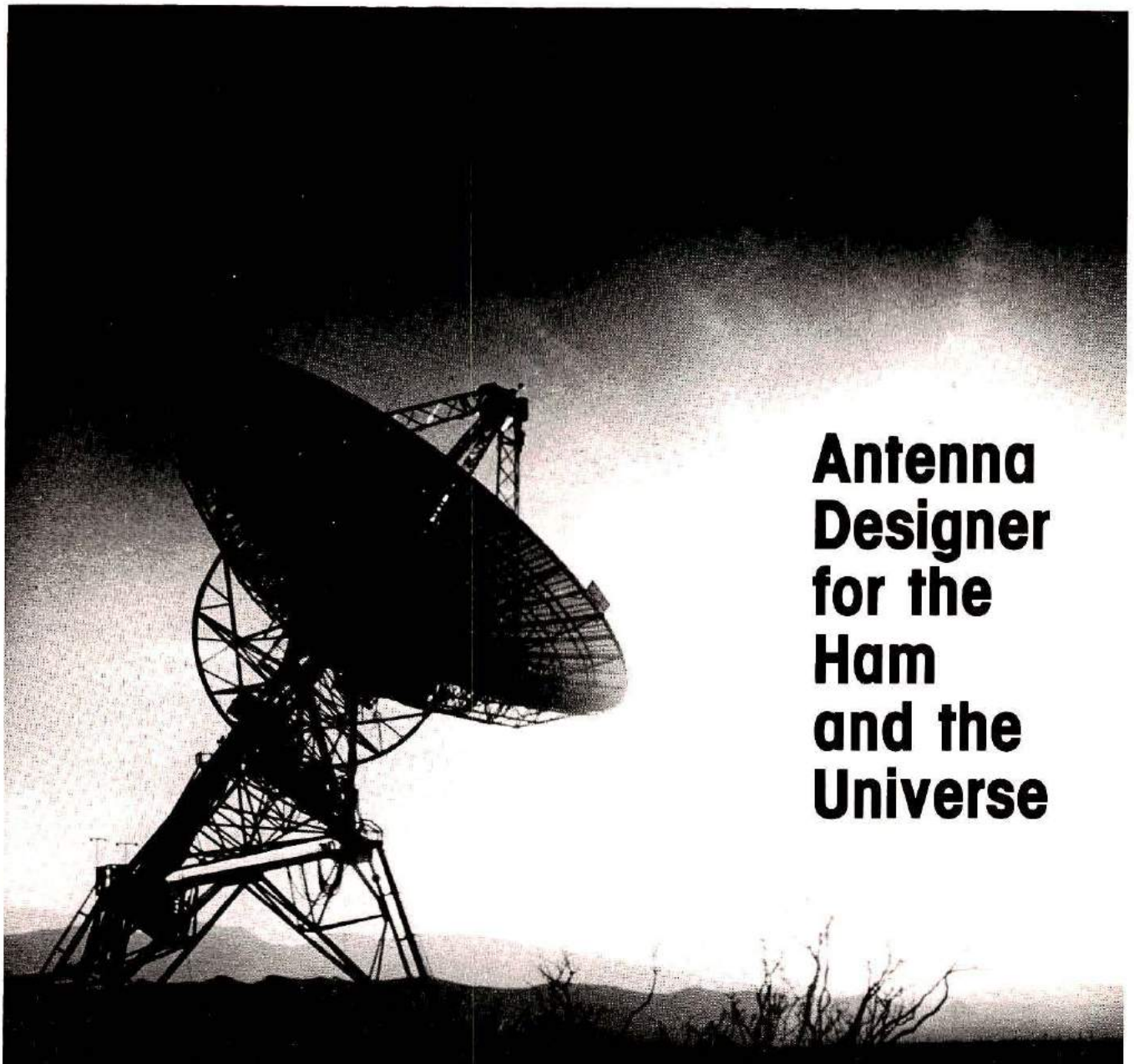
Mrs. White's Departure from the Commission will be noted by the Amateur community. She's been particularly sympathetic to the needs of the Amateur service during her term.

The FCC's Funds Almost Ran Out and some Commission activities were curtailed as the Commission's fiscal '79 appropriation was delayed until mid October, when President Carter finally signed the appropriations bill. The principal effect on Amateurs is a delay in some licenses that were in process when funding to contract services had to be temporarily cut back. It's also possible that some travel may have to be cut when the approved budget comes back for review.

LICENSE REVOCATIONS for bribing an FCC employee to issue unmerited 1x2 callsigns were handed out to two Ohio Amateurs in October. Revoked were the Amateur licenses of WA8ZDF/W8MZ and WB8AKU/WB8CPL, as an aftermath of the FBI's licensing investigation that resulted in the conviction of FCC Gettysbury employee Richard Ziegler in June, 1977, (August, October, 1977, Newsline). The revocations become effective in 50 days unless there is an appeal or the Commissioners choose to review the case.

OSCAR 7'S EMERGENCY STATUS was lifted October 12, after which the ailing spacecraft returned to a normal operating schedule. The exact cause of its ongoing problem is still undetermined, although radiation damage and a possible shorted cell in the battery are both under suspicion. It's still likely that random mode switching will throw it off schedule, and users are requested to run the minimum power necessary at all times to avoid stressing it.

Concerns Over Potential Radar interference to the SYNCOM III's Amateur transponder 23-cm input have led to thoughts of switching it from 1297 to about 1252 MHz. Amateurs who've experienced radar interference on 23 cm should relate their experiences to AMSAT Canada or AMSAT's Washington office.



Antenna Designer for the Ham and the Universe

BY DOUGLAS BLAKESLEE, N1RM

Ham Radio Horizons Interviews Dr. John Kraus, W8JK

John Kraus, W8JK, is well known to radio amateurs for his antenna designs. He is also a noted author, educator, and radio astronomer. John recently consented to talk about his life and extraordinary achievements with *Horizon's* contributing writer N1RM.

HRH: John, your 8JK antenna has been popular with amateurs for 40 years. How did you become interested in building antennas?

John: My interest was in directional, or beam, antennas, which weren't very common at that time. I wanted a beam antenna to improve reliability of some scheduled DX QSO's especially with ON4CSL, Carroll Stegal, who was a missionary in what was then called the Belgian Congo (now Zaire). We QSOed regularly in the 1930s.

An antenna is an interesting object when you stop to think about it. It's the interface between a pair of terminals connected to equipment on one end and space on the other; a special class of transducer. When receiving, it accepts a space wave and develops a voltage for the receiver, just as your eye does with light. When transmitting, it converts rf power into space waves, much as a loudspeaker converts audio signals into sound waves. It is a very important element in every radio system.

"In January of 1937 I had the idea for . . . the 8JK. It was the first antenna to use closely spaced elements."

HRH: What prompted the 8JK design? What advantages did it have over other antennas at that time?

John: The 8JK antenna had the advantage of good gain and compactness. It was the first antenna to use closely spaced elements; by this I mean spacings of less than one-quarter wavelength. An article entitled *"Directional Antennas"* had caught my interest. It was written by George Brown of RCA and published in the *Proceedings of the IRE*. In January of 1937 I had the idea for what became known as the 8JK. Rigging and adjusting the first version took several hundred trips from house to antenna poles and back — all in freezing winter weather at Ann Arbor, Michigan.

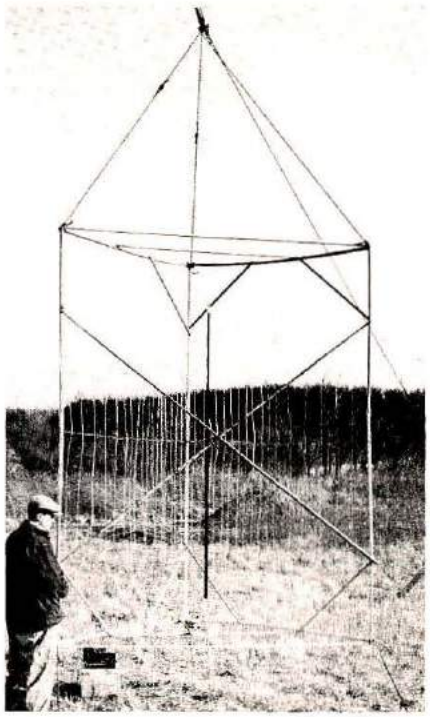
HRH: The 8JK was an instant success after you published the design in the March 1937 issue of *RADIO* magazine. What happened to you after the article appeared?

John: Letters poured in from all over the world. The antenna was an entirely new concept and raised many questions, such as how critical the dimensions were and what the best method for tuning or matching it was. The correspondence stimulated me to write a series of further articles, but the letters kept right on coming. I began to feel like the "Dear Abby" of radio for the antenna problems of Amateur Radio.

The corner reflector

HRH: Your next major design was the corner reflector. What was the inspiration for it?

John: The corner reflector is really an extension of the 8JK antenna idea. It developed out of an analysis of the operation of the 8JK antenna. In the 8JK, the two elements have opposite currents flowing. The radiated field would be the same if a shield were placed between the two elements.



John's first corner reflector antenna. Built in 1938, the antenna operated at 5 meters (then a ham band). It could be rotated for antenna pattern measurements.

Thus, one element and the shield produce the 180-degree reflector response. Bend the shield to a right angle and you have the 90-degree corner-reflector response.

HRH: What are the characteristics and advantages of a corner reflector?

John: It has high gain and a high front-to-back ratio. It's simple and noncritical, and with a bow-tie dipole it has wide bandwidth. The antenna has become very popular for uhf television reception.

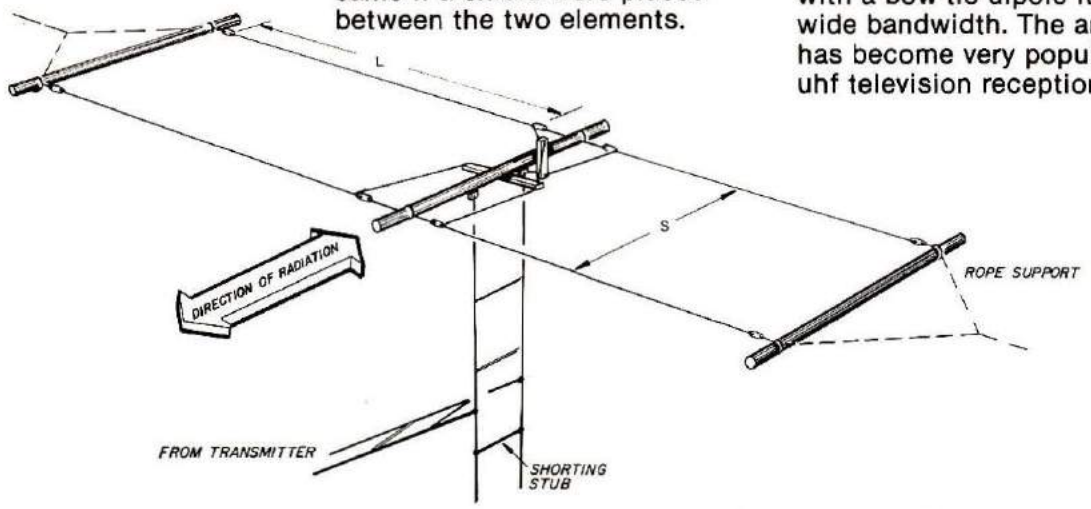


Fig. 1. Sketch of the original 8JK antenna from *Radio, circa* 1937. The spacing, S, is approximately 1/8 wavelength while the element length, L, can be either 1/4 or 1/2 wavelength.

The first rotatable "8JK" antenna. It was built in 1937 for operation at 14 MHz.

The helix

HRH: After the corner reflector came the helix. What led you to believe an antenna that looked like a corkscrew would have high gain?

John: In the case of both the 8JK and corner-reflector antennas the mathematical analysis came first, after which I built them. With the helical antenna the reverse was true. I did the experiment first out of plain curiosity and the theory came later.

HRH: In simple terms, how does a helical antenna work, and what are some typical applications for this type of antenna?

John: The helix is a remarkable antenna. Most antennas have standing waves on them, but the helix has a traveling wave, so the antenna has very wide bandwidth. It has what may be called "super" gain, because the gain is greater than for an ordinary end-fire antenna of the same length, and, the longer the helix, the greater the gain. The antenna is circularly polarized. In space communications, where the antenna on the spacecraft or satellite may have any orientation, circular polarization is desirable to prevent fading and signal drop-out due to crossed polarization. The helix has been a workhorse of space communications. Many helixes were installed on the moon.

HRH: Newcomers to radio find antennas a very confusing subject with all the varying claims for this type and that . Many shortened and miniature antennas have been described in the amateur literature, but their performance is usually disappointing, especially when compared with that of full-size antennas.

John: When you reduce a dipole antenna to less than one-half wavelength, its adjustment becomes more critical. The situation is aggravated if there are other antenna elements in the array with close spacing. And, if there are any losses in the antenna, efficiency may suffer as the antenna is made smaller in terms of wavelengths.

Antennas that are electrically small are a special case. For transmitting, the big problem is efficiency. Often very little of the transmitter power is radiated. There are many types of small receiving antennas where efficiency is not a problem. A pocket transistor radio, for example, has an antenna about the size of your thumb, yet it receives waves approximately 300 meters (984 feet) long. It works fine for receiving but would melt if you tried to use it for transmitting.

HRH: What sort of antenna developments are there today?

John: There are many specialized applications. Big antennas generally involve large parabolas or spherical surfaces with correcting devices. There is a great deal being done with arrays of dipoles that can be phased and controlled in different ways.

"My first transmitter worked on 40 meters. My antenna was a simple . . . dipole with a single-wire Windom (8GZ) feed. Everything was homemade."

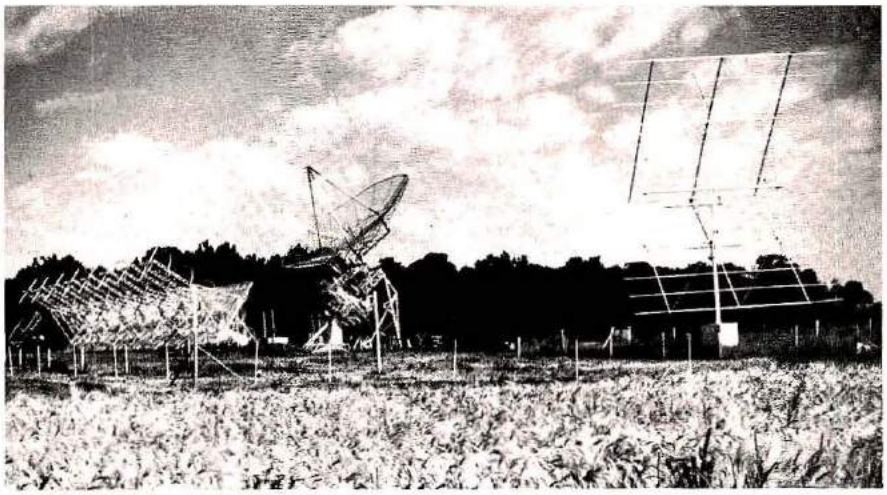
The basic principles, however, remain the same as they have always been.

W8JK's amateur career

HRH: When did you first become interested in Amateur Radio?

John: In high school. We had an amateur club station. I had previously become a radio enthusiast while listening with a crystal set. Also, I was interested in telegraphy, having set up an attic-to-attic telegraph with my friend Bob Cummings. Amateur Radio was the natural result of these two interests. Our high school club had ten members, all of whom became licensed amateurs.

The Ohio State west campus observatory as it looked in 1959. The antennas, from left to right, are a giant helix array for receiving 20-30 MHz signals from Jupiter; a steerable (40-foot) parabola, and a rotating corner reflector for 15 meters. The antennas are surrounded by a field of barley.



HRH: What equipment did you have in your first ham station and what sort of antenna did you use?

John: My first transmitter worked on 40 meters. It had a single-tube oscillator (type 210), which could take up to 5 or 10 watts input. My receiver had three tubes (rf, detector and audio). My antenna was a simple one-half-wavelength dipole with single-wire Windom (8GZ) feed. Everything was homemade.

HRH: What were some of the most memorable events in your ham career?

John: My first QSO, my first contact with an Aussie, and some of my QSOs on schedules with DX stations. The contact with Australia was a special thrill. I arose at 4 AM to try for a DX contact. When 5BY gave me an R4 report from Adelaide, South Australia, I could hardly believe my ears. I let out a whoop and stamped my feet on the floor of my attic hamshack. I made so much noise I awakened my parents, who were sleeping below.

HRH: At one point your Amateur Radio station was a link for scientists between the University of Michigan and the Radiation Laboratory at Berkeley, California. These men were leaders in research in high energy and atomic physics. Tell us what this was about.

John: When Ernest Lawrence from the University of California was in Ann Arbor during the summer of 1936 I was working on the Michigan Cyclotron and Ernest encouraged me to set up regular schedules with W6ITH in Berkeley so the Cyclotron groups at both institutions could discuss their work and exchange the latest news. Nuclear physics was just coming to the fore, and three years later Ernest received the Nobel prize for his work.

HRH: You've written books about electromagnetics, antennas, and radio astronomy. How do you go about assembling information and writing a major technical textbook?

John: These books all developed naturally out of lecture notes I prepared for classes I taught at Ohio State University.

W8JK (left center) checking adjustments on a 12-meter (40-foot) parabolic antenna with a group of students (1959).

HRH: Pat Hawes, *HRH's* Executive Editor, tells me that your book *Antennas* sells well from the *Ham Radio Bookstore*, even though it is one of the most expensive books they offer.

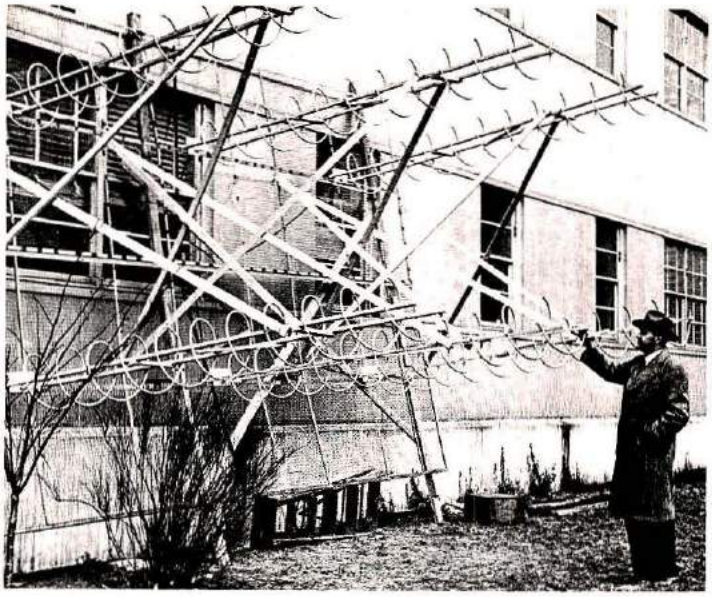
John: That's excellent. *Antennas* is now in its twenty-third printing, which is unusual for a book of its type. The reason for the book's being as useful and up-to-date today as when it was written is that it deals largely with basic antenna theory, which doesn't change.

Dr. Kraus in 1954 checking records obtained using a 96-helix array at the Ohio State radio observatory.

Radio astronomy

HRH: We recently ran a feature article in *HRH* about radio astronomy.[1] How did you first become interested in the subject?

John: My first interest dates back to 1933 when I helped in an attempt to detect radio waves from the sun on the one-centimeter wavelength. The attempt failed because in those days we couldn't build a sufficiently sensitive receiver. After World War II, radio astronomy entered a boom period, and we began some work at Ohio State University. At the time, the only other universities in the United



The first section of a 96-helix array is inspected by Dr. Kraus before its move to the radio observatory site (1951).

States doing any radio astronomy were Harvard and Cornell.

HRH: What setup did you have for your first radio telescope?

John: An array of helical antennas. Just a few at first, but we gradually added more until we had an array of 96 helixes on a tiltable ground plane 49 meters (160 feet) long. We operated at about one meter wavelength.

HRH: What results were you able to obtain?

John: The first source we detected was the sun, after which we went on to locate many other sources.

HRH: Have you ever used your ham gear in your radio astronomy or space experiments?

John: Yes. On a few occasions I used it to listen to the 20-MHz signals of the Sputniks. At first I listened to the transmissions and measured the height of the satellites. After the transmitters on the Sputniks went dead, they still proved useful for experiments. By listening to WWV when the band was dead, I noticed that the satellites appeared to leave an ionized trail that reflected radio signals, especially when in the northern auroral zone. The same receiving technique was used by Professor Wylie to observe meteors. My findings created a lot of interest; *Time* ran a story about my observations along with my picture.

Big Ear

HRH: The giant radio telescope you call Big Ear at Ohio Wesleyan (more formally known as the Ohio State-Wesleyan Radio Observatory) is an unbelievable complex. Please describe the antenna for us.

John: The telescope has two reflectors, a parabola which is fixed, and a tiltable flat reflector for deflecting the incoming waves into the parabola. The motivation for the design was to create a large collecting aperture at low cost.

"The Big Ear is the equivalent of an array of a million dipoles."

HRH: What inspired you to undertake such a monumental project?

John: After our success with the 96-helix radio telescope, it was obvious that further progress would require a much larger antenna. I favored the parabola-flat-reflector design because of its bandwidth and its large aperture per unit cost.

HRH: What is the gain of the Big Ear?

John: Well, relating it to the common dipole, our array of 96 helical antennas would be equivalent to using several thousand dipoles. The Big Ear is the equivalent of an array of a million dipoles.

HRH: How long did it take to build Big Ear?

John: Many years; a decade or more, because construction was by university students working part time. Some were electrical-engineering students, some mechanical-engineering. Others were not in the engineering school at all. It was a tremendous effort by everyone. We developed quite a number of top-notch welders.

HRH: What has been the primary project at the observatory?

John: Our principal project was a survey of the entire sky accessible to the telescope at 21 centimeters wavelength. We located, cataloged, and mapped almost 20,000 radio sources.

HRH: The discovery of OH471 during your survey (followed by later visual observation by others) gave man a glimpse of the edge of the universe — an object 12 billion light years away. What was the significance of OH471?

John: OH471 was the first object discovered with a red shift of over 3, which can be interpreted as putting it at better than 90 per cent of the distance to the edge of the universe. OH471 is so far away it has taken the radio (and light) waves 12 billion years to reach us. Those signals started out some 7 billion years before the Earth was formed. They travelled 12,000,000,000 light years (each light year equals 9,459,000,000,000 km, or 5,879,000,000,000 miles). The radio astronomer is a sort of

cosmic archeologist — he can listen to events that happened a very long time ago.

HRH: Big Ear has been used in a search for radio signals from intelligent beings elsewhere in the universe. How is such a search conducted and what have been the results to date?

John: If we can find what's out there as far as 90 per cent of the distance to the edge of the universe, might we not stand a chance of finding *who's* out there? But in what direction should we look, on what wavelength should we listen, and at what times? What we need is some kind of search strategy. Bob Dixon, W8ERD, has developed one we've been using. The search has turned up a number of interesting cold hydrogen clouds but, as yet, no signals that suggest an intelligent origin.

HRH: More down to earth, you recently let a group of students use the large aluminum ground plane at the observatory as part of a 160-meter antenna for a weekend contest. What prompted you to let them use the facility for such an endeavor?

John: Students of the Ohio State University Amateur Radio Club used the site to take advantage of the 0.01 square km (3 acre) ground plane for a balloon-supported vertical antenna. They also festooned the place with temporary antennas of many other types. I think the students had some good practical experience in rigging, tuning, and operating a variety of 160-meter antennas. They traded their assistance in some maintenance projects for the use of the site. They were back for a second year, just recently, using the balloon-supported vertical. To obtain directivity to lessen QRM problems for receiving, Beverage antennas were set up in several directions.

HRH: Amateurs doing moonbounce work have built some impressive antennas for the 144- and 432-MHz bands. Is there any meaningful work that amateurs can undertake in radio astronomy if they're willing to build the large antennas needed?

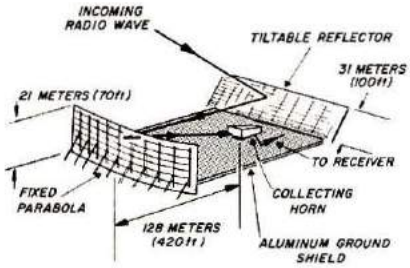
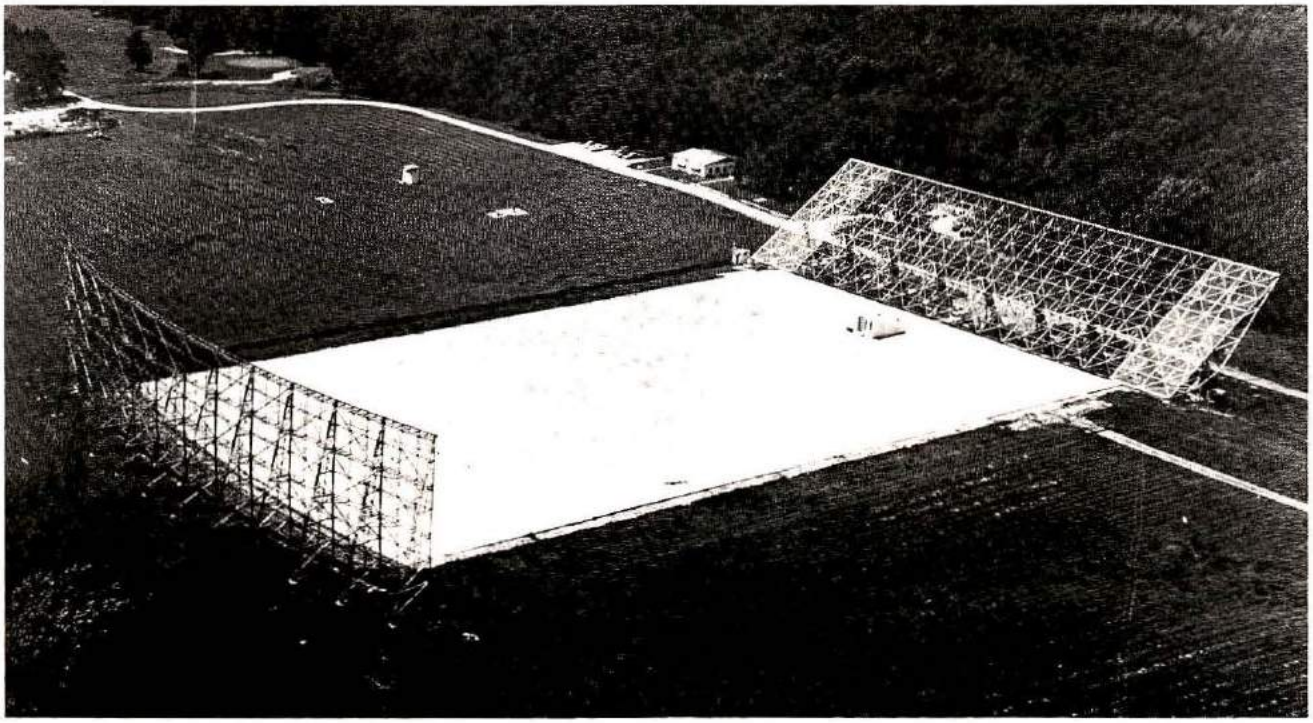
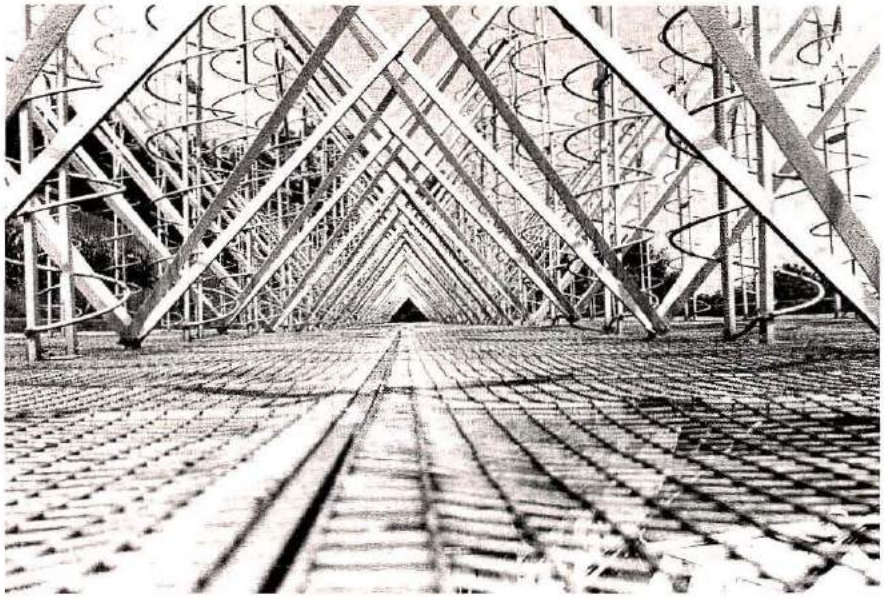


Fig. 2. This simplified diagram shows how Big Ear works. An incoming wave hits the tiltable plane reflector, is reflected to the collecting horn. The receivers are built directly below the collecting horn, underground, to minimize feed-line length. The direction of the antenna beam is changed by moving the tiltable reflector. Big Ear is built on a north-south line and relies on the rotation of the Earth for lateral movement.

