Ham Radio Magazine

April 1980

- Circuits and techniques for high-frequency receivers 20
- 40-meter log-periodic antenna 26
- Diversity reception 34
- Capacitance measurement 44
- 5-MHz prescaler 50

Low-power 40-meter transceiver
The VBC Model 3000, the world's first and only narrow band voice modulation system is now a proven success. Leading communications engineers were enthusiastic about the NBVM system from the beginning. Now the idea of more QSO's per kilocycle has fired the imagination of Amateurs everywhere. The benefits of this advanced communications system are being demonstrated all over the world.

For present VBC users we can provide a list of other happy owners. For those Amateurs who have not experienced NBVM yet, "why not add your name to the list?"

The VBC Model 3000 provides full audio level compression and expansion... complete intelligibility in only 1300 Hz bandwidth. It permits you to take full advantage of other stations' RF speech clippers and processors... similar to the amplitude compression and expansion used for many years in telephone and satellite communications.

The Model 3000 is for mobile and fixed station use and requires no modifications to your existing equipment. It is completely self contained, including its own audio amplifier. The unit automatically switches into transmit mode when microphone is keyed or voice operation is used. It connects just after the microphone on transmit and just prior to the speaker on receive. In addition to its basic function of operating in a narrow bandwidth, the Model 3000 also increases the performance of your station in the following ways:

- reduces adjacent channel interference
- increases signal to noise ratio
- increases communications range

Some of its outstanding features include:

- High quality narrow band speech
- Self contained transmit/receive adapter
- Built in audio amplifier
- 5 active filters with a total of 52 poles
- Rugged dependable hybrid IC technology
- Low power consumption

Receive only features, such as sharp voice and CW filtering and amplitude expansion, provide improved reception without requiring a unit at the transmitting station.

For the more advanced experimenter the Model 3000 is available in a circuit board configuration for building into your present transceiver.

Henry Radio is ready to offer technical assistance and advice on the use and servicing of the Model 3000 and will help introduce new owners to others operating NBVM units. Get in on the ground floor... order yours now.

Price: VBC Model 3000 $349.00
Circuit board configuration $275.00

For more detailed information please call or write. The Model 3000 will be available from most Tempo dealers throughout the U.S. and abroad.
The engineering breakthrough by Drake brings an entirely new state of the art to worldwide radio communications...

**solid state TR7** synthesized hf transceiving system

**continuous coverage**

0-30 MHz

160-10 Meters

- **continuous coverage reception** — no gaps — no range crystals required
- Amateur Band transmission, including capability for MARS, Embassy, Government, and future band expansions

* Sophisticated System Concept
* Innovative Design Features
* Straightforward Simplified Operation
* State of the art performance now a pleasure

- Broadband, **100% Solid State Design.**
- Exclusive Synthesized/PTO Frequency Control — 1 kHz dial, 100 Hz digital readout, 500 kHz range pushbuttons.
- Continuous, Wide Range Frequency Coverage — 1.5 thru 30 MHz (zero thru 30 MHz with optional Aux7).
- State of the Art “Up-Conversion” Receiver Design — with high level double balanced mixer.
- True Full-Passband Tuning improves reception in heavy QRM.
- Unique Independent Receive Selectivity — Optional front panel pushbutton-selected filters.
- Effective Noise Blanker — true impulse-type performance.
- Special High Power Solid State Power Amplifier — diagonal heat sink allows internal mounting. Continuous duty on SSTV/RTTY with optional fan.
- TR7 Internal Test Facilities — “S” meter and built-in rf Wattmeter/ VSWR Bridge.
- Receiver Incremental Tuning (RIT)

**7 Line Accessories**
- RV7 Remote VFO • PS7 120/240V Ac Supply • Aux7 Range Program Board
- MS7 Matching Speaker • NB7 Noise Blanker • FA7 Fan • SL300 Cw Filter, 300 Hz • SL500 Cw Filter, 500 Hz
- SL1800 Ssb/RTTY Filter, 1.8 kHz
- SL6000 A-m Filter, 6.0 kHz • MMK7 Mobile Mounting Kit • TR7 Service Kit/Extender Board Set • TR7 Service/ Schematic Book.

Specifications and prices subject to change without notice or obligation.

**R.L. DRAKE COMPANY**

540 Richard St., Miamisburg, Ohio 45342
Phone: (513) 866-2421 • Telex: 288-017

For a FREE Drake Full Line Catalog contact your favorite Drake Dealer.

More Details? CHECK — OFF Page 94
NEW MFJ DELUXE Versa Tuner II

$129.95 buys you one of the world's finest 300 watt antenna tuners with features that only MFJ offers, like... dummy load SWR, forward, reflected power meter, antenna switch, balun. Matches everything from 1.8 thru 30 MHz: coax, random wires, balanced lines.

MFJ's Best Versa Tuner II...
Solid American Quality

$129.95

This is MFJ's best Versa Tuner II. And one of the world's finest 300 watt (RF output) tuners. The MFJ-949 Deluxe Versa Tuner II gives you a combination of quality, performance, and features that others can't touch at this price... or any price.

Performance: You can run your full transceiver power output — up to 300 watts RF output — and match your transmitter to any feedline from 1.8 thru 30 MHz whether you have coax, balanced line or random wire.

Features: A 200 watt 50 ohm dummy load lets you tune up for maximum performance. A sensitive meter lets you read SWR with only 5 watts and both forward and reflected power in two ranges (300 and 30 watts).

A flexible antenna switch lets you select 2 coax lines direct or thru tuner, random wire or balanced line and dummy load.

A large efficient airwound inductor 3 inches in diameter gives you plenty of matching range and less losses for more watts out. 1/4 balun, 1000 volt capacitors, SO-239 coax connectors. Binding post for balanced line, random wire, ground. 10x3x7 inches.

Quality: Every single unit is tested for performance and inspected for quality. Solid American construction, quality components. The MFJ-949 carries a full one year unconditional guarantee. Order from MFJ and try it — no obligation. If not delighted, return it within 30 days for a refund (less shipping).

To order, simply call us toll free 800-647-1800 and charge it on your VISA or Master Charge or mail us a check or money order for $129.95 plus $4.00 for shipping/handling.

Don't wait any longer to tune out that SWR and enjoy solid OSO's. Order your Deluxe Versa Tuner II at no obligation, today.

CALL TOLL FREE... 800-647-1800
Call 601-323-5869 for technical information, order/repair status. Also call 601-323-5869 outside continental USA and in Mississippi.

MFJ ENTERPRISES, INC.
BOX 494, MISSISSIPPI STATE, MS 39762

NEW MFJ Dual Tunable SSB/CW filter

lets you zero in SSB/CW signal and notch out interfering signal at the same time.

Ham Radio's Most Versatile Filter

NEW

$79.95

The MFJ-752 Signal Enhancer is a dual tunable SSB/CW active filter system that gives you signal processing performance and flexibility that others can't match.

For example, you can select the optimum Primary Filter mode for an SSB signal, zero in with the frequency control and adjust the bandwidth for best response. Then with the Auxiliary Filter notch out an interfering heterodyne... or peak the desired signal.

For CW, peak both Primary and Auxiliary Filters for narrow bandwidth to give skirt selectivity that others can't touch. Or use Auxiliary Filter to notch out a nearby Q50.

The Primary Filter lets you peak, notch, low-pass, or high-pass signals with double tuned filter for extra steep skirts. The Auxiliary Filter lets you notch a signal to 70 db. Or peak one with a bandwidth down to 40 Hz.

Tune both Primary and Auxiliary Filters from 300 to 3000 Hz. Vary the bandwidth from 40 Hz to almost flat. Notch depth to 70 db.

MFJ has solved problems that plague other tunable filters to give you a constant output as a bandwidth is varied. And a linear frequency control. And a notch filter that is tighter and smoother for a more effective notch.

Works with any rig. Plugs into phone jack. 2 watts for speaker. Inputs for 2 rigs.

Switchable noise limiter for impulse noise; trough clipper removes background noise.

Simulated stereo feature for CW lets ears and brain reject ORM. Yet off frequency calls can be heard.

Speaker and phone jacks. Speaker is disabled by phones. OFF bypasses filter. 110 VAC or 9 to 18 VDC, 300 ma. 10x2x6 inches.

Every single unit is tested for performance and inspected for quality. Solid American construction, quality components.

The MFJ-752 carries a full one year unconditional guarantee. Order from MFJ and try it — no obligation. If not delighted, return it within 30 days for a refund (less shipping).

To order, simply call us toll free 800-647-1800 and charge it on your VISA or Master Charge or mail us a check or money order for $79.95 plus $3.00 for shipping/handling.

Don't wait any longer to use Ham Radio's most versatile filter. Order your MFJ Dual Tunable SSB/CW Filter at no obligation, today.

MFJ ENTERPRISES, INC.
P. O. BOX 494
MISSISSIPPI STATE, MS 39762
CALL TOLL FREE... 800-647-1800
For technical information, order/repair status, in Miss., outside continental USA, call 601-323-5869.
A
v0l1
PU
Canada
at
f c
1
Paatmaa
G
magazine
contents

12 low-power transceiver
John L. Keith, WB5DJE

20 circuits and techniques for
high-frequency receivers
Ulrich L. Rohde, DJ2LR

26 40-meter log-periodic antenna
George E. Smith, W4AE0
Paul A. Scholz, W6PYK

32 hardline coaxial connectors
Myron D. Weisberg, K2YOF

34 high-frequency diversity receiver
John J. Nagle, K4KJ

44 capacitance measurement with
your frequency counters
R. H. Griffith, W2ZUC

50 600-MHz prescaler
Thomas V. Cefalo, Jr., WA1SPI

54 Collins equipment survey
announcement
Thomas F. McMullen, W1SL

58 FCC license requirements
for amateurs

4 a second look
94 advertisers index
6 comments
85 flea market
88 ham mart

70 ham notebook
8 presstop
72 new products
94 reader service
80 short circuits

APRIL 1980
volume 13, number 4

T. H. Tenney, Jr., W1FNLE
publisher
James R. Fisk, WH1R
editor-in-chief

editorial staff
Martin Kauth, WB1CHO
administrative editor
Robert Schneider, WMBR
Alfred Wilson, W8LM
assistant editors
Thomas F. McMullen, Jr., W1SL
Joseph J. Schneider, W9JU
associate editors
W. E. Scharfenberg, Jr., N4DQG
Wayne Pierce, K3SUK

cover

publishing staff
J. Craig Clark, Jr., N1ACH
assistant publisher
advertising manager
James H. Gray, W1XU
assistant advertising manager
SuSan Shirrock
circulation manager

ham radio magazine
is published monthly by
Communications Technology, Inc.
Greenville, New Hampshire 03048
Telephone: 603-678-6141

subscription rates
United States: one year, $15.00
two years, $26.00; three years, $36.00
Canada and other countries via Surface Mail:
one year, $18.00; two years, $32.00
three years, $44.00
Europe, Japan, Australia, Air Forwarding Service:
one year, $25.00
All subscription orders payable in
United States funds, please

foreign subscription agents
American subscription agents are
listed on page 68.

microfilm copies
are available from
University Microfilms, International
Ann Arbor, Michigan 48106
Order publication number 91718.

Cassette tapes of selected articles
from ham radio are available to the
blind and physically handicapped
from Recorded Periodicals
318 Walnut Street, 8th Floor
Philadelphia, Pennsylvania 19107

Copyright 1980 by
Communications Technology, Inc.

Title registered at U.S. Patent Office.

Second-class postage
paid at Greenville, N. H. 03048
and at additional mailing offices.

Postmaster send Form 3579 to
ham radio
Greenville, New Hampshire 03048
The widely escalating precious metals market and Amateur Radio. What you might ask, does one have to do with the other? As a starter, consider the fact that the basic construction of practically every component in that new transceiver you’re thinking about buying uses silver, gold, or palladium. Those inexpensive and innocent looking ceramic bypass capacitors that are used by the hundreds, for example, use thin silver layers deposited on ceramic substrates. Most transistors, diodes, and integrated circuits use gold contact wires and many are built within a tiny gold frame; and palladium is often used in precious monolithic resistors. When you add the precious metals in these common components to the more obvious ones like silver-mica capacitors and silver-plated switch contacts, tank circuits, and variable capacitors, it is suddenly apparent that the transceiver on your operating desk is a source of hidden wealth. More important, it is indicative of the great increases in the cost of Amateur Radio equipment you can expect in the not-too-distant future.

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

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

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

Jim Fisk, W1HR
editor-in-chief
FM...SSB...CW...
ICOM Does it All!

ICOM IC-260A

Enjoy VHF mobile at its best. Sideband, FM or CW, the ICOM IC-260A does it all. The ICOM IC-260A contains all the features a mobile operator would want in a compact 2 meter mobile package with FM, SSB, CW operation. Features customers ask for most including:

- 3 memories built in (quick access to your favorite frequencies).
- Memory scan - automatically stops on an active frequency programmed in the memories.
- Programmable band scan - scan the whole band, or any portion of it you desire (adjustable scanning speed).

- Squelch on SSB, the 260A will automatically and silently scan the SSB portion of the band seeking out the SSB activity on 2.
- 600kc repeater offset built in. Easy repeater operation on the FM portion of the band.
- Variable repeater split - with the 2 built in VFOs, it's possible to work the odd splits plus accommodate future repeater band plan changes.
- Multimode operation - USB, LSB, CW, and FM. Great for getting into OSCAR, plus enjoying SSB rag chewing as well as repeater operation (including the new subband).

- With optional 117/12V supply, the 260A makes a flexible functional base for SSB/OSCAR/FM operation.

The RF amplifier and first mixer circuits using FETs, and other circuits provide excellent Cross Modulation and Intermodulation characteristics.

The IC-260A has excellent sensitivity demanded especially for mobile operation, high stability, and with Crystal Filters having high shape factors, exceptional selectivity.

The transmitter uses a balanced mixer in a single conversion system, a band-pass filter and a high-performance low-pass filter. This system provides distortion-free signals with a minimum spurious radiation level.

ICOM INFORMATION SERVICE
9112 116th Ave, N.E.
Bellevue, WA 98004

Please send me: □ IC-260A specifications sheet: □ full color ICOM Product Line Catalog: □ List of Authorized ICOM Dealers.

NAME _____________________________________________ CALL ___________________________

ADDRESS ___________________________________________

CITY _____________________________________________ STATE __________ ZIP ___

You may send a machine copy of this form.

All stated specifications are subject to change without notice. All ICOM radios significantly exceed FCC regulations limiting spurious emissions.
comments

FCC actions

Dear HR:

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

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

J.L. Ragle, W1ZI
Amherst, Massachusetts

---

Dear HR:

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

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

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

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

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

speed of light

Dear HR:

Harold Tolles, W71TB, wrote a very interesting article on the speed of light which appeared in the January issue of 
*ham radio*. May I be another pair of eyes viewing the subject from a different point of view?

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

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

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

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

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

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

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

Keith Rhodes, WB2AOT
Syracuse, New York
UNIVERSALLY RTTY
No other RTTY terminal made
gives you ALL the features
of our new DS3100 ASR:

- TX/RX operation with 3 codes: Baudot RTTY, Morse Code, ASCII RTTY
- Storage buffers for 150 lines of RX storage and 50 lines of TX storage
- The HAL "original" split screen shows both RX and TX buffers or whole screen for RX
- Ten programmable "Here's" messages can be chained from one to next
- The EAROM allows power-off storage of 2 "Here is" messages and terminal operating conditions
- Programmable WRU answer-back and selective-call features
- Separate CW identification key for RTTY operations
- Automatic TX/RX control with KOS plus 4 keyboard controlled accessory switches
- Internal real time clock keeps 24 hour time plus date
- Newly developed CW receive circuitry and programs give superior CW reception
- New green P31 phosphor display screen gives clear, eye-easing viewing
- On-screen status indicators give continuous display of terminal operating conditions
- Word Wrap-Around prevents splitting of words at end of display line
- Continuous, line, and word modes offer flexibility in editing transmit text
- Attractive streamlined metal cabinet gives effective RFI shielding from transmitters

Here Are More DS3100 ASR Specifications that Give You State-of-the-Art RTTY Operation:

- QBF and RY text messages
- Loop and RS 232 RTTY I/O
- Plus or minus CW key output
- 25 pin EIA modem connector
- Half or full duplex
- Upper-lower case ASCII
- All ASCII control codes
- Optional line printer for all codes
- Selectable ASCII parity
- 110 to 9600 baud ASCII
- 45 to 100 baud Baudot
- 1 to 175 WPM
- Morse receive and transmit
- UnShift on space for Baudot
- SYNC idle for RTTY and Morse
- Break key for RTTY
- Tune key for Morse
- Automatic CR-LF @ 120/240 v, 50/60 Hz power
- Custom labeled key tops show control operation
- Copy receive text into transmit buffer
- TX flags allow segmenting of TX buffer
- One year warranty
- Price $1995.00

HAL Communications and
amateur radio serving
the 1980 Winter Olympics
through W.O.R.A.N.
(Winter Olympics Radio
Amateur Network)

HAL COMMUNICATIONS CORP.
Box 365
Urbana, Illinois 61801
217-367-7373

For our European customers, contact: Richter & Co. D3000
Hannover 1 • I.E.C. Intereleco, 6816 Bissone/Lugano • Radioc
Shack Ltd., London NW6 3AY • Erik Torpdahl Telecom, DK 3660
Stenlose Denmark

More Details? CHECK — OFF Page 94

april 1980 7
OWNERS OF REPEATERS MUST BEAR responsibility for what goes out over them, FCC Long Beach Field Office Engineer-In-Charge Larry Guy recently told an Anaheim Amateur Radio Club meeting. His office intends to enforce that regulation. The question arose when Larry, himself K6EZM, spoke to the club on the subject of malicious interference, a topic that’s been particularly hot in southern California. Exactly what enforcement action they’d take wasn’t spelled out, but he did say that, under their interpretation of the rules, regulatory violations committed over a repeater would be treated as if the repeater owner had made them.

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

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

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

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

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

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

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

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

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

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

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

TWO NEW RUSSIAN AMATEUR SATELLITES should be launched and in operation very soon, JRLSBN, secretary of JAMSAT, reports. He says he was told of the forthcoming launch by a high ranking official of the Russian Radiosport Federation. The two satellites, designated OS-4 and "R-44," are both supposed to be checked out and ready to go. This report seems to confirm recent suspicions that unusual 10-meter signals heard from Russia in mid-January were satellite related.