John: An amateur can build a good, working radio telescope with relatively small, simple antennas, such as a pair of 10-turn helixes, which can be used to detect super-DX radio sources as distant as one billion light years. An Amateur Radio astronomer can derive a

Big Ear at the Ohio State — Ohio Wesleyan radio observatory site near Delaware, Ohio. Larger than three football fields, it has a gain of approximately one million over a single dipole at a wavelength of 10 centimeters. The 110-meter (360-foot) parabola is at left; the tiltable flat reflector is at right, and the aluminum ground plane extends in between. The horn collecting antennas are just in front of the flat reflector.





The 96-helix array of the Ohio State University radio observatory (1953) — a study in rectangles of the ground-plane mesh, triangles of the angle braces, and corkscrews of the helical antennas.

great deal of pleasure from building his own radio telescope and learning his way around the heavens. It takes a person with considerable radio background and interest. Very few optical astronomers ever make the transition to radio. I regard radio as the new astronomy and optical as the old.

Information sources for interested amateurs

HRH: Where can an amateur obtain design information about radio telescopes?

John: There are now a few books on the subject, such as ones by Lichtman and Sickels, by Dave Heiserman (TAB Books), and by John Shields (Howard Sams).* There are also tape cassettes and a periodical, *The Radio Observer*, published by Peterson Press, 657 Circle Drive, Santa Barbara, California 93108, ($4 a year). Anyone interested in Amateur Radio astronomy would do well to subscribe.

HRH: What is on the tape cassettes and where can they be purchased?

John: Much of what is picked up by a radio telescope is not audible. The tapes have the sounds of audible radio objects in space. The most spectacular are the pulsars. They are dense, rotating neutron stars, which put out a radio beam that sweeps around like a lighthouse beacon. Every time the beam sweeps by, you get a pulse in your receiver. Some of the objects are 5,000 light years away; what you hear on the tape originated perhaps 5,000 years ago. You're listening to a signal that started its journey across space before the pyramids were built in Egypt. The tapes can be purchased from Bob's Electronics in Fort Lauderdale, Florida.

Radio-frequency pollution

HRH: Rf pollution is an ongoing problem for radio astronomers (and the rest of us too). What, if anything, can be done to keep RFI under control?

John: It's a very real problem. One of the worst threats comes from the transmitters on satellites, particularly those in synchronous orbit, if they operate in, or too close to, bands reserved for radio astronomy. Frequencies close to the radio-astronomy bands can be used without interference for transmissions from the ground *to* the satellite, but the same frequency, if used for transmitting *from* the satellite to Earth, can be disastrous.

HRH: Some electrical engineering professors have tended to view amateurs as tinkerers who aren't good for much. You've seen generations of engineering students come and go. Has Amateur Radio been a beneficial hobby for those who chose to pursue it?

John: Amateur Radio can be very useful to a student by giving him some practical experience with electronic equipment and antennas. *But he needs to be motivated with a desire to understand how it works.*

"*The Big Ear* is a story of radio from the galena and catwhisker days, through the development of radio astronomy, to the discovery of distant quasars . . ."

HRH: What advice to you have for young people seeking a career in radio science or engineering?

John: The year 1977 marked the 90th anniversary of the first generation and detection of radio waves by Heinrich Hertz. Radio has come a long way in these 90 years, and I expect it will progress a lot further in the next 90 years. It has a great

The following books mentioned in this article are available from the Ham Radio's Communications Bookstore, Greenville, New Hampshire 03048. For fast service, call 800-258-5353 to order.

Antennas, by John Kraus, W8JK, $29.95.

The Big Ear, by John Kraus, W8JK, soft cover, $3.95.

Radio Astronomy For The Amateur, by David Heiserman, $5.95.

Introduction To Radio Astronomy, by John P. Shields, $4.50.

Include 40 cents postage and handling for each book.

future, which can be exciting and rewarding to any serious student of engineering or science.

HRH: You've told a lot about your life story in your new book, *Big Ear*. It's a warm, personal, witty work. After your highly technical books, how did you come to write about your personal experiences?

John: Textbooks present only cold facts. They're not very interesting and they don't tell the real story of how things were discovered or how scientists and engineers think and work. I wanted to present the more personal side, so I wrote *Big Ear*, a story of radio from the galena and catwhisker days, through the development of radio astronomy, to the discovery of distant quasars and the search for intelligent signals from space. In her review in *The Physics Teacher*, Dinah Moché catches the spirit of *Big Ear* when she says, "It takes you to the exciting frontiers of astronomy, with a sense of great adventures to come."

Closing remarks

HRH: You have certainly had a life of adventure and discovery. Do you have any additional thoughts for our readers?

John: Yes. The Earth is at least 5 billion years old. Man as a distinct species is several million years old. Yet our highly technological society, with nuclear power, space exploration, and fast electronic computers, is hardly older than a decade or two. We have just arrived. Man is just completing the first phase of his existence and just beginning the second. Attention is now focusing on problems such as population, pollution, energy, and resources, and with this comes an increasing awareness of the universe beyond, our relationship to it and its relationship to us. We are entering a challenging and exciting new era of man's development.

Reference

1. John J. Ronan, W1HLV, "An Oracle Comes of Age: The National Radio Astronomy Observatory," *Ham Radio Horizons*, May 1977, Pages 12-19.

HRH

New Magazine to be Edited by John Kraus, W8JK

Cosmic Search is a new magazine, the first devoted to mankind's most exciting adventure, the search for intelligent life in space. Are we alone in the universe or are there other civilizations out there, some perhaps far more advanced than we? The search to find out is just beginning, and *Cosmic Search* will publish popular, authoritative articles and the latest information about all facets of this rapidly developing new endeavor. This Search for Extra-Terrestrial Intelligence is often referred to by the acronym SETI.

Featured in the first issue of *Cosmic Search* will be articles on SETI by Arthur C. Clarke, Norman Cousins, Frank Drake, Carl Sagan, Walter Sullivan and many others. There also will be exclusive interviews, and reports on the latest developments. *Cosmic Search* will seek out and publish new talent, making awards for the best papers on SETI submitted by students and others under 30.

The year 1979 marks the 20th anniversary of the first article to put SETI on a firm basis. In commemoration of this anniversary, that article will be reproduced in the premier issue of *Cosmic Search* with comments by the authors, Guiseppe Coccone and Philip Morrison, from today's perspective of two decades later. In the same issue of *Cosmic Search*, Frank Drake will relate some of his recollections of the historic OZMA project, man's first attempt to detect intelligent radio signals from other worlds.

The following are *Cosmic Search* Editorial Board members:

- Richard Berendzen, University Provost, The American University
- John Billingham, Director SETI program, NASA-AMES Research Center
- Ronald Bracewell, Director, Radio Astronomy Observatory, Stanford University
- Thomas A. Clark, NASA-Goddard Space Flight Center
- Arthur C. Clarke, Sri Lanka, author of *2001, A Space Odyssey*
- Norman Cousins, Chairman, Editorial Board *Saturday Review*
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- Martin Rees, Director, Institute of Astronomy, Cambridge University, England
- Carl Sagan, Director, Laboratory for Planetary Studies, Cornell University
- Walter Sullivan, Science Editor, New York *Times*
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The editors of *Cosmic Search* are Robert Dixon, W8ERD, and John Kraus, W8JK, and the managing editor is Mirjana Gearhart, all of Ohio State University. *Cosmic Search* will be issued six times a year, with the first issue due out December 1. *Cosmic Search* is published by Cosmic-Quest, Inc., a private, nonprofit organization dedicated to the promotion and support of SETI research. Single copies will cost $2.50. A subscription for one year costs $12, with a special prepublication rate of $10. The *Cosmic Search* offices are at the Radio Observatory, Box 293, Delaware, Ohio 43015.

ATLAS RX-110...A high performance amateur band receiver at a fantastic low price!

THIS IS THE AMATEUR BAND RECEIVER YOU'VE BEEN WAITING FOR!

It's perfect for the newcomer to amateur radio who wants a low cost receiver to monitor all the action on the ham bands, or for the old timer who wants an extra receiver without having to spend a fortune.

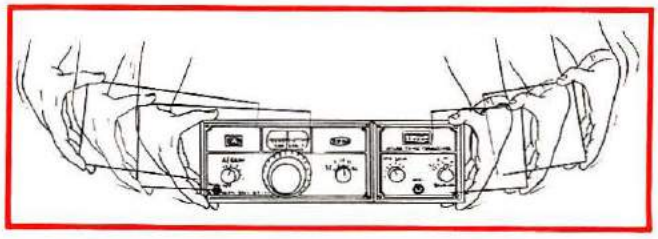
The Atlas RX-110 is all solid state and provides full coverage of 15, 20, 40 and 80 meters, and 28 to 29 MHz on the 10 meter band, with reception of CW Single Side Band. It is self-contained with its own AC supply and speaker and can also operate on 12 to 14 VDC.

The RX-110 offers well illuminated, easy to read tuning dial, velvet smooth tuning, and its handsome cabinet with attractive panel design is compact in size, and lightweight. Solid state design, with high sensitivity, selectivity, and dynamic range...make it comparable to receivers costing several times more. Yet because of its simplicity of design, and our well known value engineering, the cost is remarkably low.

SUGGESTED RESALE PRICE ..... $229.

AND HERE'S THE REAL CLINCHER!

We've made a matching solid state TX-110 transmitter module that plugs into the RX-110 and PRESTO! You have a 5 band transceiver at an unbelievable low cost!



With this completely new concept in receiver/transceiver design, we've produced a real breakthrough in low cost amateur equipment: A superb, low cost receiver to start with, and for the small extra cost of the TX-110 module, a complete 5 band CW-SSB transceiver!

THE EXCITING 110 LINE

A completely new concept in receiver/transceiver design!

RX-110 Receiver + TX-110 Transmitter Module: PRESTO! You have a complete 5 band transceiver!

WE'VE PRODUCED A REAL BREAKTHROUGH IN VERSATILE LOW COST AMATEUR EQUIPMENT!

- The Atlas 110 all solid state transceiver provides CW and SSB communications on 10, 15, 20, 40, and 80 meters with a choice of two power levels.
- The TX-110-L runs 15 watts input on 20, 40, and 80 meters; 10 watts input on 10 and 15 meters.
- The TX-110-H runs 200 watts input on 20, 40, and 80 meters; 150 watts on 15 and 100 watts on 10 meters.
- Full band coverage on 15 through 80 meters; 28 to 29 MHz on 10 meters.
- Semi-break-in CW with sidetone monitoring is a standard feature.
- PTT (Press-to-Talk) operation on SSB. Lower sideband on 40 and 80 meters. Upper sideband on 10, 15, and 20 meters.
- TX-110-L 15 watt module runs on AC supply in RX-110, so it is completely self contained, including speaker. Simply connect antenna, and key or mike.
- TX-110-H requires additional AC supply to supply high current for 200 watt amplifier (Model PS-110).
- 200 watt amplifier may be added to TX-110-L at a later date, thus converting it to a TX-110-H.
- Modular design provides much easier service and maintenance. With cabinets removed everything is wide open and fully accessible. This is a piece of solid state equipment you can work on yourself, if you wish, because you can get at everything with ease.
- The RX-110, TX-110-L, and TX-110-H will all run directly from a 12 to 14 volt DC battery supply for mobile or portable operation. When the two units are mechanically joined (brackets supplied with TX-110), the transceiver slides into a plug-in mobile mount, model MM-110.

SUGGESTED RESALE PRICES:

RX-110	**$229.**
TX-110-L	**$159.**
TX-110-H	**$249.**
PS-110	**$ 89.**

"Your Radio Company"

ATLAS RADIO INC.

417 Via Del Monte Oceanside, CA 92054
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Special Customer Service Direct Line
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MADE IN U.S.A.

EQUIPMENT ROUNDUP

BY JIM FISK, W1HR; TOM McMULLEN, W1SL, AND JIM GRAY, W1XU

Would you like to do your shopping at home? Do you need ideas or information about new equipment for your shack? Here's a miniature catalog of things available in the Amateur Radio world. Some items are new, and some have been available for several months or years, but we think the following pages offer an enticing selection that will help you build just the type of station you have been dreaming about.

You'll find the equipment listed in several categories, such as transmitters, receivers, transceivers, high-frequency gear, vhf equipment, and accessories. We don't pretend that this is a complete list, of course — such a list would fill two magazines of this size. However, there are enough goodies described here to start you at almost any level of Amateur Radio, and addresses are given so you can write for complete information on any item that catches your eye. Don't be afraid to make some obvious check marks on the pages and to leave the magazine open in a conspicuous place — sometimes Santa does get the hint! Happy hunting through the Ham Radio Horizon's 1979 Equipment Roundup.

Atlas RX-110 Receiver is a totally new, low-cost solid-state receiver designed for the newcomer to Amateur Radio as well as for the ham who wants a backup receiver. The RX-110 provides full coverage of 80, 40, 20, and 15 meters, plus 28 to 29 MHz of the 10-meter band. The unit is self contained with a built-in ac power supply and speaker; it will also operate on dc with any 12 to 14 Vdc battery source. Despite its low cost and simplicity, the RX-110 receiver offers exceptional sensitivity, selectivity, and dynamic range — performance that is comparable to receivers costing many times more.

The RX-110 offers added versatility in the form of a matching transmitter module, the TX-110, which, when plugged into the receiver, enables the two units to function as a low-cost transceiver (see Atlas Modular Transceiver, below). The Atlas RX-110 receiver sells for approximately $200. Atlas Radio Inc., 417 Via Del Monte, Oceanside, California 92054.

Atlas Modular Transceiver. This new transceiver consists of the recently introduced Atlas RX-110 receiver (lower left), in combination with the new TX-110 transmitter module. This unusual transceiver features all solid-state construction and provides full coverage of 80 through 15 meters plus 28 to 29 MHz of the 10-meter band. The transceiver will operate ssb or CW (with semi-break-in and sidetone as a standard feature). The transmitter module is available in a low-power 12-watt version, or a higher power 200-watt version if the power amplifier is included. The 12-watt transmitter operates from the receiver's self-contained ac power supply; a separate ac supply is required if the 200-watt amplifier is used.

The unit can also be operated from a 12-14 Vdc battery supply.

The new Atlas Modular Transceiver is designed primarily to meet the needs of newcomers to Amateur Radio as well as hams who want a low-cost second transceiver for portable or mobile operation. Those interested in learning more about Amateur Radio and learning the Morse code can purchase just the RX-110 receiver; later, when they have received their amateur license, they can add the inexpensive transmitter module to the receiver and have a complete five-band transceiver.

The selling price for these units is approximately $200 for the RX-110 receiver, about $125 for the 12-watt TX-110 transmitter module, and an additional $75 for the 200-watt rf power amplifier. The separate ac power supply for the rf amplifier will sell for about $90. Atlas Radio Inc., 417 Via Del Monte, Oceanside, California 92054.

Ten-Tec Omni transceivers are offered in two models, the Omni-A model 545 analog, and the Omni-D model 546 digital which

features digital frequency readout. These new high-frequency transceivers provide full coverage of the amateur bands from 160 through 10 meters in 500 kHz segments; WWV reception is provided with an additional bandswitch position. Rf power input is 200 watts on all bands, ssb and CW.

The receiver section of the Ten-Tec Omni has been designed for excellent sensitivity and good dynamic range for enhanced strong-signal performance; selectivity is set by an 8-pole crystal filter on ssb and *three* built-in filters for CW reception. A switch on the rf gain control inserts an attenuator in the input signal line for improved performance when extremely strong in-band signals are present. A squelch control circuit provides quiet monitoring of a frequency for net and schedule operation.

The transmitter is rated at 100 per cent duty cycle and offers full break-in operation on CW, switch selected fast or slow; the slow position is helpful during crowded band conditions or when operating mobile — the fast break-in position is designed for normal CW operation. Other built-in features of the Ten-Tec Omni transceivers include receiver offset tuning (RIT), pushbutton zero-beat control for netting, choice of VOX or PTT, and crystal calibrator (Omni-A only).

Power requirement for the Ten-Tec Omni is 12 to 14 Vdc; an ac power supply is available. Optional accessories include a noise blanker and matching electronic keyer. Omni measures 5-1/2″ high, 14-1/4″ wide, 14″ deep, less bail (140 × 362 × 356 mm); weighs 14-1/4 pounds (6.5 kg). Ten-Tec, Inc., Sevierville, Tennessee 37862.

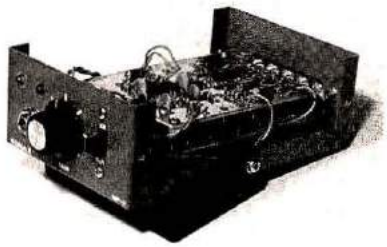
Swan 100 MX. The all solid-state Swan 100 MX mobile transceiver covers 80 through 10 meters (28.5-29.0 MHz on 10) with 100 watts rf *output*. (Full coverage of 10 meters is available by using optional crystals.) The 100 MX receiver offers sensitivity of 0.35 μV for 10 dB signal-to-noise ratio; selectivity is set by a 2.7 kHz crystal filter. Built-in features include crystal calibrator, noise blanker, receiver incremental tuning (RIT), and

linear permeability tuned oscillator with less than 100 Hz drift after warm-up. Audio output is 4 watts into 4-ohm load.

The Swan 100 MX transmitter provides selectable upper or lower sideband and CW with built-in VOX or push-to-talk. In the ssb mode carrier suppression is 50 dB or more, and unwanted sideband suppression is greater than 60 dB; third-order IMD is more than 30 dB down. The Automatic Level Control (ALC) increases effective voice power and reduces problems with overmodulation. The ALC system also protects the final transistors when operating into a high SWR.

Power requirement for the Swan 100 MX is 13.8 Vdc nominal (optional ac power supply is available for fixed-station use). Optional accessories include a digital dial, mobiel antenna matchbox, and front retractable tilt stand (the gimble type mobile mount is standard). The Swan 100 MX measures 3-3/4″ high, 11-1/2″ wide, 9-3/4″ deep (95 × 295 × 248 mm); weighs 13 pounds (5.9 kg). Swan Electronics, 305 Airport Road, Oceanside, California 92054.

Maximilian Associates VOMAX SBP-3 is a split-band speech processor used primarily for increasing the average output power of an amateur ssb voice-modulated transmitter without exceeding the peak rating of the equipment or producing distortion. The VOMAX SBP-3 operates on the principle of increasing the relative amplitude of the weaker consonants in the human voice, as opposed to the vowel sounds, which are typically many times stronger. Basically, the VOMAX splits the speech frequency spectrum into four parts, processes each of the parts, and then recombines them in the proper phase to produce "processed" speech. The VOMAX can be used on a-m voice transmissions, fm voice transmissions, and ssb voice transmissions, to effectively improve the intelligibility of each — particularly under conditions of difficult reception. It does not work with CW, RTTY, facsimile or slow scan TV. Each SBP-3 is impervious to rf feedback, has automated level control, visual level indicators, and a dynamic range of 60 dB. The SBP-3 comes with a



one-year warranty and money-back guarantee. The price is $179.95. For more information, write Maximilian Associates, P.O. Box 223, Swampscott, Massachusetts 01907.

EQUIPMENT ROUNDUP

Icom IC-701 high-frequency amateur transceiver provides complete coverage of the amateur bands from 1.8 through 29.7 MHz with a frequency synthesized VFO system. The two independent VFOs built into the IC—701 offer high operating

versatility and can be quickly selected with a front-panel switch. Other features of the IC-701 are continuously variable bandwidth and a built-in rf speech processor.

The triple conversion receiver of the IC-701 has sensitivity of 0.25 μV or less for 10 dB signal-to-noise ratio. Immunity to strong-signal overload is provided by the double-balanced diode mixer in the front end. Selectivity of the receiver can be set at 2.2 kHz for ssb and 500 Hz for Cw (200 Hz with audio filter for narrow CW). All spurious signals are more than 60 dB down.

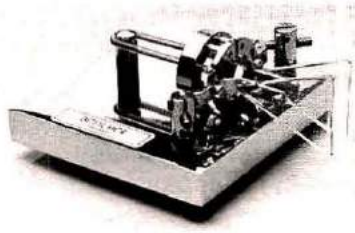
The IC-701 transmitter has 100 watts output on ssb and CW and is designed to operate into a 50-ohm load. On ssb, the carrier and unwatned sideband are suppressed more than 40 dB. Harmonics and spurious outputs are more than 60 dB.

Power requirement for the IC-701 is 13.6 volts ± 15% at 18 amps maximum (transmitting, 100 watts output). An ac power supply is provided in the speaker console for fixed station operation. The IC—701 transceiver measures 4.4″ high, 9.5″ wide, 12.2″ deep (111 × 241 × 311 mm); weighs 16 pounds (7.3 kg). Icom East, Inc., Suite 307, 3331 Towerwood Drive, Dallas, Texas 75234; or Icom West, Inc., Suite 3, 13256 Northrup Way, Bellevue, Washington 98005.

Kantronics Sky Switch. The new antenna isolator introduced by Kantronics can save you time and money because it allows you to feed your 2-meter and high-frequency antennas with the same feedline. The Sky Switch is mounted on the antenna tower or mast, and requires no special relays or control wires. The S-9 Antenna Feedline Isolator measures about 12.7 × 14 × 7.6 cm (5 × 5-1/2 × 3 inches) and includes hardware and mounting bracket. There are three ports for connection between the feedline and the antennas: The HF Port accepts a coaxial cable from any high-frequency antenna (or multiband antenna) having a feed-point impedance of 50 ohms; the VHF Port accepts a similar coaxial cable from your 2-meter antenna; and the Transmitter Port accepts the main 50-ohm coaxial cable from the shack. The power rating is 1 kilowatt, and the iso-

lation is between 12 and 20 dB from short to open circuit conditions at the ports. Priced at $29.95, the Sky Switch is available from Kantronics, 1202 East 23rd Street, Lawrence, Kansas 66044.

Bencher series of keyer paddles provides many unusual and interesting features that will improve your CW and help make operating a real pleasure. In addition to the dual levers that permit iambic keying, there are adjustable contact point spacing, a wide range of tension adjustments that can be tailored to match your "fist," self-adjusting needle bearings, solid silver contact points, precision-machined components, and a heavy steel base with nonskid feet. The standard BY-1 base is



finished in attractive black wrinkle. The BY-2 has a polished chrome base, and the BY-3 is available with a gold-plated base on special order. A unique feature are the paddles themselves, made from crystal-clear, polished plastic that blends nicely with the chrome main-frame and black-wrinkle base. Model BY-1 is priced at $39.95, and Model BY-2 is $49.95. Write for quotation one Model BY-3. Please add $2.00 for shipping and handling. No COD orders accepted. For more information, see your local dealer or write to Bencher Inc., 333 West Lake Street, Chicago, Illinois 60606.

DenTron Radio dummy load. Join the Big Dummy Club and stop testing your transmitter on the air. Here's an rf load that will stand 1 kW continuous or 2 kW PEP for 10 to 20 minutes at a 50 per cent duty cycle. It comes complete with cooling oil so you don't have to search for the coolant before using it. Frequency coverage is 1.8 to 300 MHz. The swr is 1.05:1 below 30 MHz, and no worse than 1.5:1 up to 300 MHz. The Big Dummy is in a 1-gallon container and uses a standard UHF connector. Amateur net price is $29.50. Write to DenTron Radio Company, 2100 Enterprise Parkway, Twinsburg, Ohio 44087.

Drake TR-7. This transceiver is the first commercially available amateur transceiver which uses an i-f above 30 MHz, a concept which allows greater flexibility in frequency coverage as well as offering greatly improved image rejection. Reception through the entire range from 1.5 through 30 MHz is provided by the TR-7, and, with the use of an optional range-program

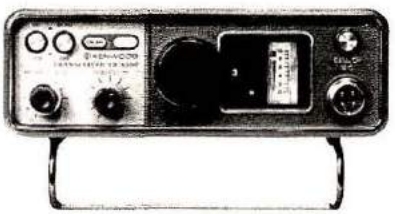
board, frequency coferage can be expanded from zero to 30 MHz. The upconversion technique, along with the synthesized frequency control system, makes this extended frequency coverage possible. Receiver sensitivity is less than 0.5 μV for 10 dB signal-to-noise ratio; image and i-f rejection are greater than 80 dB.

The all solid-state design and broadband tuned circuits mean that there are no preselector or peaking circuits to contend with. The transmitter is rated at 250 watts input on all modes, continuous duty for ssb and CW operation. Carrier suppression on ssb is greater than 50 dB, and undesired sideband suppression is greater than 60 dB at 1 kHz. Intermodulation distortion is 30 dB below PEP. Harmonics are suppressed more than 45 dB.

Other features of the TR-7 include a built-in wattmeter/SWR bridge and optional digital frequency readout with accuracy of ± 100 Hz, or analog readout with ± 1 kHz accuracy when properly calibrated. The digital frequency display can be used as a test instrument up to 150 MHz. Full passband tuning is another feature — it is possible to tune the receiver from the top edge of one sideband, through zero, to the bottom edge of the other sideband. Further improved reception can be obtained by installing optional receiving selectivity filters in the rig; the desired filter is selected by pushbutton switches on the front panel. The receiving filter can be selected independently of the transmitter mode or function. Optional filter widths include 300 Hz, 500 Hz, 1.8 kHz, and 6 kHz.

Power requirement for the Drake TR-7 is 11 to 16 Vdc at 25 amps on transmit (3 amps on receive). The PS-7 ac power supply is designed to provide continuous duty power for any mode and accepts input voltages of 90-132 Vac or 180-264 Vac, 50/60 Hz. Optional accessories include a noise blanker, mobile mounting kit, crystal filters, speaker, and matching remote vfo. The TR-7 measures 4.6″ high, 13.6″ wide, 12.5″ deep (116 × 346 × 318 mm); weighs 17 pounds (7.8 kg). R. L. Drake Company, 540 Richard Street, Miamisburg, Ohio 45342.

Trio-Kenwood 440-MHz fm transceiver. The Model TR-8300 is a transceiver for the second most popular fm and repeater band — 440 MHz. The unit provides 10 watts of output, with a switch for 1 watt if desired, and has positions for 23 channels; crystals for 3 channels are supplied with



the transceiver. It has a monitor switch so you can check modulation and frequency "netting," and a call switch for subaudible tone squelch. The transmitter and receiver can be adjusted to cover any 5-MHz segment in the band 440 to 450 MHz. The output amplifier stages are swr protected against burnout, and the transceiver circuitry is protected against overvoltage and reverse-polarity. See it at authorized Kenwood dealers or write to Trio-Kenwood Communications, Inc., 1111 West Walnut, Compton, California 90220.

Heathkit HR-1680 is an amateur-band receiver for 80 through 15 meters plus 28 to 29 MHz of the 10-meter band. It features a dual-conversion front end which offers sensitivity of 0.5 μV or less for 10 dB signal-to-noise ratio; selectivity of 2.1 kHz is set by 4-pole crystal filter. I-f rejection is 60 dB or more and image rejection is 50 dB or greater; internal spurious signals are

below 1$ μV equivalent antenna input signal. Audio power output is 1.2 watt into a 4-ohm speaker.

Frequency stability (drift) of the Heathkit HR-1680 is less than 100 Hz after 30 minutes warm-up. Tuning rate is approximately 15 kHz per turn; dial accuracy is within 2 kHz after calibration to the nearest 100-kHz crystal marker. Power requirement is 115/230 Vac, 50/60 Hz) power consumption is 27 watts maximum or 11.5 to 15 Vdc at 750 mA. Measures 6-3/4″ high, 12-3/4″ wide, 12″ deep (171 × 324 × 305 mm); weighs 9.8 pounds (4.4 kg). Heath Company, Department 348-480, Benton Harbor, Michigan 49022.