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

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

HAM RADIO has a new Advertising Manager, Craig Clark, NIACH, who will also retain his title of Assistant Publisher in the Ham Radio organization. Jim Gray, WI6U, continues as Assistant Advertising Manager, while Dottie Sargent, KA1BEB, becomes Assistant to the Publisher.
DELTA — the symbol of change—the name of a great new TEN-TEC transceiver. A transceiver for changing times, with new features, performance, styling, size and value.

TOTAL SOLID-STATE. By the world's most experienced manufacturer of hf solid-state amateur radio equipment.

ALL 9 HF BANDS. First new transceiver since WARC. 160-10 Meters including the new hf bands (10, 18 & 24.5 MHz). Ready to go except for plug-in crystals for 18 and 24.5 MHz segments (available when bands open for use).

SUPER RECEIVER. New, low noise double-conversion design, with 0.3 µV sensitivity for 10 dB S+N/N.

HIGH DYNAMIC RANGE. 85 dB minimum to reduce overload possibility. Built-in, switchable, 20 dB attenuator for extreme situations.

SUPER SELECTIVITY. 8-pole monolithic SSB filter with 2.4 kHz bandwidth, 2.5 shape factor at 6/60 dB points. And optional 200 Hz and 500 Hz 6-pole crystal ladder filters. Eight pole and 6-pole filters cascade for 14 poles of near ultimate skirt selectivity. Plus 4 stages of active audio filtering. To sharpen that i-f response curve to just 150 Hz bandwidth.

4-position selectivity switch.

BUILT-IN NOTCH FILTER. Standard equipment. Variable, 200 Hz to 3.5 kHz, with notch depth down to -50 dB. Wipes out interfering carriers or CW.

OFFSET TUNING. Moves receiver frequency up to ±1 kHz to tune receiver separately from transmitter.

“HANG” AGC. For smoother, clearer, receiver operation.

OPTIONAL NOISE BLANKER. For that noisy location, mobile or fixed.

WWV RECEPTION. Ready at 10 MHz.

“S”/SWR METER. To read received signal strength and transmitted standing wave ratio. Electronically switched.

SEPARATE RECEIVER ANTENNA JACK. For use with separate receiving antenna, linear amplifier with full break-in (QSK) or transverters.

FRONT PANEL HEADPHONE AND MICROPHONE JACKS. Convenient.

DIGITAL READOUT. Six 0.3” red LEDs.

BROADBAND DESIGN. For easy operation. Instant band change—no tuneup of receiver or final amplifier. From the pioneer, TEN-TEC.

SUPER TRANSMITTER. Solid-state all the way. Stable, reliable, easy to use. 200 WATTS INPUT. On all bands including 10 meters (with 50 ohm load). High SWR does not automatically limit you to a few watts output. Proven, conservatively rated final amplifier with solid-state devices warranted fully for the first year, and pro-rata for five more years.

100% DUTY CYCLE. All modes, with confidence. 20 minutes max. key-down time. Brought to you by the leader in solid-state finals, TEN-TEC.

QSK — INSTANT BREAK-IN. Full and fast, to make CW a real conversation.

BUILT-IN VOX AND PTT. Smooth, set-and-forget VOX action plus PTT control. VOX is separate from keying circuits.

ADJUSTABLE THRESHOLD ALC & DRIVE. From low level to full output with ALC control. Maximum power without distortion. LED indicator.

ADJUSTABLE SIDETONE. Both volume and pitch, for pleasant monitoring of CW.

SUPER STABILITY. Permeability tuned VFO with less than 15 Hz change per F° change over 40° range after 30 min. warmup—and less than 10 Hz change for 20 Volt AC line change with TEN-TEC power supply.

VERNIER TUNING. 18 kHz per revolution, typical.

SUPER AUDIO. A TEN-TEC trademark. Low IM and HD distortion (less than 2%).

SUPER STYLING. The '80s look with neat, functional layout. “Panelized” grouping of controls nicely human engineered for logical use. New, smaller size that goes anywhere, fixed or mobile (4¾”h x 11¾”w x 15”d).


MODULAR/MASS-TERMINATION CONSTRUCTION. Individual circuit boards with plug-in harnesses for easy removal if necessary. Boards are mailable.

FULL ACCESSORY LINE. All the options: Model 282 200 Hz CW filter $50; Model 285 500 Hz CW Filter $45; Model 286 Power Supply $139; Model 645 Dual Paddle Keyer $85; Model 670 Single Paddle Keyer $34.50; Model 247 Antenna Tuner $69; Model 234/214 Speech Processor & Condenser Microphone $163; Model 215 PC Ceramic Microphone $34.50. Model 283 Remote VOX, Model 287 Mobile Mount, and Model 289 Noise Blanker available soon.

Experience The Notable Change In HF Transceivers, Experience DELTA. See your TEN-TEC dealer or write for full details.
A fresh idea!

Our new crop of tone equipment is the freshest thing growing in the encoder/decoder field today. All tones are instantly programmable by setting a dip switch; no counter is required. Frequency accuracy is an astonishing ± .1 Hz over all temperature extremes. Multiple tone frequency operation is a snap since the dip switch may be remoted. Our SS-32 encode only model is programmed for all 32 CTCSS tones or all test tones, touch-tones and burst-tones.

And, of course, there’s no need to mention our 1 day delivery and 1 year warranty.

TS-32 Encoder-Decoder
- Size: 1.25" x 2.0" x .40"
- High-pass tone filter included that may be muted
- Meets all new RS-220-A specifications
- Available in all 32 EIA standard CTCSS tones

SS-32 Encoder
- Size: .9" x 1.3" x .40"
- Available with either Group A or Group B tones

Frequencies Available:

<table>
<thead>
<tr>
<th>Group A</th>
<th>Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequencies</strong></td>
<td><strong>Frequencies</strong></td>
</tr>
<tr>
<td>67.0 XZ</td>
<td>91.5 ZZ</td>
</tr>
<tr>
<td>71.9 XA</td>
<td>94.8 ZA</td>
</tr>
<tr>
<td>74.4 WA</td>
<td>97.4 ZB</td>
</tr>
<tr>
<td>77.0 XB</td>
<td>100.0 1Z</td>
</tr>
<tr>
<td>79.7 SP</td>
<td>103.5 1A</td>
</tr>
<tr>
<td>82.5 YZ</td>
<td>107.2 1B</td>
</tr>
<tr>
<td>85.4 YA</td>
<td>110.9 2Z</td>
</tr>
<tr>
<td>88.5 YB</td>
<td>114.8 2A</td>
</tr>
</tbody>
</table>

- Frequency accuracy, ± .1 Hz maximum – 40°C to + 85°C
- Frequencies to 250Hz available on special order
- Continuous tone

**Group B**

<table>
<thead>
<tr>
<th>TEST-TONES:</th>
<th>TOUCH-TONES:</th>
<th>BURST-TONES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>697 1209</td>
<td>1600 1850</td>
</tr>
<tr>
<td>1000</td>
<td>770 1336</td>
<td>1650 1900</td>
</tr>
<tr>
<td>1500</td>
<td>852 1477</td>
<td>1700 1950</td>
</tr>
<tr>
<td>2175</td>
<td>941 1633</td>
<td>1750 2000</td>
</tr>
<tr>
<td>2805</td>
<td></td>
<td>1800 2100</td>
</tr>
</tbody>
</table>

- Frequency accuracy, ± 1 Hz maximum – 40°C to + 85°C
- Tone length approximately 300ms. May be lengthened, shortened or eliminated by changing value of resistor

Wired and tested: TS-32 $59.95, SS-32 $29.95

Communications Specialists
426 West Taft Avenue, Orange, California 92667 (800) 854-0547 / California: (714) 998-3021
40-meter transceiver for low-power operation

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

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

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

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

receiver

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

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

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

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

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

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

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

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

VFO

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

For a change of pace try operating QRP in the 40-meter Amateur band. What is QRP? It's an operating mode that uses the minimum amount of radio-frequency power that will sustain communications. Some QRP stations use less than 1 watt of input power, sometimes even less than 500 milliwatts. Others use up to, say, 5 or 10 watts. The idea in the QRP world is to see how far you can conduct reliable radio communications with the least amount of radiated power. This article provides construction information on a QRP transceiver that will do a good job on 40 meters with only 1 watt output. The receiver is a notch above most circuits using the direct-conversion process. QRP operation on the Amateur bands today is a real challenge, especially on 40 meters. The circuit and information by WB5DJE will get you started. Good luck and have infinite patience. Editor.
fig. 1. Schematic of the QRP transceiver. The receiver has some novel features not found in most direct-conversion circuits. The VFO is a Seiler type that provides an output between 3500-3590 kHz. On receive the VFO frequency is used directly; on transmit it's doubled. The transmitter provides 1 watt output and uses transistor keying. As an added operating aid, a sidetone circuit is also included.
which seemed to work very well. However, when I keyed the transmitter it shifted about 650 Hz. After working on shielding and buffering, and still stuck with a 300-Hz shift, I threw it out and designed the Seiler, which, without any shielding, shifts only about 25 Hz when the transmitter is keyed and sounds as if it is crystal controlled.

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

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

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

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

\[
L = \frac{I - \frac{\omega_0}{\omega_f}}{\left(\frac{\omega_0}{\omega_f}\right)^2 (\Delta C)}
\]

where \( L \) = inductance (henries)
\( \omega_0 = 2\pi f_0, f_0 \) being the lowest frequency of interest (Hz)
\( \omega_f = 2\pi f_1, f_1 \) being the highest frequency of interest (Hz)
\( \Delta C \) = change in capacitance available (farads)

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

\[
C_o = \frac{I}{\left(\frac{\omega_0}{\omega_f}\right)^2} \quad \text{and} \quad C_I = C_o - \Delta C
\]

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

**transmitter**

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

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

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

Driver Q304 operates class C with some self bias, which should not be changed. The bias selected pro-
vides a clean optimum output for the drive level in use. T302 is tuned by C311 and provides a low-impedance drive to power amplifier Q305.

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

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

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

construction

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

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

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

*Many components for this transceiver are available from Radiokit, Box 429, Hollis, New Hampshire 03049.
tered the markings with dry transfers. I then sprayed an adhesive onto the front of the Mylar and attached it to the back of the Plexiglas. This prevents finger-nails from damaging the dial markings. To make the pointer, I cut a slit with a saw blade into a thin aluminum plate, which fits behind the dial, and I back-lighted the slit with a green LED. The dial mounts with two screws onto the Jackson Drive (a ball bearing 8:1 reduction drive).

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

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

bibliography


Antique Radio Collector

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

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

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

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

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

Paul C. Crum, W9LC
Chicago, Illinois
JE600 HEXADECIMAL ENCODER KEYBOARD

**FEATURES**
- **Six digit segmented LED displays** for each key, allow easy reading of 16 digits.
- **Compact circuit** sized to fit in a 3x5x3 in. enclosure.
- **Three digit input** is supported by a single key.
- **6-digit input** is supported by a single key.
- **Compact circuit** sized to fit in a 3x5x3 in. enclosure.
- **Three digit input** is supported by a single key.
- **6-digit input** is supported by a single key.

**Digital Alphanumeric LED Displays**

**FEATURES**
- **6-key alphanumeric display** for each key, allow easy reading of 16 digits.
- **Compact circuit** sized to fit in a 3x5x3 in. enclosure.
- **Three digit input** is supported by a single key.
- **6-digit input** is supported by a single key.
- **Compact circuit** sized to fit in a 3x5x3 in. enclosure.
- **Three digit input** is supported by a single key.
- **6-digit input** is supported by a single key.

**JE610 62-Key ASCII Encoded Keyboard**

**FEATURES**
- **60-key generate the full 128 characters, upper and lower case ASCII.**
- **Fultly buffered.**
- **User defined keys provided for custom applications.**
- **Portability for upper case only.**
- **Compact circuit** sized to fit in a 3x5x3 in. enclosure.
- **Three digit input** is supported by a single key.
- **6-digit input** is supported by a single key.
- **Compact circuit** sized to fit in a 3x5x3 in. enclosure.
- **Three digit input** is supported by a single key.
- **6-digit input** is supported by a single key.

**Hickok LX303 Portable LCD Digital Multimeter**

**FEATURES**
- **3-digit alphanumeric display** for each key, allow easy reading of 16 digits.
- **Compact circuit** sized to fit in a 3x5x3 in. enclosure.
- **Three digit input** is supported by a single key.
- **6-digit input** is supported by a single key.
- **Compact circuit** sized to fit in a 3x5x3 in. enclosure.
- **Three digit input** is supported by a single key.
- **6-digit input** is supported by a single key.

**Price**

- **JE600:** $59.95
- **JE300:** $39.95
- **JE610:** $79.95
- **Hickok LX303:** $74.95

**More Details? Check—OFF Page 94**

**April 1980**
recent developments in circuits and techniques for high-frequency communications receivers

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

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

- Good input selectivity
- Ultralinear amplifiers
- High level mixers
- Low distortion Thompson VHF crystal filters
- Choice of AGC
- Linear detectors
- New low noise synthesizers
- Microprocessor support

input selectivity

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

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

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

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

ultralinear amplifier

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

high level mixers

Even without the use of a preamplifier, the mixer has always been the weakest link in the chain because the mixing action requires a prescribed non-linearity and the third-order term will always be apparent. A number of efforts were made to build an
fig. 3. Vhf input filter covers the range from 118 to 136 MHz. Tuning capacitors are 5-55 pF trimmers. Selectivity curve is shown below in fig. 4.

active high dynamic mixer like the one shown in fig. 6.6.7 These mixers are extremely sensitive to load changes and cannot be easily built totally symmetrically at the higher frequencies. The fet version of these mixers recommended by Siliconix requires fairly high local-oscillator drive. Since the input of these fets is purely capacitive, the cable requires a termination into 50 ohms and, ultimately, the same drive power as a passive mixer.

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

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

Thomson vhf crystal filters

Immediately following the mixer and its amplifier, it’s necessary to provide as much selectivity as possible. The type of filter and its bandwidth depends on the receiver’s application. In some cases, such as fast data transmission, it is desirable to use Thomson-type9 crystal filters with bandwidths from ±3 kHz to ±8 kHz. The basic disadvantage of a Thomson filter is skirt selectivity, and it may not be possible to obtain 80 dB skirt selectivity 60 kHz away from the center frequency. In those cases where perfect pulse response and group delay performance are required, a higher second i-f between 200 kHz and 500 kHz must be chosen.

Thomson filters have been recently developed and are available commercially.9 Such filters exhibit less than 3 dB attenuation even with 10 crystal resonators and have an intercept point in the vicinity of 35 dBm. Applications that require a higher intercept point should be based on helical resonators. These reso-

*Communications Consulting Corporation, 52 Hillcrest Drive, Upper Saddle River, New Jersey 07458.
nators can have $Q$ of 1000 or more and will not introduce any noticeable distortion.

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

**agc choice**

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

**linear detectors**

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

![fig. 6. Circuit for a high-level balanced fet mixer. Local oscillator requirement is approximately 1.5 volts rms.](image)

![fig. 7. High-level mixer stage used in the Rohde & Schwarz HF1030 communications receiver offers noise figure of 2 dB with intercept point at +35 dBm.](image)
should be driven from an impedance of less than 200 ohms which can easily be provided by using an emitter follower.

**low noise synthesizers**

I previously discussed the impact of nonlinear effects like intermodulation distortion of second, third, and higher order, and will now consider reciprocal mixing or blocking. The so-called blocking effect (which is commonly confused with receiver desensitization) is a result of poor sideband performance of the local oscillator.\textsuperscript{11,12} Synthesizers are traditionally built with a compromise of three parameters in mind: noise sideband performance; spurious response; and settling time. Some military applications require a switching time of less than 10 microseconds, but practical applications can live with about 1 millisecond switching time. Most current synthesizers are multiloop synthesizers using the techniques described in references \textsuperscript{13, 14, and 15}. The recently developed digiphase system\textsuperscript{16} or fractional division \textit{N} system offers new capabilities and substantially higher resolution. The digiphase system is used by Hewlett-Packard\textsuperscript{17} and Racal\textsuperscript{18} and offers a number of advantages. While the presently published digiphase systems suffer from the noise sideband limitations of this technique, an improved version of this would use the phase locked loop not only as a control mechanism for almost infinite resolutions but also for suppressing these sidebands. If it were possible to build a VCO and use it with a very narrow loop bandwidth of less than 500 Hz, the unwanted sidebands of the digiphase system could be kept under control; if the tuning range of each oscillator could be kept extremely small, the added noise from the tuning diode would not have to be taken into consideration. Fig. 9 shows such an oscillator where the tuning range is held to about 1 MHz while the coarse steering is done by a "look-up table" under microprocessor control. Such an oscillator exhibits a noise figure of about 90-100 dB/Hz \textsuperscript{1} kHz from the carrier and 140 dB 20 kHz from the carrier.

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

**microprocessor support**

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

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

**conclusion**

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

**references**

log-periodic fixed-wire beams
for 40 meters

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

Because the QRN on 40 meters was generally less than that on 75 meters during the DX window (1000-12000 UTC), I decided to remove the three-element 75-meter beam1 and replace it with a similar beam for 40 meters, also using an optimum LP design.

40-meter LP design

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

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

By George E. Smith, W4AEO, in collaboration with Paul A. Scholz, W6PYK. Mr. Smith's address is 1816 Brevard Place, Camden, South Carolina 29020. Mr. Scholz's address is 12731 Jimeno Avenue, Granada Hills, California 91344

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

TOTAL BOOM LENGTH
--/ 1
122 METERS
(71.8 FT.)
FEED
TO 4:1 BALUN
OR
TWO WIRE TUNED FEEDER
BEAM

VSWR

FREQUENCY, MHz

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

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

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

test antennas

For the 40-meter tests I used four antennas for direct comparison with the 40-meter west beam illustrated in figs. 1 and 2. The comparison antennas were:
1) a 40/75 meter trap dipole sloper suspended over a pond;
2) a four-band Hustler trap vertical mounted on the roof of my house at about 9 meters (35 feet) above ground. Radial elements were used in the ground system;
3) the dipole shown in fig. 2;
4) a 40-meter LP-Yagi consisting of seven elements directed north.

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

40-meter north beam

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

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

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

construction notes

The construction information presented in part 1 and its references apply to the 40-meter designs shown here.
fig. 2. Author’s 40-meter LP west beam using four driven elements and a director. A dipole was added for comparison in the 40-meter tests described in the text.

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

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

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

Feedline considerations. Little information has been published on the spacing of the two-wire intra-array feedline for high-frequency LP wire beams, so I tried various spacing distances from 3.75 to 15 cm (1 ½ to 6 inches). All LPs constructed here since 1975, including the 75- and 40-meter arrays described, have used a feedline spacing of 3.75 cm (1 ½ inches) and no. 16 (1.3 mm) insulated wire.