Antenna Mart SW-5 and SW-5G switches permit remote-controlled selection of up to five antennas, with only a single transmission line and a control cable between the operating position and the remote switch locations. They are ideal for multiband quads, stacked arrays, or any system of several high-frequency antennas located at a distance from the station. SW-series switches employ a heavy-duty transmitting-type rotary switch with excellent high-voltage insulation, silver-plated stator clips, and double-wiping, coin-silver contacts. The remote unit is housed in a rugged, weather-proof enclosure suit-

able for wall, tower, or mast mounting, and is fitted with SO-239 type coaxial connectors for the rf transmission line. Operating voltage (26 Vdc) is supplied to the switch by the control unit, which also contains indicator lights to show at a glance which antenna is in use. Both SW and SW-G switches are available in models offering 3 to 9 positions, and most are available with N-type connectors. Other connector types are available on special request. RF power capability is 4 kW PEP (in matched 50-ohm line), and switching time for full rotation is only two seconds. The control-box power required is 115 Vac, 50/60 Hz, with a 230 Vac option available. Prices range from $128 for the SW-3 to $209 for the SW-9G. Add $2 per connector for type-N connectors, and $3 per order for UPS delivery in the continental U.S. For more information, write Antenna Mart, Box 1010, I.S.U. Station, Ames, Iowa 50010.

Palomar Engineers' All-Band Preamplifier is continuously tunable and covers all amateur bands from 160 through 6 meters. It provides 20 dB of gain with a dual-gate FET for a low noise figure. The gain and low noise figure greatly improve reception on most receivers, particularly on the higher frequency bands. The added selectivity reduces image and spurious

responses. Gain is continuously variable to prevent overloading the receiver. An rf-sensing circuit allows the unit to be used with transceivers; the preamplifier is automatically bypassed during transmit. A 117-Vac power supply and a connecting coaxial cable for the transceiver are included. For a free descriptive brochure, write Palomar Engineers, P.O. Box 455, Escondido, California 92025.

Cover Craft equipment dust covers are available in a variety of sizes to fit all popular amateur

gear. They protect your investment, decrease maintenance, and keep equipment new-looking. Each is made of high-quality, heavy-gauge flexible vinyl, machine stitched for extra strength and long life. The covers are custom designed to precisely fit hundreds of models. In addition, they are backed by a 100 per cent satisfaction guarantee. Available at leading amateur dealers, or write Cover Craft, P.O. Box 555, Amherst, New Hampshire 03031.

KDK FM Transceiver. The FM2015R 2-meter fm transceiver from KDK is the most sophisticated unit now on the market. It provides full coverage across the band in 5-kHz steps, including the new fm subband of 144.5 to 145.5 MHz. It also features a 4-channel scanner which you can program at will. An internal battery maintains the memory so the channel programming is not lost when the unit is turned off. The FM2015R has provisions for multiple offset operation, and has a built-in tone oscillator for "whistle-on" access to repeaters. The receiver front-end and transmitter circuits are automatically tuned by varactor diodes coupled to the PLL frequency control circuitry to provide best sensitivity and optimum intermod rejection across the entire band. The receiver has an RIT control to allow improved reception of signals that may be off frequency. Output is 15 watts on high power, 1 watt on low. The transceiver features true fm for best audio fidelity. Internal circuits operate from a regulated 9-volt supply for optimum stability, and a large hash filter is included to eliminate automotive electrical-system noise. An ac-operated supply is available for home-station operation. Price for the FM2015R is $419. For full specifications, write Amateur-Wholesale Electronics, 8817 S.W. 129th Terrace, Miami, Florida 33176.

Drake R-7 is a solid-state com munications receiver which is fully synthesized in conjunction with a Permeability Tuned Oscillator (PTO) for smooth tuning and continuous coverage from 0 to 30 MHz; it offers both a digital readout and an analog dial. The R-7 features up conversion to a first i-f above 30 MHz; the special balanced mixer provides good strong-signal handling characteristics. The receiver uses a full set of bandpass "window filters" that operate from 30 MHz down to zero MHz; this permits operation in the low-frequency range that is similar to high-frequency perform-

ance. Sensitivity of the Drake R-7 is 0.5 μV or less for 10 dB signal-to-noise (0.2 μV with internal preamplifier turned on). SSb selectivity is 2.3 kHz; extremely flexible selectivity

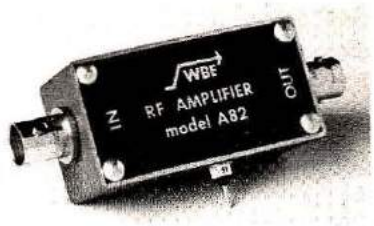
combinations can be realized by the proper choice of crystal filter, notch adjustment, and positioning of the passband tuner.

The Drake R-7 will transceive with the Drake TR-7, and these functions are pushbutton controlled. The R-7 also has a unique antenna switch/toroidal power splitter so that both the R-7 and TR-7 may be used on the same antenna for simultaneous dual receive. The antenna selector also permits alternate antennas to be used on the receiver and a main antenna on the transceiver, or vice versa.

Power requirement for the Drake R-7 receiver is 115/230 Vac, 50/60 Hz, or 11 to 16 Vdc. The styling, color, and size of the R-7 matches the TR-7, and either the internal speaker or an external speaker may be used. Measures 4.6″ high, 13.6″ wide, 12.5″ deep (116 × 346 × 318 mm). R. L. Drake Company, 540 Richard Street, Miamisburg, Ohio 45342.

Inline Instruments coaxial switching system combines a remotely controlled SPDT coaxial relay and a coupler module, which allows the coaxial cable between them to conduct an rf signal and the relay-energizing voltage simultaneously. This permits the relay to be mounted on the tower or mast near the antenna, where it is most effective. The coupler can be located near the radio. Since separate power wiring to the relay is eliminated, the result is a one-cable installation for less wind loading and better resistance to weather. The relays are available in type 103, covering 20 to 550 MHz, and type 105, for the range 1.5 to 180 MHz. They are for 50-ohm cable, and have an insertion loss of less than 0.1 dB. Power ratings vary with model and frequency, but generally are from 350 watts (type 103), to 1250 watts (type 105 at 1.5 to 60 MHz). Relay energizing voltage is 9 to 18 Vdc, at approximately 80 mA. Standard connectors are SO-239, but UG58A/U types are available on special order. Prices start at $41.95 for type 103, and $51.95 for the 105. For more information on these and other coaxial relays and systems, write Inline Instruments, Inc., Box 473, Hooksett, New Hampshire 03106.

Wide Band Engineering rf preamplifier. Model A82H is the Amateur Radio version of WBE's popular A82 amplifier series. It has a frequency range of 4-450 MHz, gain of 20 dB flat to ± 0.5



dB, and power requirements of + 20 Vdc at 28 mA. The A82H can be used with frequency counters and meters, signal and harmonic generators, detectors, single and multiple high-frequency and vhf receivers, sweep gear, and for wide bandwidth applications. Write Wide Band Engineering Co., Inc., P.O. Box 21652, Phoenix, Arizona 85036.

MFJ Enterprises MFJ-400 8044 Econo Keyer is a reliable, full-featured economy keyer using the Curtis-8044 keyer-on-a-chip. The panel controls consist of a speed control (8 to 50 WPM) that you pull to tune your transmitter, and a volume control with an on/off switch. The Econo Keyer has an internal weight control that lets you adjust the dot-dash space ratio for a distinctive signal to penetrate heavy QRM for solid DX contacts. It also has an internal tone control for its built-in sidetone oscillator and speaker. It requires an external squeeze key for iambic operation. It has dot and dash memory, instant start, self-completing dots and dashes, and jam-proof spacing. Its reliable solid-state keying output can handle – 300 volts at 10 mA maximum for grid-block keying, and + 300 volts at 100 mA maximum for cathode-keyed and solid-state transmitters. The MFJ-400 8044 Econo Keyer is available for $39.95 plus $2.00 shipping and handling. To order, call toll-free 800-647-8660, or mail order to MFJ Enterprises, P.O. Box 494, Mississippi State, Mississippi 39762.

Hy-Gain hand-held transceiver. The Model 3806 is a miniature hand-held transceiver for the amateur 2-meter band. It features 6 channels for versatility and low cost, and has an internal adjustable microphone preamplifier for good audio quality. Excellent immunity to out-of-band signals is provided by the FET mixer stages and the selectivity of the rf amplifier circuits. The 3806 has a separate microphone and speaker element, and the case is assembled with gaskets to keep out dirt and moisture. Power output is 2 watts. A connection is provided for external antenna. Accessories include an AC adaptor, an automotive cigar-

lighter plug, and a tone-control pad which mounts easily on the back of the 3806 case. A leather carrying case is also available. Price is $189.95, amateur net. See the 3806 at Amateur Radio

equipment dealers, or write Hy-Gain Electronics, 8601 N.E. Highway 6, Lincoln, Nebraska 68505.

Heathkit SB-104A is an all solid-state transceiver that provides complete coverage of the high-frequency amateur bands from 80 through 10 meters and features a digital frequency readout; readout accuracy is ± 200 Hz. A pushbutton on the front panel selects full power output of 100 watts, or 1 watt output for QRP operation. The broadband driver and power amplifier

stages in the transmitter require no tuning when switching from band to band.

The receiver offers sensitivity of 0.5 μV for 10 dB signal-to-noise ratio, and selectivity is set with a 2.1-kHz crystal filter; a CW filter with 400-Hz bandwidth is available as an optional accessory. Receiver image rejection is – 60 dB. The frequency response of the audio output circuitry is especially tailored for CW and ssb communications.

The transmitter section of the SB-104A features audio processing on both microphone and phone-patch inputs, crystal filter sideband generation, crystal-controlled heterodyne oscillator for maximum stability, and a unique ALC system to eliminate distortion producing overdrive. Output impedance is 50 ohms, unbalanced; built-in power regulating circuitry prevents damage to the rf power amplifier under high SWR operating conditions. The carrier and unwanted sideband are suppressed – 50 dB; third-order intermodulation distortion is more than 30 dB down.

Power requirement for the Heathkit SB-104A is 12 Vdc. Optional accessories include an ac power supply, noise blanker, CW filter, and mobile mounting bracket; a matching remote vfo, station monitor, station console, and speaker are also available. The SB-104A measures 5-3/4″ high, 14-1/2″ wide, 14″ deep (146 × 367 × 352 mm); weighs 32 pounds (14.6 kg). Heath Company, Department 348-480, Benton Harbor, Michigan 49022.

Shure Brothers portable and mobile microphones. A series of hand-held microphones for portable and mobile use is offered by Shure Brothers. They are identified as the 401, 404, 405, 507B, and 577. The 401 is designed to provide excellent performance at low cost; $19.80. The 404 is an omnidirectional microphone for high speech intelligibility; its price is $30.60. The 414B is about half the size of a conventional microphone, yet is a rugged unit for in-

door/outdoor fixed or mobile use. It is priced at $30.00. The 507B is a hand-held dynamic unit which features easy disassembly and extended low- and high-frequency response; price is $33.00. The 577 is a noise-cancelling microphone for use in noisy environments. Available in high-impedance (577A), or low-impedance (577B), they are priced at $51.45. All prices are user net. See them at dealers, or write to Shure Brothers, Inc., 222 Hartrey Avenue, Evanston, Illinois 60204.

DenTron Radio wattmeter. The new W-2 wattmeter from DenTron is a dual instrument that will allow you to read both reflected and forward power without switching. The forward-pow-

er section has two ranges, 0-200 and 0-2000 watts. The reflected-power meter has a 200-watt full-scale rating. The sensing unit is separate, to allow neat and easy installation. Frequency range is 1.8 to 30 MHz, and the meter accuracy is ± 5 per cent. Amateur net price is $99.50 from DenTron Radio Company, 2100 Enterprise Parkway, Twinsburg, Ohio 44087.

Swan 350. There are two models of the Swan 350 transceiver, the 350B, which has a standard analog dial; and the 350D, which features a digital dial. In other respects the transceivers are exactly the same. Receive sensitivity of the Swan 350 is 0.5 μV for 10 dB signal-to-noise ratio; selectivity is set by a 2.7 kHz crystal filter. For CW operation a built-in audio filter offers bandwidths of 80 or 100 Hz centered on 800 Hz. The CW sidetone monitor has adjustable pitch and volume, independent of the received signal audio level.

Audio output is 3 watts into a 3.2-ohm load with built-in speaker.

The Swan 350 may be operated on ssb or CW with 300 watts PEP input on ssb and 200 watts dc input on CW. In the ssb mode the carrier and the unwanted sideband are suppressed more than 50 dB; all spurious signals and harmonics are down at least 45 dB. Built in features include grid-block keying on CW, amplified ALC for increased voice power without overmodulation flat-topping, and a built-in ac power supply.

Power requirement for the Swan 350 transceiver is 117 Vac (220 Vac version available on special order). Optional accessories include a VOX control and

dc-dc converter for mobile and portable operation. Measures 5-3/4″ high, 13-1/4″ wide, 11″ deep (146 × 337 × 279 mm); weighs 17-1/4 pounds (7.8 kg). Swan Electronics, 305 Airport Road, Oceanside, California 92054.

Trio-Kenwood synthesized 2-meter mobile transceiver. The new TR-7400A fm transceiver provides fully synthesized operation across the entire 144-148 MHz band. It has a six-digit LED frequency readout, and will work with plus or minus repeater offsets anywhere in the band. Power output is 25 watts or better, with a low-power switch to select 5 to 15 watts, adjustable. It incorporates a sub-audible tone system which may be used on either transmit or receiver, or both. Tone-burst modules are available as an option. High-Q helical resonators provide improved rejection of interference from outside the amateur bands. You can also obtain a PS-8 ac power supply which will provide 13.8 volts dc to operate this or other Kenwood equipment in your home station. See the TR-7400A, the PS-8, and other equipment at authorized Kenwood dealers nationwide, or write Trio-Kenwood Communications, Inc., 1111 West Walnut, Compton, California 90220.

Kantronics 8040B Novice CW receiver features simplicity, sensitivity, and good selectivity. In addition to being small and battery powered, its good performance makes it ideal as a standby receiver for the more advanced amateur. The 8040B receiver tunes 3.65 to 3.75 on 80 meters and 7.05 to 7.14 on 40 meters, including Novice portions of both bands. On 80 meters the signals are converted directly to audio, while on 40 meters the signals are first converted to 80 meters and then to audio, which is filtered and amplified to drive a small speaker or earphones. Sensitivity of 1 μV provides readable signals; selectivity is 1 kHz. Careful design and component selection minimizes frequency drift with temperature changes, and the audio response is shaped to provide optimum listening ease.

Front-panel controls of the 8040B include an off-on switch, bandswitch, rf gain, audio gain, and vernier tuning dial. The receiver is powered by two 9-volt batteries and includes a standard phono plug for an 8-ohm speaker or earphones. Its small

size makes it perfect for portable use; measures 3-1/4″ high, 5-1/4″ wide, 7-3/4″ deep (83 × 133 × 197 mm). Kantronics, 1202 East 23rd Street, Lawrence, Kansas 66044.

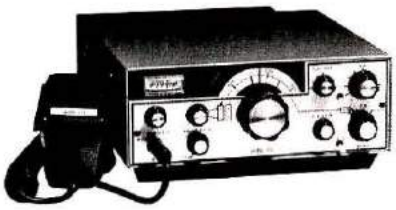
Yaesu 2-meter handheld transceiver. The new FT-20R is a lightweight, handheld transceiver that offers high performance in a compact size. The unit has six crystal-controlled channels in the two-meter band, and provides 1 watt of rf output. Power is supplied by internal Nickel Cadmium AA cells, or by alkaline dry cells. The case is high-strength ABS plastic, mounted to a metal frame for ruggedness and low cost. Options available are an external speaker/microphone, battery charger, and a leather carrying case. The FT-20R comes equipped with a flexible antenna, vinyl carrying case, and shoulder strap. Batteries are not included. Frequency coverage is 144 to 148 MHz, and three crystals are supplied. See the FT-20R at Yaesu dealers nationwide, or write to Yaesu Electronics Corporation, 15954 Downey Ave., P.O. Box 498, Paramount, California 90723.

Alda 103. The Alda 103 solid-state transceiver covers 80 through 20 meters with 250 watts dc input on CW (250 watts PEP on ssb). All stages are broadbanded so no tuneup is required when switching from band to band. The transceiver switches to CW operation whenever the key is pressed, so no CW mode switch is required; the set features full break-in CW with a T/R relay hold circuit which stays energized between letters and automatically reverts to receive after a pause between words. The main tuning dial uses a dual-speed drive mechanism with a smooth zero backlash vernier; VFO drift is less than 100 Hz from turn-on at room temperature.

Receiver sensitivity of the Alda 103 is 0.5 μV for 10 dB signal-to-noise ratio; audio output is 3 watts minimum. A 6-pole crystal filter with 2.5 kHz bandwidth provides excellent audio characteristics on receive as well as transmit. A built-in Receiver Incremental Tuning (RIT) control allows independent receiver frequency adjustment

± 500 Hz from the transmit frequency. The CW sidetone monitor has an adjustable level control on the front panel.

The transmitter is designed to match a 50-ohm (unbalanced) antenna, but no damage results from high SWR loads. Carrier suppression on ssb is better than – 45 dB, and unwanted

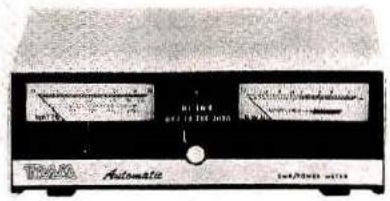


sideband suppression is greater than – 55 dB at 1000 Hz; all harmonics are suppressed more than – 45 dB below 30 MHz (more than – 60 dB above 30 MHz).

Power requirement for the Alda 103 is 13.8 Vdc input at 15 amps, negative ground only. Power consumption on receive is 5.5 watts (including dial and meter lamps); on transmit, 260 watts. Optional accessories include a crystal calibrator, noise blanker, and ac power supply. Measures 3-1/4″ high, 9″ wide, 12-1/2″ deep (83 × 229 × 318 mm); weight 8-1/4 pounds (3.7 kg). ALD Industries, 215 Via El Centro, Oceanside, California 92054.

Trio-Kenwood all-mode vhf transceiver, the TS-700SP, is a 2-meter transceiver that you can use for all modes and all occasions on the most popular amateur vhf band. It has many features that will add to your operating pleasure — digital frequency display for accuracy in finding your favorite net, repeater, or schedule partner; a preamplifier for improved receiver sensitivity; vox operation; semi-break-in operation; and CW sidetone. It's vfo controlled, and covers 144-148 MHz. There's a new crystal for convenience in covering the new repeater and fm segment at 144.5 to 145.5 MHz. Power output is 10 watts on ssb, fm, and CW; 3 watts on a-m. There are excellent accessories available, such as the matching VFO-700S, SP-70 speaker, HS-4 headphone, and either the noise-cancelling MC-30 microphone or the MC-50 dynamic microphone on a desk stand. Available at authorized Kenwood dealers nationwide; for the name of the one nearest you, write Trio-Kenwood Communications, Inc., 1111 West Walnut, Compton, California 90220.

Tram/Diamond SWR/Power Meter is an automatic indicating device designed to make it easier to monitor the performance of your transmitter and antenna/transmission-line system. It automatically reads swr — there is no need to calibrate the instrument. It will indicate power and swr as you operate so there is no need to apply a steady carrier for calculation or reading. The indicating meters are separate for swr and power, and the directional coupler unit is separate from the indicator, thus allowing you to mount it at a convenient location. It will operate from battery or the ac line, and has an LED indicator for high-swr warning. The meter has three calibrated ranges; 0-20, 0-200, and 0-2000 watts. Fre-



quency coverage is from 1.8 to 30 MHz. For further information, write Tram/Diamond Corporation, P.O. Box 187, Lower Bay Road, Winnisquam, New Hampshire 03289.

Bird Electronics Wattmeter is a piece of professional test gear that's available to the amateur. The Bird model 43 Thruline wattmeter is in use at thousands of commercial installations, service shops, and laboratories worldwide. You can use one of these versatile and reliable instruments in your ham shack to

measure power levels from 5 to 5000 watts, over a frequency range of 2 to 1000 MHz. A calibrated plug-in element for each range of interest assures accuracy without any edge-of-band compromises. Quick-change (QC) connectors allow you to fit the wattmeter into any coaxial transmission line system without hard-to-find adapters. The model 43 is available with a plug-in element for the band of your interest, or, for the all-band amateur, it can be obtained in a cushioned carrying case with space for a selection of elements. You can find the Bird Model 43 at authorized dealers nationwide; for the name of one near you, write Bird Electronics Corporation, Cleveland, Ohio 44139.

R.L. Drake's new three-band vhf transceiver, the Drake UV-3, will provide fm transmission and reception on three amateur bands — 144, 220, and 420 MHz. It incorporates modern phase-locked circuitry for minimum spurious output from the transmitter. Frequency coverage is synthesized in 5-kHz steps, and the receiver has some unique scanning capabilities: it will scan a programmed frequency from any dial frequency, scan

any dial frequency from a programmed channel, or scan a programmed channel from another programmed channel. Construction of the UV-3 is of the modular plug-in kind, and the control panel can be removed for split mounting — the rig in the trunk of your car and the control head under the dash. You can purchase the basic 2-meter unit first, then have the other bands factory-installed later, if you wish. Power output is 20 to 25 watts, with a switch to select a low-power level of approximately 2 watts. Also available is an ac power supply which will provide the 13.8 Vdc required for operation of the UV-3 at your home station. For complete information and prices on the UV-3 with options and accessories, write R.L. Drake Company, 540 Richard St., Miamisburg, Ohio 45342.

Select Circuits CW decoding units are designed to convert audible Morse code into a visual display. The "Morse-A-Letter" displays each letter by means of an LED readout on the front panel. The "Morse-A-Line" accepts the output of the "Morse-A-Letter" unit and converts it to a display on your TV screen. The display is in the form of a single line of letters traveling from right to left across the screen. The Morse-A-Letter unit contains a built-in oscillator for code practice, and a filter to help eliminate interference. It also features a speaker to monitor the code as you are practicing or receiving. Both units are available in either partial or full kits, or as assembled units. Prices start at $17.95 for the printed-circuit board only, up to $199.95 for a completely assembled Morse-A-Letter in a cabinet. For more information on these and other kits, write Select Circuits, 1411 Lonsdale Road, Columbus, Ohio 43227.

Mirage Communications has entered the Amateur Radio market with the introduction of the MP2 vhf Wattmeter. The MP2 is designed to provide the amateur vhf operator with a versatile instrument to help obtain optimum performance from his station. The unit will work from 50 to 200 MHz, and measures power in three ranges; 50, 500, and 1500 watts. The MP2 displays average-reading power for fm or CW, or peak-reading for ssb. Standing-wave ratio may also be measured with as little as 2 watts of power, and is displayed directly without having to use

charts or graphs. The swr and peak-reading features have not been available on a single instrument before. The coupler unit may be remotely mounted for added installation convenience. Suggested list price is $119.95. For further information, contact your local dealer or Mirage Communications, P.O. Box 1393, Gilroy, California 95020.

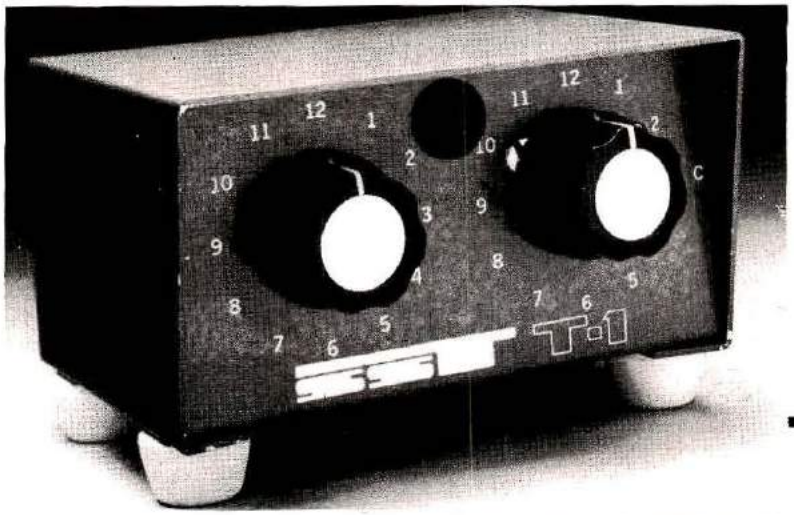
Palomar Engineers has introduced a new broadband rf transformer to match vertical and mobile antennas to 50-ohm coaxial cable. Impedance values of 8, 12.5, 16, 22, 32 and 50 ohms are selected by a panel switch.

The transformer is mounted in a die-cast aluminum case fitted with uhf (SO-239) connectors. The rf ferrite toroid core is wound with Teflon-insulated wire and is rated to 500 watts in continuous commercial service. Operating frequency range is 1-30 MHz (1-10 MHz below 20 ohms). The price is $35. Add $2 for shipping in United States and Canada. For free descriptive brochure, write to Palomar Engineers, P.O. Box 455, Escondido, California 92025.

Astro 200A is a miniature frequency synthesized high-frequency transceiver that provides full coverage of 80 through 10 meters in 100-Hz steps. Digital frequency readout is built-in; Receiver Incremental Tuning (RIT) and fine tuning control provide continuous tuning with crystal stability. there are no moving parts in the frequency tuning arrangement; momentary pushbutton switches are used to either increase or decrease

Continued on page 76

SST T-1 RANDOM WIRE ANTENNA TUNER



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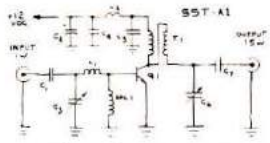

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Camouflage Your 2-Meter Antenna

BY WARREN HODGES, W6DHX,
AND BILL WISE, JR., WB6QEZ

More and more hams are facing antenna restrictions in today's crowded cities. Here's an idea I dreamed up, with help from my artist/neighbor Bill, to produce an answer that's both functional and has eye appeal. Bill and I live in an area where no outside antennas are permitted. Having joined the growing ranks of the 2-meter world, we faced the dilemma of what to do about an antenna in our "land of no antennas."

The 2-meter 1/4-wavelength ground plane weather-vane antenna mounted on the peak of the roof. Design is easily modified to a 5/8-wavelength vertical by adding a loading coil at the base and a wire whip extension at the top.

Bingo! — why not a 2-meter weather vane? Properly designed, it would not only provide an outlet for our 2-meter signal but also enhance the appearance of the roof top.

I had the workshop, and artist Bill had the drawing board. The results of our collaboration and subsequent shop efforts are shown in the photos and drawing.

Most of the materials were purchased from a local metal salvage yard. The antenna is built around a quarter-wave ground plane design. Components are aluminum, except for the 6.5-mm (1/4-inch) stainless-

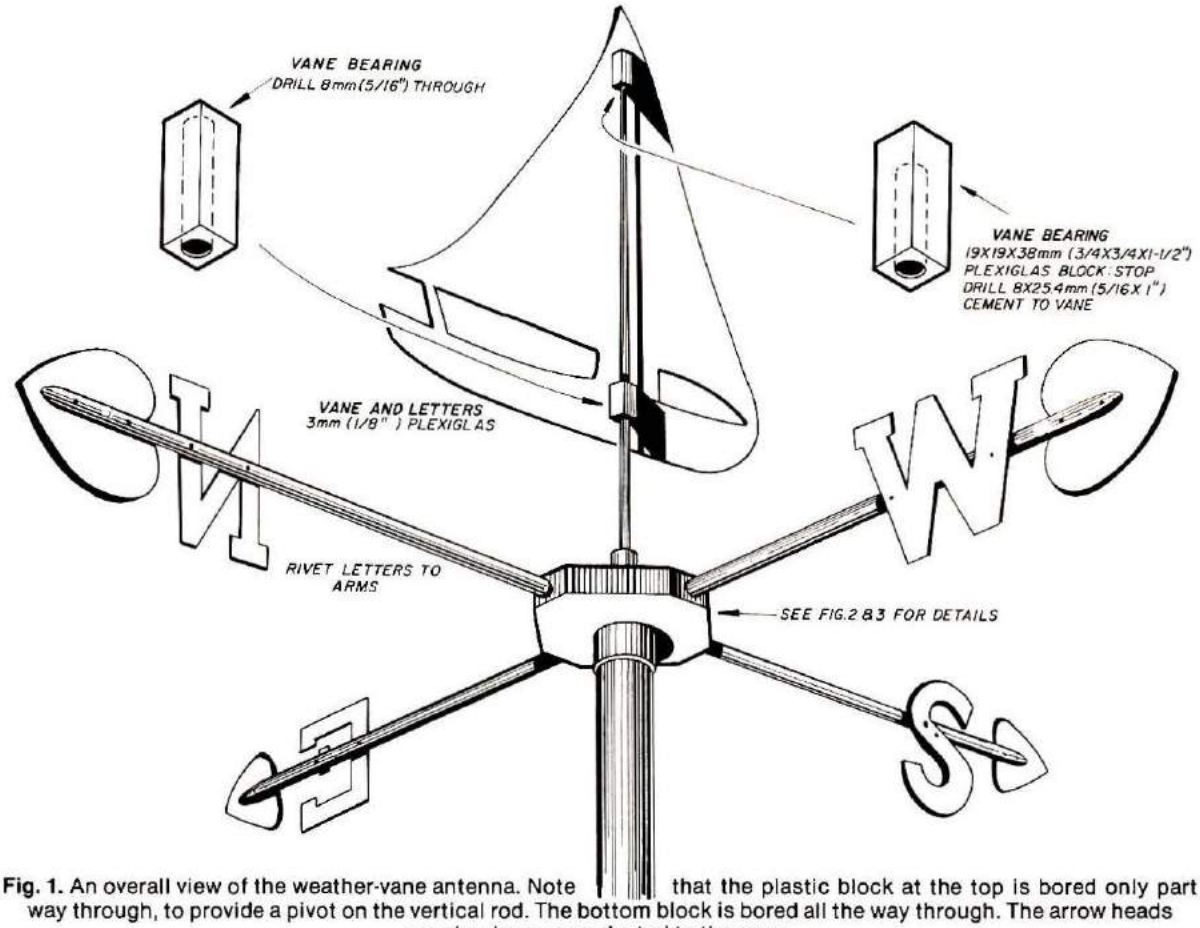


Fig. 1. An overall view of the weather-vane antenna. Note that the plastic block at the top is bored only part way through, to provide a pivot on the vertical rod. The bottom block is bored all the way through. The arrow heads are aluminum, pop-riveted to the arms.

steel vertical member. The 102-mm (4-inch) black letters and the sailboat vane are 3-mm (1/8-inch) plexiglas, while the arrowheads that terminate the radials are aluminum. Note, in particular, the simple plexiglas bearing arrangement for the vane. We spray-painted the completed antenna and mast with flat-black paint, in keeping with traditional weather-vane color.

The design is well within the means and ability of most hams who like to build their own gear, and they'll recognize that the idea has many alternative designs. We modified one of the weather-vane antennas by adding a loading coil at the base of the stainless element and a piece of 0.6-mm (0.025-inch) music wire to the top to make a 5/8-wavelength unit.

We are pleased with the overall results — electronic and cosmetic — and the neighbors now know "which way the wind blows."

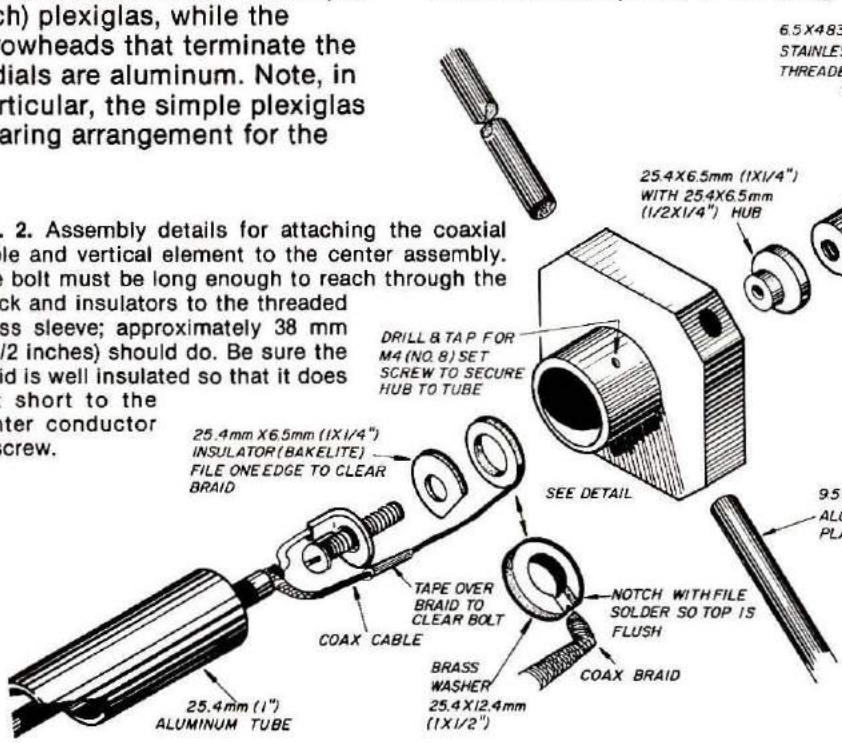
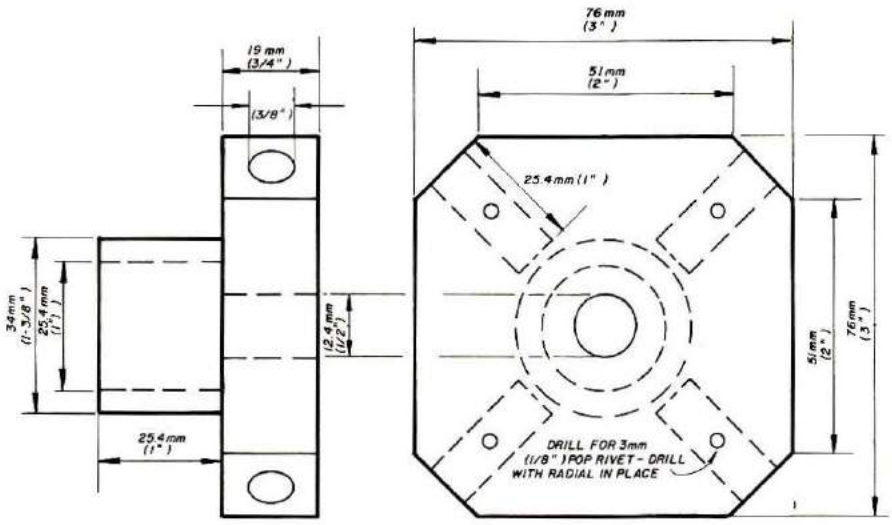
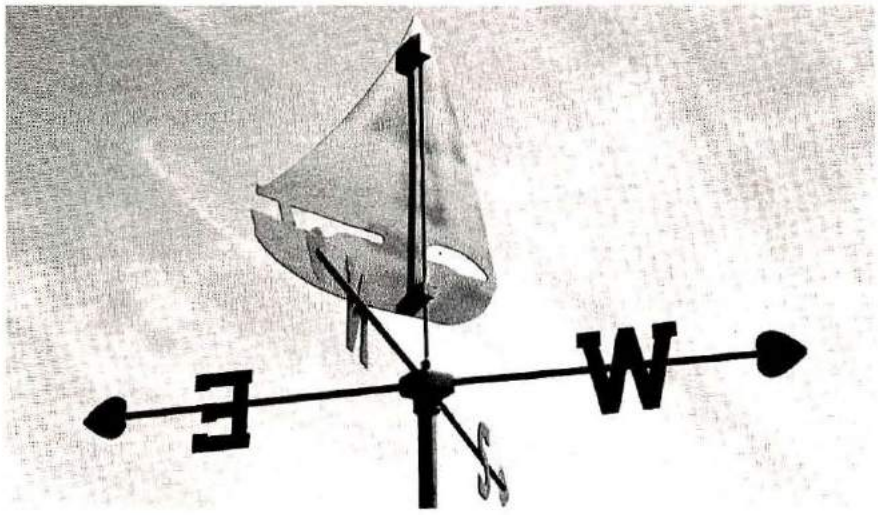


Fig. 2. Assembly details for attaching the coaxial cable and vertical element to the center assembly. The bolt must be long enough to reach through the block and insulators to the threaded brass sleeve; approximately 38 mm (1-1/2 inches) should do. Be sure the braid is well insulated so that it does not short to the center conductor or screw.

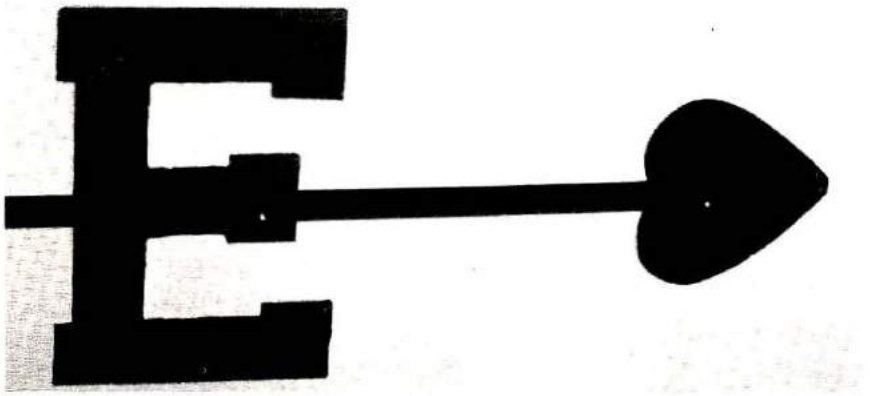


ALUMINUM HUB

Fig. 3. Dimensions and plan for the center block. The radials should be a snug fit into the holes, and held in place by aluminum pop-rivets. Most of the materials for this weather-vane antenna were obtained from scrap yards. If you're lucky, the cost will be very low.



Close-up view of the 2-meter quarter-wave ground plane antenna showing construction details. Antenna was built from easily obtainable materials in a home workshop.



Detail showing construction of one of the ground-plane arms. The letter is 3-mm (1/8-inch) plastic. The arrow head is made of aluminum. Letters and arrow heads are riveted to the arms.

HRH

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C1000	10Hz to 1GHz	.1PPM 0° to 40°C	20MV	1MV	>50MV	9	.5 Inch	115VAC-BATT 8 to 15VDC	4"H x 10"W x 7½"D

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looking east WAY east

BY CHUCK MARTIN, WA4YRA/DA1NR

Take your Amateur Radio license with you on a visit to Germany

There are more American servicemen in the Federal Republic of Germany than in any other country in the world, except the United States. Where Americans go, ham radio goes along. So, if you are planning a brief visit — or an extended stay — take along the greatest hobby in the world.

Operating in Germany has its pleasures and pitfalls, and everyone can have a rewarding time. The German postal and telecommunications service has made it easy for Americans to get in on the action here. Reciprocal licensing is available, with the ARRL offering information and assistance for civilians, and the U.S. Army Signal Command at Worms providing a similar service for military personnel.*

Under the current agreement, visiting American tourists will receive a 90-day license which cannot be renewed. You use your home call and add /DL for a suffix. Technician licensees will receive a Class-C license good for 144 MHz and up (there is no 6-meter amateur band in Europe). General and higher licensees will receive a Class-B license with privileges on all ITU Region-1 frequencies. A special permit must be secured before operation is allowed on 160 meters.

For those who will remain for an extended period of time, such as students, military personnel, or businessmen, a special permit will be issued. You'll receive a "DA" prefix, which is solely for foreigners. I have had the dubious pleasure of easing myself out of DX pileups when I announce my "rare" call.

Repeaters

Two-meter FM is very enjoyable in Europe. There is no such thing as a closed repeater in Germany. All have 1750-Hz tone-access control, but they are available for use by all licensed amateurs. They are channelized in 25 kHz increments, starting at 145.0 MHz. About 10 sets of crystals will get you on every machine on the Continent, see **Table 1**.

Simplex channels are 145.0, 145.5, and 145.55 MHz. If you don't have the 1750-Hz tone in your rig, you can whistle a reasonably close tone and bring up the repeater, or you can key it up when it identifies. I use a Heath-2036 and have always had success in using the repeaters.

After you access the machine it is permitted to call CQ 2 meters. No one will be offended if you ask, "Do you speak English?" Most German hams are very cordial. The Trier machine, DB0UT, covers southern Belgium, the Grand Duchy of Luxembourg, and northeastern France. The French language is permitted on the repeaters, and many of the French-speaking operators use English as a second language.

Be prepared to keep a good log, because people will want

*For reciprocal licensing information for Germany and other countries, write to the American Radio Relay League, 225 Main Street, Newington, Connecticut 06111. An addressed, stamped envelope will help speed the reply to you.

QSL cards, even if you work them through a repeater. The German and American DARC members will tell you their "DOK" number, which is their QSL guide number. Jot this number on the card and it will help move the card along faster.

The Wiesbaden Amateur Club has the only repeater in Germany that is club-owned and sponsored. It operates on channel R87 in the 430-MHz repeater band, 431.475 in/439.075 out. It has a special call sign, DA4FB, because it is foreign-sponsored. Its coverage is excellent, reaching from the Frankfurt-Wiesbaden area to the Belgium-Luxembourg border. It is the only machine I know of that suffers from a chronic lack of users. To hams in the Eifel-Hunsruck-Rhineland area, welcome aboard — a fine machine is waiting for you.

Other bands

The high-frequency bands offer great excitement, too.

Table 1. European repeater frequency plan.

Channel	Input (MHz)	Output (MHz)
R0	145.000	145.600
R1	145.025	145.625
R2	145.050	145.650
R3	145.075	145.675
R4	145.100	145.700
R5	145.125	145.725
R6	145.150	145.750
R7	145.175	145.775
R8	145.200	145.800
R9	145.225	145.825

English is the universal language here, and some of the best fists you have ever heard will greet you on CW. Incidentally, there are no "sub-bands" for phone or CW or other modes. As long as the bandwidth of the emission is less than 7 kHz, you are free to use any mode of emission in the high-frequency bands. Through practice, and gentlemen's agreements, CW is found at the lower portion of the band and phone toward the upper portion, with various meeting places for specialized modes.

Even though the English language is in universal use, the high-frequency bands offer a great opportunity to learn German. It is more difficult to learn this way, because you lose eye contact and cannot gesture. But the Germans are flattered that you are trying to speak their tongue, and will gladly slow down while you limp along. The highest compliment you can pay to a man is to speak to him in his own language. It influences international goodwill immeasurably.

Restrictions

Your power-class is determined by the plate dissipation of the final-amplifier stage, with the Class-B license good for 150 watts. Interestingly, the Germans have a no-code license that is good for 2-meters and up. This "Communicator" license seems to work well for them. No third-party traffic is allowed, and you cannot let an unlicensed person speak over the mike. I have been told that if you hear a call from a sinking ship, you are not allowed to aid in the rescue. You are permitted to tell the authorities the frequency to listen on, but you cannot relay any details of the emergency. Autopatch is strictly forbidden.

I work for Air Force MARS and I handle a lot of traffic and stateside phone patches, but this is done entirely within military frequencies and under MARS jurisdiction.

I hope that I have shed some light on how amateur radio works here in the Federal Republic of Germany. We'd love to meet you on the air during your visit. **HRH**

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BY WILLIAM I. ORR, W6SAI

The Hammarlund Comet Pro Receiver

It was the first shortwave superheterodyne receiver I had ever seen. Gingerly I slid into the operator's swivel chair and timidly reached out for the tuning dial. The dial figures were projected on a small frosted screen, and, as I moved the control the numbers moved slowly across the screen as if by magic. I hardly breathed.

"Go ahead. Tune it! It's the best receiver in the world," said the owner as he sat back and watched this newly licensed amateur's awed expression as signals poured forth from the loudspeaker.

The 20 meter CW signals boomed in. "London," said Charlie as he copied the code in his head. A little later, "Havana," and then, "That's NN1NIC, the U.S. Marine station in Nicaragua."

But the young amateur ignored the remarks as he sat mesmerized by the beautiful receiver. Massive in its heavy black-wrinkle cabinet, the *Comet Pro* tuned easily across the band. I couldn't believe the sensitivity and selectivity. The simple two-step regenerative receiver I owned was mentally thrown in the trash can. But how could I possibly save eighty-eight dollars and twenty cents and buy a *Comet Pro*? Would I ever own one? Probably not!

And I never did, until now. Born in the spring of 1932, the Hammerlund Comet Pro

The Comet Pro receiver in its rugged cabinet. The bandspread tuning dial is at the center, flanked by the smaller OSCILLATOR and WAVELENGTH tuning controls. This model incorporates such modern features as a crystal filter (right of panel), standby switch, and earphone jack. Quiet and sensitive, the "Crystal Pro" was a favorite with many CW DX operators during the 1930s.

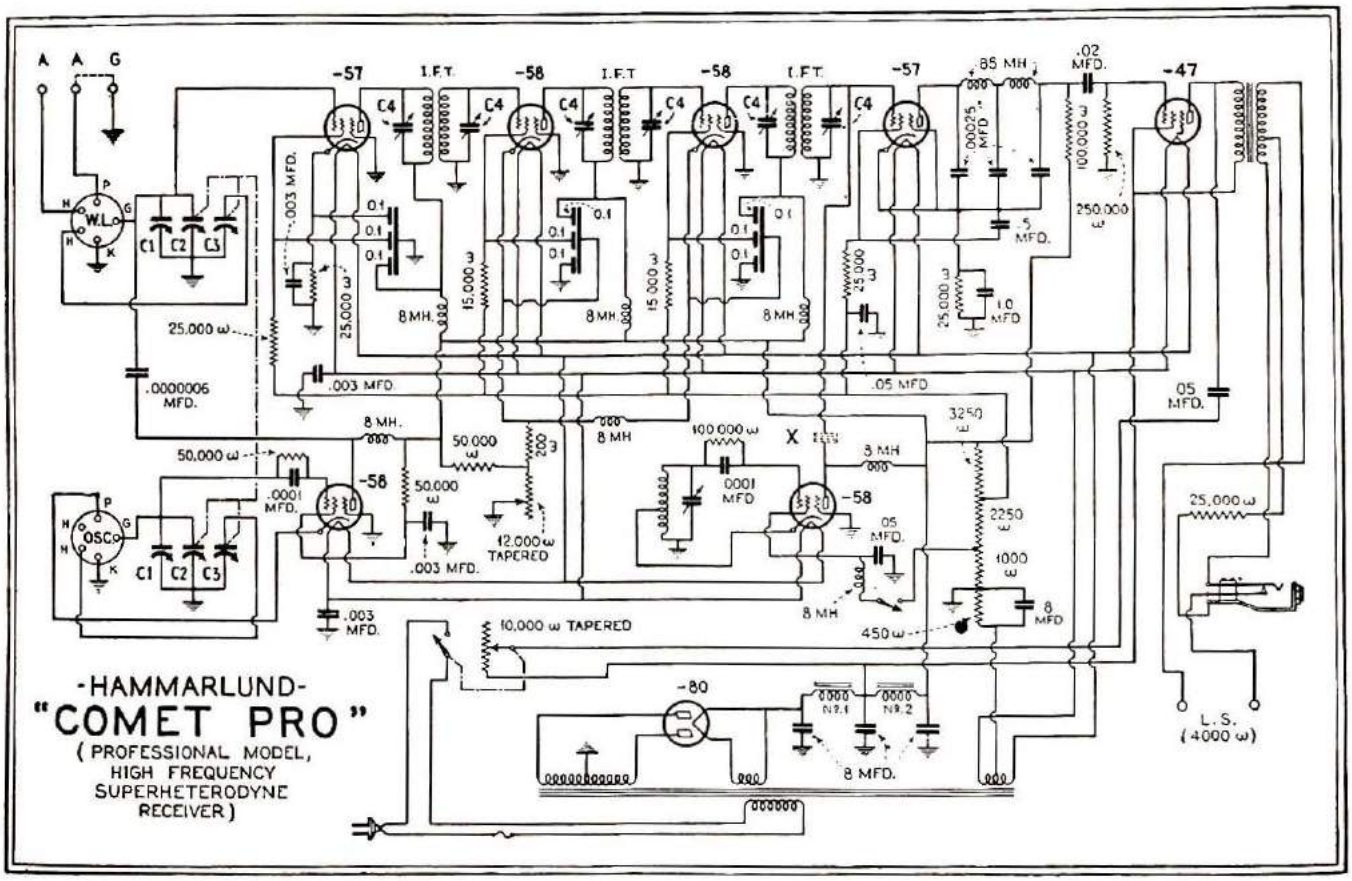


Fig. 1. The Hammarlund Comet Pro, the godfather of the modern shortwave superheterodyne receiver (reprinted from the instruction manual). Later versions of this receiver incorporated an i-f crystal filter and automatic volume control circuitry.

receiver reigned supreme for a few years, and was then relegated to also-ran status when the newer, improved superheterodynes arrived on the market.

But, by undergoing a series of modifications, the Comet Pro remained in production until World War II, when rebuilt versions of it were still in use. Looking back on those days from the present, it is clear that the Hammarlund Comet Pro had a decisive influence upon the design of shortwave receivers. Its impact upon the world of shortwave radio was much greater than its short life would lead one to believe.

The year was 1932; the "broadcast boom" had collapsed. Radio manufacturers hopefully assumed that the next great public interest would be in shortwave broadcasting. Already the National Broadcasting Company had thrilled listeners by rebroadcasting the sound of Big Ben striking midnight in London. More than anything else, this short rebroadcast spurred the interest in "round-the-world" shortwave reception. The problem was: how to enter the market?

The *Hammarlund-Roberts Company* of New York (manufacturers of the famous broadcast receiver bearing that name) thought they had the answer. A first class, superheterodyne receiver that would tune from 200 to 14 meters, with bandspread available at *any* wavelength. The first, timid advertisement for the new "professional" receiver appeared in the April, 1932, issue of *QST*. "An eight-tube custom-built superheterodyne which will do all that the professional operator demands," said the advertisement.

It would seem that reader interest was minimal in the new "Pro" receiver, which was perhaps ahead of its time. No further advertisements for the Comet Pro were seen until the July, 1932, *QST*. It was obvious that the receiver had been face-lifted in the interim. Neat, vernier tuning-dials had been added. The receiver still had less than a watt of audio power, however, and an external power amplifier was required for loudspeaker operation. But by the winter of 1932 a "final" version of the Comet Pro appeared which remained the basic design until the receiver was taken out of production about ten years later.

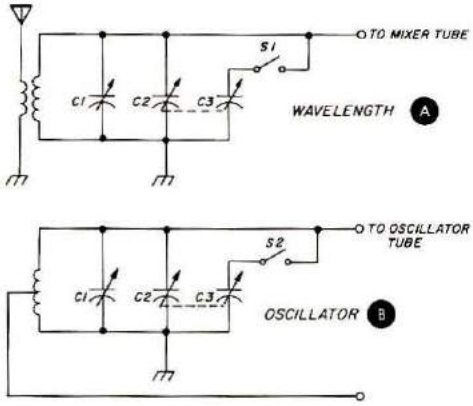


Fig. 2. Bandspread in the Comet Pro. On the 80- and 160-meter ranges an extra tuning capacitor (C3) was connected across the main tuning (bandspread) capacitor to allow complete coverage of these bands. The changeover was accomplished by S1, a jumper in the coil forms.

It is instructive to review the Comet Pro circuit (**Fig. 1**). Basic in concept, the design employed eight tubes in a superheterodyne circuit using an intermediate frequency of 465 kHz. Plug-in coils were used, as was the vogue in those days, and the Hammarlund company went to great lengths to provide high-Q, efficient coils. No rf amplifier stage was used; the selectivity of the detector stage and the choice of a higher-than-normal intermediate frequency provided a good degree of image rejection, particularly on the lower frequencies. And, making a virtue of necessity, the Hammarlund instruction manual informed the user that the problem of image interference "is often an advantage rather than a disadvantage because it sometimes happens that if severe interference is encountered when using the normal setting of the oscillator, a shift to the image setting will completely eliminate the trouble."

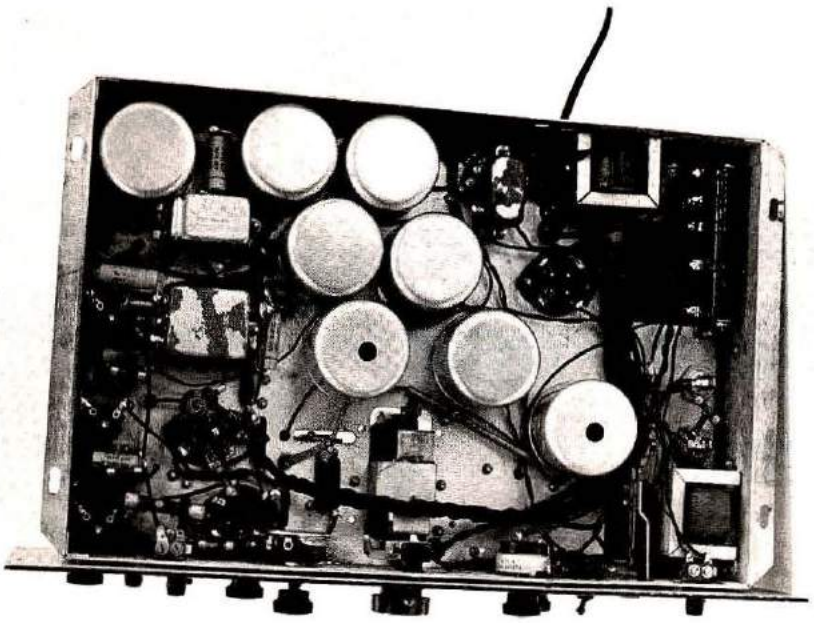
Not immediately apparent to the casual observer is the unique bandspread system used in the Comet Pro (**Fig. 2**). The two small tuning dials located on each side of the main tuning dial were called WAVELENGTH and OSCILLATOR in the manual. These, of course, were the detector and oscillator tuning controls. Unganged, they allowed the user to tune to any spot in the receiver range by the use of a large chart supplied with the receiver. Upon reaching the desired range, the WAVELENGTH control was peaked for maximum background noise and all further tuning was done by the main (bandspread) dial. Thus, bandspread could be applied at any spot in the whole tuning range.

Because the various plug-in coils had generous overlaps in their coverage and the user could adjust the tuning system to provide bandspread by tuning either up or down from the bandset frequency, the amount of bandspread provided was extraordinarily flexible. And, in addition, the plug-in coil scheme allowed the receiver operator to wind his own bandspread coils, if he so desired.

Receiver selectivity was very good, as high-Q i-f transformers, wound with Litz wire, were employed.* Later models of the receiver incorporated a crystal filter and an automatic volume control system as the state-of-the-art advanced. And, early in the game, the audio amplifier (using a 247 pentode) was incorporated into the receiver proper, instead of being an auxiliary unit.

Chassis layout of the Comet Pro. The main tuning control and band-setting capacitors are partly hidden behind the aluminum cans that contain the plug-in coils (center). At left is the i-f strip, with the beat-frequency oscillator in the corner of the chassis. At right is the power supply. Speaker and antenna connections, plus a line fuse (an almost unknown luxury in those days) are at the rear of the chassis. Note the chassis flange along the side that fits within a track in the receiver cabinet.

*Litz wire, named after its inventor, is made up of many strands of very fine wire, each with its own coating of insulation. The strands are woven together so that each conductor successively takes up all possible positions in the cross section. Litz wire reduces skin effect, thus it offers less resistance to high-frequency current and increases *Q*. It was very popular in the early days of radio construction, and is still used today in low-frequency rf stages, i-f transformers, and some rf chokes. ***Editor***



Underneath the Comet Pro. Heavy, rubber-insulated wiring was used, along with point-to-point placement of resistors and condensers (capacitors). The multitude of small aluminum cans hold r-f chokes and decoupling circuits. This is a fair representation of receiver assembly technique used in the 1930s, especially in small production runs.

Receiver construction

The builders of today's solid state, circuit-boarded communication equipment would smile at the construction techniques used in the Comet Pro. The only means of achieving high gain and circuit stability was to use metal, and a lot of it. A heavy, plated-steel chassis formed the central assembly. The chassis slid into a double keyway in the ponderous steel cabinet in such fashion as to lock the two units firmly together. Once in the cabinet, numerous screws made the units as one, and the final assembly truly represented "battleship construction." In truth, the Navy admired the rugged Comet Pro so much that they granted a contract to the Norden Company in 1934 to supply a number of Comet Pro receivers, modified to match the Navy's audio lines and incorporating plate and filament voltmeters.

While the mechanical stability of the Comet Pro was outstanding, the electrical wiring left something to be desired. The wiring could best be described as "point-to-point," which, in today's terms means "haywire". A feeble attempt was made to lace some wires into a primitive harness, but most wires ran freely back and forth beneath the chassis (see photograph). Worst of all (from the standpoint of today's collector), the wiring had rubber insulation which quickly grew brittle and flaked off in large chunks. But, aside from this minor irritation, the Comet Pro was "the best receiver in the world."

Many amateurs apparently thought so. Although not as widely advertised as some other popular receivers, a quick look at the "Station Descriptions" pages in pre-war issues of *QST* will show that a large number of prominent stations used Comet Pro receivers, even at the astronomical cost of over eighty-eight dollars!

The Comet Pro today

How many Comet Pro receivers were built? An educated guess indicates about 3,500 over a period of nearly ten years. Today, they are a vanished breed. The author was lucky enough to find a Comet Pro, complete with coils, in good condition a few years ago. Some of the rubber-covered wiring has been replaced, a few new bypass capacitors were put in, and new filter capacitors have replaced the old units — and the receiver works! While stability is poor compared with today's standards, receiver sensitivity is excellent and image rejection quite good, considering the lack of a separate, tuned rf-amplifier stage. And, as the Hammarlund manual recommended, it is always easy to tune up on the image signal and move the offending signal away in frequency.