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

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

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

*Saxton Products, Inc., 215 North Route 303, Congers, New York 10920 (Catalog no. 2500 or C-4-500-6).
inch) and has molded insulators spaced every 153 mm (6 inches). It’s available in standard lengths of 30.5, 76, and 153 meters (100, 250, and 500 feet).

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

W6PYK mentions the requirement of air dielectric “to be used to prevent excessive phase shift within the array feed. Any other dielectric has the effect of increasing the spacing factor, α, in a complex manner.”

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

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

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

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

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

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

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

**a higher-gain LP**

Should you have the available space and necessary supports and want a 40-meter wire beam having a gain of 10 dB over a dipole, you can build a monoband LP giving this gain. Referring to W6PYK’s article table 1 (B = 1), and using τ = 0.972 – 0.978 and σ = 0.180 – 0.181, will give about maximum gain for an LP.

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

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

**summary of 75- and 40-meter LP antenna tests**

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

At my location, the last 75-meter LP, designed for 3808 kHz with τ = 0.94 and σ = 0.175 (reference 1), appeared to be the best of the various beams tested. Second best were the first 75-meter LPs and the
fig. 3. Seven-element LP for 40 meters with improved performance. You'll need an open space about 30 meters (100 feet) wide by about 46 meters (150 feet) long in the desired beam direction.

Yagi. These were compared with the more common antennas.

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

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

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

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

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

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

References


Low cost, high performance, that’s the DM-700. Unlike some of the hobby grade DMMs available, the DM-700 offers professional quality performance and appearance at a hobbyist price. It features 26 different ranges and 5 functions, arranged in a convenient, easy to use format. Measurements are displayed on a large 3½ digit, ½ inch high LED display, with automatic decimal placement, automatic polarity, and overrange indication. You can depend upon the DM-700, state-of-the-art components such as a precision laser trimmed resistor array, semiconductor band gap reference, and reliable LSI circuitry insure lab quality performance for years to come. Basic DC volts and ohms accuracy is 0.1%, and you can measure voltage all the way from 100 μV to 1000 volts, current from 0.1 μA to 2.0 amps and resistance from 0.1 ohms to 20 megohms. Overload protection is inherent in the design of the DM-700, 1250 volts, AC or DC on all ranges, making it virtually goof proof. Power is supplied by four “C” size cells, making the DM-700 portable, and, as options, a nickel battery pack and AC adapter are available. The DM-700 features a handsome, jet black, rugged ABS case with convenient retractable tilt base. All factory wired units are covered by a one year limited warranty and kits have a 50 day parts warranty.

Order a DM-700, examine it for 10 days, and if you’re not satisfied in Every way, return it in original form for a prompt refund.

Specifications
DC and AC volts: 100 μV to 1000 Volts, 5 ranges
DC and AC current: 0.1 μA to 2.0 Amps, 5 ranges
Resistance: 0.1 to 20 megohms, 6 ranges
Input protection: 1250 volts AC/DC all ranges fuse protected
Input impedance: 10 megohms, DC/AC volts
Display: 3½ digits, 0.5 inch LED
Accuracy: 0.1% basic DC volts
Accuracy: 4 “C” cells, optional nickel pack, or AC adapter
Size: 6”W x 3½”H x 6”D
Weight: 2 lbs with batteries

Prices
DM-700 wired + tested $99.95
DM-700 kit form 79.95
AC adapter/charger 9.95
Nicad pack with AC adapter/charger 19.95
Probe kit 3.95

The CT-70 breaks the price barrier on lab quality frequency counters. No longer do you have to settle for a kilometric or poor performance, the CT-70 is completely wired and tested, features professional quality construction and specifications, plus is covered by a one year warranty. Power for the CT-70 is provided by four AA size batteries or 12 volts, AC or DC, available as options are a nickel battery pack, and AC adapter. Three selectable frequency ranges, each with its own pre-amp, enable you to make accurate measurements from less than 10 Hz to greater than 600 MHz. All switches are conveniently located on the front panel for ease of operation, and a single input jack eliminates the need to change cables as different ranges are selected. Accurate readings are insured by the use of a large 0.4 inch seven digit LED display, a 1.0 ppm TCXO time base and a handy LED gate light indicator.

The CT-70 is the answer to all your measurement needs. In the field, in the lab, or in the ham shack. Order yours today, examine it for 10 days, if you’re not completely satisfied, return the unit for a prompt and courteous refund.

Specifications
Frequency range: 10 Hz to over 600 MHz
Sensitivity: less than 10 μV to 150 μV
Stability: 1.0 ppm, 20-40°C, 0.05 ppm/°C TCXO crystal time base
Display: 7 digits, LED, 0.4 inch height
Input protection: 50 VAC to 60 kHz, 10 VAC to 600 MHz
Input impedance: 1 megohm, 6 and 60 mHz ranges 50 ohms.
600 MHz range
Power: 4 AA cells, 12 V AC/DC
Gate: 0.1 sec and 1.0 sec LED gate light
Decomposition: Automatic, all ranges
Size: 5”W x 1½”H x 5½”D
Weight: 1 lb with batteries

Prices
CT-70 wired + tested $99.95
CT-70 kit form 79.95
AC adapter 9.95
Nicad pack with AC adapter/charger 19.95
Telescopic whip antenna, BNC plug 7.95
Tilt ball assembly 3.95

Ramsey Electronics
BOX 4072, ROCHESTER, N.Y. 14610
PHONE ORDERS CALL (716) 271-6487

More Details? CHECK — OFF Page 94

April 1980 31
homebrew
hardline-to-uhf
coaxial cable connectors

Easy method for making your own coaxial connectors for CATV cable

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

assembly

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

installation

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

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

By Bud Weisberg, K2YOF, 62 Harriet Avenue, Bergenfield, New Jersey 07621
The final connection should be waterproofed with heat-shrink tubing or Mylar tape wrap. Although this is unconfirmed, I expect that the compression union will add little or no impedance disturbance to the line, because the union bore conveniently approximates the shield ID for its entire length. Compression unions are available in straight and reducing configurations, from 1/4 inch OD to 5/8 inch OD in 1/8-inch steps, suggesting that similar connectors could be made for other hardline sizes.

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

**Bibliography**


high-frequency diversity receiver from the 1930s

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

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

the monster

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

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

diversity reception

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

By John J. Nagle, K4KJ, 12330 Lawyers Road, Herndon, Virginia 22070
effects of multipath fading by receiving the same signal on two or more diverse, or different, antenna-receiver combinations with a means of choosing the combination with the strongest signal.

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

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

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

brief history of diversity reception

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

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

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

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

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

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

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

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

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

fig. 4. The diversity receivers used by RCA Communications, Inc., Riverhead, Long Island, New York. Notice the clipboards in the center; these held the receiver log. The log clipped at the top, in the usual way, indicates that receiver is in use. The log held by the corner indicates that that receiver is on standby. The index file on each receiver gives dial settings for commonly used frequencies. (Photo courtesy Robert McGraw, W2LYH, and Harlod Moore.)
differences between this and the prototype appear to be cosmetic. I'll briefly mention these for the benefit of collectors and historians.

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

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

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

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

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

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

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

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

**fig. 9. Simplified schematic of the Hallicrafters model DD-1 dual diversity receiver.**
upper send position of the lever-type switch has a spring return for a quick transmit; the lower send position has a holding position. Separate contacts on the switch are wired to terminals on the rear apron, which may be used to turn on the transmitter. These are conveniences not found on many receivers today.

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

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

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

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

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

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

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

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

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

The off-frequency rejection system. This circuit was described by McLaughlin and Miles9 a month before the DD-1 itself. The basic schematic is shown in fig. 13. To quote the author:

It will be observed that coupling is provided by the mutual inductance, M, between L2 and L3 and the capacitive coupling, C3. Mutual inductance, M, and the capacity coupling, C3, are so chosen that at some determined frequency off resonance the voltage induced through M is opposite in sign to the voltage induced in C3 and will therefore cancel it out. In other words, no coupling exists at this particular frequency. In order to achieve infinite rejection at this undesired frequency, correction for power factor in the circuit must be made. Resistor R1 in the diagram is the power factor corrector. The rejector control, C3, can be made variable and tuned over a fairly wide frequency range of rejection without noticeable interlocking effect on the i-f. For proper operation, resistor R1 should be variable; but once the infinite rejection point has been found, it need not be touched again...

[Fig. 14 shows the response of a single rejector circuit set to reject a frequency 4.5 kHz off resonance. The rejector slot, as is apparent, goes to infinity at this frequency and its action is very similar to the rejection in a crystal filter...]

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

fig. 14. Frequency response of a single rejector circuit set for infinite attenuation at 4.5 kHz above the resonant frequency (from reference 9).
so-called single-sideband mixer used in the microwave region today.

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

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

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

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

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

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

**Fig. 16.** Same as fig. 15 except that rejector circuits are 5 kHz above and below resonance (from reference 9).
The method used by the commercials is to feed the output of the i-f amplifier for each channel into its own diode detector without using a BFO. Each detector output becomes a series of dc pulses, in Morse code, from which all phase information has been removed. The detector outputs are then summed in a conventional summing network; as this sum is the total of all channels, it is relatively fade-free. The summed output is used to key a local audio oscillator, which the operator hears in his headset.

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

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

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

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

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

closing comments

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

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

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

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

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

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

acknowledgments

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

references

capacitance-measurement accessory for your frequency counter

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

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

This is a modification of the W6ALF1 circuit using the 555 timer IC in the one-shot mode to produce an output pulse of length proportional to the capacitance used in the RC timing network. The pulse is used to gate a transistor switch, which passes 1-MHz pulses obtained from the counter time base. The counter displays the number of 1-MHz pulses passed through during the timing period.

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

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

circuit operation

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

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

The delay timer, therefore, inhibits the count for a

By R. H. Griffith, W2ZUC, 476 Keenan Avenue, Ft. Myers, Florida 33907
Cl, C2, C2, C3, C5

Cl, C4, C6

C2

disc ceramic

crystal ceramic

miniature ceramic trimmer

tantalum

gating pulse in

1-MHz pulses in

gated 1-MHz pulses to counter

S1

range switch, dpdt toggle

1/4-watt, 5 per cent carbon composition;
pots 10 mm (0.4 inch) square

PC-board mount

fig. 1. Schematic of the capacitance-measurement accessory

for use with a frequency counter. Circuit is a modification of

that in reference 1. It uses a second NE-555 timer IC, which

allows the count to be zeroed when no capacitor is connected

to the test terminal. Circuit works with TTL- or CMOS-level sig-

nals, requiring only a 1-second gating pulse and 1-MHz clock

pulses from the counter.

time interval that is adjustable by R10 and C3. That

interval is made equal to the open-circuit time of U1 —

the pulse length that occurs when no external ca-

pacitor is connected to the test terminals. The delay

circuit is not needed on the high range. S1B grounds

Q2 emitter on that range.

The diode in Q3 emitter circuit ensures that the

transistor is turned off when either CR1 or CR2

cathode is low. Pin 3 of the 555 goes to less than 100

millivolts when low; but when this voltage is added

to the drop across either CR1 or CR2, Q3 base may

be sufficiently positive to cause some conduction in

Q3.

Bypass capacitors C2 and C5 were included for

good design practice. No jitter on the timer output

pulse was seen using a 15-MHz scope. Capacitor C4

suppresses a vhf oscillation in the counter input circuit

when the tester is connected but not in use.

Battery voltage is not at all critical. The unit works

over a range of 5-15 volts. Stability was slightly bet-

ter at 9 volts than at 5 volts, but no noticeable im-

provement occurred at 13.8 volts. I used the 9-volt

battery for convenience. It should last a long time in

this service. It can be checked easily by loading with

a 470-ohm resistor. If its voltage drops below 8 volts

after a few seconds, replace the battery.

component selection

The total resistance needed for the timer circuit

can be calculated from \( t = \frac{1}{1.1RC} \). When \( t = 1 \) sec-

ond and \( C = 1 \) pF, \( R = 909 \) kilohms. The series

string, R3, R4 and R5, allows adjustment from about

880 to 930 kilohms. For the high range, which is one

times the low range, \( R \text{ calculated} = 9.09 \) kilohms. R6 and R7 provide adjustment from 8.2 kilo-

ohms to 9.2 kilohms.

The low range will allow measurement from typi-

cally 2 or 3 pF to nearly 1 \( \mu \)F on a six-digit counter, or

up to 0.1 \( \mu \)F on a five-digit counter, provided the

counter will resolve 1 Hz. The high range is useful

from about 0.01 \( \mu \)F (count of 100) to over 50 \( \mu \)F.

The resistor string for the delay timer uses the

same values as the main timer. The two should track

reasonably well with changes in temperature and

humidity.

There’s no point in using precision resistors in this

circuit except for improved long-term stability that

might be obtained. Likewise, multiturn pots aren’t

really needed.

Battery voltage change from 8.0-9.5 volts made

less than 0.1 per cent change in counter reading.

Transistor Q1 can be any medium-speed switch,

but Q2 and Q3 should be fast-switching. The

2N2369A works well at low collector current. Some

2N3904s tried as Q2 and Q3 were found not to switch

reliably.

Capacitor C1 was the smallest value that allowed

reliable triggering of the 555s. Pin 2 of the 555 should

be driven close to ground; but if it’s held low too

long, the timer will be fired again when the output

pulse is short.

counter interface

This accessory unit was built to be used with a

Heathkit IB-1102 counter. A pin jack and a BNC con-

nector were mounted on the counter back panel,

from which unshielded leads were connected to J4-1

and J4-3 respectively on the timebase-board socket,

which are the gate (1-second or 1-millisecond) and 1-
Accessory unit in use with the Heath IB 1102 counter. The extra BNC socket to the right of the counter MHz-kHz switch is for input to a divide-by-10 scaler.

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

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

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

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

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

As a pulse counter or totalizer, the displayed digits are the same regardless of the MHz-kHz switch position if the number of pulses is less than allowed by the gate time. For example, a 910-pF 5 per cent mica cap measured 877 pF on the low-C range using a 1-second gate (1-MHz position) and exactly the same using a 1-millisecond gate (1-kHz position).

This is an interesting observation, because it shows that the pulse length is essentially independent of the duty cycle of the 555 timer. But a 1500-pF cap, which measured 1506 pF using 1-second gate, caused a display of 970 using the 1-millisecond gate. The reason for 970 instead of 1000 is that the delay circuit suppressed the first 30 pulses, and the shorter gate time eliminated counting the last 506 pulses.

**construction**

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

A single 16-pin socket accommodates both 555s. The board fits inside the 57 x 57 by 100 mm (2 1/4 by 2 1/4 by 4 inch) aluminum box. The dpdt HI-LO range switch, momentary NO pushbutton switch, and the banana jacks are on the face of the box. A length of RG-58/U comes through a grommet, and a UG-88/U BNC connector on its end goes to the counter input jack. A single angle bracket holds the board in position. The 9-volt battery fits at the end of the board; it’s held in place by a bit of polystyrene foam.

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

**calibration and use**

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

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

**checks for**

**low-range operation**

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

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

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

**high-range checks**

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

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

**final checks**

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

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

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

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

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

**reference**


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

TR-7800 FEATURES:

- 15 multifunction memory channels, easily selectable with a rotary control
  - M1-M13: memorize frequency and offset (±600 kHz or simplex)
  - M14: memorize transmit and receive frequencies independently for nonstandard offset
  - M0...priority channel, with simplex, ±600 kHZ, or nonstandard offset operation.

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

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

- Extended frequency coverage
  143.900-148.995 MHz, in switchable 5-kHz or 10-kHz steps

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

- Front-panel keyboard
  For frequency selection, transmit offset selection, memory programming, scan control, and selection of autopatch encoder tones

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

- Up/down manual scan
  Entire band (5-kHz or 10-kHz steps) and memories, with UP/DOWN microphone (standard)

- Repeater reverse switch
  Handy for checking signals on the input of a repeater or for determining if a repeater is "upside down"

- Separate digital readouts
  To display frequency (both receive and transmit) and memory channel.

- Selectable power output
  25 watts (HI)/5 watts (LOW)

- LED bar meter
  For monitoring received signal level and RF output.

- LED indicators
  To show: ±600 kHz, simplex, or -600 kHz transmitter offset, BUSY channel, ON AIR.

- TONE switch
  To activate subaudible tone module (not Kenwood-supplied)

- Compact size
  Depth is reduced substantially.

- Mobile mounting bracket
  With quick release latches.

NOTE: Price specifications subject to change without notice and obligation

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

MATCHING ACCESSORY:
- KPS-7 fixed-station power supply
"Cents-ability" in an HF rig.

A quality 160-10 meter SSB/CW transceiver

TS-520SE

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

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

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

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

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

Other accessories not shown:
- CW-520 500-Hz CW filter
- AT-200 antenna tuner/ SWR and RF power meter/ antenna switch
- TL-922A linear amplifier
- SM-222 Station Monitor with BS-5 pan display module option
- MC-50 dynamic desk microphone
- MC-355 noise-cancelling, high-impedance microphone
- HS-5 and HS-4 headphones
- PC-1 phone patch
- HC-10 world digital clock
600-MHz prescaler for use with electronic counters

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

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

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

design

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

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

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

The schematic of the prescaler is shown in fig. 3. To achieve a higher input impedance in the hf front end, the amplifier has a fet input. The RCA 3028 differential amplifier is used as an amplifier and limiter with a gain of approximately 30 dB. The sensitivity of the hf input is shown in fig. 4 and input impedance in table 2. The output of the amplifier is a limited sine-wave but not directly compatible with TTL. The fet at the amplifier output converts the signal to a TTL level. This signal isn't divided, so the 74S86 gates the signal to the output buffer, completing the hf section.

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

<table>
<thead>
<tr>
<th>frequency (MHz)</th>
<th>magnitude (ohms)</th>
<th>phase (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>98.6</td>
<td>-16.3</td>
</tr>
<tr>
<td>80</td>
<td>85.4</td>
<td>-20.5</td>
</tr>
<tr>
<td>100</td>
<td>80.7</td>
<td>-21.8</td>
</tr>
<tr>
<td>200</td>
<td>58.7</td>
<td>-20.4</td>
</tr>
<tr>
<td>300</td>
<td>41.1</td>
<td>-13.3</td>
</tr>
<tr>
<td>400</td>
<td>41.2</td>
<td>+14.0</td>
</tr>
<tr>
<td>500</td>
<td>53.8</td>
<td>+33.2</td>
</tr>
<tr>
<td>600</td>
<td>91.7</td>
<td>+29.3</td>
</tr>
</tbody>
</table>

By Thomas Cefalo, Jr., WA1SPI, 29 Oak Street, Winchester, Massachusetts 01890
fig. 1. (top). Sensitivity of the vhf and uhf ranges.

fig. 2. (center). Functional block diagram of the 600-MHz prescaler. Three separate amplifiers are used, one for direct counting and two for inputs to be prescaled.

fig. 3. (bottom). Prescaler schematic: circuit was constructed on a PC board. Power requirements are 15 Vdc at 35 mA and 5 Vdc at 325 mA. L1 is six turns no. 30 (0.6-mm) on 3B ferrite bead.

---

**fig. 2**

**fig. 3**
fig. 4. Measured sensitivity of the high-frequency range.

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

table 2. VHF input impedance.

<table>
<thead>
<tr>
<th>frequency (MHz)</th>
<th>magnitude (ohms)</th>
<th>phase (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>54</td>
<td>-2</td>
</tr>
<tr>
<td>10</td>
<td>54</td>
<td>0</td>
</tr>
<tr>
<td>20</td>
<td>52</td>
<td>0</td>
</tr>
<tr>
<td>30</td>
<td>51</td>
<td>+3</td>
</tr>
<tr>
<td>40</td>
<td>51</td>
<td>+7</td>
</tr>
<tr>
<td>50</td>
<td>52</td>
<td>+8</td>
</tr>
<tr>
<td>60</td>
<td>54</td>
<td>+10</td>
</tr>
</tbody>
</table>

Table 3. HF input impedance.

<table>
<thead>
<tr>
<th>frequency (kH)</th>
<th>magnitude (ohms)</th>
<th>phase (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>12,600</td>
<td>-30</td>
</tr>
<tr>
<td>600</td>
<td>11,000</td>
<td>-34</td>
</tr>
<tr>
<td>700</td>
<td>11,000</td>
<td>-36</td>
</tr>
<tr>
<td>1000</td>
<td>10,000</td>
<td>-39</td>
</tr>
<tr>
<td>900</td>
<td>9,800</td>
<td>-46</td>
</tr>
<tr>
<td>1000</td>
<td>9,000</td>
<td>-50</td>
</tr>
<tr>
<td>2000</td>
<td>5,300</td>
<td>-62</td>
</tr>
<tr>
<td>3000</td>
<td>3,000</td>
<td>-69</td>
</tr>
<tr>
<td>4000</td>
<td>2,900</td>
<td>-74</td>
</tr>
<tr>
<td>5000</td>
<td>2,300</td>
<td>-76</td>
</tr>
<tr>
<td>6000</td>
<td>2,000</td>
<td>-78</td>
</tr>
</tbody>
</table>

Acknowledgment

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

Ham Radio
With the introduction of the 5510 DSI has filled a long standing void in the frequency counter market place. You now have the choice of selecting a 512 MHz model 5500 for $110 or for only $30.00 more you can buy an 8 digit 1 GHz counter model 5510. With this 1 GHz capability, the new world of 960 MHz is immediately available to you. Both the 5500 and 5510 are available with a rechargeable battery pack which includes the AC adapter and battery charger for one low price. Whether you select the 5500 or the 5510, you will receive the best price to quality features ratio in the industry. No wonder DSI has become one of the world's largest manufacturers of freq. counters.

**1.2 GHz Only $199.95**

10 MHz Proportional Oven
- .2 PPM 10° to 40° C Time Base
- .1 Hz Resolution to 50 MHz.
- External 10 MHz inputs outputs.
- 9 Bright .5 inch LED Readouts.
- 100% Factory Tested
- Kits 95% Factory Assembled.
- 50 Ohm, 1 Meg, BNC Inputs
- 10 MV Sensitivity at 250 MHz Typ.

Whether you select a 5600, 5612 Kit with 95% of the assembly completed by DSI, or select a factory wired and calibrated frequency counter, you can count on DSI to solve all those difficult bench or field problems from measuring audio signals to checking a 960 MHz mobile radio (model 5612), servicing a VTR, trouble shooting a PLL signal in a TV or FM radio, etc. The 5600 or 5612 has the sensitivity and accuracy to meet any FCC landmobile, broadcast, RF, or telecommunications requirements. DSI offers a 10 HR rechargeable battery pack (BA56) option, and an audio multiplier (AM56) which will allow you to resolve a 1/1000 Hz signal in one second. DSI 5600 series offers just the right instrument for all your communication RF, TV servicing and industrial testing needs.

**FOR INFORMATION — DEALER LOCATION — ORDERS — OEM CALL 800-854-2049 CALIFORNIA RESIDENTS CALL 800-542-6253**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
<th>Frequency Range Typ</th>
<th>Accuracy Over Temperature</th>
<th>Sensitivity Typ</th>
<th>Number of Resolvers</th>
<th>Power Requirements</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>5600A-Kit</td>
<td>$169.95</td>
<td>50Hz-550MHz</td>
<td>Proportional Oven</td>
<td>12-25mV</td>
<td>9</td>
<td>115 VAC or 12.2-14.5 VDC</td>
<td>3 1/8&quot; x 9 1/4&quot; x 9</td>
</tr>
<tr>
<td>5600A-Wired</td>
<td>$199.95</td>
<td>50Hz-550MHz</td>
<td>Proportional Oven</td>
<td>12-25mV</td>
<td>9</td>
<td>115 VAC or 12.2-14.5 VDC</td>
<td>3 1/8&quot; x 9 1/4&quot; x 9</td>
</tr>
<tr>
<td>5612Kits</td>
<td>$199.95</td>
<td>50Hz-1.2GHz</td>
<td>Proportional Oven</td>
<td>12-25mV</td>
<td>9</td>
<td>115 VAC or 12.2-14.5 VDC</td>
<td>3 1/8&quot; x 9 1/4&quot; x 9</td>
</tr>
<tr>
<td>5612BAC Wired</td>
<td>$239.95</td>
<td>50Hz-1.2GHz</td>
<td>Proportional Oven</td>
<td>12-25mV</td>
<td>9</td>
<td>115 VAC or 12.2-14.5 VDC</td>
<td>3 1/8&quot; x 9 1/4&quot; x 9</td>
</tr>
<tr>
<td>5500 Wired</td>
<td>$108.95</td>
<td>50Hz-512MHz</td>
<td>TCXO</td>
<td>12-25mV</td>
<td>8</td>
<td>115 VAC or 12.2-14.5 VDC or NICAD PAK</td>
<td>1 1/8&quot; x 5&quot; x 5 1/4&quot;</td>
</tr>
<tr>
<td>5510 Wired</td>
<td>$139.95</td>
<td>50Hz-1GHz</td>
<td>Proportional Oven</td>
<td>12-25mV</td>
<td>8</td>
<td>115 VAC or 12.2-14.5 VDC or NICAD PAK</td>
<td>1 1/8&quot; x 5&quot; x 5 1/4&quot;</td>
</tr>
</tbody>
</table>

*With AC-9 Adapter

Factory wired units carry 1 year limited warranty kits carry a 90 day limited warranty.
Prices and/or specifications subject to change without notice or obligation.

**TERMS:** MC — VISA — AE — CHECK — M.O. — COD in U.S. Funds. Please add 10% to a maximum of $10.00 for shipping, handling and insurance. Orders outside of USA & Canada, please add $20.00 additional to cover air shipment. California residents add 6% Sales Tax.

**5612 Kit** ........................................ 199.95
**5612 Wired** ...................................... 239.95
**5600A Kit** ........................................ 199.95
**5600A Wired** ..................................... 199.95
**BA56 Rechargeable** .............................. 29.95
**10 Hr. Bat. Pack** ................................. 29.95
**AM-56 Audio Multiplier** ........................ 34.95

**5510 Wired** ....................................... 139.95
**5500 Wired** ....................................... 109.95
**5510/BAC Wired** .................................. 164.95
**5510/BAC Wired** .................................. 134.95

**TERMS:** MC — VISA — AE — CHECK — M.O. — COD in U.S. Funds. Please add 10% to a maximum of $10.00 for shipping, handling and insurance. Orders outside of USA & Canada, please add $20.00 additional to cover air shipment. California residents add 6% Sales Tax.

**5510 Wired** ....................................... 139.95
**5500 Wired** ....................................... 109.95
**5510/BAC Wired** .................................. 164.95
**5510/BAC Wired** .................................. 134.95

**T800 BNC ANT (all models)** .................. 7.95
**AC-9 AC Adapter (all models)** ............. 7.95

**LC 5000** ........................................... 169.95
**INTERNAL BATTERY ONLY AC-9 NOT REQUIRED.**

**DSI INSTRUMENTS, INC.**
9550 Chancellors Park Drive
San Diego, California 92123
(714) 565-8402

**TERMS:** MC — VISA — AE — CHECK — M.O. — COD in U.S. Funds. Please add 10% to a maximum of $10.00 for shipping, handling and insurance. Orders outside of USA & Canada, please add $20.00 additional to cover air shipment. California residents add 6% Sales Tax.

**5510 Wired** ....................................... 139.95
**5500 Wired** ....................................... 109.95
**5510/BAC Wired** .................................. 164.95
**5510/BAC Wired** .................................. 134.95

**T800 BNC ANT (all models)** .................. 7.95
**AC-9 AC Adapter (all models)** ............. 7.95

**LC 5000** ........................................... 169.95
**INTERNAL BATTERY ONLY AC-9 NOT REQUIRED.**

**DSI INSTRUMENTS, INC.**
9550 Chancellors Park Drive
San Diego, California 92123
(714) 565-8402

**TERMS:** MC — VISA — AE — CHECK — M.O. — COD in U.S. Funds. Please add 10% to a maximum of $10.00 for shipping, handling and insurance. Orders outside of USA & Canada, please add $20.00 additional to cover air shipment. California residents add 6% Sales Tax.

**5510 Wired** ....................................... 139.95
**5500 Wired** ....................................... 109.95
**5510/BAC Wired** .................................. 164.95
**5510/BAC Wired** .................................. 134.95

**T800 BNC ANT (all models)** .................. 7.95
**AC-9 AC Adapter (all models)** ............. 7.95

**LC 5000** ........................................... 169.95
**INTERNAL BATTERY ONLY AC-9 NOT REQUIRED.**
Collins amateur radio equipment survey

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

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

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

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

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

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

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

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

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

By Thomas McMullen, W1SL, Managing Editor, Ham Radio Horizons
Owner Report on Amateur Radio Equipment

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

1. Make and Model (please indicate the exact unit or system you are reporting on).
   
   | 32S-1 | 75S-1 |
   | 32S-2 | 75S-2 |
   | 32S-3 | 75S-3 |
   | 32S-3A | 75S-3A |
   | 75S-3B |
   | 75S-3C |

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

3. Where did you buy it?
   Dealer ______ Mail Order ______ Individual ______ Flea Market ______
   800 Number ______ Other ______

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

5. Amount of use: Daily ______ Often ______ Occasional ______ Seldom ______

6. Is this your primary ______ or backup ______ rig?

7. What modes have you used? CW ______ SSB ______ RTTY ______ SSTV ______ AM ______ Other ______

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

9. Worst feature? ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

10. Have you had any problems? ______ Explain ____________________________________________________________
    ____________________________________________________________
    ____________________________________________________________
    ____________________________________________________________

11. Have you had the rig serviced? ______ Where? Manufacturer ______ Dealer ______ Other ______

12. Was the service satisfactory? Yes ______ No ______

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

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

15. Have you been satisfied with these accessories? Yes ______ No ______

16. If not, why? ____________________________________________________________
    ____________________________________________________________
    ____________________________________________________________
17. Additional features you would like to see built into a rig of this type ____________________________

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

   Ease of operation ____________________________
   Reliability ____________________________
   Durability (in continuous use) ____________________________
   Instruction Book ____________________________
   Factory/Dealer Service ____________________________
   Quality of Workmanship ____________________________
   Performance ____________________________
   Maintenance ____________________________
   Parts Availability ____________________________
   Accessories (ease of connection) ____________________________
   Price ____________________________
   Flexibility ____________________________

19. How long have you been licensed? ___________ Your Age ___________ License Class ____________________________

   Principal activities: Contest ___________ DX ___________ Rag Chewing ___________
   Traffic Handling ___________ Experimenter ___________

20. What antenna do you use most? Beam ___________ Wire ___________ Other ___________

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

22. Would you buy this same rig again? ____________________________

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

   Submitted by: Name ____________________________ Call ____________________________
   Address ____________________________
   City ____________________________ State ____________________________ Zip ____________________________

   (Signature)

(Your signature authorizes *Ham Radio Horizons* to quote portions of your comments in our report.) May we use your name and/or call? Yes __________ No __________

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

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

*Mail To: Ham Radio Horizons, User's Report No. 3, Greenville, NH 03048*
FACTORY DIRECT SALE!!
Wilson Electronics

MARK II
Save $105.90

MARK IV
Save $112.90

- At greatly reduced prices.
- Mark II and IV accessories.
- Introducing the new Mobile Amplifier Charger.
- Battery and Five free Xtal pairs of your choice with radio.

Mobile Amplifier Charger and Amplifier Specifications

<table>
<thead>
<tr>
<th>POWER (Watts)</th>
<th>USEABLE IN</th>
<th>OUT (Typ)</th>
<th>AMP. 12.0 VDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>WMH 440TT</td>
<td>Mobile Amplifier Charger</td>
<td>1-6</td>
<td>40</td>
</tr>
<tr>
<td>WMH 480TT</td>
<td>Mobile Amplifier Charger</td>
<td>1-6</td>
<td>40</td>
</tr>
<tr>
<td>WA 440</td>
<td>Broad Band Amplifier</td>
<td>1-6</td>
<td>40</td>
</tr>
<tr>
<td>WA 480</td>
<td>Broad Band Amplifier</td>
<td>1-6</td>
<td>40</td>
</tr>
<tr>
<td>WA 2080</td>
<td>Broad Band Amplifier</td>
<td>1-6</td>
<td>40</td>
</tr>
</tbody>
</table>

MOBILE AMPLIFIER FEATURES
- 5-watt audio amplifier for external speaker.
- Automatic fast/trickle charge.
- Front panel Touch-Tone Pad which allows generation of DTMF tones.
- Over and under mounting bracket for under dash, floor mounting or base station use.
- A Key-locking feature for security.
- Mobile antenna connect.

MODEL NUMBER
- MARK II: 1 and 2.5 Watt 2m HH
- MARK IV: 1 and 4 Watt 2m HH Radios
- BC-2: Desk Battery Charger: 31.00
- BP-4: Extra Battery Pack: 19.00
- LC-3: Leather Case: 15.00
- LC-3P: Leather Case for Touch-Tone Pad: 15.00
- TTP: Touch-Tone Pad (Factory Installed): 48.50
- MC-12: Mobile Charger Only: 125.00
- WHH 440: 40W Mobile Amplifier Charger: 199.00
- WHH 480: 80W Mobile Amplifier Charger: 271.00
- WHH 440TT: 40W Mobile Amplifier Charger with Touch-Tone Pad: 240.00
- WHH 480TT: 80W Mobile Amplifier Charger with Touch-Tone Pad: 309.00
- WA 440: 40W No Tuning Amplifier for Portable Radios: 108.00
- WA 480: 80W No Tuning Amplifier for Portable Radio: 181.00
- WA 2080: 80W No Tuning Amplifier for Mobile Units: 147.00

TO: Wilson Electronics
4288 South Polaris Avenue
Las Vegas, Nevada 89103

Ship me all indicated on above chart.

Enclosed is $ .

Card Number
Xtals 59/59

Name
City
Signature

Shipping Prepaid — Nevada Residents Add 3½% Sales Tax

More Details? CHECK — OFF Page 94
FCC study guide

Study Guide for Amateur Radio License Examinations

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

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

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

This Bulletin contains syllabi for the FCC Amateur radio examinations.

Why Are Amateur Radio Operator Examinations Required?

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

What Subjects Do The Amateur Radio Examinations Cover?

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

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

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

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

Where Can Study Manuals Be Obtained?