L'envoi

Alas, the Comet Pro is no more. By the beginning of World War II it was superseded by the "Super Pro"; post-war, the Hammarlund SP-600JX represented the last of a long line of extraordinary shortwave communications receivers.

A toast, then, to the forgotten designers of the Comet Pro. One of the first true shortwave receivers, this design showed the way to the ultimate, modern communications receiver. Others profited from the attributes and shortcomings of the Comet Pro, which unknowingly was the "test bed" of yesterday for the receiver of today.

How many Comet Pro receivers exist today? Aside from the ones in radio museums, the author knows of three others and would be pleased to hear from readers who have a model of this grand old receiver that can still give a good account of itself today.

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BUILT-IN ZERO BEAT SWITCH. Permits placing your transmitted signal exactly on the listening frequencies of CW stations.

BUILT-IN SWR BRIDGE. The "S" meter electronically switches to read SWR every time you transmit to provide a continuous antenna check.

FRONT PANEL MICROPHONE AND PHONE JACKS.

ADJUSTABLE AUTOMATIC LEVEL CONTROL. For setting output power level from low power to full output, for retaining low distortion at desired drive power to linear amplifier.

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17 VOX DELAY control.
18 VOX ANTI-TRIP control.
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20 MICROPHONE jack; hi-z input.
21 HEADPHONES jack.
22 RECEIVER OFF-SET TUNING SWITCH; 3-position: Max-Min-Off.
23 VOX-PTT SWITCH.
24 QSK (full break-in) SWITCH; 2-position: Fast-Slow.

Write that Article!

BY ALF WILSON, W6NIF

Want to cash in on your ideas? Here are some tips on writing articles for the Amateur-Radio magazines

First of all, I'd like to say that this article is not intended to be a short course in writing, technical or otherwise. It is rather a set of guidelines on how to get your ideas into print in the Amateur Radio magazines. You don't have to be an engineer or a master of journalism to sell ham articles. However, if you observe a few established rules in preparing your article, the chances of the article's being published will certainly increase.

The publishers of Amateur Radio magazines are always looking for articles that appeal to readers, and payment for accepted material certainly makes writing worth the effort. Who knows? If your idea is appealing and well presented, perhaps the check you get for it will help pay for some of that new equipment you'd like to buy.

Originality counts. If you've discovered a new way of doing something that costs less or requires less effort; if you've solved a problem in a unique way; or if you have a tale to tell that will benefit other hams — you may have a winner. Here's how to cash in on those ideas.

Discipline

Don't let the word "discipline" scare you. If you're a beginning writer with a good idea that you'd like to see in print, you *must* observe a few basic requirements of presentation in your manuscript. By "discipline" I mean scrupulous attention to detail. Let me explain.

Suppose you're thinking about submitting an article to a ham magazine on a pet circuit, an adventure you've had during Field Day, a report on a club project, or whatever. When the manuscript arrives at the editorial office, the editors pay particular attention to *details* — details such as these:

1. Are all pages numbered?
2. Are all figures (*i.e.*, photos and schematics) numbered, and do they have captions?
3. Are all figures mentioned by figure number in the text?
4. Is the author's name on each page of manuscript?
5. Are all dimensions (length, diameter, wire sizes, screw sizes, distances) in metric terms followed by English terms in parentheses?

Such details may seem irrelevant to you, but if your submitted manuscript contains such essential information you can be assured that its chances of being accepted are much better than if these important details are neglected. Manuscripts lacking these details require more work by the editorial staff.

If you're planning to submit an article to a particular ham magazine, look at the articles that have already been published. Note their organization, the headings used, the method of identifying artwork.

Originality in writing your article is most important. The subject matter doesn't necessarily have to be novel, but your approach to it must be original. And above all, the article must be *accurate*. Don't guess at component values, for example. If you make an error in a parts list or schematic, the fellow trying to duplicate your circuit might very well ruin some expensive components.

Let's examine an example of originality in a ham-magazine article. Antennas are a favorite subject. Almost every issue of every ham magazine has at least one article on them. If you take a look at page 54 of the June, 1978 issue of *Ham Radio Horizons*, for example, you'll see an article by G3LLL entitled "Inverted-V 2-Element Delta-Loop Antennas."

Well, there's certainly nothing new about inverted-V or delta-loop antennas. They've been around for years. But notice how author G3LLL exploited the characteristics of these two antenna designs into an *original* article that explains how to build a beam antenna for next to nothing. The article is only two pages long, but all essential information is included. Notice the short, direct sentences; the short paragraphs; the attention to detail in the illustration. Nothing is left to guesswork for the builder. If you can read English and follow simple directions, you can build this inverted-V delta-loop antenna.

Author G3LLL capitalized on an idea by injecting some originality into an old subject. He probably spent a lot of time preparing the article in outline form before he started to put it together. And that's what pays off!

Organization of your material is also important — first things first. Let's talk about that.

Article organization

How to put the pieces together is perhaps one of the worst stumbling blocks for a beginning writer. If you're seriously interested in writing for publication, you can get a lot of ideas by just examining printed articles. The article must have a definite beginning, a middle, and an end. The beginning must spark the reader's interest and make him want to read further: why did you write the article in the first place? Why should the reader read further? Did you have a problem that you solved? How will your solution benefit the reader?

The middle of the article defines the solution to the problem: how to build it; where to find the parts; precautions; tips based on your experience with the project; and illustrations (with appropriate captions).

The end of the article sums up your concluding thoughts. It includes your observations on further work, perhaps, or recommendations for further reading. The concluding part of a construction article (as in this antenna example) needs only a few sentences — a summary of the results obtained by the author with the antenna. Use your own judgment and tailor the end of your article to the subject matter. Many readers look first at the conclusion of an article before deciding to read further.

How long?

Generally speaking, an article should be long enough to tell the story in full, but not so long that the reader gets lost or bored. Excess material will be spotted and cut by the editor, of course, and taken into account when acceptance and payment are considered; more words don't automatically mean more money.

If you would like to estimate how long your article will be, pick an article from the magazine you hope will publish yours, and type a page from it on your own typewriter. Use the recommended double spacing, and leave 4-cm (1-1/2-inch) margins all around. This will tell you approximately how many sheets of typewritten copy will make up a printed page for that particular magazine.

Artwork

Illustrations and photographs enliven an article and help the reader become interested in it. They should also help tell the story. You do not need to be a draftsman to draw the accompanying diagrams — just be sure they are clear and correct. Most publishers have prople who will redraw diagrams and illustrations to meet the standards of their magazine, so don't worry about submitting a finished product.

Photographs should be *clear* and *large*. All photographic material will lose quality as it goes through the reproduction process, so you must start with the highest quality in the first place. If your photographs are fuzzy, dull, and of poor contrast, they will be worse when they come off the printing press. If you have negatives, send them along with your prints. Sometimes a poor but essential photo can be salvaged by good work by the photo processor. Most color slides and Polaroid prints are useless for article illustration purposes.

In your photo, try to show what is essential. A shot of a chassis taken from 5 meters (15

feet) away is useless if you are trying to show how a wire is connected to a tube-socket pin.

The editor's viewpoint

Magazine editors are human, believe it or not, and they have problems. If you can reduce the editor's workload by submitting a well-organized and well-thought-out article, your chances of acceptance will be greatly enhanced. Take time to go over your piece objectively. Let it rest for a few days after you've prepared it, then scrutinize it from the standpoint of the editor. Remember, the editor can be relentless. He's looking for trite phrases, clichés, unnecessary words. Above all, he's looking for completeness in your handling of the technical material. The magazine editor is the guy who has to take the lumps from irate readers who find errors!

Ideas, ideas, ideas

You don't have to write an article to break into publication in the ham magazines. Perhaps you like to draw and are a pretty good cartoonist. Many ham magazines publish cartoons as fillers at the bottom of a page. Surely you've had an idea for a cartoon. Even if you can't draw, perhaps you have a friend who can put your idea into a *good* drawing. Here's one for openers:

Scene: An elaborate ham station. Loads of equipment from floor to ceiling. A DX pileup is in progress, and the OM is shouting into the mike.

Cartoon caption: "Hey, Joe , this is Bill. I'm running low power. Tell him to listen for me!"

Corny? You bet! But if the cartoon is handled well, it'll sell!

Another source of income is writing small articles for departments of special interest, such as *Benchmarks* in *Ham Radio Horizons*. These pieces are short, to the point, and contain information capsulated into a few paragraphs. Often they don't have illustrations but provide informative reading on a "better way to do it." The opportunities are endless.

Checklist

Before you take the plunge and mail your article to your favorite ham magazine, look again at the following list of essential requirements:

1. Name and callsign on each page
2. All pages numbered
3. All illustrations have captions
4. All illustrations with figure numbers are mentioned in text
5. All dimensions are given in metric terms followed by English terms in parentheses (saves a lot of editorial work)
6. Self-addressed stamped envelope for return of unacceptable material
7. Cover letter to the editor

(This is the "concluding" section of the article.)

Presented here are some ideas for those who would like to see their ideas in print in Amateur-Radio magazines. Magazines have different standards, but all require the essentials of presentation I've outlined. Originality is the keyword. Attention to detail is essential. Completeness and accuracy sum it all up. See you in print. **HRH**

Cue Card for two-meter FM

Have you ever been frustrated by seeing a two-meter antenna and call-letter plate on the car in front of you and realizing that it would be difficult if not impossible to alert the driver and to talk to him on the air? A simple cardboard frequency-cue-card can solve the problem. The card I use is about 15 x 45 cm (6 x 18 in.) and has 146.520 on one side and the mirror image of 146.520 on the opposite side. The lettering was done with a dark colored felt marking pen. If the car you want to talk to is ahead of you, the mirror image is held up facing your windshield. The driver ahead reads 146.520 in his mirror and should promptly respond on that frequency. Holding the card so it is visible through the rear window with the direct lettering exposed will let a following driver know what frequency you are on. It works!

George A. Wilson, Jr., W1OLP

The "mirror image" card is displayed through the windshield to let a driver in front of you know that you want him to go to the 146.520 direct frequency.

W1QON displays the "direct" side of the frequency cue card. This side is used to let following drivers know what frequency you want them to go to. Simply hold the card over your shoulder and listen or call on 146.520!

Dust Covers

make great, inexpensive stocking stuffers.

Here's a Holiday gift every Ham can use that costs less than $5. Our custom made covers protect equipment value and make Ham stations look great. We have covers for all currently available equipment and accessories, as well as hundreds of items no longer manufactured.

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Warren Electronic Service
Forrest City, AK 72334
501-633-8887

CALIFORNIA
CDS Elect. & Hobbies, Unltd.
Buena Park, CA 90620
714-994-6843

Electronic City, Inc.
Burbank, CA 91505
203-842-5275

Ham Radio Outlet
Burlingame, CA 94010
415-342-5757

Ham Radio Outlet
Anaheim, CA 92801
714-761-3033

Ham Radio Outlet
Van Nuys, CA 91401
213-988-2212

Ham Radio Outlet
San Diego, CA 92123
714-560-4900

Quement Electronics
San Jose, CA 95128
405-998-5900

Shaver Radio
Santa Clara, CA 95051
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Sacramento, CA 95818
916-441-7388

Tower Electronics Corp.
Mission Viejo, CA 92675
714-768-8900

Webster Radio, Inc.
Fresno, CA 93726
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CONNECTICUT
Hatry Electronics
Hartford, CT 06114
203-527-1881

Thomas Communications
Newington, CT 06111
203-667-0811

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Amateur & Advanced Communications
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302-478-2757

FLORIDA
Amateur Electronic Supply, Inc.
Orlando, FL 32803
305-894-3238

Amateur Wholesale Electronics
Miami, FL 33176
305-233-3631

Grice Radio & Electronics
Pensacola, FL 35202
904-434-2481

International Fox Tango Club
248 Lake Dora Drive
W. Palm Beach, FL 33411
(for Yaesu Products Only)

Ray's Amateur Radio
Clearwater, FL 33516
813-535-1416

GEORGIA
ACK Radio Supply Co.
Atlanta, GA 30309
404-351-6340

Britts 2-Way Radio
Smyrna, GA 30080
404-432-8006
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College Park, GA 30349
404-996-4900

IDAHO
Ross Distributing Co.
Preston, ID 83263
208-852-0830

ILLINOIS
Aureus Electronics, Inc.
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Spectronics, Inc.
Oak Park, IL 60304
312-848-6778

INDIANA
Hoosier Electronics, Inc.
Terra Haute, IN 47802
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Kryder Electronics
Fort Wayne, IN 46815
219-484-4964

Van Sickle Radio Supply Co.
Indianapolis, IN 46205
317-547-3589

IOWA
Bob Smith Electronics
Ft. Dodge, IA 50501
515-576-3886

HI Inc
Council Bluffs, IA 51501
712-323-0142

KENTUCKY
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301-946-1088

Comm Center, Inc.
Laurel, MD 20810
301-792-0600

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Tel Com, Inc.
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617-486-3040

Tufts Radio Electronics
Medford, MA 02155
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Northboro, MA 01532
617-393-2411

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Minneapolis, MN 55412
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Atkinson & Smith, Inc.
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Radios Unlimited
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201-469-4599

Radiomasters
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201-568-0738

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Adirondack Radio Supply, Inc.
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518-842-8350

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315-732-3656

Barry Electronics
New York, NY 10012
212-925-7000

Harrison Radio Corp.
Farmingdale, NY 11735
516-293-7990
also —
- New York City
- Valley Stream
- Carle Place
- Oceanside

Radio World
Oneida County Airport
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Slep Electronics
Otto, NC 28763
704-524-7519

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Amateur Electronic Supply
Wickliffe, OH 44092
216-585-7388

Universal Amateur Radio, Inc.
Reynoldsburg, OH 43068
614-221-2335

OREGON
Oregon Ham Sales
Albany, OR 97321
503-926-4591

Portland Radio Supply
Portland, OR 97205
503-228-8647

Portland Radio Supply
Medford, OR 97501
503-773-5815

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Souderton, PA 18964
215-723-1200

"Ham" Buerger, Inc.
Willow Grove, PA 19090
215-659-5900

Hamtronics, Inc.
Trevose, PA 19047
215-357-1400

S. CAROLINA
General International Services (Metro Outlet), Inc. (G.I.S.M.O.)
Rock Hill, SC 29730
803-366-7157

TENNESSEE
Germantown Amateur Supply
Memphis, TN 38112
1-800-238-6168 in Tenn.
901-452-4276

Sere-Rose & Spencer Electronics
Memphis, TN 38108
901-683-9125

TEXAS
AGL Electronics
Dallas, TX 75234
214-241-6414

Electronic Center, Inc.
Dallas, TX 75204
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Seattle, WA 98108
206-767-3222

ABC Communications
Seattle, WA 98155
206-364-8300

B & W Electronics
Seattle, WA 98188
206-242-2065

WISCONSIN
Amateur Electronic Supply
Milwaukee, WI 53216
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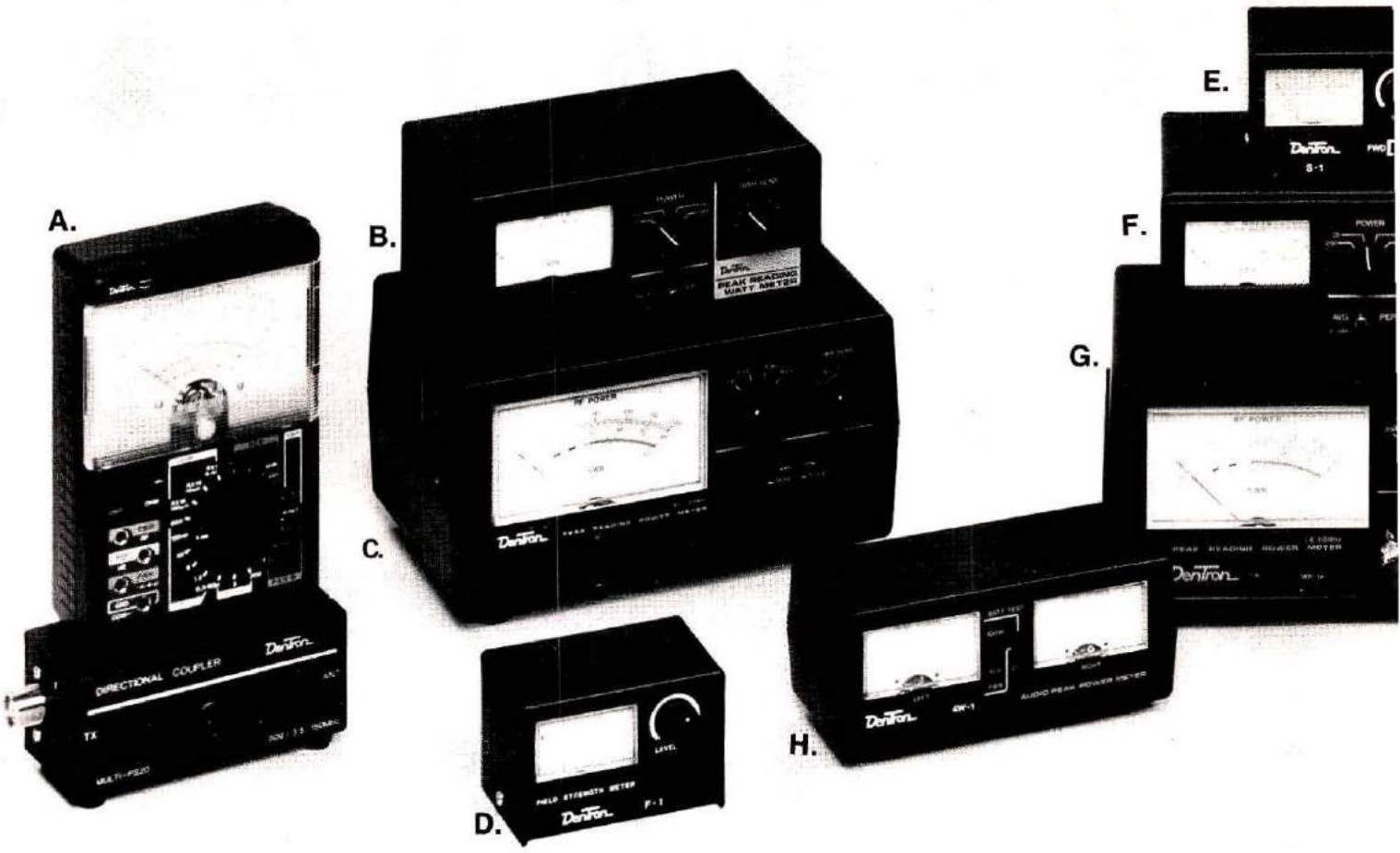


Are You a Watt Watcher?

If so, take a good look at the NEW DenTron wattmeters.

A./Multi-PS-20: Complete 20 K per volt VOM that doubles as an RF wattmeter, 20/200/2000 watt ranges with directional coupler (included), also handles SWR duties. Large 4" scale. **Suggested Retail - $69.50**

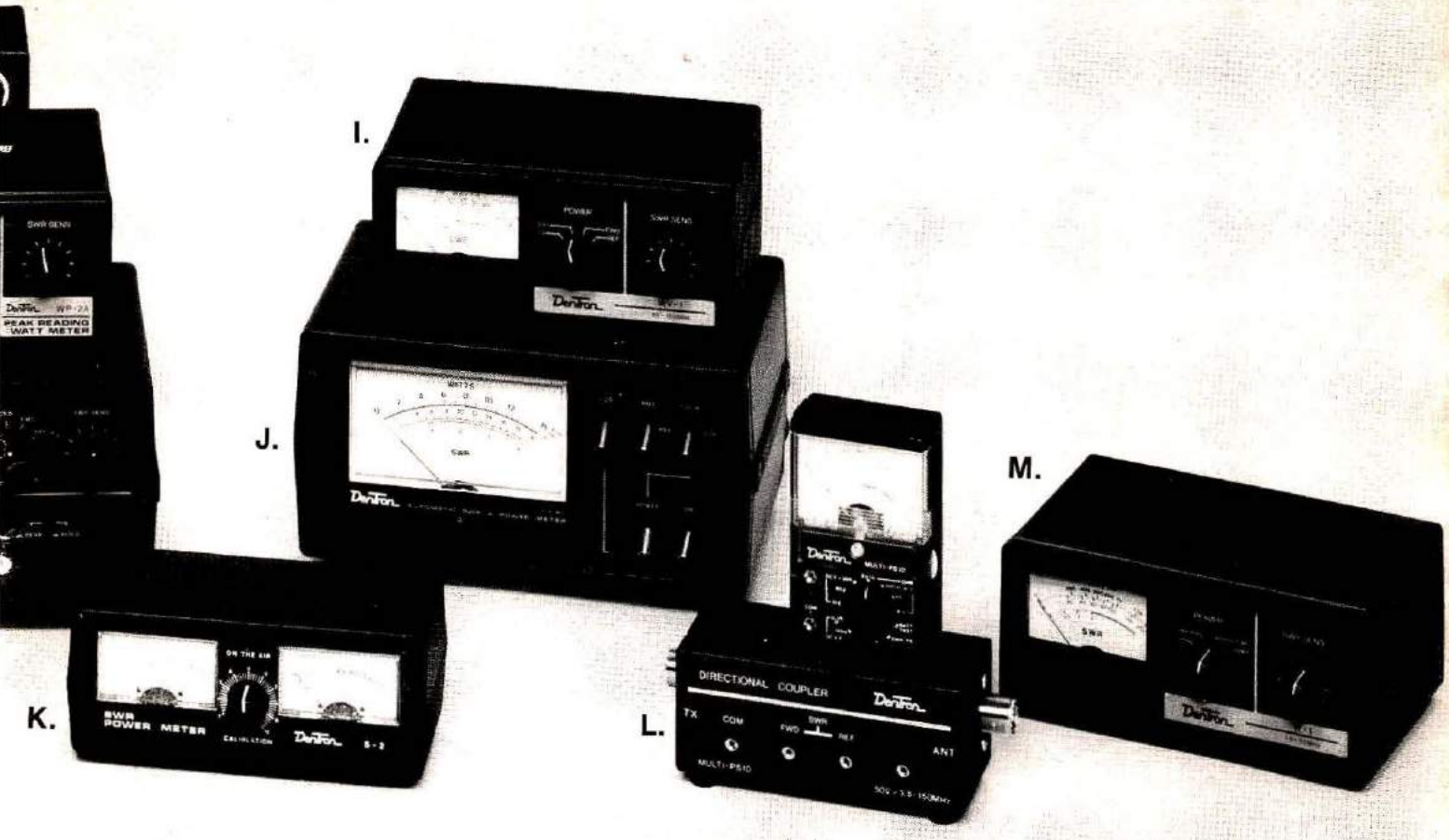
B./WVP-2A: Large 2½" meter measures 20/200 watt ranges from 50 to 160 MHz (6 and 2 meters), with peak reading feature and SWR bridge built-in. **Suggested Retail - $99.50**

C./WVP-1A: The top of the DenTron VHF wattmeter line! 6 - 2 meters (50 - 160 MHz), with peak reading and hold function, 20/200 watt ranges. Giant 3½" meter with easy to read calibrations. **Suggested Retail - $149.50**

D./F-1: Super compact field strength meter, complete with antenna and superior sensitivity 1.8 - 150 MHz (160 - 2 meters). **Suggested Retail - $19.50**

E./S-1: The SWR bridge! 1.8 - 150 MHz coverage, super compact for mobile or portable use. **Suggested Retail - $19.50**

F./WP-2A: Full function SWR/peak reading wattmeter, 160 - 6 meters (1.8 - 60 MHz) coverage, 2½" scale, 200/2000 watt ranges. **Suggested Retail - $99.50**



G./WP-1A: Giant 3½" meter calibrated for 20/200/2000 watts, covers 160 - 6 meters (1.8-60 MHz), with peak reading feature and hold function (locks on highest voice peak), and SWR bridge. **Suggested Retail - $149.50**

H./AW-1: An audio peak reading meter for your stereo gear! Measures both right and left channel stereo (separate metering) at the 10 and 100 watt levels. Operates mobile on 12V, complete with Velcro™ mounting strips. Also ideal for home use. Meters are illuminated. Also accepts 12V battery for portable use. **Suggested Retail - $79.50**

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J./WP-3: The top of the DenTron HF meter line! 160 - 6 meters (1.8 - 60 HMz), with peak reading and hold function, 20/200/2000 watt ranges. It automatically calibrates forward against reflected power for consistent SWR measurements without need for manual calibration! **Suggested Retail - $199.50**

K./S-2: Unique product! A full range SWR bridge/relative power meter, with 12V DC illuminated meters, 1¾" scales, even an on-air indicator that's keyed by your RF power! 160 - 2 meter coverage (1.8 - 160 MHz). **Suggested Retail - $39.50**

L./Multi-PS-10: A complete 10 K per volt VOM that doubles as an RF wattmeter! A directional coupler is included for 20/200 watt power measurements plus SWR functions. Easy to read 2½" scale. **Suggested Retail - $49.50**

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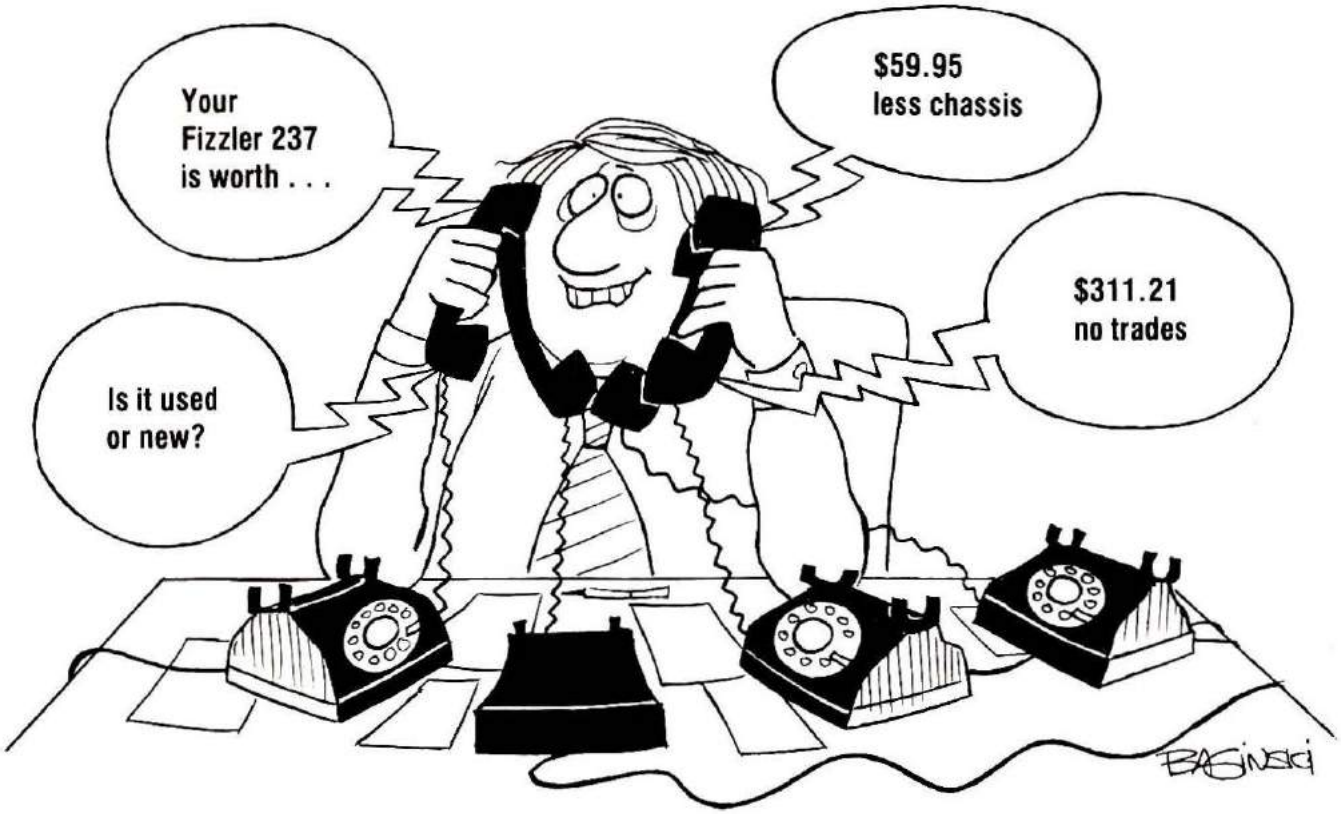


Save When You Buy!

BY EARL SAVAGE, K4SDS

Do you know *anyone* who pays sticker price for a car? (Well, I must admit that I know a couple of nuts who do!) Do you usually buy at less than "suggested" prices in discount stores, at clearance sales, and so on? Most of us do all we can to stretch our dollars as far as they will go. Yet, it seems that most hams still buy their gear at nationally advertised prices.

We hams always dicker over the price of used gear but, for some reason, do not extend this same practice to new equipment. We seem to think if a "Super-Blooper 748" is advertised at $799.95, that is the price we have to pay. Sometimes it may be, but more often it can be had for less. You *can* buy and save at the same time if you know how.

In some 20 years of hamming, I have paid less than list price, with but one exception, for all major pieces of gear. This was possible because I have been following an established and respected business practice that you, too, can use. All you have to do is to send out bid invitations and wait for the results to come in.

It has been some time since I purchased the last piece of major gear but a recent experience proves that bidding and the free enterprise system can still save bucks. Here is how my latest effort turned out:

Bid invitations mailed	24
Bids returned	22
High bid price	100%
Average bid price	85.6%
Low bid price	77.5%

(Savings to me 22.5%)

Now, that's no small amount, nearly one-fourth on an item that costs several hundred dollars. Here is what it cost me to save that much:

24 bid-form copies	$ .72
24 envelopes	.11
24 stamps	3.12 (3.60 today!)
	$3.95 (4.43)

Plus two weeks for the returns to come in.

How to put out bids

Sending out bid invitations is really a simple process; you can get bids on one item or twenty at the same time — just list them on the form.

Invitations to bid on small items do not get much response unless the quantity is large. Since hams usually get only one or two of an item at a time, it is not worth the dealer's effort to submit a bid (nor is it really worth yours) on small, low-cost items.

As a general rule of thumb, I

would suggest that unless an item has a list price of $100 or more, don't ask for bids. Of course, if you are sending out bid sheets for a large piece of gear, it is perfectly acceptable to list smaller related items, too. For example, you could list earphones, antenna relay, coax cable, and other accessories with a receiver.

A suggested bid form is shown in **Fig. 1**. You can use one like it or change it to meet your particular circumstances. Notice that this form *includes* shipping charges in the bid price, so that it is easy for you to compare costs whether the bidder is across town or across country.

This form is set up to get one bid price for the package of items. It works well if you feel reasonably sure that most dealers will be able to supply both (or all) items. If this is not the case, the form should be modified as in **Fig. 2** to allow bids on each individual item or subgroup of items.

Where do you send bid invitations? Just go through this (and other) magazines and note the names and addresses of advertisers who sell the kind of equipment you want to buy. If you are not sure that a dealer handles the brand(s) you seek, send him one anyway — it will only cost you a few cents.

Attempt to get a good cross-section of dealers — large and small; big city and boondocks; Eastern, Western, and Midwest. I suggest that you send at least a dozen invitations; more than 25 or 30 is superfluous.

Trade-in items

This buying procedure will work whether or not you want to trade in your old equipment. Notice that the sample bid form asks for both cash price and trade-in price. It could specify either one without the other.

My experience has shown that you are financially better off to take a low cash price and then sell the old gear yourself at a fair price or even a little less. It just depends upon your circumstances.

Pros and cons

As with everything, there are advantages and disadvantages to purchasing by bid. A list of them will answer some of your questions and may even surprise you.

The obvious advantage is that you can save a bunch of cash. Depending upon the items you are purchasing and where you send for bids, your saving may be more or less than my recent 22.5%. You will never know until you try.

Fig. 1. Sample bid form for a package deal.

K4SDS
Earl R. Savage
2503 Westerly Avenue
Charlottesville, Virginia 22903

December 15, 1978

TO:

I am planning to purchase the following package:

Super-Blooper 748 Transceiver

Super-Blooper 749 Tuner

Please respond to the packages listed below, which you offer under these conditions:

1. You will honor your prices for up to 30 days.
2. Your prices include pre-paid shipping via UPS.
3. My Fizzler 237 is in very good condition (both operation and appearance) and is unmodified.

73,

(Signature)

- -

☐ With trade-in of Fizzler 237
$_____ for a new 748/749 package

☐ With trade-in of Fizzler 237
$_____ for a used 748/749 package

☐ No trade-in
$_____ for a new 748/749 package

☐ No trade-in
$_____ for a used 748/749 package

_____ _____
Date Signature of Company Official

Fig. 2. Sample bid form for individual items.

K4SDS
Earl R. Savage
Charlottesville, Virginia 22903

December 15, 1978

TO:

I am planning to purchase the items listed below. Please indicate your bid on the items individually and/or in groups of your selection. Your bid signifies agreement to the following conditions:

1. Your prices include shipping via UPS.
2. You will honor your prices for up to 30 days.
3. Purchaser reserves the right to order items individually and/or by group at the prices shown.

73,

(Signature)

- -

Quantity	Unit		Your Quote per unit	total
1	each	Super-Blooper 749 Tuner	_____	_____
125	feet	RG-11/U Coaxial Cable	_____	_____
4	each	PL-259 Coax Connectors	_____	_____
1	each	Speedy 15 Electronic Keyer	_____	_____
1	each	Jackson 5 Paddle	_____	_____
1	each	Green 352 SS Digital Multimeter	_____	_____

_____ _____
Date Signature of Company Official

Now, let's take a look at the real and supposed disadvantages, one at a time. First, of course, is that matter of a two- or three-week wait for the responses. If you must have the equipment *now*, forget about bidding. This is not for spur-of-the-moment buying or for the impatient ham.

Then there is the question of service, and a general feeling that you can't have low prices and service, too. The answer to this one is: Yes and No. Certainly, you have every right to expect *supreme* service from the guy who makes an *extra* $100 (more or less) on your purchase. On the other hand, how much service do you expect to need on a piece of fresh, factory-sealed gear? If your rig should need service during the manufacturer's warranty period, it will probably end up going back there anyway. You can ship it just as well as the dealer. After the warranty expires, you are going to have to pay for service, either at the place you bought it or elsewhere. To me, this disadvantage does not seem very important on new equipment.

There are those who say they prefer to buy locally: "Old Jake surely has been helpful to me." Fine, give old Jake a bid form, too, and let him take his chances with the competition. (Advice is cheap; when was the last time he gave you a $100 item off the shelf?) An alternative is to get your bids and then ask Jake how close he can come to the low bid — he should be at an advantage since he won't have to pay any shipping. But, of course, you could just pay old Jake his asking price and, thus, bear the cost of mixing business with pleasure.

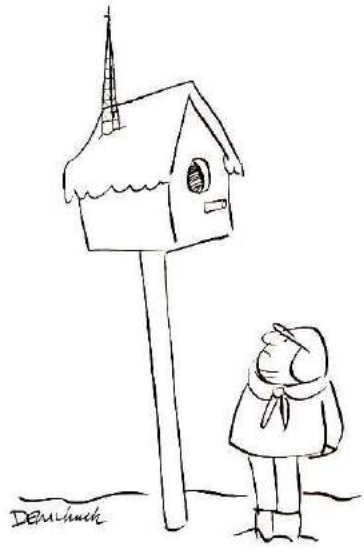
Some hams may feel that they won't know what they are getting. Well, friend, if you don't know, you had better not buy at all until you do know. Check the advertisements, study the specifications, read the laboratory and user reviews and evaluations, check with other hams, perhaps even operate one at a friend's shack. You should feel free to visit old Jake's store to look it over since he will have an opportunity to sell you one. Then, check your money sock and make your decision *before* you buy anything by any method.

That just about takes care of the major "disadvantages" of asking for bids on ham gear. Personally, I have not had any problems while using this method over the years.

Summary

In most cases, using a bidding procedure can save you money on purchases of new ham equipment. Of course, it won't do much for you if the item is available from only one supplier. It will work on the purchase of used gear but the risks are greater; keep in mind that most dealers will not take trade-ins on used items.

The way I figure it, this bidding adds up to one of two things. Either I can buy what I want for about 20 per cent less than the advertised price or I can get, in effect, a second item worth about one fourth as much for "free." The old free enterprise system works if you give it a chance! **HRH**



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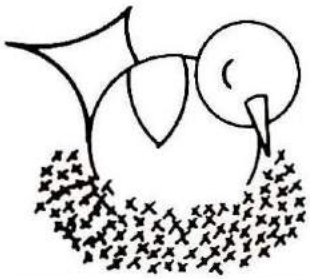
ELECTRONICS SUPPLY, INC.

1508-C McKINNEY HOUSTON, TEXAS 77002
713/658-0268 Nites 713/497-5683

BIRD LOVERS



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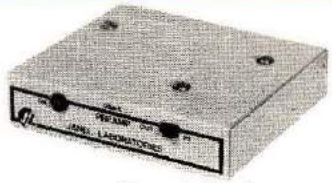

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		100	1.8	5.9
		200	2.6	8.5
		300	3.3	10.8
		400	3.8	12.5
 8/U JAN-C-17A	8237 21¢/ft	100	2.0	6.6
		200	3.0	9.8
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		900	7.8	25.6
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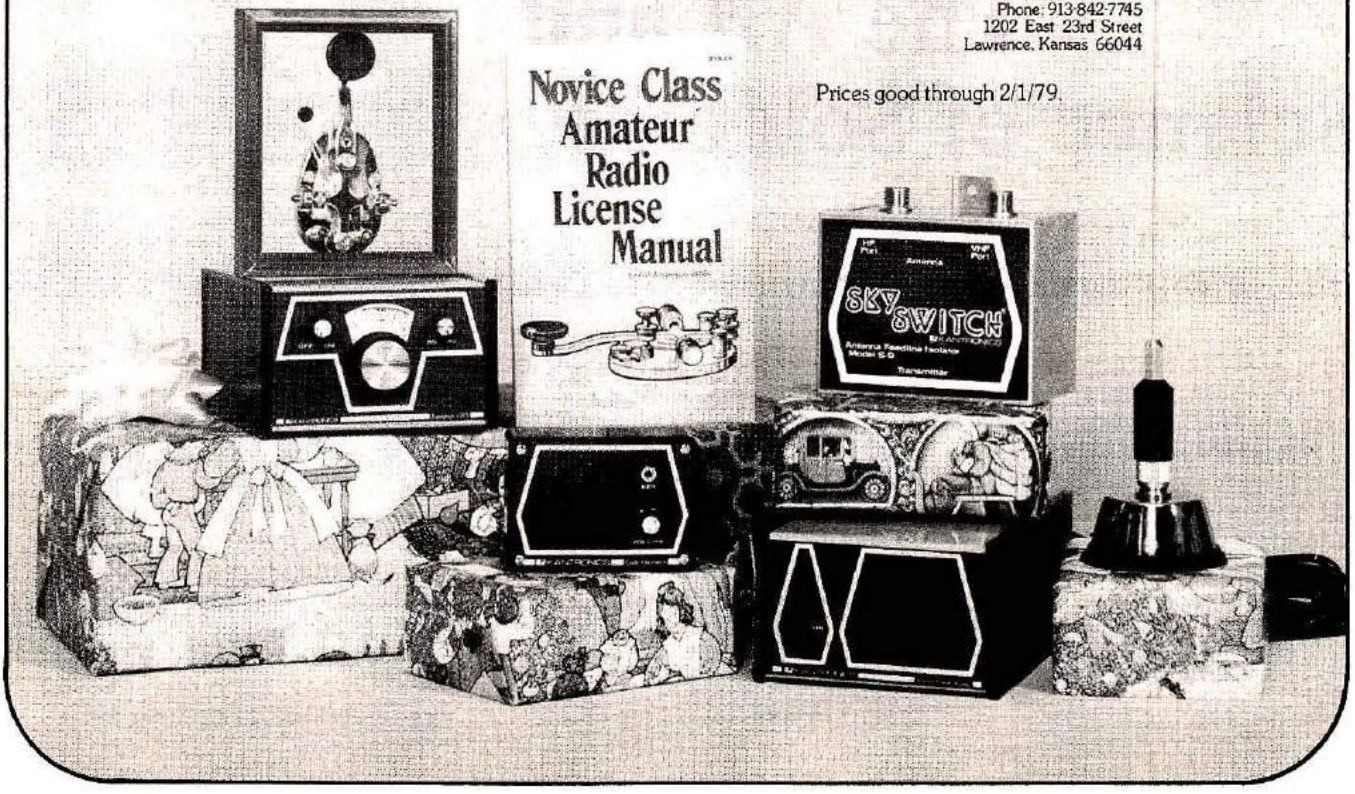
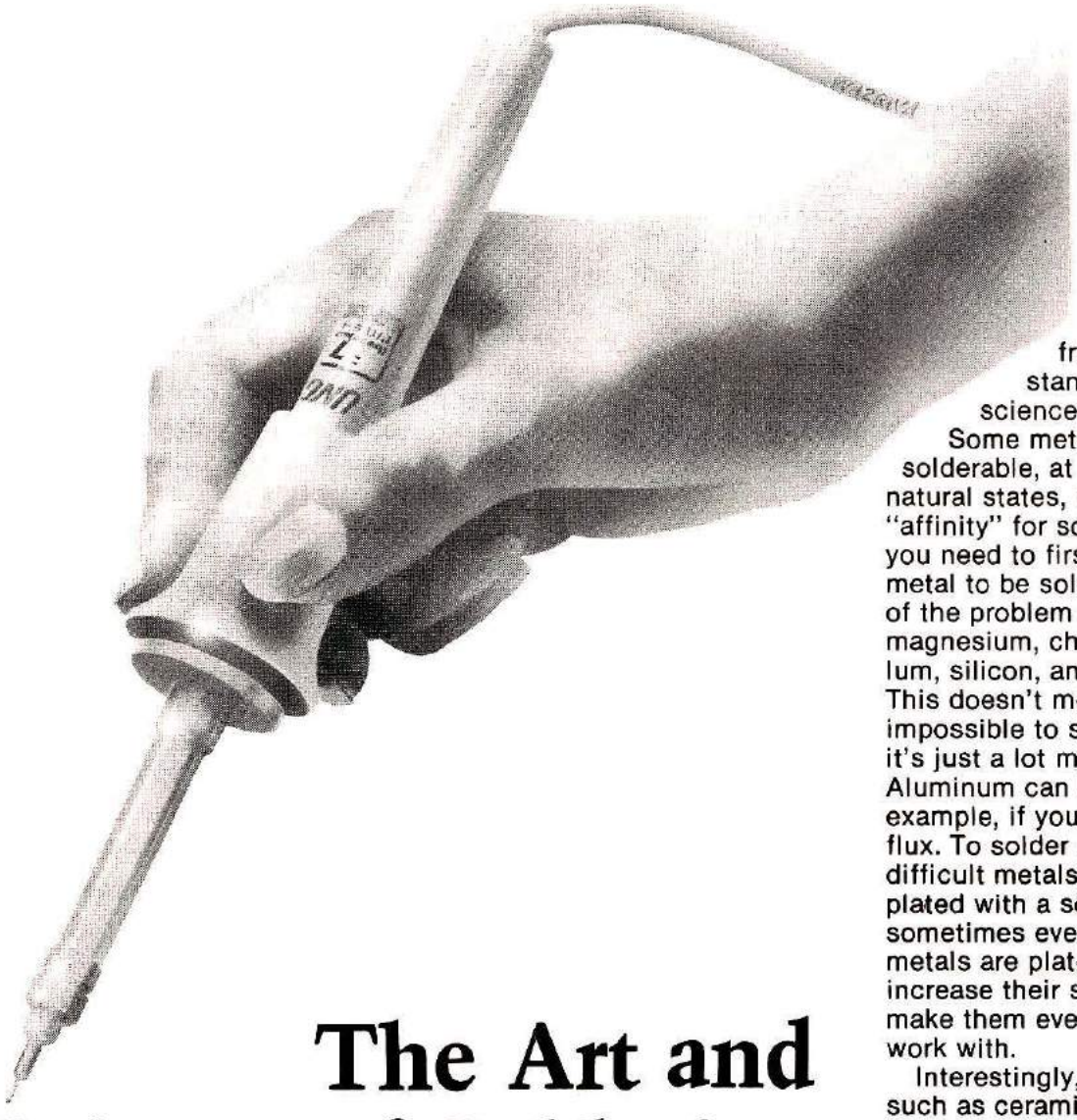




The Art and Science of Soldering

BY KARL T. THURBER, JR., W8FX/4

Learn to do it right, and save many later headaches

There really is nothing all that difficult about soldering. Still, most kits that are returned to the manufacturer, and a good number of homebrew projects that go awry, suffer from no more than poor soldering. Although "cold" connections cause most soldering problems, short circuits, flux corrosion, heat damage to components, and the like also cause grief to the builder.

Soldering is a quick, simple, and inexpensive method of joining metals together. In fact, solder is one of mankind's oldest and most widely used alloys, being used by the ancient Romans and medieval architects. Unfortunately, it is frequently misunderstood and even more frequently misused. So, before discussing how to solder properly and what equipment to use, let's first take a look at solder from a *technical* standpoint — the science of soldering.

Some metals are just not solderable, at least in their natural states, not having an "affinity" for solder. Therefore, you need to first consider the metal to be soldered — some of the problem ones being magnesium, chromium, tantalum, silicon, and aluminum. This doesn't mean that it's impossible to solder to them; it's just a lot more difficult. Aluminum can be soldered, for example, if you use a special flux. To solder most of the difficult metals, they must be plated with a solderable metal; sometimes even solderable metals are plated in order to increase their shelf-life and make them even easier to work with.

Interestingly, non-metals such as ceramics and glass can be made solderable by a process called "firing," in which powdered silver, or other metal, is mixed with a borate, heated, and applied to the non-metallic surface, resulting in its becoming coated with the solderable metal.

What is solder?

Solder is simply a tin-lead *fusible alloy* that flows at a fairly low temperature, around 370°F (187°C). The low melting temperature allows connections to be made easily with home-workshop tools — soldering irons, guns, and pencils. Sometimes, small amounts of other metals such as antimony, bismuth, or silver are added to the tin-lead alloy

to enhance the solder's characteristics or to make it suitable for some special purpose. Because of its relatively low melting point, solder is used to form a metallic union or "joint" of two metals at a temperature well below their own melting points. To do the job right, the metals must be clean and free of *all* non-metallic matter, such as grease, or oxides which form on the surfaces of most metals. These impurities form an *insulating barrier* that prevents good metal-to-metal contact; excess oxides or other "junk" on the surfaces will make good soldering very difficult, if not impossible.

Solder is usually identified by its tin-to-lead composition. If you look at a package or roll of solder, you will probably find listed either the figures 40/60, 50/50, 60/40, or 63/37. These numbers are the percentages of tin and lead, the tin percentage always being given *first*. As you will see later on, solder with a higher tin content melts at a lower temperature, which is usually desirable. Solder with more tin also costs more, because tin is an expensive metal.

Let's examine more closely just what happens when you use that soldering iron or gun. Since solder adheres by depending on a solvent or metallurgical action, the whole process breaks down if the solder itself is of poor quality, or of the wrong composition. When tin is added to lead, the melting point of the *lead* decreases along a known *composition-temperature line*. Likewise, when lead is added to tin, the melting point of the *tin* is lowered along another such composition-temperature line. The intersection of these two lines is known in the trade as the *eutectic point* and is shown graphically in **Fig. 1**. The so-called "eutectic alloy", made up of 63% tin and 37% lead, has a melting, or eutectic, temperature of 361°F (182°C). This composition is the standard for electronic purposes (being approximated by 60/40 solder), and has a very sharp, pronounced, melting point. Other solder compositions will have a flexible or *plastic* range running from the 361-degree eutectic temperature up to the melting points of either pure lead (620°F, 326°C), or pure tin (450°F, 232°C).

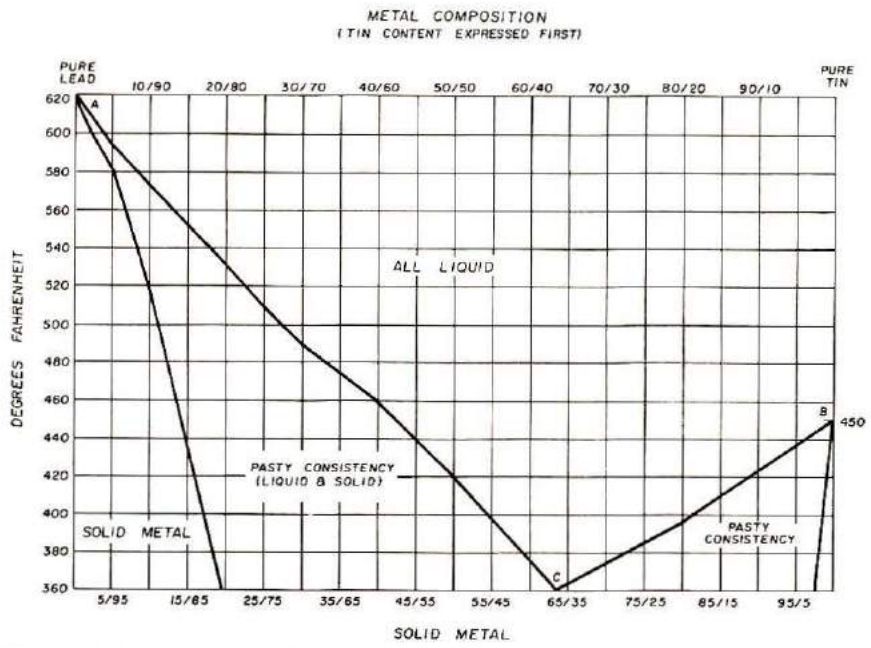


Fig. 1. As the percentage of tin and lead changes, the melting point varies along a smooth line. The lowest melting-point temperature is for a mixture of 63 per cent tin, 37 per cent lead (*information from the booklet* Solders and Soldering, *prepared by the Solder Manufacturers Committee of the Lead Industries Association*).

Rosin core solder of 60/40 composition is the most free flowing variety. The smaller diameters are particularly good for PC board work. High-quality solder is essential for good solder connections and trouble-free electronic circuits.

Another point that we haven't discussed is strength: a nice-looking solder connection does nothing for you if it won't take at least a little stress and strain. Since tin is a more active metallic "solvent" than lead, the quality of the joint is very closely related to its tin content. Taking a look at **Fig. 2**, you can see that solder with less than about 30 per cent tin content is inferior in its ability to take stress. The alloy "quality curve" reaches its peak with about 60 per cent tin alloy, which happens to closely correspond to the composition of the eutectic alloy we just described. Solders with a 63/37 or 60/40 composition are the most free-flowing kinds and are particularly good for working on delicate printed circuits.

Solder is most convenient to use in thin 16- or 18-gauge wire form; thicker solders are difficult to control in terms of quantity and usually don't flow quickly enough. Be sure to buy only the best solder, and if it causes any problems, discard it and try another brand!

How about fluxes?

Three things are necessary for good soldering: good

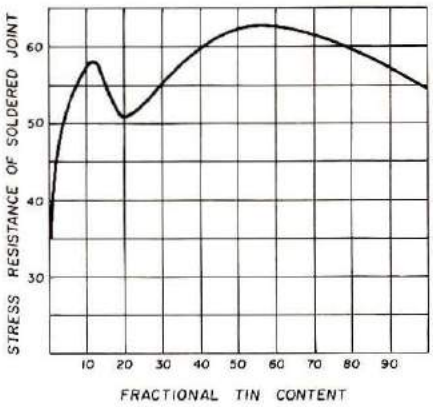


Fig. 2. The stress resistance of a soldered connection is related to the percentage of tin in the alloy, and the point of best resistance is not far from the 63/37 eutectic point shown in **Fig. 1** (*from "Solder and Soldering," by Clifford L. Barber, Research Director, Kester Solder Company, in* Popular Electronics, *March, 1973, reprinted by permission*).

solder, enough heat, and the right flux. The solvent action that takes place between metals when you solder them can't properly take place if the metals are insulated from one another by a nonmetallic barrier or film, such as that formed by an oxide. The soldering *flux* removes the oxide film (which is usually invisible to the eye) during soldering, to allow good metal-to-metal contact and the metallurgical process to take place. The action of the flux is sometimes known as *wetting* the metal; after soldering is complete, the oxides lie inert on the surface of the solder joint.

There are literally hundreds of soldering fluxes on the market. But, you will likely see three basic types: acid or chloride, organic, and resin or rosin. Rosin flux is the only kind that's usable in electronic construction and repair work. Acid and chloride-salt fluxes are very highly corrosive (since they attract moisture) and have no place in electronics! A non-corrosive, non-conductive, rosin-type flux is excellent for general-purpose electronic soldering. A special aluminum-oxide-reducing flux is also available for soldering to aluminum. Using the acid or salt type fluxes is almost sure to lead to later problems with circuitry — remember this fact, if nothing else, from this article!

For solder to properly adhere to a connection, the metal surfaces have to be free of oxides, clean, and well heated. The most effective way of reducing oxidation is the use of an oxide-reducing rosin flux, though it won't remove grease, dirt, paint, oil, dust, or other foreign matter (you do this yourself with a brush or cloth).

Solder and soldering fluxes are so closely related that the two have been combined and manufactured in a balanced combination for general purposes. The solder is fabricated so that it contains one or more *cores* of rosin flux. Since the flux-core types of solder combine both the solder and flux, two materials whose characteristics are physically and chemically very different, the solder should be used in such a manner that both are applied at the same point where the action of both is needed. This is done by placing the tip of the soldering iron *directly* against the connection to be soldered, and *simultaneously* applying the solder at the point of contact of the iron with the metal. This means that you don't let the solder run down the tip, or try to heat up the whole area first. (More on soldering techniques later.)

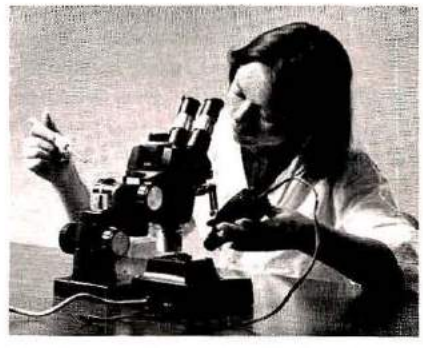
From the preceding discussion, it's pretty obvious that you don't want any acid-core solder in your toolbox; these types may have some good industrial or automotive uses, but are not what we want to use at all. Most kit manufacturers are adamant against the use of acid-core solder on their kits, often supplying just enough rosin-core solder to build the kit, hoping the kit-builder will take the hint and use the hank supplied. In fact, Heath Company's warranty clearly states that it will not cover any kit damage caused by *corrosive solder*; also, if you run into trouble with a kit wired with acid-core solder or paste flux, Heath *won't repair it*. Take heed!

Finally, watch out for solder you may find in discount stores, hardware outlets, and other places that cater to the general public. Read the label of the solder pack carefully (reject it if there is none!), to make sure that what you have isn't an acid-core type, or an excessively thick-diameter industrial version that's hard to work with, or is solder of the wrong composition (such as 40/60 type). You don't want this, either, since the melting point of 40/60 solder is many degrees higher than the 60/40 kind!

Some soldering problems

One of the biggest problems in getting good results in the soldering process is *insufficient heat*. The alloying action just won't proceed properly if there isn't adequate and uniform application of heat between the solder and the metal being soldered. Good solder joints won't happen unless the metal is hot enough to keep the solder liquid; otherwise, what results is the classic *cold solder joint*. The cure: use enough heat to do the job, *but no more*.

Another exasperating situation occurs when you try to solder a heavy piece of metal



A professional at work soldering delicate equipment. A binocular microscope is used to view the operation (*courtesy Ungar Division of Eldon Industries*).

with a cheap, under-rated soldering iron with insufficient heating capacity. The cure, obviously, is to use a big enough iron — but recognize that if you're trying to solder something really large, that it isn't really electronic work at all, but more like welding!

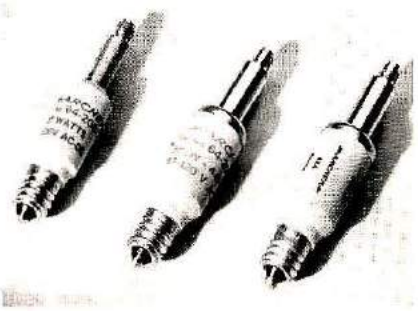
Cold-solder joints can cause enough frustrations to make the most stalwart individual curse and mutter under his breath when he tries to trouble-shoot the symptoms of this malady. These cold-solder problems tend to blend into regular electronic malfunctions, making them particularly difficult to spot. They can appear as either open, intermittent, high-resistance, or even apparently normal connections. They can trick you into suspecting other components, such as resistors, transistors, capacitors, and tubes. (A good magnifying glass and a sharp eye to check for ragged-looking, flaky, or loose connections helps).

The tools of the trade

If you are confused and perplexed by the catalog descriptions and advertisements for soldering gear (guns, irons, and accessories), you have good company. The state of the soldering art has progressed considerably over the years, along with the rest of the electronics field, and has spawned many new, and even exotic, tools and aids.

For most applications, the plain old soldering iron is still the most widely used and is quite effective, if one is chosen that is right for the job. On the other hand, too much of a good thing can cause problems, too, in soldering delicate printed-circuit boards; too much heat invites disaster in complicated electronic circuits. Obviously, the iron used and amount of heat applied must be suited to the specific application — 200- or 300-watt irons and guns shouldn't even be on your workbench if you plan on doing *electronic* soldering as opposed to general-purpose *electrical* soldering.