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

STUDY TOPICS FOR THE NOVICE CLASS AMATEUR RADIO OPERATOR LICENSE EXAMINATION

(Element 2 Syllabus)

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

Novice Class Operator Privileges:
(9) Authorized frequency bands 97.7(e)
(10) Authorized emission (A1) 97.7(e)

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

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

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

C. RADIO WAVE PROPAGATION
(1) Sky wave; "skip"
(2) Ground wave

D. AMATEUR RADIO PRACTICE
(1) Measures to prevent use of Amateur radio station equipment by unauthorized persons

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

Electromagnetic compatibility — identify and suggest cure:
(5) Overload of consumer electronic products by strong radio frequency fields
(6) Interference to consumer electronic products caused by radiated harmonics

Interpretation of S.W.R. readings as related to faults in antenna system:
(7) Acceptable readings
(8) Possible causes of unacceptable readings

E. ELECTRICAL PRINCIPLES

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

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

F. CIRCUIT COMPONENTS

Physical appearance, applications, and schematic symbols of:
(1) Quartz crystals
(2) Meters (D'Arsonval movement)
(3) Vacuum tubes
(4) Fuses

G. PRACTICAL CIRCUITS
Block Diagrams:
(1) The stages in a simple telegraphy (A1) transmitter
(2) The stages in a simple receiver capable of telegraphy (A1) reception
(3) The functional layout of novice station equipment, including transmitter, receiver, antenna switching, antenna feedline, antenna, and telegraph key

H. SIGNALS AND EMISSIONS
(1) Emission type A1
Cause and cure:
(2) Backwave
(3) Key clicks
(4) Chirp
(5) Superimposed hum
(6) Undesirable harmonic emissions
(7) Spurious emissions

I. ANTENNAS AND FEEDLINES
Necessary physical dimensions of these popular high frequency antennas for resonance on amateur radio frequencies:
(1) A half-wave dipole
(2) A quarter-wave vertical
Common types of feedlines used at Amateur radio stations:
(3) Coaxial cable
(4) Parallel conductor line

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

D. AMATEUR RADIO PRACTICE
STUDY TOPICS FOR THE TECHNICIAN/GENERAL CLASS AMATEUR RADIO OPERATOR LICENSE EXAMINATION
(Element 3 Syllabus)

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

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

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

Electromagnetic compatibility; identify and suggest cure:
(10) Disturbance in consumer electronic products caused by audio rectification

Proper use of the following station components and accessories:
(11) Reflectometer (VSWR meter)
(12) Speech processor — RF and AF
(13) Electronic T-R switch
(14) Antenna tuning unit; matching network
Monitoring oscilloscope
Non-radiating load; "dummy antenna"
Field strength meter; S-meter
Wattmeter

E. ELECTRICAL PRINCIPLES

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

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

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

F. CIRCUIT COMPONENTS

Physical appearance, types, characteristics, applications, and schematic symbols for:
(1) Resistors
(2) Capacitors
(3) Inductors
(4) Transformers
(5) Power supply type diode rectifiers

G. PRACTICAL CIRCUITS

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

H. SIGNALS AND EMISSIONS

(1) Emission types A0, A3, F1, F2, F3
(2) Signal; information
(3) Amplitude modulation
(4) Double sideband
(5) Single sideband
(6) Frequency modulation
(7) Phase modulation
(8) Carrier
(9) Sidebands
(10) Bandwidth
(11) Envelope
(12) Deviation
(13) Overmodulation
(14) Splatter
(15) Frequency translation; mixing, multiplication
(16) Radioteleprinting; audio frequency shift keying, mark, space, shift

I. ANTENNAS AND FEEDLINES

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

Characteristics of popular Amateur radio antenna feedlines; related concepts:
(7) Characteristic impedance
(8) Standing waves
(9) Standing wave ratio; significance of
(10) Balanced, unbalanced
(11) Attenuation
(12) Antenna-feedline mismatch

STUDY TOPICS FOR THE ADVANCED CLASS AMATEUR RADIO OPERATOR LICENSE EXAMINATION
(Element 4A Syllabus)

A. RULES AND REGULATIONS

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

B. OPERATING PROCEDURES

(1) Facsimile transmission
(2) Slow-scan television transmission
C. RADIO WAVE PROPAGATION
(1) Sporadic-E          (3) Auroral propagation
(2) Selective fading    (4) Radio-path horizon

D. AMATEUR RADIO PRACTICE

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

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

E. ELECTRICAL PRINCIPLES

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

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

F. CIRCUIT COMPONENTS

Physical appearance, types, characteristics, applications, and schematic symbols for the following:
(1) Diodes; zener, tunnel, varactor, hot-carrier, junction, point contact, pin
(2) Transistors; NPN, PNP, junction, unijunction, power, germanium, silicon
(3) Silicon controlled rectifier, triac
(4) Light emitting diode, neon lamp
(5) Crystal lattice ssb filters

G. PRACTICAL CIRCUITS

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

Transmitter and receiver circuits — know purpose of each, and how, basically, each function:
(6) Modulators; am, fm, balanced
(7) Transmitter final amplifiers
(8) Detectors, mixer stages
(9) RF and IF amplifier stages

Calculation of voltages, currents, and power in common Amateur radio oriented circuits:
(10) Common emitter class A transistor amplifier; bias network, signal gain, input and output impedances
(11) Common collector class A transistor amplifier; bias network, signal gain, input and output impedances

Circuit design; selection of circuit component values:
(12) Voltage regulator with pass transistor and zener diode to produce given output voltage
(13) Select coil and capacitor to resonate at given frequency

H. SIGNALS AND EMISSIONS

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

I. ANTENNAS AND FEEDLINES

(1) Antenna gain; beamwidth
(2) Trap antennas
(3) Parasitic elements
(4) Radiation resistance
(5) Driven elements
(6) Efficiency of antenna
(7) Folded, multiple wire dipoles
(8) Velocity factor
(9) Electrical length of a feedline
(10) Voltage and current nodes
(11) Mobile antennas
(12) Loading coil; base, center, top
STUDY TOPICS FOR THE AMATEUR EXTRA CLASS AMATEUR RADIO OPERATOR LICENSE EXAMINATION
(Element 4B Syllabus)

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

B. OPERATING PROCEDURES
(1) Use of Amateur radio satellite
(2) Amateur fast-scan television

C. RADIO WAVE PROPAGATION
(1) EME; “moonbounce”
(2) Meteor burst
(3) Trans-equatorial

D. AMATEUR RADIO PRACTICE
Use of test equipment:
(1) Spectrum analyzer; interpret display; display of transmitter output spectrum, such as commonly found in new product review articles in Amateur radio magazines
(2) Logic probe; indication of high or low state, pulsing state
Electromagnetic compatibility:
(3) Vehicle noise suppression; ignition noise, alternator whine, static
(4) Direction finding techniques; methods for location of source of radio signals

E. ELECTRICAL PRINCIPLES
Concepts:
(1) Photoconductive effect
(2) Exponential charge/discharge
Mathematical relationships; calculations:
(3) Time constant for R-C and R-L circuits (including circuits with more than one resistor, capacitor or inductor)
(4) Impedance diagrams; basic principles of Smith chart
(5) Impedance of R-L-C networks at a specified frequency
(6) Algebraic operations using complex numbers; real, imaginary, magnitude, angle

F. CIRCUIT COMPONENTS
Physical appearance, types, characteristics, applications, and schematic symbols for:
(1) Field effect transistors; enhancement, depletion, MOS, CMOS, N-channel, P-channel
(2) Operational amplifier and phase-lock loop integrated circuits
(3) 7400 series TTL digital integrated circuits
(4) 4000 series CMOS digital integrated circuits
(5) Vidicon; cathode ray tube

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

High performance receiver characteristics
(4) Noise figure, sensitivity
(5) Selectivity
(6) Dynamic range
Calculation of voltages, currents, and power in common amateur radio oriented circuits:
(7) Integrated operational amplifier; voltage gain, frequency response
(8) F.E.T. common source amplifier; input impedance
Circuit design; selection of circuit component values:
(9) L-C preselector with fixed and variable capacitors to tune a given frequency range
(10) Single stage amplifier to have desired frequency response by proper selection of bypass and coupling capacitors

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

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

ham radio
A trap loaded antenna that performs like a monobander! That’s the characteristic of this six element three band beam. Through the use of wide spacing and interlacing of elements, the following is possible: three active elements on 20, three active elements on 15, and four active elements on 10 meters. No need to run separate coax feed lines for each band, as the bandswitching is automatically made via the High-Q Wilson traps. Designed to handle the maximum legal power, the traps are capped at each end to provide a weather-proof seal against rain and dust. The special High-Q traps are the strongest available in the industry today.

**SPECIFICATIONS**

- **Band MHz**: 14-21-28
- **Maximum power input**: Legal limit
- **Gain (dBi)**: Up to 9 dB
- **VSWR @ resonance**: 1.3:1
- **Impedance**: 50 ohm
- **F/B ratio**: 20 dB or better
- **Boom (O.D. x Length)**: 2" x 24' 2½"
- **No. of elements**: 6
- **Longest element**: 28' 2¾"
- **Turning radius**: 18' 6"
- **Maximum mast diameter**: 2"
- **Surface area**: 8.6 sq. ft.
- **Wind loading @ 80 mph**: 215 lbs.
- **Maximum wind survival**: 100 mph
- **Feed method**: Coaxial Balun
- **Assembled weight (approx.)**: 53 lbs.
- **Shipping weight (approx.)**: 62 lbs.

**Compare the SY-36 with others . . .**

Compare the size and strength of the boom to element clamps. See who offers the largest and heaviest duty. Which would you prefer?

**CALL FACTORY DIRECT**

1-800-634-6898

Wilson Systems traps offer a larger diameter trap coil and a larger outside housing, giving excellent Q and power capabilities.

**WSI WILSON SYSTEMS, INC.**

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

Prices and specifications subject to change without notice.

More Details? CHECK — OFF Page 94
A trap loaded antenna that performs like a monobander! That's the characteristic of this six element three band beam. Through the use of wide spacing and interlacing of elements, the following is possible: three active elements on 20, three active elements on 15 and four active elements on 10 meters. No need to run separate coax feed lines for each band, as the bandswitching is automatically made via the High-Q Wilson traps. Designed to handle the maximum legal power, the traps are capped at each end to provide a clamping and holding strength to prevent element misalignment.

**SPECIFICATIONS**

**WV-1A**

- **4 BAND TRAP VERTICAL**
- **10-40 METERS**

No bandswitching necessary with this vertical! An excellent low cost DX antenna with an electrical quarter wavelength on each band and low angle radiation. Advanced design provides low SWR and exceptionally flat response across the full width of each band.

- Featured is the Wilson large diameter High-Q traps which will maintain resonant points with varying temperatures and humidity.

- Easily assembled, the WV-1A is supplied with a base mount bracket to attach to vent pipe or to a mast driven in the ground.

- Note: Radials are required for peak operation. (See GR-1 below)

**GR-1**

- **IN STOCK**
- **1295**

The GR-1 is the complete ground radial kit for the WV-1A. It consists of: 150' of 7/14 stranded copper wire and heavy duty egg insulators, instructions. The GR-1 will increase the efficiency of the GR-1 by providing the correct counterpoise.

---

**NEW!**

ADD 40 METERS TO YOUR TRI-BAND WITH THE NEW 33-6 MK

- **IN STOCK**
- **$495**

Now you can have the capabilities of 40-meter operation on the System 36 and System 33. Using the same type high quality traps, the 40-meter addition will offer 200KHZ of bandwidth at less than 2:1 SWR. The new 33-6 MK will fit your present SY36 or SY33, and using the same single feed line.

**SPECIFICATIONS**

- **19' total height**
- **Self supporting - no guys required**
- **Weight - 14 lbs.**
- **Input impedance: 50 ohms**
- **Power handling capability: Legal Limit**
- **Two High-Q traps with large diameter coils**
- **Low angle radiation**
- **Omni directional performance**
- **Taper swaged aluminum tubing**
- **Automatic bandswitching**
- **Mast bracket furnished**
- **SWR: 1:1:1 or less on all bands**

**GR-1**

- **IN STOCK**
- **$14995**

Capable of handling the Legal Limit, the "SYSTEM 33" is the finest compact tri-bandier available to the amateur. Designed and produced by one of the world's largest antenna manufacturers, the traditional quality of workmanship and materials excels with the "SYSTEM 33". Now boom-to-element mount consists of two 1/8" thick formed aluminum plates that will provide more clamping and holding strength to prevent element misalignment. Superior clamping power is obtained with the use of a rugged 1/4" thick aluminum plate for boom to mast mounting. The use of large diameter High-Q traps in the "SYSTEM 33" makes it a high performing tri-bandier and at a very economical price. A complete step-by-step illustrated instruction manual guides you to easy assembly and the lightweight antenna makes installation of the "SYSTEM 33" quick and simple.

**SPECIFICATIONS**

- **Band MHz**: 14-21-28
- **Maximum power input**: Legal Limit
- **Gain (db)**: Up to 9 db
- **VSWR at resonance**: 1.3:1
- **Impedance**: 50 ohms
- **F/B Ratio**: 20 db or better

- **Boom (O.D. x length)**: 2" x 14'4"
- **No. of elements**: 3
- **Longest element**: 27'4"
- **Turning radius**: 16'9"
- **Maximum mast diameter**: 2" O.D.
- **Surface area**: 5.7 sq. ft.

- **Wind loading at 80 mph**: 114 lbs.
- **Assembled weight (approx.)**: 37 lbs.
- **Shipping weight (approx.)**: 42 lbs.
- **Maximum wind survival**: 140 mph

**ORDER FACTORY DIRECT**

1-800-634-6898
WILSON SYSTEMS TOWERS

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

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

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

WIND LOADING
Tower Height Sq. Ft.
ST-77B 69 18
MT-61B 53 18
TT-45B 45 12

Square footage based on 50 MPH Wind

BASE CHART
Tower WIDTH DEPTH
TT-45B 12' x 12' 30'
FB-45B 30' x 30' 4'
RB-45B 30' x 30' 4'
MT-61B 18' x 18' 4'
FB-61B 3' x 3' 5'
RB-61B 3' x 3' 5'
ST-77B See Below Bases
FB-77B 3½ x 3½ 6'
RB-77B 3½ x 3½ 6'

The TT-45B and MT-61B come complete with house bracket and hinged base plate for against-house mounting. For totally freestanding installation, use either of the tilt-over bases shown below. The TT-45B can be mounted against the house and must be used with the tilt-over base FB-77B or RB-77B shown below.

TILT-OVER BASES FOR TOWERS

FIXED BASE
The FB Series was designed to provide an economical method of moving the tower away from the house. It will support the tower in a completely free-standing vertical position, while also having the capabilities of tilting the tower over to provide an easy access to the antenna. The rotor mounts at the top of the tower in the conventional manner, and will not rotate the complete tower.
FB-45B...112 lbs...$154.95
FB-61B...169 lbs...214.95
FB-77B...250 lbs...299.95

ORDER
FACTORY DIRECT
1-800-634-6898

ROTATING BASE
The RB Series was designed for the Amateur who wants the added convenience of being able to work on the rotor from the ground position. This series of bases will give that ease plus rotate the complete tower and antenna system by the use of a heavy duty thrust bearing at the base of the tower mounting position, while still being able to tilt the tower over when desiring to make changes on the antenna system.
RB-45B...144 lbs...$219.95
RB-61B...229 lbs...299.95
RB-77B...300 lbs...449.95

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

IN STOCK

WS1 WILSON SYSTEMS, INC.
4286 S. Polaris Ave., Las Vegas, Nevada 89103

66 APRIL 1980

More Details? CHECK — OFF Page 94
THE ALL NEW 5 ELEMENT 20 METER BEAM

M520A

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

1. **Taper Swaged Elements** - The taper swaged elements provide strength where it counts and lowers the wind loading more efficiently than the conventional method of telescoping elements of different sizes.

2. **Mounting Plates - Element to Boom** - The new formed aluminum plates provide the strongest method of mounting the elements to the boom that is available in the entire market today. No longer will the elements tilt out of line if a bird should land on one end of the element.

3. **Mounting Plates - Boom to Mast** - Rugged 1/4" thick aluminum plates are used in combination with sturdy U-bolts and saddles for superior clamping power.

4. **Holes** - There are no holes drilled in the elements of the Wilson HF Monobanders. The careful attention given to the design has made it possible to eliminate this requirement as the use of holes adds an unnecessary weak point to the antenna boom.

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

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

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

**SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Length</th>
<th>Diameter</th>
<th>Impedance</th>
<th>Matching Element</th>
<th>Element O.D.</th>
<th>Boom Length</th>
<th>Turning Radius</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>M520A</td>
<td>20 11.5 25 db 500 KHz 1.1 50</td>
<td>Beta 5</td>
<td>36'6&quot; 2&quot;</td>
<td>34'2&quot;</td>
<td>25'1&quot;</td>
<td>8.9</td>
<td>22.7</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>M240A</td>
<td>20 10.0 25 db 500 KHz 1.1 50</td>
<td>Beta 4</td>
<td>36'6&quot; 2&quot;</td>
<td>36'0&quot;</td>
<td>22'6&quot;</td>
<td>7.6</td>
<td>18.9</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>M318A</td>
<td>15 12.0 25 db 400 KHz 1.1 50</td>
<td>Beta 5</td>
<td>26'6&quot; 2&quot;</td>
<td>26'0&quot;</td>
<td>17'6&quot;</td>
<td>4.2</td>
<td>10.7</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>M415A</td>
<td>15 10.0 25 db 400 KHz 1.1 50</td>
<td>Beta 4</td>
<td>24'2&quot; 2&quot;</td>
<td>17'0&quot;</td>
<td>14'11&quot;</td>
<td>3.1</td>
<td>54.2</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>M510</td>
<td>10 12.0 25 db 1.5 MHz 1.1 50</td>
<td>Beta 5</td>
<td>18'8&quot; 2&quot;</td>
<td>26'0&quot;</td>
<td>16'9&quot;</td>
<td>2.8</td>
<td>22.2</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>M615A</td>
<td>10 10.0 25 db 1.5 MHz 1.1 50</td>
<td>Beta 4</td>
<td>18'3&quot; 2&quot;</td>
<td>12'11&quot;</td>
<td>11'3&quot;</td>
<td>1.4</td>
<td>36.2</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

Wilson's Beta match offers maximum power transfer.

WILSON SYSTEMS ANTENNAS

<table>
<thead>
<tr>
<th>Qty</th>
<th>Model</th>
<th>Description</th>
<th>Shipping</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 10 Ele. Tribander for 10, 15, 20 Mtrs.</td>
<td>SY40</td>
<td>UPS</td>
<td>274.95</td>
<td></td>
</tr>
<tr>
<td>6 Ele. Tribander for 10, 15, 20 Mtrs.</td>
<td>SY36</td>
<td>UPS</td>
<td>199.95</td>
<td></td>
</tr>
<tr>
<td>3 Ele. Tribander for 10, 15, 20 Mtrs.</td>
<td>SY33</td>
<td>UPS</td>
<td>149.95</td>
<td></td>
</tr>
<tr>
<td>33.6 K 40 Mtr. Mod Kit for SY33 &amp; SY36</td>
<td>33.6K</td>
<td>UPS</td>
<td>49.95</td>
<td></td>
</tr>
<tr>
<td>Trap Vertical for 10, 15, 20, 40 Mtrs.</td>
<td>WV-1A</td>
<td>UPS</td>
<td>49.95</td>
<td></td>
</tr>
<tr>
<td>Ground Radials for WV-1A</td>
<td>GR-1</td>
<td>UPS</td>
<td>12.95</td>
<td></td>
</tr>
<tr>
<td>5 Elements on 20 Mtrs.</td>
<td>M-520A</td>
<td>TRUCK</td>
<td>229.95</td>
<td></td>
</tr>
<tr>
<td>4 Elements on 20 Mtrs.</td>
<td>M-420A</td>
<td>UPS</td>
<td>159.95</td>
<td></td>
</tr>
<tr>
<td>5 Elements on 15 Mtrs.</td>
<td>M-515A</td>
<td>UPS</td>
<td>129.95</td>
<td></td>
</tr>
<tr>
<td>4 Elements on 15 Mtrs.</td>
<td>M-415A</td>
<td>UPS</td>
<td>84.95</td>
<td></td>
</tr>
<tr>
<td>5 Elements on 10 Mtrs.</td>
<td>M-510</td>
<td>UPS</td>
<td>84.95</td>
<td></td>
</tr>
<tr>
<td>4 Elements on 10 Mtrs.</td>
<td>M-410</td>
<td>UPS</td>
<td>69.95</td>
<td></td>
</tr>
</tbody>
</table>

**ACCESSORIES**

| T1X | Tail Twister Rotor | UPS | 199.95 |
| HD-73 | Alliance Heavy Duty Rotor | UPS | 109.95 |
| RC-8C | 8/C Rotor Cable | UPS | 12/Ft. |
| RG-8U | RG-8U Foam Ultra Flexible Coaxial Cable | UPS | 21/Ft. |

**NOTE:**
- On Coaxial and Rotor Cable, minimum order is 100' and 50' multiples.
- Prices and specifications subject to change without notice.
- Ninety (90) Day Limited Warranty - All Products FOB Las Vegas, Nevada.
Hustler's 5-BTV™ five band vertical antenna.

Made heavier for better performance and quality. Heavier optimum Q traps assure accurate and permanent resonance for greater bandwidth. Heavier solid one-inch fiberglass trap forms give optimum electrical and mechanical stability.

One setting provides total band coverage from 10 through 40 meters with SWR of 1.6:1 or better at band edges, and up to 100 kHz on 75/80 meters.

Easy to assemble and install. Features high strength heat treated seamless aluminum construction throughout, plus heavy duty stainless steel hardware. Feed with any length 50 ohm coax.

For the BIG difference in performance, it's the Hustler 5-BTV antenna.

3275 North B. Ave, Kissimmee, Florida 32741
Clearly the choice of those who know quality.
Barn Electronics...
New York's Friendliest Amateur Radio Store

HAMS: ARE YOU READY FOR SPRING? BARRY IS WAITING FOR YOU!

We have everything you'll need for that new station - mobile, or fixed. How about one of the new SWAN transceivers? Let us quote on the ASTRO-150, or the 102 BX. Naturally, we have DRAKE, COLLINS, YAESU, and more. Have you considered the YAESU FT-107, or the Wayfarer FT-707? Let us give you the BARRY quote.

What about antennas, or maybe a tower? Do you need a new rotator? We have 'em at BARRY, and we've been waiting for your call.

SHORTWAVE LISTENERS: Your hobby and interest is among the fastest-growing in the entire marketplace! BARRY knew that, and ordered a BIG STOCK of all the things you'll need - antennas, rotors, towers, repeaters, microphones, keys and keyers, tubes, just to name a few. We'll help you choose the right antenna, too. JUST CALL BARRY.

We Also Stock...

- AEA
- ANTEenna SPECIALISTS
- B&B WIRE
- BIRD COMMUNICATIONS SPECIALISTS
- CUSHCRAFT
- DENTRON
- DRAKE
- E-ZWAY
- HY-GAIN
- ICOM
- KDK
- KLM
- MIRAGE
- MOSLEY
- MURCH
- NEWTRONICS
- ROHN
- SHURE
- STANDARD
- SWAN
- TEMPO
- TEN-TEC
- TRI-EX
- VHF
- ENGINEERING

Ask about our Amateur Radio License Classes - Novice thru Extra! Wed. & Thurs. evenings, 7-9; Saturday morning 10-noon

The Export Experts Invite Overseas orders - We Ship Worldwide

512 BROADWAY, NEW YORK, N.Y. 10012
TELEPHONE (212) 925-7000

BARRY ELECTRONICS

FAST SCAN ATV

WHY GET ON FAST SCAN ATV?
- You can send broadcast quality video of home movies, video tapes, computer games, etc, at a cost that is less than sloscan.
- Really improves public service communications for parades, RACES, CAP searches, weather watch, etc.
- DX is about the same as 2 meter simplex - 15 to 100 miles.

ALL IN ONE BOX
TC-1 Transmitter/Conv.
Plug in camera, ant, mic and you are on the air .............. $399 ppd

HITACHI HV-62 TV CAMERA
High performance closed circuit camera just right for ATV, with lens .............. $239 ppd

PUT YOUR OWN SYSTEM TOGETHER
TVC-1B CONVERTER tunes 420 mhz down to ch 2 or 3 $49.50 ppd
TXAS EXCITER .......... $69 ppd
PAS 10 WATT LINEAR .. $79 ppd
FMAS Audio Subcarrier . $24.50 ppd

SEND FOR OUR CATALOG, WE HAVE IT ALL
Modules for the builder, complete units for the operator, antennas, color cameras, repeaters, preamps, lines, video ider and clock, and more. 19 years in ATV.

Call 213-447-4565 5-6 pm or time

P.C. ELECTRONICS

Maryann 2522 PAXSON
WB8YSS ARCADIA, CA 91006
Tom WB8ORG

NEW!

WHY GET ON FAST SCAN ATV?
- You can send broadcast quality video of home movies, video tapes, computer games, etc, at a cost that is less than sloscan.
- Really improves public service communications for parades, RACES, CAP searches, weather watch, etc.
- DX is about the same as 2 meter simplex - 15 to 100 miles.

ALL IN ONE BOX
TC-1 Transmitter/Conv.
Plug in camera, ant, mic and you are on the air .............. $399 ppd

HITACHI HV-62 TV CAMERA
High performance closed circuit camera just right for ATV, with lens .............. $239 ppd

PUT YOUR OWN SYSTEM TOGETHER
TVC-1B CONVERTER tunes 420 mhz down to ch 2 or 3 $49.50 ppd
TXAS EXCITER .......... $69 ppd
PAS 10 WATT LINEAR .. $79 ppd
FMAS Audio Subcarrier . $24.50 ppd

SEND FOR OUR CATALOG, WE HAVE IT ALL
Modules for the builder, complete units for the operator, antennas, color cameras, repeaters, preamps, lines, video ider and clock, and more. 19 years in ATV.

Call 213-447-4565 5-6 pm or time

P.C. ELECTRONICS

Maryann 2522 PAXSON
WB8YSS ARCADIA, CA 91006
Tom WB8ORG

More Details? CHECK - OFF Page 94
counter control pulses

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

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

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

dc-dc converter increases Gunnplexer frequency swing

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

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

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

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

1. Noise figure of a receiver in dB.

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

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

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

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

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

\[ e = \sqrt{\frac{10^{10.2} \times 4 \times 50 \times 2000}{10^6}} = 7 \mu V \]

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

\[ T_e = (F - 1) 290 K \]

\[ F = 10^{10} \text{, where NF is in dB} \] (4)

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

\[ e = \sqrt{\frac{10^{10.2} \times 4 \times 50 \times 2000}{10^6}} = 7 \mu V \]

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

\[ NF = 10 \log \frac{T_e + T_0}{T_0} \] (5)

example: T_e = 190 K
T_0 = 290 K standard

\[ NF = 10 \log \frac{190 + 290}{290} = 2.19 \text{ dB} \]

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

\[ dBm = 10 \log \frac{1 \times 10^{-3}}{4 \times 10^{-21}} = 174 \text{ dBm} \] (6)

\[ e = \sqrt{\frac{NF \times 4RB}{10^6}} \mu V \] (3)

\[ dBm = 144 - 10 \log B \] (7)

example: B = 3 kHz
\[ dBm = 144 - 10 \log 3 = 144 - 4.77 = 139.2 \text{ dBm} \]

I.L. McNally, K6WX

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

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

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

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

where \( e = \mu V \) to produce the desired

\[ \frac{SNR}{N} \text{ ratio} \]

\[ R = \text{input resistance} \]
\[ B = \text{bandwidth in kHz} \]

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

\[ NF = 10 \log \left( \frac{(0.3)^2 \times 10^6}{4 \times 50 \times 2.7} \right) = 22 \text{ dB} \] (2)

3. Given the NF in dB, B in kHz and the input resistance, R, the \( \mu V \) sensitivity can be determined by

\[ e = \sqrt{\frac{NF \times 4RB}{10^6}} \mu V \] (3)

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

\[ T_e = (F - 1) 290 K \]

\[ F = 10^{10} \text{, where NF is in dB} \] (4)

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

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

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

\[ NF = 10 \log \frac{T_e + T_0}{T_0} \] (5)

example: \( T_e = 190 K \)
T_0 = 290 K standard

\[ NF = 10 \log \frac{190 + 290}{290} = 2.19 \text{ dB} \]

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

\[ dBm = 10 \log \frac{1 \times 10^{-3}}{4 \times 10^{-21}} = 174 \text{ dBm} \] (6)

\[ dBm = 144 - 10 \log B \] (7)

example: \( B = 3 \text{ kHz} \)
\[ dBm = 144 - 10 \log 3 = 144 - 4.77 = 139.2 \text{ dBm} \]

I.L. McNally, K6WX

When it comes to AMATEUR RADIO QSL's...

it's the ONLY BOOK!

US or DX Listings

1980 callbooks NOW READY!

Here they are! The latest editions, world-famous Radio Amateur Callbooks, the most respected and complete listing of radio amateurs: Lists calls, license classes, address information. Loaded with special features such as call changes, prefixes of the world, standard time charts, world-wide QSL bureaus and more. The new 1980 Radio Amateur Callbooks are available now. The U.S. Edition features over 450,000 listings, over 120,000 changes from last year. The Foreign Edition, over 315,000 listings, over 90,000 call changes. Place your order now.

<table>
<thead>
<tr>
<th>Each</th>
<th>Shipping</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Callbook</td>
<td>$16.95</td>
<td>$17.70</td>
</tr>
<tr>
<td>Foreign Callbook</td>
<td>$15.95</td>
<td>$17.70</td>
</tr>
</tbody>
</table>

Order both books at the same time for $34.65, includes shipping.

Order from your favorite electronics dealer or direct from the publisher. All direct orders add $1.75 for shipping. Illinois residents add 5% Sales Tax.

SPECIAL LIMITED OFFER!

Amateur Radio Emblem Patch
only $2.50 postpaid

Pegasus on blue field; red lettering, 3" wide x 3" high. Great on jackets and caps. Sorry, no call letters.

ORDER TODAY!

RADIO AMATEUR callbook INC.
Dept. FB 2
925 Sherwood Drive
Lake Bluff, IL 60044

april 1980
A new satellite receiver, covering 3.7-4 GHz, is available from International Crystal Mfg. Co., Inc. The TV 4200 receiver is fully tunable and provides standard dual audio outputs of 6.2 and 6.8 MHz, with other outputs available. The receiver has a built-in LNA power supply and output levels are compatible with video monitor or VTR input. It’s priced at $1,995.

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

Bird rf power analyzer

A new era in rf power measurement was announced by THRULINE® Wattmeter designer, Bird Electronic Corp., with the introduction of the new series 4380 RF Power Analyst™. First of the series, the portable model 4381 is a multi-purpose, digital, directional rf wattmeter for power levels from 1/10 watt to 10,000 watts, and from ½ to 2300 MHz. CW or fm power in both forward or reflected directions is displayed in watts or dBm at the push of a button. VSWR is calculated continuously, and indicated through a fifth button, as is dB return loss. Button seven and eight are for peak envelope power (as in SS8 transmissions) in watts, and the ninth button calls up per cent modulation. The final set of three buttons make tuning a transmitter, matching an antenna or tweaking rf components a fast and simple task. A delta (Δ) function identifies either rise or fall in displayed values, while a minimum or maximum memory recalls optimum conditions during adjustments. Other models in the 4380 series measure to 250 kW, or are panel mounted.

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

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

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

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

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

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

Hamtronics 1980 catalog

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

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

**Amateur Radio computer packages from Snow Micro Systems, Inc.**

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

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

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

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

It is S-100 bus interfaced, using standard IC’s (8095, 8216 and 8131). Operation of the card is controlled by an 8253 PROM and jumpers.

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

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

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

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

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

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

**keyer add-on provides practice and memory**

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

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

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

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

For further information, contact Curtis Electro Devices, Inc., Box 4090, Mountain View, California 94040.
**TELESCOPING (CRANK UP)**
* GUYED (STACK-UP)
* TILT-OVER MODELS

Easy to Install. Low Prices. Crank-up to 100 ft.

**EXCELLENT FOR HAM COMMUNICATIONS**

SPECIAL
Four Section 50 Ft. Van Mounted Crank-Up Aluma Tower

Over 36 types aluminum and steel towers made—specials designed and made—write for details

**JUST LOOK AT THESE FEATURES:**
- Tough "Mobile Environment" Microphone
- Positive-Action Tactile Keys
- High-Impedance Ceramic or 500-ohm Dynamic Cartridge
- Adjustable Tone Balance and Output Level
- "Positive Hold - Easy Lift" Hanger
- For Vehicle or Hand-held Portable Use
- Complete... Not a Kit... $39.00

*Touch-Tone is a registered trade name of A&I*

**NEW — NEW — NEW**

TOUCH-TONE® MICROPHONE DATA CODER 5

$39.00

**DATA SIGNAL, INC.**
2403 COMMERCE LANE
ALBANY, GEORGIA 31707
Tel. 912-883-4703

**ufh glass-mounted antennas**

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

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

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

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

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

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

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

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

**MFJ hybrid phone patches**

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

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

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

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

The MFG-620 Telepatch is a less...
new 1980 Radio Shack catalog

Radio Shack's new 1976-page 1980 catalog is now available free on request from more than 6,000 participating stores and dealers nationwide. The catalog has 120 full-color pages and features the latest in everything electronic — from computers and stereo components to toys, parts, and accessories for home entertainment, hobbyists, and experimenters.

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

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

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

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

test encoder

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

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

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

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

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

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

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

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

Anteck MT-1 mobile antenna

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

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

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

For more information, contact MFJ Enterprises, Inc., P.O. Box 494, Mississippi State, Mississippi 39762.
Full range of adjustment in tension and contact spacing.
Self-adjusting nylon and steel needle bearings.
Solid silver contact points.
Polished lucite paddles.
Precision-machined, chrome plated brass frames.
Standard model has black, textured finish base; deluxe model is chrome plated.
Heavy steel base; non-skid feet.

WRITE FOR LITERATURE
BENCHER, INC.
333 W. Lake Street, Dept. A
Chicago, Illinois 60606 • (312) 263-1808

P-DLE
Standard model has black, textured finish base; deluxe model is chrome plated.
Heavy steel base; non-skid feet.

WRITE FOR LITERATURE
BENCHER, INC.
333 W. Lake Street, Dept. A
Chicago, Illinois 60606 • (312) 263-1808

available at selected dealers
or send $42.95 ($52.95 for chrome model)
PIUS 52.00 shipping and handling. Overseas amateurs invited to request quotation for air parcel post shipment.

IRON POWDER and FERRITE PRODUCTS
AMIDON
Fast, Reliable Service Since 1963
Small Orders Welcome Free 'Tech-Data' Flyer
Toroidal Cores, Shielding Beads, Shielded Coil Forms Ferrite Rods, Pot Cores, Baluns, Etc.
12033 OTSEGO STREET, NORTH HOLLYWOOD, CALIFORNIA 91607

Microcraft’s New Morse-A-Word
Eight character moving display.
Built-in code practice oscillator.
Excellent for learning Morse Code.
Complete — no CRT or expensive extras needed.
Decodes audio CW signals from your receiver’s speaker and displays letters, numbers, punctuation and special Morse characters as the code is received.

MORSE-A-WORD Kit with 4 character readout ............... MAWK-4 $149.95
MORSE-A-WORD Kit with 8 character readout ............... MAWK-8 $169.95
MORSE-A-WORD wired & tested with 8 character readout .... MAWF $249.95
Send check or money order. Use your VISA or Master Charge. Add $3.50 shipping and handling for continental U.S. Wisconsin residents add 4% State Sales Tax.

Microcraft Corporation
P. O. Box 513HR 
Thiensville, Wisconsin 53092

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

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

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

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

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

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

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

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

digitally compensated crystal oscillator

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

The D-100 occupies only 8 cubic inches and "warms up" in less than 5 seconds after being turned on.

$299.95

Here is a new tuner that puts more power into your antenna, works from 160 through 10 meters, handles full legal power and then some, and works with coax, single wire and balanced lines. And it lets you tune up without going on the air!

WE INVESTIGATED

All tuners lose some rf power. We checked several popular tuners to see where the losses are. Mostly they are in the inductance coil and the balun core.

So we switched from #12 wire for the main inductor to 1/4" copper tubing. It can carry ten times the rf current. And we've moved the balun from the output, where it almost never sees its design impedance, to the input where it always does. Thus more power to your antenna.

IMPOSSIBLE FEAT

The biggest problem with tuners is getting them tuned up. With three knobs to tune on your transceiver and three on the tuner and ten seconds to do it (see the warning in your transceiver manual) that's 1 1/2 seconds per knob.

We have a better way; a built-in 50-ohm noise bridge that lets you set the tuner controls without transmitting. And a switch that lets you tune your transmitter into a dummy load. So you can do the whole tuneup without going on the air. Saves that final; cuts QRM.

BROCHURE AVAILABLE NOW

For further details on this exciting new high-power low-loss, easy-to-use tuner send for our new brochure. Or visit your Palomar Engineers dealer.

To order send $10 shipping/handling. California residents add sales tax.

Palomar Engineers
Box 455, Escondido, CA. 92025 • Phone: [714] 747-3343

More Details? CHECK — OFF Page 94
seconds. It offers a great number of uses where size, power consumption, and stability are important. Price of the D-100 is approximately $850.00 in small quantities.

For more information, write Green-ray Industries, 840 West Church Road, Mechanicsburg, Pennsylvania 17055.

**microminiature encoder-decoder**

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

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

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

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

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

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

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

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

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

mobile charger/amplifier

Trilectric, Inc., Van Nuys, California, announces the introduction of the mobile charger amplifiers for the Wilson Mark Series and Yaesu's FT-202R 2-meter hand-held transceivers. The MAC440H and MAC480H have 40- or 90-watt rf power output capability respectively with 4 watts drive. An MC101 charger is also available separately. Additional features are a built-in 5-watt audio amplifier for an external speaker, automatic regular or trickle charger, an optional front-panel mounted Touch-Tone® pad which allows generation of DTMF tones while the hand-held is in the case, over or under mounting bracket, for under dash, floor mounting, or base station use, and a locking feature for portable security.

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

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

A unique radio chart called "Worldwide Listeners Guide to the Radio Spectrum" is available from Radio Publication Co., Lake Geneva, Wisconsin. The chart covers the radio spectrum from 10 kHz to 30 GHz with sample listings of stations found on particular frequencies. For example, on 16,715 MHz (high frequency), the chart lists the Queen Elizabeth II (inter-ship communications). Over five hundred listings across the spectrum appear on the chart.

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

short circuit

CMOS synthesizer

In the construction article for the 144-MHz CMOS synthesizer in the December, 1979 issue of ham radio (page 14), author K9LHZ has pointed out several drawing errors in the component placement on the printed-circuit board (fig. 7). The 22-pF capacitor next to Q6 should be C36 not C26; resistor R25 has a value of 820 ohms. J1 and J2 should go to pin 13 of U6, not pin 12. T1 is a tapped coil with the tap going to C16 (cold end of T1 goes to ground). U4 is a CD4060 not CD4066, and the collector of Q13 is +8 TX not +8 RX; diodes D5, D6, D17, D25, and D27 are backwards. Finally, switch labeling should be 100 kHz.