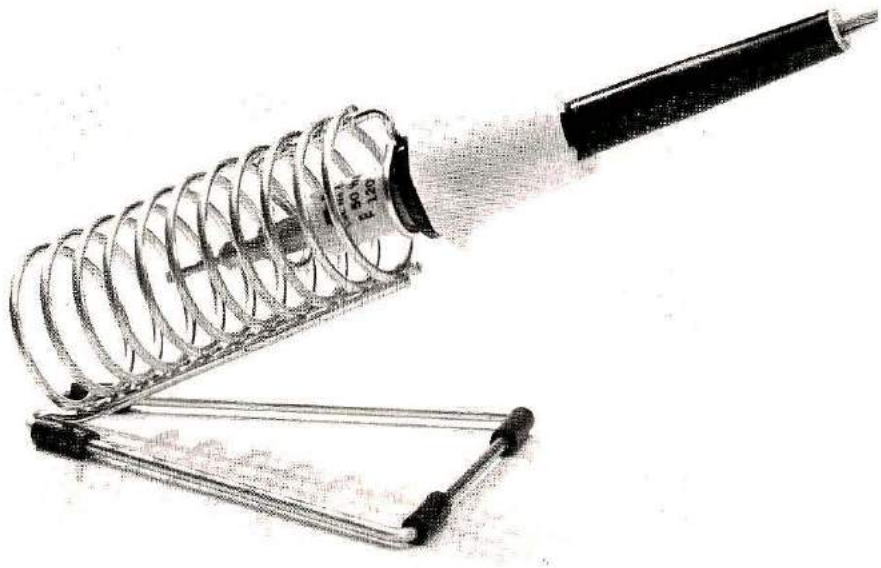
There are a large number of soldering tools on the market for both general and specialized applications, including large soldering irons, pencil irons, and guns. All of them are rated by their electrical power consumption. Due to their high efficiency, you can disregard



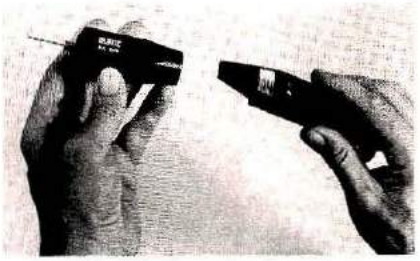
Many of the modern soldering irons have heating elements that you can remove from the handle. In addition to the easy replacement feature, it allows you to tailor the heat power to your need. Shown here are the 27, 37½, and 50 watt sizes (*courtesy Radio Shack Corporation*).

any losses and consider the wattage rating as "heat power," for practical purposes. This heat-power rating designates the tool as being for light duty (15 to 50 watts); medium duty (50 to 100 watts); or heavy duty (100 watts and over). However, the arbitrary ratings placed on the equipment by manufacturers can be tricky. For example, some very cheap "30-watt" irons have a tough time even getting solder to melt, while some "100-watt" guns will practically vaporize your connections. So you have to be aware of the ratings, but at the same time don't depend on them too much.

Both soldering irons and pencils are characteristically lightweight and compact, costing from about $2 for a "cheapie," up to $30 or more for precision, long-life units which sport special interchangeable elements, tips, and other attachments. Irons and pencils are designed for prolonged use with minimum tip deterioration, and therefore are especially good for kit-building and extensive project work. Both have a resistance element as the heat-generating device, which is (hopefully!) *electrically isolated* from the soldering tip, but *thermally coupled* to it. The tip is possibly the most important part of the unit, since the size of the tip greatly affects the



Radio Shack *Custom Design* soldering iron is shown here resting on a handy iron holder, which keep the iron conveniently located, but which prevents the hot tip from coming into contact with other materials or components (*courtesy Radio Shack Corporation*).



A miniature drill attachment for a cordless soldering iron is useful in more ways than you can imagine. It has been used extensively in the construction and repair of PC boards (*courtesy Wahl Clipper Corporation*).

initial heating and heat-recovery times. The tips are made of various types of metal, though copper is generally used. A simple, straight, copper tip with two flat faces, like a wedge, is most often used for general-purpose irons. Very slim, pointed tips are frequently used for delicate PC-board work. Many styles of tip faces are available, as can be seen by the representative sample in **Fig. 3.**

In recent years, a new type of "controlled heat" iron has become quite popular, particularly among kit-builders and repair shops. It has several different heat-power settings available to allow the solderer to select the amount of current for the range desired. With this type of iron, there is usally a separate step-down transformer, with a tapped secondary winding, housed in a small box separate from the iron.

In contrast to soldering irons and pistols, the *soldering gun* (which has a built-in transformer) is relatively heavy and bulky. However, the easy-to-grip, pistol-like design makes it very handy to use; the guns usually cost from $7 to $20 or more. The soldering *gun* has a distinct advantage over the iron: *instantaneous heating*. It has a built-in transformer which provides a high current *directly* to the tip, causing the tip to come up to full heat almost instantaneously.

The soldering *pistol* usually has about the same shape as its close cousin, the soldering gun. It's a hybrid design, with the features of both the soldering iron and gun. It combines the gun-type heating element and step-down transformer with the iron's soldering tip. It, too, heats almost instantaneously. As a general rule, soldering irons and pencils are light- and medium-duty tools; guns are for medium- to heavy-duty work, while pistols can be found in either light, medium, or heavy-duty designs. (There are probably more exceptions to this rule-of-thumb than you would care to count!)

State of the art

One of the most useful soldering tools developed in recent years is the rechargeable "cordless" soldering iron. This device allows completely portable operation without being tied to the ac mains like conventional irons. The typical cordless unit is equivalent to a 50-watt iron and has a self-contained, rechargeable battery pack that will produce anywhere from 100 to 175 solder joints per charge. The tip usually comes up to operating temperature in 5 to 8 seconds. Early rechargeable units suffered from inability to

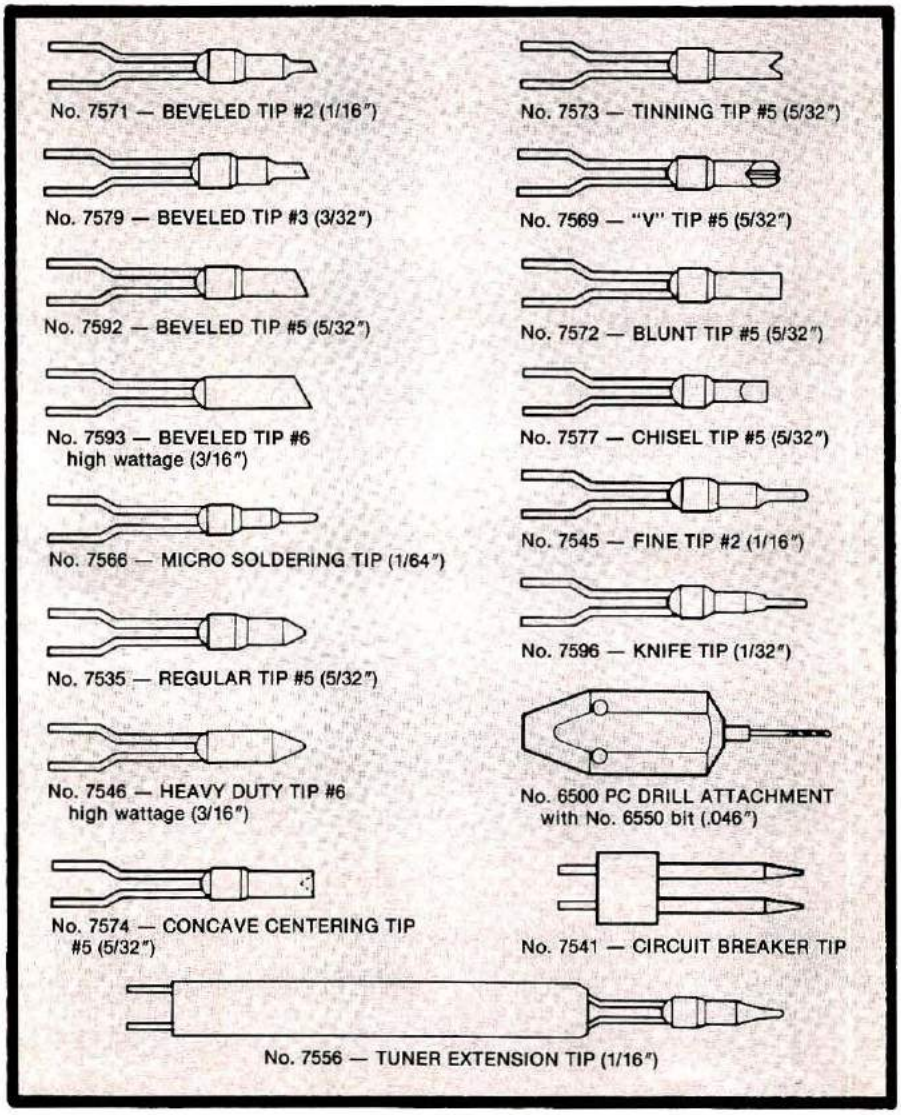


Fig. 3. Some of the many styles of tips available for general purpose or special applications. These are for Wahl equipment; most manufacturers offer several tip sizes and shapes (*courtesy Wahl Clipper Corporation*).

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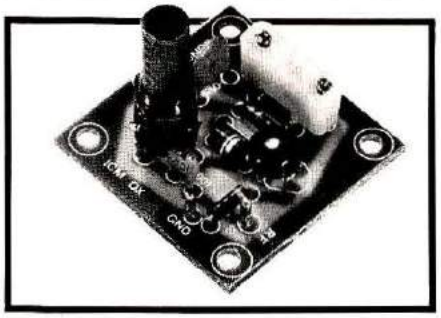

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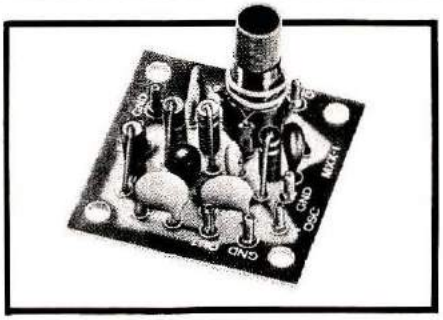

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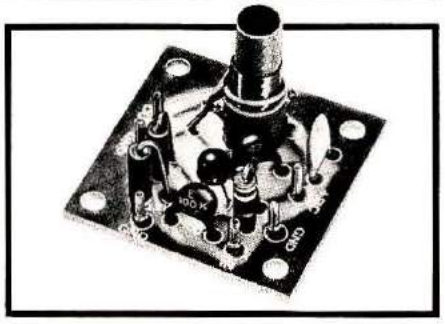

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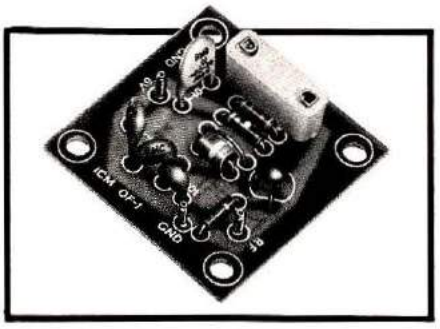

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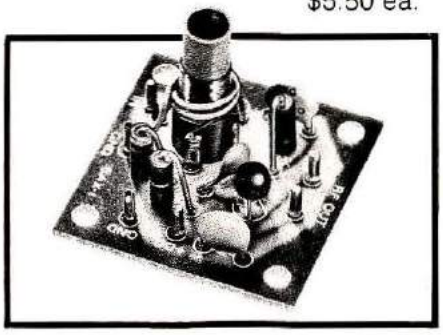

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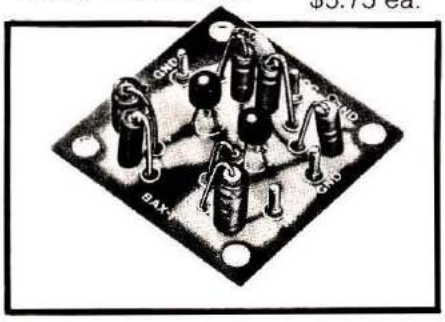

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The new generation of cordless soldering irons provides great freedom from the ac cord that often hampered movement in delicate soldering operations. The very small tips available make the unit especially useful for densely packed construction projects (*courtesy Wahl Clipper Corporation*).

be used *continuously*, making them unsuitable for extended kit-building or project work; their charges became depleted very rapidly. However, most present units on the market have overcome this problem, and the batteries can be brought up to a full charge again in less than an hour after completely discharging. Some of the more advanced models allow for continuous trickle-charging when not in use and have LED indicators which tell when charging is complete. Many of these units have provisions for interchangeable tips and other accessories.

Wahl Clipper Corporation has a novel drill attachment for their *Iso-Tip* rechargeable iron; it replaces the tip of the iron, and obtains power from the unit's battery pack. Accessory burrs, abrasive wheels, and discs are also available which allow the drill to carve, shape, form, and rout on wood, plastic, leather, and other materials.

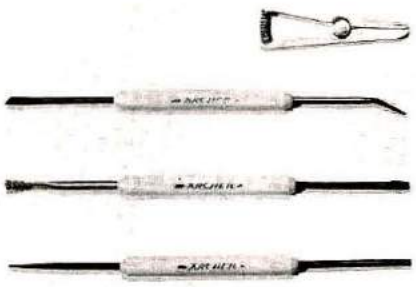
If you're starting from scratch with no soldering gear, you may be interested in Heath Company's controlled-heat soldering iron kit, model GH-17A. It is unique in that it combines the chicken and the egg into one package, so to speak: you can actually use the kit to build *itself* by following the special instructions that Heath provides! It's easy to assemble in approximately an hour. Some of its good features include selectable 20, 22, or 24 watt heat positions, a hood to shield the iron from inadvertently touching other components, and a special holding bracket that brings your work to the iron. It comes with a small chisel tip, especially good for solid-state work; other tips are available. I built one of the units and find that it works well for all but the heaviest electrical work.

Another new product is the "hybrid" cordless soldering gun which has double or triple the capacity of regular rechargeable irons. Wahl manufactures a gun that will produce from 350 to 400 electronic joints per charge, and which has an automatic solder-feed system that is activated by the trigger. Sixteen interchangeable tips are available making this gun useful for delicate micro-circuit applications, up to production electrical soldering.

We've looked at the hardware — now let's look at the *software*: the human element in soldering. Have you ever thought about just what goes into making a good electrical connection? It doesn't take much time to practice and learn good soldering techniques and habits, nor does good soldering require expensive tools. And, if you stick to a few rules, you'll consistently produce good, permanent, soldered connections, whether it be for purposes of kit-building or repair work. (Incidentally, the Romans made watertight lead pipes, medieval workmen soldered stained-glass windows in cathedrals, and Victorian tinsmiths made tin roofs watertight — and many of these soldering jobs are intact today!)

If there's a basic rule about soldering, — referring to both the *connection and tools*, it is: Keep it *clean*! The tip itself must be clean, with its surface lightly coated with solder to prevent its deterioration from oxidation. This is called *tinning*, and helps in the transfer of heat from the tip to the connection to be soldered. You should clean and tin the tip of the soldering tool with solder after its purchase, *before* you try to use it in actual soldering operations. Wear on the tip is *not* due to

Cordless soldering guns, such as the Wahl unit shown here, can provide up to three times the "heat power" of regular cordless irons. This type of gun has a plug-in type of charger which can completely recharge a dead battery overnight. It also has a solder feed, and a choice of 16 different accessory tips (*courtesy Wahl Clipper Corporation*).



Some basic soldering accessories: a heatsink for protecting sensitive components, wire brush/scraper, and slotted probes (*courtesy Radio Shack Corporation*).

erosion or to the flux; rather, it's due to the effect of the molten solder on it. Some manufacturers coat their copper tips with iron; this makes them less efficient in heat transfer, though it increases their lifetime.

In addition to a clean tip, the terminals and components to be joined must be clean; the old saw, "well cleaned is already half soldered," is certainly true. You can easily clean a dirty lug or component lead with a special steel-hair brush designed for the purpose, or you can use a small strip of emery cloth or a file to remove stubborn foreign particles. The iron or gun should be hot enough to allow soldering to proceed quickly, but not so hot that the solder "burns" and the free flux on the tip develops into black flakes; if your iron or gun is adjustable, try different settings to determine which are the best to use. The tip should be cleaned frequently during prolonged sessions. This can easily be done by lightly running a common washcloth or rag across its surface, particularly when it is only moderately hot. Don't let the cloth remain in contact with the tip for any extended period, or it will char and possibly catch fire. Specially-treated cleaning pads and sponges offered by several manufacturers can also be used.

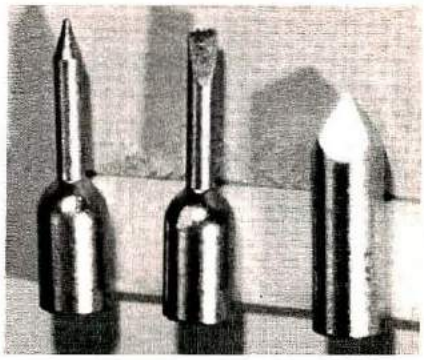
If the tip becomes pitted, don't be too concerned; this is a result of normal soldering action. The iron's (copper) tip can be lightly filed to remove the black spots of oxidation, and then retinned. Also, if your iron has a detachable tip (most do), you should periodically dismantle it from the heating element, or you may find that it has permanently bonded itself in place! Some people like to store the heating element and handle with the tip removed, though this isn't by any means necessary.

Once the components and terminals you want to solder are clean, they should be connected together to form *both* a good mechanical and electrical joint *before* soldering. Do not rely on the solder to hold the works together! If parts fit too loosely, a weak joint will be the result, or even no joint at all if the gap is too wide for the solder to bridge.

You should place a *heatsink* on the leads of particularly delicate or heat-sensitive components such as transistors, integrated circuits, small capacitors, diodes, and the like, to divert heat from them. The heatsink can be a commercially-available device, pliers, or even a paper clip. In any case, the heatsink should be placed as close to the component as possible.

While on the subject of heatsinking, I'll bring up another closely-related matter: many components, such as integrated circuits and field-effect transistors, can be destroyed by static or stray electricity which comes in contact with them. For this reason, many of these devices are furnished with the leads jumpered or shorted together with a ring of fine wire to prevent static electricity build-up from damaging them. Since the tip of the soldering tool is a conductor, be sure to leave the short on the leads of these devices until soldering is complete and you're ready to apply power (but don't forget that they're jumpered!).

If you're going to do a lot of work on PC boards or other miniature equipment, a magnifier can be a great tool to inspect the completed connection. This one is 4x magnification, and illumination is powered by two AA cells (*courtesy Radio Shack Corporation*).



Some of the most common tip shapes for electronic work are included in this selection from Radio Shack. These units, for light, medium, and heavy-duty applications, can be obtained in either copper-alloy or long-life iron-clad styles (*courtesy Radio Shack Corporation*).

Now, to solder the connection . . . apply the tip to the connection and almost simultaneously apply the solder to the junction between the tip and the connection. A small amount of solder should flow between the iron tip and the wire or component, which aids in transferring heat to the connection. The connection then becomes hot enough for the solder to flow onto it, forming a solder fillet between all of the parts. Apply just enough to fill the gaps, and no more. Excess solder will flow into places where it is not needed, or where it can cause a short circuit. No additional flux is needed, because the flux core in the solder will melt and flow over the connection just before the solder does. Any small amount of oxide that has formed since you cleaned the connection will float to the top of the solder, out of harm's way. The time for the entire operation should be very short

A desoldering vacuum bulb is useful for removing solder from a connection without splattering. The treated sponge will help to keep the iron's tip clean and free of excess solder and flux (*courtesy Radio Shack Corporation*).

— it can be done in less time than it takes you to read this sentence, especially for small components.

To complete the process, remove the solder first, then the tip, and be very careful not to allow the connection to move while the solder is solidifying; resist the temptation to prematurely "test" the connection — you'll set up tiny fractures within the joint if you do, thereby weakening it.

Now, what does a good solder connection look like? It is one where the solder has uniformly flowed over all the surfaces to be connected, following their contours. The connection should appear bright and smooth, all wires in the connection appearing well-soldered. However, if the connection is *rough* or *flaky-looking* — or if the solder has formed into little round balls, *do it over*! If allowed to cool undisturbed, the solder should solidify nicely into a permanent connection. Don't apply water to speed up the process of chilling. It's best not to use water to clean any solder joint that uses a rosin flux, due to the possibility of a corrosive chemical reaction. The rosin residues can be left in place with no danger of corrosion, or they can be removed with a rag or a brush and special solvents.

That's really all there is to good soldering! With a little practice and keeping these rules in mind, you can do a professional soldering job every time.

There are a number of soldering accessories and gadgets that can make kit building, home-brewing, and general repair work a great deal easier. Let's take a look at some of them. Assuming you are fairly well-equipped with some basic tools, such as needle-nose pliers, an assortment of screwdrivers, knives, wire strippers, and the like — as well as a soldering iron or gun suited to your taste and the job at hand — probably the most important soldering accessories would be a set of brushes, scrapers, and probes as shown in the photo. A heat-sink to protect delicate components is a must, although it need not be a commercially manufactured item. It may be a paper clip or home-built clamp of some sort; even your pliers can serve to grip the components that need protection from excessive heat.

Something to clean up the iron and keep its tip shiny is also a must; this can be a sponge, rag or even brown paper towels. A good 3x to 4x illuminating magnifier is also handy for examining connections, working with small components, and doing delicate PC-board repair work.

Solder-removing wicks are used in repairing PC boards or salvaging components. To use them, heat the soldered connection with an iron, and apply the tip of the metal wick. Solder is pulled up the wick, away from the component. After the tip has cooled, a section is cut off, exposing fresh wick ready for the next application (*courtesy Radio Shack Corporation*).

A combination iron holder and cleaning sponge keeps the iron in a safe place and makes cleaning the tip a matter of seconds (*courtesy Ungar Division of Eldon Industries*).

If you do a good deal of repair work, a desoldering vacuum bulb is very helpful in removing solder from fragile PC boards without splattering and damaging nearby components. A simple vacuum bulb works well, although fancier devices are available from several manufacturers. Radio Shack makes a unique gadget called a *Solder-Up*, which is a specially designed solder-removing wick used in conjunction with a soldering iron or gun to repair or revise circuits.

Finally, anyone who has had the unfortunate experience of having a hot soldering iron inadvertently come in contact with a component or cabinet, thereby causing heat damage, will want to use an iron holder to keep the iron in a safe place. Some of the fancier iron holders even have built-in sponges for tip cleaning.

A final word

When building that kit, don't overlook the soldering hints packed inside most major manufacturer's kits. They're interested in seeing that you know how to solder properly, because the success of the kit depends largely on the quality of the wiring and soldering job. Take time to read them! Happy soldering. **HRH**

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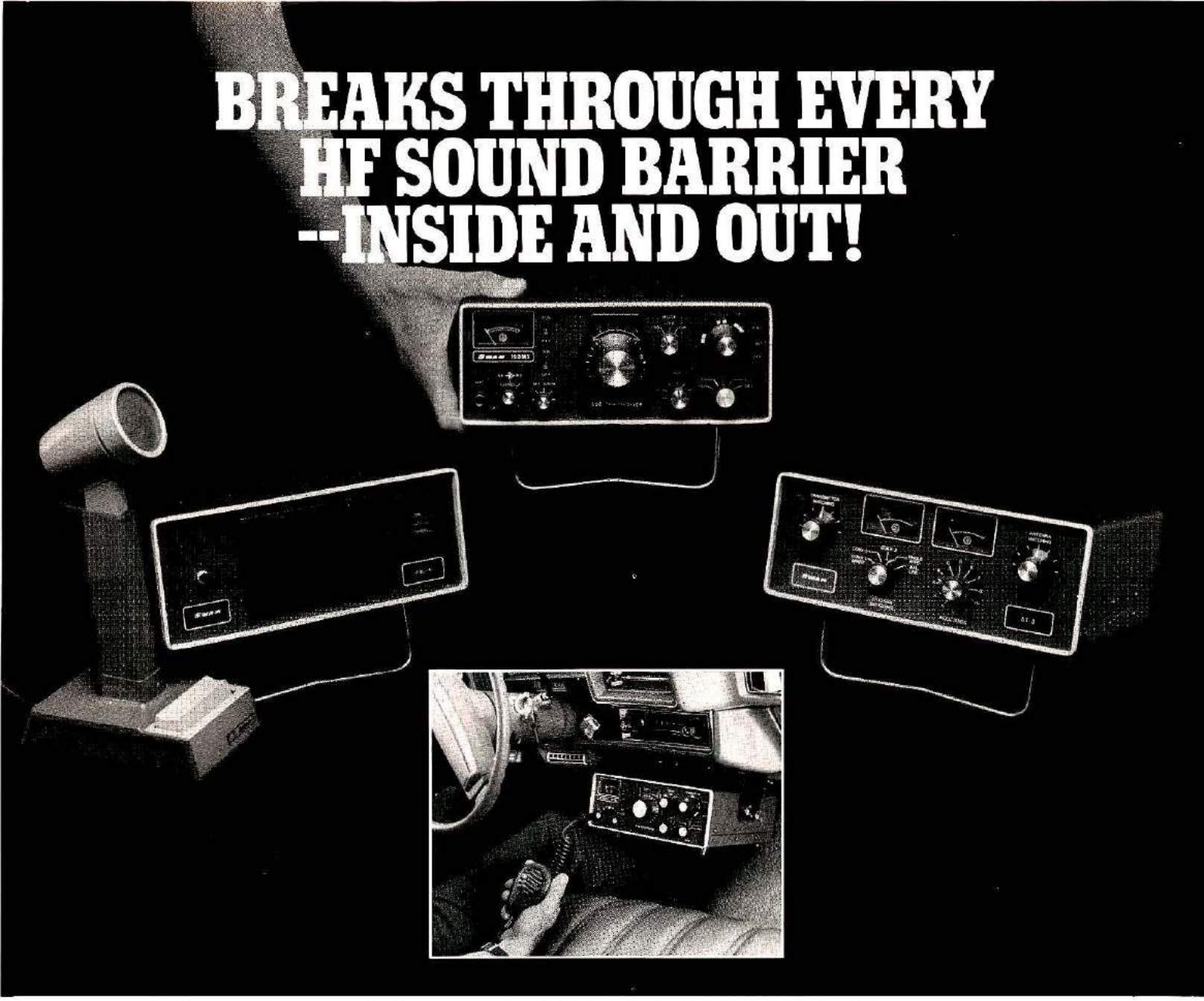

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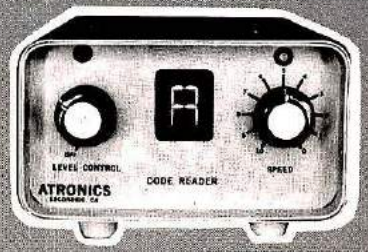

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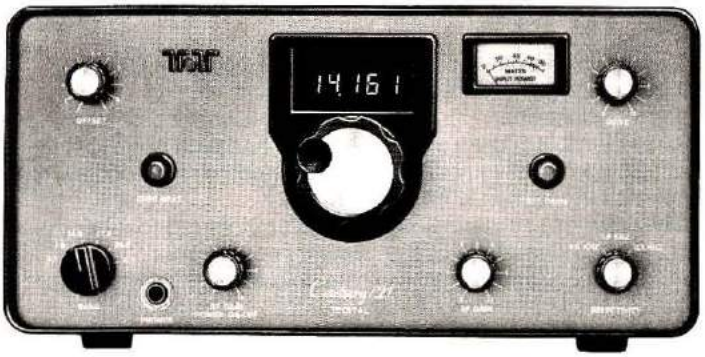

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the carrier frequency; fast and slow scan rates are available.

Receive sensitivity of the Astro 200A is 0.3 μV for 10 dB signal-to-noise ratio; selectivity of 2.7 kHz is set by 8-pole crystal filter. Image rejection is greater than 50 dB on 80 through 15 meters, and greater than 40 dB on 10 meters.

Power input of the Astro 200A is 200 watts dc on CW and 200 watts PEP on ssb into a 50-ohm load; the broadband design offers excellent harmonic and TVI suppression and eliminates the need for tuning controls. On ssb the carrier is suppressed more than 50 dB, and the unwanted sideband is suppressed 60 dB or better; third-order intermodulation distortion is more than 30 dB below peak power. VOX or PTT control is available for ssb; semi-break-in for CW.

Power requirement for the Astro 200A is 12 to 14 Vdc, negative ground only; an ac power supply is available for fixed-station use. Other optional accessories include a 400-Hz CW filter, station operating console, matching speaker enclosure,

Table 1. Performance characteristics and operating accessories of high-frequency amateur transceivers; all major manufacturers are represented. Ssb input power is in PEP; receive sensitivity is for 10 dB signal-to-noise ratio; selectivity is measured at −6 dB points. VOX is an abbreviation for Voice Operated Transmitter, RIT is Receiver Incremental Tuning (clarifier), NB is Noise Blanker, and Cal is crystal calibrator. Prices were correct October 1st, and are not expected to change until 1979.

Model	Bands	Modes	SSB Input Power	Sensitivity	Selectivity	All Solid State	VFO	VOX	RIT	CW Filter	NB	Cal	CW Sidetone	Digital Readout	Price	Model
Alda 103	80-20	SSB/CW	250 W	0.5 μV	2.5 kHz	Yes	Yes	No	Yes	No	Opt	Opt	Yes	No	$495	Alda 103
Astro 200A	80-10	SSB/CW	200 W	0.3 μV	2.7 kHz	Yes	Yes	Yes	Yes	Opt	Yes	No*	Yes	Yes	$1095	Astro 200A
Atlas 210x	80-10	SSB/CW	200 W	0.4 μV	2.7 kHz	Yes	Yes	Opt	No	No	Opt	Yes	No	Opt	$765	Atlas 210X
Atlas 215x	160-15	SSB/CW	200 W	0.4 μV	2.7 kHz	Yes	Yes	Opt	No	No	Opt	Yes	No	Opt	$765	Atlas 215x
Atlas 350-XL	160-10	SSB/CW	350 W	0.4 μV	2.7 kHz	Yes	Yes	Yes	Yes	Yes	Yes	Opt	Yes	Opt	$1195	Atlas 350-XL
Collins KWM-2A	80-10	SSB/CW	175 W	0.5 μV	2.1 kHz	No	Yes	Yes	No	Opt	Opt	Yes	Yes	No	$3533	Collins KWM-2A
Drake TR-7	160-10	SSB/CW	250 W	0.5 μV	2.3 kHz	Yes	Yes	Yes	Yes	Opt	Opt	Yes	Yes	Opt	$1295	Drake TR-7
Heathkit HW-8	80-15	CW	3.5 W	1.0 μV	750 Hz	Yes	Yes	No	No	Yes	No	Yes	Yes	No	$129	Heathkit HW-8
Heathkit HW-101	80-10	SSB/CW	180 W	0.35 μV	2.1 kHz	No	Yes	Yes	No	Opt	No	Yes	Yes	No	$369	Heathkit HW-101
Heathkit SB-104A	80-10	SSB/CW	100 W	0.5 μV	2.1 kHz	Yes	Yes	Yes	No	Opt	Opt	No*	Yes	Yes	$699	Heathkit SB-104A
Hy-Gain 3750	160-10	SSB/CW	200 W	0.25 μV	2.4 kHz	No	Yes	Yes	Yes	Yes	Yes	No*	Yes	Yes	$1895	Hy-Gain 3750
Icom IC-701	160-10	SSB/CW	100 W	0.25 μV	2.2 kHz	Yes	Yes	Yes	Yes	Yes	Yes	No*	Yes	Yes	$1650	Icom IC-701
Kenwood TS-520S	160-10	SSB/CW	200 W	0.25 μV	2.4 kHz	No	Yes	Yes	Yes	Opt	Yes	Yes	Yes	Opt	$739	Kenwood TS-520S
Kenwood TS-820	160-10	SSB/CW	200 W	0.25 μV	2.4 kHz	No	Yes	Yes	Yes	Opt	Yes	Yes	Yes	Opt	$919	Kenwood TS-820
Palomar PTR-130K	160-10	SSB/CW AM/FM	12 W	0.34 μV	2.4 kHz	Yes	Yes	Yes	Yes	Opt	No	No*	No	Yes	$699	Palomar PTR-130K
Swan 100MX	80-10	SSB/CW	100 W	0.35 μV	2.7 kHz	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Opt	$849	Swan 100MX
Swan 350B	80-10	SSB/CW	300 W	0.5 μV	2.7 kHz	No	Yes	Opt	No	Yes	No	Yes	Yes	No	$649	Swan 350B
Swan 350D	80-10	SSB/CW	300 W	0.5 μV	2.7 kHz	No	Yes	Opt	No	Yes	No	No*	Yes	Yes	$749	Swan 350D
Ten-Tec 509 Argonaut	80-10	SSB/CW	5 W	0.5 μV	2.5 kHz	Yes	Yes	No	Yes	Opt	No	Opt	Yes	No	$369	Ten-Tec 509 Argonaut
Ten-Tec 540	80-10	SSB/CW	200 W	0.3 μV	2.6 kHz	Yes	Yes	No	Yes	Opt	Opt	Yes	Yes	Opt	$699	Ten-Tec 540
Ten-Tec 544	80-10	SSB/CW	200 W	0.3 μV	2.6 kHz	Yes	Yes	No	Yes	Opt	Opt	No*	Yes	Yes	$869	Ten-Tec 544
Ten-Tec 545 Omni-A	160-10	SSB/CW	200 W	0.3 μV	2.6 kHz	Yes	Yes	Yes	Yes	Yes	Opt	Yes	Yes	No	$899	Ten-Tec 545 Omni-A
Ten-Tec 546 Omni-D	160-10	SSB/CW	200 W	0.3 μV	2.6 kHz	Yes	Yes	Yes	Yes	Yes	Opt	Yes	Yes	Yes	$1069	Ten-Tec 546 Omni-D Digital
Ten-Tec 570 Century/21	80-10	CW	70 W	1 μV	2.5 kHz	Yes	Yes	No	Yes	Yes	No	Opt	Yes	Opt	$299	Ten-Tec 570 Century/21
Ten-Tec 574 Century/21 Digital	80-10	CW	70 W	1 μV	2.5 kHz	Yes	Yes	No	Yes	Yes	No	Opt	Yes	Yes	$399	Ten-Tec 574 Century/21 Digital
Yaesu FT-101F	160-10	SSB/CW AM	260 W	0.3 μV	2.4 kHz	No	Yes	Yes	Yes	Opt	Yes	Yes	Yes	Opt	$799	Yaesu FT-101F
Yaesu FT-301	160-10	SSB/CW AM/FSK	200 W	0.25 μV	2.4 kHz	Yes	Yes	Yes	Yes	Opt	Yes	Yes	Yes	Opt	$769	Yaesu FT-301
Yaesu FT-901D	160-10	SSB/CW AM/FSK	180 W	0.25 μV	2.4 kHz	No	Yes	Yes	Yes	Yes	Yes	No*	Yes	Yes	$1259	Yaesu FT-901D

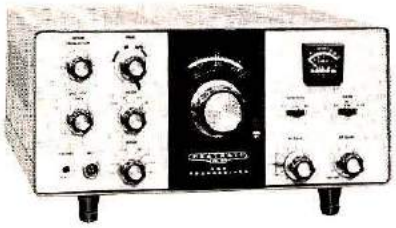
*Crystal calibrator not required in digital readout transceiver because a crystal is used as a time base for the digital counter circuitry.

and mobile mount. Transceiver measures 2.8″ high, 9.5″ wide, 12.1″ deep (72 × 241 × 308 mm); weighs 8 pounds (3.6 kg). Swan Electronics, 305 Airport Road, Oceanside, California 92054.

Heathkit HW-101 features ssb and CW operation on 80 through 10 meters with PTT and VOX transmit functions and a fet VFO for excellent frequency stability. Drift is less than 100 Hz per hour after 45 minutes warm-up. Dial calibration is accurate to 5 kHz; a 100-kHz crystal calibrator is built in.

Dc power input on transmit is 180 watts PEP on ssb and 170 watts on CW. Rf power output is 100 watts on 80 through 15 meters; 80 watts on 10 meters. Carrier and unwanted sideband are suppressed 45 dB or more; intermodulation distortion is rated at – 30 dB. Harmonics are suppressed 40 dB. Heath's Triple Action Level Control (TALC) compression circuitry prevents overdrive distortion.

Receiver sensitivity is less than 0.35 μV for 10 dB signal-to-



noise ratio. Selectivity is 2.1 kHz minimum (400 Hz minimum with optional CW filter). Image and i-f rejection are greater than 50 dB. Audio output is 2 watts into an 8-ohm speaker.

Power requirements for the Heath HW-101 are 700-850 Vdc at 250 mA; 300 Vdc at 150 mA; – 115 Vdc at 10 mA, and 12 volts ac/dc at 4.8 amps (ac power supply available). The HW-101 measures 6-1/4″ high, 14-1/2″ wide, 13-1/2″ deep (160 × 370 × 340 mm); weighs 22 pounds (10 kg). Heath Company, Department 348-480, Benton Harbor, Michigan 49022.

Hy-Gain 3750 transceiver covers all amateur bands for 1.8 to 29.7 MHz and uses advanced phase-locked loop (PLL) frequency generation circuitry to lock the first local oscillator with the VFO. This system provides frequency stability that is essentially crystal controlled. The Hy-Gain 3750 also features digital readout; no crystal calibrator is required once the digital readout has been calibrated against WWV using the built-in 10-MHz WWV receive position. Readout accuracy after calibration is ± 100 Hz. The Hy-Gain 3750 also features a frequency display memory which can be used to store any frequency for reference purposes, or return to for an operation frequency.

The receiver in the Hy-Gain 3750 offers ssb sensitivity of

0.25 μV for 10 dB signal-to-noise ratio (0.15 μV on CW). I-f image rejection is greater than 50 dB. Two selectivity positions are offered: 2.4 kHz for ssb and 400 Hz for CW. There's also a built-in notch filter for reducing the level of interfering stations near your operating frequency. Audio power output is 2.5 watts.

The transmitter in the Hy-Gain 3750 is rated at 200 watts on ssb and CW, and provides carrier and sideband suppression of more than 50 dB. Spurious radiation is down more than −40 dB. The output stage is designed to operate into a 50-75 ohm unbalanced load.

Power requirement for the Hy-Gain 3750 is 120 Vac or 240 Vac 50/60 Hz. The power supply is built in. Power consumption is approximately 78 watts when receiving, 400 watts when transmitting. Optional accessories include an external VFO and a matching speaker unit. The Hy-Gain 3750 measures 7-1/2″ high, 14-3/4″ wide, 8″ deep (189 × 375 × 203 mm); weighs 15.8 pounds (7.2 kg). Hy-Gain Electronics Corporation, 8601 N.E. Highway Six, Lincoln, Nebraska 68505.

Collins KWM-2A is the latest model of the first ssb/CW transceiver ever offered to amateurs; rf power input is 175 watts PEP on ssb and 160 watts on CW. The KWM-2A covers the amateur bands from 80 through 10 meters with built-in crystals, but with optional crystals will tune from 3.4 to 30 MHz in 200 kHz segments (except the range from 5 to 6 MHz). The main tuning dial features 1-kHz division on all bands, with excellent linearity provided by a linear Permeability Tuned Oscillator

(PTO). Frequency stability is within 100 Hz following a 20-minute warm-up period.

Receive sensitivity of the Collins KWM-2A is 0.5 μV for 10 dB signal-to-noise ratio; selectivity is set at 2.1 kHz with a Collins mechanical filter. Receiver image rejection is greater than 40 dB, and internal spurious are below 1 μV equivalent antenna input signal.

Transmitting in the ssb mode, the carrier and unwanted sideband are suppressed 50 dB or more; oscillator feedthrough and mixer products are more than 50 dB down; and third-order intermodulation products are down 30 dB or better. Minimum rf power output is 100 watts PEP on 80 through 20 meters, 90 watts PEP on 15 meters, and 80 watts PEP on 10 meters.

Power requirement for the KWM-2A is 800 Vdc at 230 mA, 285 Vdc at 210 mA, −55 to −80 Vdc, and 6.3 volts at 11 amps; tube filaments may also be operated from 12.6 volts or 24 volts. Power consumption with optional ac power supply is 190 watts on receive, 290 watts on ssb transmit. Optional accessories include mobile and portable power supplies, mobile mount, noise blanker, matching remote VFO, and matching speaker console. Measures 7-3/4″ high, 14-3/4″ wide, 14″ deep (197 × 375 × 356 mm); weighs 18.2 pounds (8.3 kg). Collins Radio Group, Rockwell International, Cedar Rapids, Iowa 52406. **HRH**

Henry Radio hand-held transceiver. The Tempo S1 is a fully synthesized hand-held transceiver for the amateur 2-meter band. It provides 5-kHz channels over the entire range of 144 to 148 MHz. Operation is from internal nickel-cadmium batteries, at a current drain of 17 mA on receive, 400 mA transmit. Output power is 1.5 watts or better. The S1 comes equipped with a battery pack, charger, and telescoping whip antenna. Other accessories available include a tone pad, tone-burst generator, tone-squelch circuits, and flexible rubber antenna. Suggested price is $349 without the tone pad, or $399 with the pad. For more information on the Tempo S1 write Henry Radio, Inc., 11240 West Olympic Boulevard, Los Angeles, California 90064.

DenTron Radio Jr. Monitor Antenna Tuner. With power-handling capabilities of 300 watts through balanced, coax, and random-wire-fed antennas, DenTron's Jr. Monitor tuner also includes a relative power output meter and a mobile mounting bracket. The Jr. Monitor measures a mere 5-1/2 inches wide by 2-3/4 inches high by 6 inches deep, making it ideal for portable, mobile, or fixed operation. Designed to handle virtually any transceiver or receiver-transmitter combination, the Jr. Monitor is priced at $79.50 amateur net. See it at your dealer, or write DenTron Radio Company, 2100 Enterprise Parkway, Twinsburg, Ohio 44087.

Shure Brothers desk microphones. The model 444 and 450 microphones from Shure Brothers are desk-type microphones which feature a telescoping support for height adjustment. Both are omnidirectional in response, and have a push-to-talk switch on the base. The 444 is designed with the Amateur Radio operator in mind, with audio response tailored to ssb use. It also fea-

tures a switch in the base to allow the selection of either voice-operated (VOX) or manually operated (MOX) transmit function. Model 450 is suitable for fm communications systems, and has a switch to select high or low impedance output. Price for the 444 is $38.70 user net, and for the 450 is $44.85. See them at communications equipment dealers, or write Shure Brothers, Inc., 222 Hartrey Avenue, Evanston, Illinois 60204.

Pipo Communications tone encoder is a compact unit designed to work with fixed, portable, or mobile equipment for remote control or access by tone signaling. It is small enough to be mounted on most hand-held transceivers, and is not subject to rf interference. Voltage requirements are 6 to 16 volts at less than 25 mA. The PP-1 series is a 12-button pad; the PP-2 is a 16-button pad. Either may be obtained with an internal relay for transmitter control by ordering the PP-1K, or PP-2K. The PP-1 and PP-2 are priced at $55 and $58; the PP-1K and PP-2K are $66 and $69, respectively. Available direct or at selected dealers nationwide. Write Pipo Communications, P.O. Box 3435, Hollywood, California 90028.

Palomar Engineers Loop Antenna for receiving is a versatile antenna, small enough to fit on your operating desk or table. Yet it is capable of receiving desired signals or nulling out unwanted signals on frequencies ranging from 10 kHz through 5 MHz, depending upon the plug-in loop you choose to match the amplifier, which serves as the mounting base for the antenna. A tuning capacitor resonates the loop to the desired listening frequency, while the amplifier boosts the received signal strength and preserves the high Q of the loop. Operation is simple; all you do is peak the loop's response on the desired listening frequency by

using the tuning control. Then rotate the loop and tilt it if necessary to eliminate any interference, such as local noise or stations. Power required is 9 Vdc at 3 mA, and connection to 50-75 ohm receiver or converter input is provided by an SO-239 connector (uhf type). Loop amplifier is priced at $67.50; plug-in loops are $47.50 each. Add $2.00 shipping and handling in U.S. and Canada. California residents add 6 per cent sales tax. For more information, ask your local dealer or write Palomar Engineers, P.O. Box 455, Escondido, California 92025.

Ten-Tec 544 ssb transceiver is totally solid-state, offers digital readout of the operating frequency, and runs 200 watts input on all bands, 80 through 10 meters (the Ten-Tec 540 is similar in all respects but has a standard slide-rule dial). The receiver has 0.3 μV sensitivity for 10 dB signal-to-noise ratio, 2.6 kHz bandwidth, and agc controlled by the rf gain control. Offset tuning (FIT) is provided and has a defeat switch and LED indicator. Other features include WWV reception on 10 and 15 MHz, CW sidetone, with adjustable tone and volume, and a built-in speaker.

The transmitter is rated at 100 per cent duty cycle and offers full break-in operation on CW. The Automatic Level Control (ALC) sets the output power level which is needed to drive a linear amplifier or maintain acceptable performance when feeding an antenna with high swr. Rf output impedance is 50-75 ohms, unbalanced.

Power requirement for the Ten-Tec 544 is 12 to 14 Vdc, 1 amp on receive, 18.5 amps during transmit (power requirement for the model 540 is 500 mA less). Optional accessories include a 160-meter converter, remote vfo, crystal oscillator, noise blanker, CW filter, and digital readout (for model 540). Transceiver measures 4-1/4" high, 13-5/8" wide, 13" deep (114 × 346 × 330 mm); weighs 12 pounds (5.5 kg). Ten-Tec, Inc., Sevierville, Tennessee 37862.

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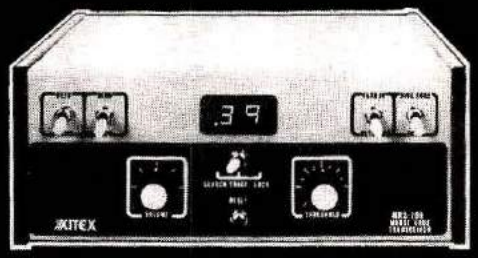

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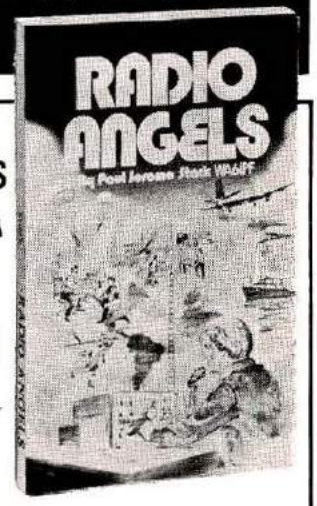

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4. FREQUENCY OF ISSUE: monthly	5. NO. OF ISSUES PUBLISHED ANNUALLY: 12	6. ANNUAL SUBSCRIPTION PRICE: $10.00

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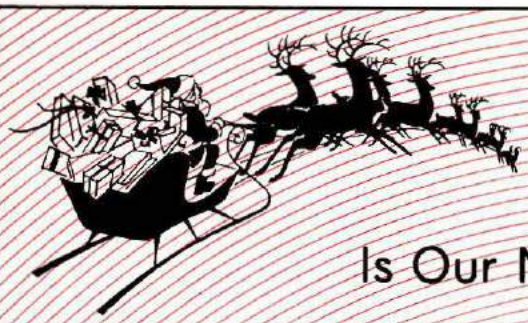

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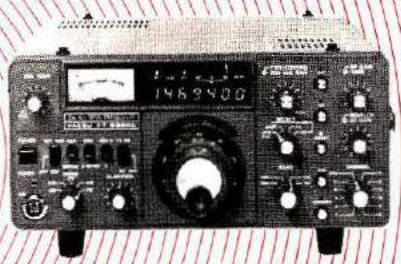

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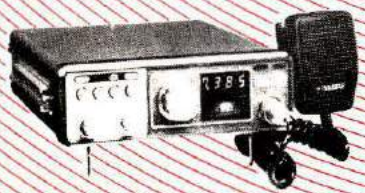

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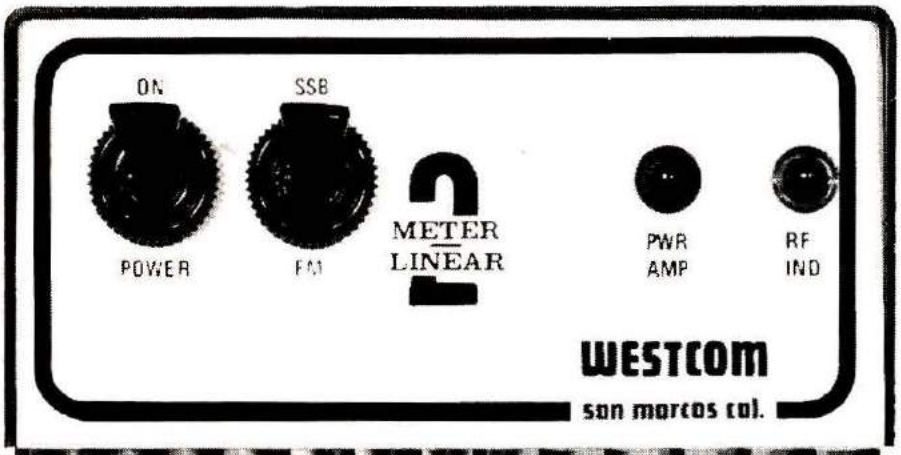

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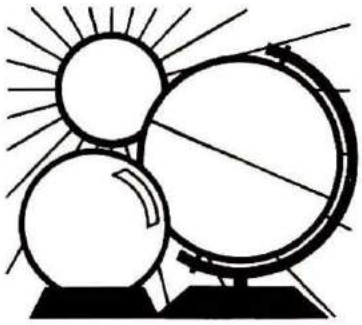

DX FORECASTER

The week of December 7th through 14th is likely to be active with ionospheric and geomagnetic field disturbances. It is too early to tell how severe the disturbances will become, but as these days approach, keep plotting the information given by WWV at 14 minutes after the hour. Look for the geomagnetic "A" index, the solar flux, and the geomagnetic "K" index values. Sudden rises in these values are clear indications of possible solar storm conditions, and your plots of these data will be the best indicator of conditions to come. Descending values mean that the disturbance is dying, while ascending values indicate that the severity is increasing. The week of December 20th through 27th is likely to contain some minor disturbances, centered around Christmas eve and Christmas day, but these will in all likelihood not disrupt communications. Perhaps a mild enhancement will be seen. As usual, look for weather changes and freak atmospheric conditions at times of, or closely following, geomagnetic upsets.

Once again, it is nice to see the muf climbing into the vicinity of 30 MHz, even at this time of year. General lack of atmospheric noise (static) will mean that even the low bands can be used for good DX catches, particularly in the early evening. Early darkness in the Northern Hemisphere will cause the higher-frequency bands to close somewhat sooner than they do in the summer, but the chart indicates many bands useable well into the evening hours.

Ten and Fifteen Meters will open to South America and South Africa from the East Coast, while West Coast stations can expect openings to South America and Pacific areas. Mid-U.S. hams will share a little of both Pacific and South African openings. These may be the two best DX bands during December.

Twenty and Forty Meters will be less active than fifteen in producing DX; with twenty somewhat more consistent than forty, and certainly less erratic than ten. It is probable that twenty meters, at last, will not produce quite the spectacular performance we've become used to. On both bands, however, be sure to consult the chart for times and areas of openings.

Eighty and One-Sixty Meters are always good evening bands in the winter because of the quiet atmosphere and propagation along the darkness path. Look for Europe from the East Coast in the early evening on eighty, and later on one-sixty. WAC on one-sixty should be achievable for those who need that certificate, although it will be easier on eighty. For Pacific stations, look in the wee morning hours, after the stations east of you have hit the hay.

Sunspot cycle 21 is racing to a peak, perhaps in late 1979 or early 1980, so conditions are rapidly getting better. Take advantage of them while they are good, and have fun with your DXing. **HRH**

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

HAM CALENDAR

December 1978

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
*All international events such as contests are shown on the GMT days on which they take place even though they may actually begin on the evening of the preceding day in North America.			See December 2, 4, 7, 9, 15, 16, 18, 27 		1	ARRL 160-Meter Contest — 2-3 EA Contest — Phone — 2-3 International Island DX Contest — By the Whidbey Island Amateurs — INFO SASE to Bill Gosney, WB7BFK, 2665 N. 1250 East, Oak Harbor, Whidbey Island, Washington 98277 USA. Foreign stations enclose (3) IRCs. 0001Z 12/2 — 2400Z 12/3* Telephone Pioneers QSO Party — 2-3 2
3	FLORIDA HAM NEWS — SWAP NET By the Broward ARC 146.31-91 at 7:30PM GLENHURST RADIO SOCIETY Transmits Amateur Radio News — 222.66/224.26 MHz via WR2APG and 21.400 MHz USB WEST COAST BULLETIN Edited & Transmitted by W6ZF 8PM PST 3540 kHz A-1, 22 WPM 4	AMSAT Eastcoast Net 3850 kHz 8PM EST (0100Z Wednesday Morning) AMSAT Mid-Continent Net 3850 kHz — 8PM CST (0200Z Wednesday Morning) AMSAT Westcoast Net 3850 kHz 7PM PST (0300Z Wednesday Morning) 5	6	West Coast Qualifying Run — 0500Z 7	8	ARRL 10-Meter Contest — 9-10 EA Contest — CW — 9-10 HA-DX Contest — 9-10 9
10	FLORIDA HAM NEWS — SWAP NET By the Broward ARC 146.31-91 at 7:30PM GLENHURST RADIO SOCIETY Transmits Amateur Radio News — 222.66/224.26 MHz via WR2APG and 21.400 MHz USB 11	AMSAT Eastcoast Net 3850 kHz 8PM EST (0100Z Wednesday Morning) AMSAT Mid-Continent Net 3850 kHz — 8PM CST (0200Z Wednesday Morning) AMSAT Westcoast Net 3850 kHz 7PM PST (0300Z Wednesday Morning) 12	13	14	W1AW Qualifying Run — 0300Z* 15	The Society of Wireless Pioneers (SOWP) Christmas CW QSO Party, full Zulu period this weekend. This special event gives SOWP members an opportunity to meet on the air and to exchange Season's Greetings and other pleasantries. There are no formal exchange requirements and no need for members to submit logs, etc. As in the past, the call is CQ SOWP and all members with Amateur licenses are urged to take part. Here is another opportunity to renew old friendships, establish new ones and to continue a comaraderie developed over the years. Suggested frequencies for the Party are 50 and 60 kHz up from the low end of each Amateur band. Novices should consider the middle of each Novice band. Info: Bill Willmot, K4TF, 1630 Venus Street, Merritt Island, Florida 32952 16
SEASON'S GREETINGS  17	FLORIDA HAM NEWS — SWAP NET By the Broward ARC 146.31-91 at 7:30PM GLENHURST RADIO SOCIETY Transmits Amateur Radio News — 222.66/224.26 MHz via WR2APG and 21.400 MHz USB WEST COAST BULLETIN Edited & Transmitted by W6ZF 8PM PST 3540 kHz, A-1, 22 WPM 18	AMSAT Eastcoast Net 3850 kHz 8PM EST (0100Z Wednesday Morning) AMSAT Mid-Continent Net 3850 kHz — 8PM CST (0200Z Wednesday Morning) AMSAT Westcoast Net 3850 kHz 7PM PST (0300Z Wednesday Morning) 19	20	21	22	23
24	 25	AMSAT Eastcoast Net 3850 kHz 8PM EST (0100Z Wednesday Morning) AMSAT Mid-Continent Net 3850 kHz — 8PM CST (0200Z Wednesday Morning) AMSAT Westcoast Net 3850 kHz 7PM PST (0300Z Wednesday Morning) 26	W1AW Qualifying Run — 1400Z 27	28	29	30
31		HA5-WW Contest — 24th		Straight Key Night January 1 — 0001Z*		**WORKSHOPS:** An expanded and new series of four lecture/laboratory workshops on microcomputer data acquisition, instrumentation and measurement systems are being given by the authors of the popular Bugbooks. Course dates are November 27 to December 2, 1978 and December 18-21, 1978. For more information, contact Dr. Linda Leffel, Center for Continuing Education, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061 (303) 961-5241.

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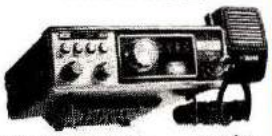

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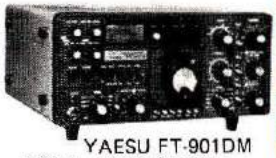

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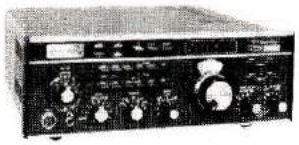

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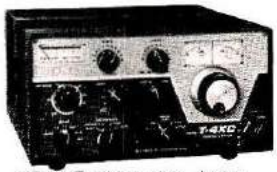

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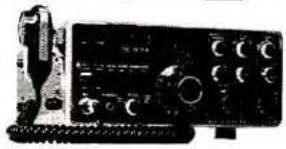

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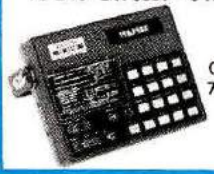

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- Effective noise blanker is built in.
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