For those of you interested in the math equations given in the appendix, the quantity on the left side of the fourth equation should be a lower case c. This fits the modified binomial solution in line 2.
UNADILLA
FULL POWER - QUALITY
HAM ANTENNA ACCESSORIES
at your dealer

the Big Signal
W2AU
Balun

the Old reliable
W2VS Traps

For over 20 years, the choice
of Hams, Armed Forces and
Commercial Communications - world-wide.

UNADILLA / REYCO Division Microwave Filter Co., Inc., E. Syracuse, NY 13057

THE ANSWER IS: NOW!
All 800 channels of it!

SPECTRONICS, INC. — 1009 GAMFIELD ST.
OAK PARK, I11. 60304

PHONE: [312] 848-6777

HAMS - call for our
free catalog PC-80

DEALERS - join over 400
dealers world-wide. Call us
today for no-risk deal.

HAMFEST MANAGERS -
UNADILLA cooperates!
Call us:
US - TOLL-FREE 1-800-448-1666
NY & Canada - COLLECT -
1-315-437-3953

Ask for Hugh Gunnison, WA2ZOT,
or Bonnie, or Emily.

ANTENNA COMPONENTS
Antenna wire, stranded #14 copperweld....... 5.06 ft.
Antenna Wire, stranded #15 copperweld....... 0.55 ft.
Antenna wire, stranded #16 copperweld....... 0.5 ft.
Van Gorden Hi-Q Baluns, 11:1 or 4:1....... 9.95 ea.
Unadilla/Reyco, W2AU Baluns, 1:1 or 4:1....... 14.95 ea.
Van Gorden Hi-Q center insulators....... 4.95 ea.
Unadilla/Reyco, W2AU center insulators....... 9.75 ea.
Ceramic “Dogbone” end insulators, pair........ 96
Unadilla/Reyco plastic end insulators, pair........ 3.50
Nylon guy rope, 450 lb. test, 100' roll........ 3.49
Poly guy rope, 275 lb. test, 100' roll........ 3.00
Unadilla/Reyco W2VS Traps, KW-10 thru KW-40........ 21.95 pr.
Belden 8214 RG-8U type foam coax........ 28 ft.
Belden 8219 RG-58 A/U foam coax........ 11 ft.
Berk-Tex 6211 RG-8X foam coax, Ultraflexible........ 15 ft.
Amphenol 83-1SP PL-259 silver plated connectors........ 75 ea.
Amphenol UG-175/U adapters (RG-58)........ 25 ea.
Amphenol PL-258, straight adapter........ 1.07

LARSEN MOBILE ANTENNAS
Larsen Mount LM-150 2 mtr. whip and coil........ 21.65
LM-MM magnetic mount........ 13.29
LM-TLM trunk lid mount........ 12.77
New Motorola type mount, NMO-150 2 mtr. whip and coil .23.22
NMO-MM magnetic mount........ 14.91
NMO-TLM trunk lid mount........ 15.98
Other Larsen Models Available
Complete Palomar Engineers Line Available
Centurion International Rubber Duck Antennas in Stock
WRITE FOR A FREE COPY OF OUR CATALOG

G & C Communications
730 Cottonwood
Lincoln, Nebraska 68510

More Details? CHECK — OFF Page 94
Call or Write for Delivery or Quote

KENWOOD
TR-9000

LEAVE A MESSAGE & WE’LL CALL YOU BACK!

MADISON
Electronics Supply, Inc.
1508 McKinney • Houston, Texas 77002 • (713) 658-0268

there’s nothing like it at any price

MORSE PAK-B $350.00

with all the receive features of MORSE PAK-A, it also is a complete MORSE KBD

Features include:

1. Speed set from KBD 5 to 80 wpm
2. Defeatable side tone
3. 40 key full travel KBD
4. 16 character transmit buffer
5. Displays received and transmitted text
6. Same excellent MORSE PAK-A receiver and demodulator
7. Relay keyed output for complete compatibility
8. Unbelievable price $350
   plus $5 shipping

MORSE PAK
604 MARCELLA PL. NE
ALBUQUERQUE, NM 87123
505/293-3553

WANTED FOR CASH

400-T Ant. Tuning Unit
(Also known as CU1668 and CU1669)

618-T Transceiver
(Also known as MRC95, ARC34, ARC102, or VC102)

4CX150
4CX250
4CX300A
4CX350A
4CX1000
4CX1500
4CX3000
4CX5000
4CX10,000
4CX10,000
5CX1500
125A
4-250
4-1000
304TL

Highest price paid for these units. Parts purchased.
Phone Ted, W2KUW collect. We will trade for new amateur gear GRC106, ARC105, ARC112, ARC114, ARC115, ARC116, and some aircraft units also required.

DCO, INC.
10 Schuyler Avenue No. Arlington, N. J. 07032
Call Toll Free (201) 988-4246
800-526-1270
Evenings (201) 998-6475
NEC/CEL's world-famous 4GHz GasFETs and NE64535 silicon bipolar transistors are offered at reduced prices to qualified experimenters and hams.

**GasFETs:**
- NE24483 1.5dB NF/13.0dB GNF at 4GHz $35.00 each*
- NE38883 1.3dB NF/13.0dB GNF at 4GHz $50.00 each*

**Bipolar:**
- NE64535 10.5dB MAG at 4GHz $13.00 each*

Immediate delivery. Contact California Eastern Laboratories, Inc., or the CEL sales office nearest you.

*U.S. Domestic Prices Only.

**NEC microwave semiconductors**

California Eastern Laboratories, Inc.

Exclusive sales agent for Nippon Electric Co., Ltd. Microwave Semiconductor Products. U.S.A. □ Canada □ Europe

SAVE TIME & MONEY!

Shop By Mail

RSGB AMATEUR RADIO OPERATING MANUAL
Edited by R. J. Eckersley
Compiled by the RSGB, this exciting new book covers just about every facet of Amateur Radio. Starting with a precise description of the Amateur Service worldwide, the Amateur Radio Operating Manual leads the Amateur through the steps to setting up a station correctly, how to operate properly, DX contests, satellites, RTTY and Slow Scan Television. You also get 5 big appendices jam-packed with more information: call signs in use, maps, DXCC country list, time zones and international callsign assignments. 190 pages. ©1979.
[RB-DM] Softbound $9.95

NEW

GENERAL CLASS AMATEUR LICENSE
STUDY GUIDE
by Phil Anderson, WBXJ
This book was written in simple laymen's language with uncomplicated explanations and examples used to present electronic radio concepts and ideas. Throughout each chapter, questions and answers are used to strengthen your understanding of the terms and concepts presented. This book also covers several methods that can be used to improve code reception skills. The final chapter is a sample FCC exam which the author feels he would ask if he were to give the FCC exam. 140 pages. ©1979.
[12617] Softbound $5.50

NEW

RADIO PUBLICATIONS SPECTRUM CHART
Here's how to tune in the world! Organized by frequency, this big, attractive, multi-colored wall poster is a must for every ham shack. Covers 10 kHz to 30 GHz listing stations or services assigned by frequency. You also get a time chart that shows each time zone and its relation to GMT. 1978.
[RP-SC] $4.95

NEW

ADVANCED CLASS TEST GUIDE
by Dick Bash, KL7IHP
Based upon the FCC exam syllabus and feedback from actual test experiences, this new book is probably one of the best study guides available today. Over 190 sample questions cover each major subject area completely. You also get helpful hints on how to study successfully and on how to prepare yourself mentally before you take the exam. You aren't fully prepared until you don't have this book. ©1978.
[DB-AG] Softbound $9.95

AMATEUR RADIO THEORY COURSE
by Martin Schwartz, W2OSH
A complete, well-explained, home study course in radio theory, from elementary electronics to antennas, covering the requirements for the Novice, Technician, Conditional, and General Class Amateur License. Each of 14 lessons is followed by practice questions and "FCC Type" examination questions similar to those in the Novice and General Class exams. A complete reprint of the FCC Amateur Radio Rules and Regulations is also provided. Even if you have no prior background in electronics, you'll find this latest revised edition an excellent way to get yourself on the air. 320 pages. ©1979.
[102-01] Softbound $5.95

NEW 1980 34th EDITION
WORLD RADIO & TV HANDBOOK
The world's only complete reference guide to international radio and television. This 1980 edition has complete information on each station, including address, frequency and scheduling. Much additional information such as solar activity and World Time Table is included. Unquestionably the leading book of this type. 554 pages. ©1980.
[WR-TV] Softbound $14.95

RADIO HANDBOOK 20th Edition
by William I. Orr
Here's an unbeatable bargain. The Twentieth Edition of the Radio Handbook features:
• A long list of HF/VHF linear amplifier designs using popular high-power tubes.
• Many of the receiver, transmitter, antenna and accessory construction projects which have made the Radio Handbook series so popular.
• A large measure of current reference material.
Lots of usable and valuable information for an unbeatably low price. 966 pages. ©1975. Hurry! Quantities limited!
[24032] was $18.50 Hardbound $8.95

SAVE over 50%

KANTRONICS THEORY CASSETTE
Here's a new, easy way to study theory for your Novice, General, Advanced or Extra class exam. Designed for folks on the run. All you have to do is drop in the cassette at home, work or in the car and listen to an interview-style tape covering Novice, General, Advanced or Extra class theory. A great way to reinforce other study methods.
[KT-NT] Novice Class Theory Cassette
One tape $4.95
[KT-GT] General Class Theory Cassette
Two tapes $8.95
[KT-AT] Advanced
One tape $4.95
[KT-ET] Extra
One tape $4.95

For Even Faster Service
Call Toll Free 1 (800) 258-5353
HAM RADIO'S BOOKSTORE • GREENVILLE, NH 03048

More Details? CHECK—OFF Page 94

OSL's — No stock designs! Your art or ours; photos; originals. 50¢ for samples, details (refundable). Certified Communications, 4138 S. Ferris, Fremont, MI 49412.

WANTED: A good, used HP97 calculator. Will pay $350.00 to $400.00 cash. David Sloan, VEC/218, 212 West 20th Avenue, Vancouver, B.C. V5Y 2CA. Phone number: (604) 874-2171.

S.A.S.E. Tubes: antique, transmitting, surplus equipment and parts from 1935. Handbooks, meters, etc. WASCAG, 1449 W. Ash, Fullerton, California 92633.

FOR SALE: Drake R4C Receiver, mint, Jeff V. Nielsen, Box 365, Monroe, Utah 84754. (503) 257-4242.

SALE: Collins KWS-1 set spare finals mint $800, KWS-1 needs work $350. Buy with Hammarlund solid good $400, great Northern FSK good guys $30, CE0A-A with VFO good $75, all with manuals. Model 19 with manual fair $75, Roberts 450-75S guyed no rust, needs new top guys, $300 where is. W. L. Brown, 1739 Middle Sullivan's island, South Carolina 29482.

CB TO 10 METER PROFESSIONALS — your rig or buy ours — SB/MI/MC. Certified Communications, 4138 S. Ferris, Fremont, MI 49412. (518) 436-4561.


MOBILE HF ANTENNA 3.2-30 MHz inclusive, 750 watts ERP, car driven, tuned from the base, eliminating coil changing or removing from mount. Less than 1.5 to VSWR thru entire coverage. $129.95 ea. plus shipping. Contact your local dealer or write for price list. Anteck, Inc., Route One, Hanover, Idaho 83334. (208) 423-4100. Master Chk, and VISA accepted. Dealer and factory rep. inquiries invited.

SATELLITE — MDS Signal Generators 1.8-4.1 GHz clean, checked for transmitting case. $175.00. S. Landau, 2615 W. Ash, Fullerton, California 92633.


ICOM INTERNATIONAL USER'S CLUB. Details SASE Pochorence, 9600 Kickapoo Pass, Streetsboro, Ohio 44240.


MOBILE IGNITION SHIELDING provides more range with no noise. Available most engines. Many other suppression accessories. Littelfuse Engineering, 30 Marine Dr., Port Angeles, WA 98362.


WANTED: Hilltop property near Pollock Pines, California. WASCOA, 4 Ajax Place, Berkeley, CA 94708.


BUY-SELL-TRADE. Send $1.00 for catalog. Give name address and call letters. Complete stock of major brands new and reconditioned amateur radio equipment. Call for best deals. We buy from Drake, Swan, etc., Associated Radio, 8120 Conover, Peabody, KS 66204. (913) 361-9090.

CWSSS FILTERS: IC audio install in any radio, sharp CW, stagger tuned ssb — $15, $32. SASE info: W8CBR, PO Box 31,航线柳溪, NC 28701.

QSLs — $2.70 per hundred (minimum order, 1000) and up. 32 color designs. Send 30¢ for stamps for catalog. Satisfaction guaranteed or money back. Since 1934. VPQSDP Press, Box 1523, Boca Raton, FL 33432.

WANTED: Marantz 88 or 9 tube type audio amplifiers. Bob Savage, 18880-A S.W. Butternut, Aloha, OR 97007, 503-642-6085 days.


WANTED — Instructor Ham Radio, N.Y.S. Co-ed Amateur Extra.

RATES Non-commercial ads 10¢ per word; commercial ads 60¢ per word both payable in advance. No cash discounts or agency commissions allowed.

HAMFESTS Sponsored by non-profit organizations receive one free Flea Market ad (subject to our edit). Repeat insertions of hamfest ads pay the non-commercial rate.

COPY No special layout or arrangements available. Material should be typewritten or clearly printed (not all capitals) and must include full name and address. We reserve the right to reject unsuitable copy. Ham Radio cannot check each advertiser and thus cannot be held responsible for claims made. Liability for correctness of material limited to correct ad in next available issue.

DEADLINE 15th of second preceding month.

SEND MATERIAL TO: Flea Market, Ham Radio, Greenville, N.H. 03048.
NEW FROM CLB

A complete line of QUALITY 50 thru 450 MHz TRANSMITTER AND RECEIVER KITS. Only two boards for a complete receiver. 4 pole crystal filter is standard. Use with our CHANNELIZER or your crystals. Priced from $69.95. Matching transmitter strips. Easy construction, clean spectrum, TWO WATTS output, unsurpassed audio quality and built in TONE PAD INTERFACE. Priced from $29.95.

SYNTHESIS KITS from 50 to 450 MHz. Prices start at $119.95. Now available in KIT FORM - GLB Model 200 MINI-SIZER.

Fixes any HT. Only 3.5 mA current drain. Kit price $159.95 Wired and tested. $239.95 Send for FREE 16 page catalog.

We welcome Mastercharge or VISA

GLB ELECTRONICS
1952 Clinton St., Buffalo, N.Y. 14206

July 26 thru August 8, 1980

Our 21st year of successful teaching

Boost your Ham Skills on the Blue Ridge

“A Vacation with a Purpose”

Two weeks saturation learning program in Amateur Radio:
• Novice to General
• General or Technician to Advanced
• Advanced to Amateur Extra

Expert Instruction starting at your level. Code and Theory in depth along with Friendly Amateurs, Who Care About You.

C. L. PETERS, K4DNJ, Director
Oak Hill Academy Amateur Radio Session Mount of Wilson, Virginia 24363

Name: ____________________________
Address: ____________________________
City/State/Zip: ______________________

86 • april 1980

MOTOROLA ALL SOLID STATE MORTRAN RADIOS.
MORTRAN COMMUNICATIONS KITS. Priced from $300 (30W), receive 450 MC. Will operate in Ham Bands. No modification required. Large stock available. $150.00 each. Omni Communications. Call (312) 852-0739.

SATELLITE T.V. 3.7-4.2 GHz mixer with 20dB of gain, 70 MC. Will receive 100 MC of activity. Built in LNA PCB and output +40 dBm. Motorola $69.95.

Coming Events

DX YL to NORTH AMERICA YL Phone starts Tuesday, April 8 at 1800 UTC, ends Wednesday, April 9 at 1800 UTC: CW: Contact Gloster’s Tuxedo, PO Box 3026, DeKalb, Illinois 60115. Saturday, April 16. All licensed YL operators throughout the world are invited to participate. GM contacts do not count. Send logs to W6GRL. No fee.

VIVE YL". All bands 160-10 meters. Cross band operation not permitted. Logs must be postmarked no later than May 31, 1980, and received no later than May 17, 1980 by the YLR Vice President.

MISSOUR: The Missouri Valley Amateur Radio Club, Inc. proudly announces its second annual Pony Express Day from the original stations in St. Joseph, April 9 and 10. Operating time 1000CST to 1900CST both days. Anyone making contact with the club station will receive the Pony Express Award. Send legal-size SASE along with payment of $5 per card. Cards mailed by Secretary/Manager, 401 North 12th Street, St. Joseph, MO 64501. Certificate will be stamped with original seal of the Pony Express. Operating frequencies will be between 30738 and 198030. Price includes SASE and 100000000000.

OHIO: Dayton Hamvention, April 25, 26, 27, 1980 at the Arena and Exhibition Center. Exhibits and Flea Market open Friday noon. Usual gatherings, forums, lectures, flea market, food service, and exhibits. Dayton Amateur Water. K7UQA. Special awards, prizes, including 26th annual "Ham of the Year" award. Nominations to be sent to Awards Chairman, Box 44, Dayton, Ohio 45401. Dayton Flea Market hours are: Friday 1200 to 1900; Saturday 0900 to 1700; and Sunday 0900 to 1600. No self-contained vendor may enter. Vendor fee: $15 for advance, $13 for general, maximum four spaces. Permits will be $15 and are available on Fridays from 0900 to 1700. All vendors must register at Flea Market area. For further information, reservations, etc., telephone (513) 216-1165, or write Box 44, Dayton, Ohio 45401.

NEW YORK: Southern Tier Amateur Radio Club's 21st annual Hamfest, Saturday, May 3. NEW LOCATION: Owego Trafficway Inn, Rt. 17, Exit 65, Owego, New York. Flea market, tech. talks. Buffet dinner tickets and general admission $8. Reservations received after April 20 will be $10. Admission only $2.00. STARC has use of all public rooms of Treadway for that day, all on ground level. For hotel accommodations at the Treadway contact: Debbie Chambers, 607-667-4000. For information, ticket reservations contact: STARC, PO Box 11, Endicott, NY 13760.

MASSACHUSETTS: The Central Massachusetts Amateur Radio Association is holding a Hamfest and flea auction on April 25th at 7:30 pm (doors open at 6:00 pm) at the Main South American Legion Post No. 341, Worcester. Flea market table, door prizes, refreshments. Talk-in on 377-97, 52-52. For more information call: Ren Brodeur, WA1ELE, 617-753-7480.

ILLINOIS: Kishwaukee Radio Club & DeKalb County Amateur Repeater Club's 22nd annual Indoor/outdoor hamfest, Sunday, May 4, 8 a.m. to 3 p.m., Notre Dame School (3 miles south of DeKalb between hwys. 23 and 9). Contact: Staci, 307-185-4000. Information, ticket reservations contact: STARC, PO Box 44, Sycamore, Illinois 60178.

NEW JERSEY: The Fifth Trenton Computer Festival will be held on April 18th, 9:00-6:00 p.m., April 20th 10 a.m.-4 p.m., at the Trenton Community Center, Ogletown. Admission $5, students $2 -- tickets available only at door. Free parking. For more information call: 609-771-2497 or write: Dr. Alien Katz, Trenton State College, Hillwood Lakes, 95x 940, Trenton, N.J. 08625.

ONTARIO: Lake Simcoe Hamfest, June 13th, 14th and 15th, at Molson's Park, Barrie, Ontario, Canada. Registration $1 by mail, $5 at gate. Children under 18 admitted free. Doors open at 1230 noon on Friday the 13th. Talk-in on VE3LRS 143.8S. For information, reservations, or tickets, write to Lake Simcoe Hamfest, P.O. Box 2885, Orillia, Ontario L3V 6B1, Canada.
HA-2 HORIZONTAL/VERTICAL 2 METER ANTENNA

The HA-2 is a low profile half wave, horizontally polarized omnidirectional 2 meter antenna. Although the HA-2 is 2-meter omnidirectional, it will work well as a fixed or portable antenna and its small size provides the traveling ham with an antenna that can easily be packed in a briefcase. The HA-2 comes complete with RG-8, which is led through the center of the section, PL-259 RF connector and 3/32 stud base. A gain-mounting is recommended for mobile operation.

The HA-2 is designed to provide maximum horizontal gain with a high gain directivity. This antenna is ideal for CQ DXers, those cruising around the Inside 1000 and those looking for a low profile, yet high gain solution to their 2 meter needs.

More Details? CHECK-OFF Page 94

Vertical gain over mount $5.95.

SEND CHECK OR MONEY ORDER TO: SEM CON INC., Box 2751, Plainview, NY 11803

P.O. Box 98548
F.C.C. - Certified

USED FLEA ? FOR SALE ??

Then your ad should be here!

(600) 258-5353

HR FLEA MARKET

TACK YOUR FRIENDS about ham radio

Tell your friends about ham radio

New England: The Azalea Coast Amateur Radio Club's 26th annual Spring Flea Market will be held Saturday, May 3, from 8 a.m.-3 p.m., at the New England County Fairgrounds in Newport, R.I., with proceeds going to support the Club's educational programs.

Pennsylvania: The fledgling Ham Radio Club of Pennsylvania will hold its third annual Spring Flea Market on April 26 and 27, from 10 a.m.-5 p.m., at the Radnor High School in Radnor, Pa., with proceeds going to support the Club's educational programs.

New York: The Rochester Amateur Radio Club will hold its seventh annual Spring Flea Market on April 26 and 27, from 10 a.m.-5 p.m., at the Radnor High School in Radnor, Pa., with proceeds going to support the Club's educational programs.


Ohio: The Ottawa Radio Club Area of Ottawa, an organization of Ottawa hams, has developed an operating frequency of 144.630, and an output frequency of 145.230. This repeater is carrier operated, and all door operating needs are met by the use of the repeater.

Illinois: Rock River Radio Club's 14th Annual Hamfest April 13th in Lee County 4th Center NR Amboy, (1 mile east of RD #2 & #3, south of Dixon, IL). Camping is available, all tables furnished at $5 each (open Saturday 10 a.m. for early dealer arrivals). Breakfast served 7:30-8:30 a.m. on 146.37194. Full registration $5.25 at door lor tables and tickets. Talk-in on 146.34974. For further information write: D.V.R.R.A., P.O. Box 7024, West Trenton, NJ 08626.

Michigan: South Eastern Michigan Amateur Radio Association's 22nd Annual Hamfest on April 13th, 8 a.m.-3 p.m. EST at South Lake High School, 21900 E. Nine Mile Road (at Mack Ave), St. Clair Shores, MI 48080.

Minnesota: Rochester Amateur Radio Club and the Rochester Repeater Society will again sponsor the Rochester Area Hamfest, Saturday, April 12th, starting at 8:30 a.m. at the St. John's School Gymnasium, Rochester. Large indoor flea market, prize raffles, refreshments, free parking. Talk-in on 146.228 MHz. For further information write: D.V.R.R.A., P.O. Box 7024, West Trenton, NJ 08626.

Connecticut: Pioneer Valley Repeater Association's 3rd annual Flea Market, April 27th, 10 a.m.-5 p.m., at the Newington High School, Newington. Capacity 1,000 people; tables, chairs, power. The flea market will be held on April 26th, 10 a.m.-5 p.m. Contact: Kevin P. Kelly, WAT1HV, 7 Lawnwood Place, Charlestown, MA 02129.

Massachusetts: Wellesley Amateur Radio Society's annual auction on Saturday, April 12th, starting at 11:00 a.m., Wellesley High School Cafeteria, Wellesley. Talk-in on 630.944, 10 a.m.-5 p.m. Contact: Lee D. Mayhoney.

Massachusetts: Framingham Amateur Radio Club's annual Spring Flea Market, April 27th, 10 a.m.-5 p.m., at the Framingham Police Station Drill Shed, Framingham. Admission $1 — sellers $6/table. Sellers must register in advance. Talk-in on 7515 & 52 Contact: Ron Eganla, K1YHN, F.A.R. Inc., P.O. Box 3005, Saxonville, MA 01710, 507-877-4520.


Indiana: Lake County Radio Club's 27th annual Herbert S. Brier Memorial Banquet, April 19th, starting at 6 p.m. at the Holiday Inn, 1400 S. Broad St., Griffith. Famous surprise speaker, door prizes, awards. Tickets $10 — write L.C.R.C., P.O. Box 1009, Gary, Indiana 46409. No tickets at door.

North Carolina: The Azaete Coast Amateur Radio Club holds its annual Spring Flea Market on April 26th, 10 a.m.-5 p.m., at the South Carolina State Fairgrounds in Columbia, S.C. Anyone making contact with Club Station receives South Carolina Anniversary Award — just send SASE & QSL Card to: Sheriff's Radio Club, 1000 P.O. Box 653, Crawford, PA 16335 Attn: Hamfest Committee.


Wisconsin: The Madison Area Repeater Association will be sponsoring the 8th Annual Madison Swapfest on Sunday, April 13th at the Dane County Expo Center Forum Building, Madison. Doors open at 9 a.m. — tickets $2.50 in advance, $3.50 at door (children 12 under free). Tables $4 in advance, $5 at door — reserve early — sell out last year! Dealers and commercial exhibitors, free movies, arts & crafts, all you can eat pancake breakfast and beef bar-b-que lunch. For information on booths contact: MARA, Box 3403, Madison, WI 53704.

Wisconsin: The 3-F Amateur Radio Club of Madison's Swapfest will be held on Saturday, May 3, from 8 a.m.-3 p.m., at the Neenah Labor Temple, 157 South Green Bay Rd., Neenah. Facilities include large parking area, large indoor and outdoor swap area, free auction. Food and beverage available. Admission $1.50 for tickets and tables and in advance. $2 at door for tables and tickets. Talk-in on 5025. For further information write: W153704, P.O. Box 1388, Neenah, WI 54952 or call: 414-722-4034.


Call Sign Plaques — Handsome, professionally routed and finished with your own station calligns, $14.95. Hamplaques, 1001A Spearfish, Ellsworth, SD 57706.


Rohn Tower: Buy wholesale from nationwide distributors. 20G, $29.44 each; 25G, $37.62 each; 45G, $80.60 each. Freight paid. QSL, K1YHN, 301 56th St. W, Winnipeg, MB R2J 3M9, Canada.


Tell your friends about ham radio

More Details? CHECK-OFF Page 94

Vertical gain over mount $5.95.

Vertical gain over mount $5.95.

Send check or money order to: SEM CON Inc., Box 2751, Plainview, NY 11803

P.O. Box 98548
F.C.C. - Certified

Vertical gain over mount $5.95.

Send check or money order to: SEM CON Inc., Box 2751, Plainview, NY 11803

P.O. Box 98548
F.C.C. - Certified

Vertical gain over mount $5.95.
Ham Radio's guide to help you find your loc

**Arizona**

KRYDER ELECTRONICS
5520 NORTH 7TH AVENUE
NORTH 7TH AVE. SHOPPING CTR.
PHOENIX, AZ 85013
602-249-3739
Your Complete Amateur Radio Store.

POWER COMMUNICATIONS
6012 N. 27 AVE.
PHOENIX, ARIZONA 85017
602-242-6030
Arizona's #1 "Ham" Store. Yaesu, Kenwood, Drake, Icom and more.

**California**

C & A ELECTRONIC ENTERPRISES
2210 S. WILMINGTON AVE.
SUITE 105
CARSON, CA 91045
213-834-5868
Not The Biggest, But The Best - Since 1962.

POWER COMMUNICATIONS
C & A ELECTRONIC ENTERPRISES
2210 S. WILMINGTON AVE.
SUITE 105
CARSON, CA 90745
213-834-5868
Not The Biggest, But The Best - Since 1962.

**Delaware**

DELWARE AMATEUR SUPPLY
71 MEADOW ROAD
NEW CASTLE, DE 19720
302-328-7728
ICOM, Ten-Tec, Swan, DenTron, Wilson, Tempo, KDK, and more.
One mile off I-95, no sales tax.

**Florida**

AGL ELECTRONICS, INC.
1898 DREW ST.
CLEARWATER, FL 33515
813-461-HAMS
West Coast's only full service Amateur Radio Store.

AMATEUR RADIO CENTER, INC.
2805 N.E. 2ND AVENUE
MIAMI, FL 33137
305-573-8383
The place for great dependable names in Ham Radio.

RAY'S AMATEUR RADIO
1590 US HIGHWAY 19 SO.
CLEARWATER, FL 33516
813-535-1416

SUNRISE AMATEUR RADIO
1351 STATE RD. 84
FT. LAUDERDALE, FL 33315
(305) 761-7676
"Best Prices in Country. Try us, we'll prove it."

**Illinois**

AUREUS ELECTRONICS, INC.
1415 N. EAGLE STREET
NAPERVILLE, IL 60540
312-420-8629
"Amateur Excellence"

ERICKSON COMMUNICATIONS, INC.
5456 N. MILWAUKEE AVE.
CHICAGO, IL 60630
Chicago - 312-381-5681
Outside Illinois - 800-621-5802
Hours: 9:30-5:30 Mon, Tu, Wed & Fri; 9:30-9:00 Thurs; 9:00-3:00 Sat.

**Indiana**

KRYDER ELECTRONICS
GEORGETOWN NORTH SHOPPING CENTER
2810 MAPLECREST RD.
FORT WAYNE, IN 46815
219-484-4946
Your Complete Amateur Radio Store. 10-9 T, TH; 10-5 W, SAT.

**Iowa**

BOB SMITH ELECTRONICS
RFID #3, HIGHWAY 169 & 7
FORT DODGE, IA 50501
515-576-3886
800-247-2476/1793
Iowa: 800-362-2371
For an EZ deal.

**Kansas**

ASSOCIATED RADIO
8012 CONSER. P. O. BOX 4327
OVERLAND PARK, KS 66204
913-381-5901
America's No. 1 Real Amateur Radio Store. Trade - Sell - Buy.

**Maryland**

THE COMM CENTER, INC.
LAUREL PLAZA, RT. 198
LAUREL, MD 20810
800-638-4486
Kenwood, Drake, Icom, Ten-Tec, Tempo, DenTron, Swan, and Apple Computers.

**Massachusetts**

TEL-COM, INC.
675 GREAT ROAD, RT. 119
LITTLETON, MA 01460
617-486-3040
The Ham Store of New England You Can Rely On.

**Michigan**

RSE HAM SHACK
1207 W. 14 MILE
CLAWSOM, MI 48017
313-435-5660
Complete Amateur Supplies.

**Connecticut**

THOMAS COMMUNICATIONS
95 KITTS LANE
NEWINGTON, CT 06111
203-667-0811
Authorized dealer for Kenwood, Yaesu, Drake, Icom, etc. - CALL US!

**Ohio**

**Oregon**

**Pennsylvania**

**Rhode Island**

**South Carolina**

**South Dakota**

**Tennessee**

**Texas**

**Utah**

**Washington**

**West Virginia**

**Wisconsin**

**Wyoming**

**Dealers:**

YOU SHOULD BE HERE TOO!

Contact Ham Radio now for complete details.

88 April 1980
Amateur Radio Dealer

**Minnesota**

PAL ELECTRONICS INC.
3452 FREMONT AVE. NO.
MINNEAPOLIS, MN 55412
612-521-4662
Midwest's Fastest Growing Ham Store, Where Service Counts.

**New York**

HAM-BONE RADIO
3206 ERIE BLVD. EAST
SYRACUSE, NY 13214
315-446-2266
We deal, we trade, all major brands!
2-way service shop on premises!

**Nebraska**

COMMUNICATIONS CENTER, INC.
443 NORTH 48TH ST.
LINCOLN, NE 68504
800-228-4097
Lowest Prices in the USA on Ham Equipment.

**New Hampshire**

EVANS RADIO, INC.
BOX 893, RT. 3A BOW JUNCTION
CONCORD, NH 03301
603-224-9961
Icom, DenTron & Yaesu dealer.
We service what we sell.

**New Jersey**

ATKINSON & SMITH, INC.
17 LEWIS ST.
EATONTOWN, NJ 07724
201-542-2447
Ham supplies since "55".

**Ohio**

UNIVERSAL AMATEUR RADIO, INC.
1280 AIDA DRIVE
COLUMBUS (REYNOLDSBURG)
OH 43068
614-866-4267
Complete Amateur Radio Sales and Service. All major brands - spacious store near I-270.

**Pennsylvania**

HAMTRONICS, DIV. OF TREVOS ELECTRONICS
4033 BROWNSVILLE ROAD
TREVOS, PA 19047
215-357-1400
Same Location for 30 Years. Call Toll Free 800-523-8998.

**Wisconsin**

WITTIE ELECTRONICS
384 LAKEVIEW AVENUE
CLIFTON, NJ 07011
(201) 772-2222
Same location for 52 years.
Full line authorized Drake dealer.

WITTE ELECTRONICS
384 LAKEVIEW AVENUE
CLIFTON, NJ 07011
(201) 772-2222
Full line authorized Drake dealer.

WITTIE ELECTRONICS
384 LAKEVIEW AVENUE
CLIFTON, NJ 07011
(201) 772-2222
Full line authorized Drake dealer.

80 & 84-METER TRANSECIEVERS
ONLY $79.95 EACH

- 84-meter transceiver which covers 3500 to 3600 kHz is for the 84-meter band.
- NOVICES should order the 80-meter unit which covers 3685 to 3755 kHz.
- CW operation with VFO control.
- Output power approximately 10 watts.
- Expect up to 1000 mile range when used with a half-wave dipole.
- Adjustable RF output impedance.
- Low distortion sidetone oscillator doubles as a code practice oscillator.
- Direct conversion receiver.
- RF amplifier and sharp audio filter.
- Receiver independent tuning.
- Long life operation from 9 cell-contained 1.5 volt carbon-zinc D cells.
- Size 9" wide by 5" high by 8" deep.
- Instruction manual included.

Accessories required but not included, are 8-ohm stereo phones, telegraph key, a good antenna such as a half-wave dipole, and an ADF with a millimeter.

MANUAL AVAILABLE SEP. $2.00
SEND S.A.S.E. FOR SPEC SHEET
R.I. RESIDENTS ADD 6% SALES TAX

80 & 84-METER TRANSECIEVERS
ONLY $79.95 EACH

- 84-meter transceiver which covers 3500 to 3600 kHz is for the 84-meter band.
- NOVICES should order the 80-meter unit which covers 3685 to 3755 kHz.
- CW operation with VFO control.
- Output power approximately 10 watts.
- Expect up to 1000 mile range when used with a half-wave dipole.
- Adjustable RF output impedance.
- Low distortion sidetone oscillator doubles as a code practice oscillator.
- Direct conversion receiver.
- RF amplifier and sharp audio filter.
- Receiver independent tuning.
- Long life operation from 9 cell-contained 1.5 volt carbon-zinc D cells.
- Size 9" wide by 5" high by 8" deep.
- Instruction manual included.

Accessories required but not included, are 8-ohm stereo phones, telegraph key, a good antenna such as a half-wave dipole, and a dc voltmeter.

MANUAL AVAILABLE SEP. $2.00
SEND S.A.S.E. FOR SPEC SHEET
R.I. RESIDENTS ADD 6% SALES TAX

The Best Got Better

MODEL 4381 RF POWER ANALYST
This new generation RF Wattmeter with nine-mode system versatility reads...
IN STOCK QUICK DELIVERY
AUTHORIZED DISTRIBUTOR

Webster
associates
115 BELLARMINE
ROCHESTER, Ml 48063
CALL TOLL FREE
800-521-2333
IN MICHIGAN 313-375-0420

April 1980
STEP UP TO TELREX WITH A TELREX “BALUN” FED-“INVERTED-VEE” KIT THE IDEAL HI-PERFORMANCE INEXPENSIVE AND PRACTICAL TO INSTALL LOW-FREQUENCY MONO OR MULTIPLE BAND, 52 OHM ANTENNA SYSTEM

Telrex “Monarch” (Trapped) I.V. Kit $85.50 Post Paid Continental U.S.

Optimum, full-size doubler performance, independent of ground conditions! "Balanced-Pattern", low radiation angle, high signal to noise, and signal to performance ratio! Minimal support costs, (existing tower, house, tree). A technician can resonate a Telrex “Inverted-Vee” to frequency within the hour! Minimal SWR is possible if installed and resonated to frequency as directed! Pattern primarily low-angle, Omni-directional, approx. 6 DB null at ends! Costly, tossy, antenna tuners not required!

Complete simplified installation and resonating to frequency instructions supplied with each kit.

For technical data and prices on complete Telrex line, write for Catalog PL 7 (HRH) Budwig Mfg. Co. PO Box 829, Ramona, CA 92065

Bind 'em and Find 'em Keep those valuable issues of both Ham Radio and HORIZONES like new. Prevent smears, tears and dog ears. Bind 'em together and enjoy for years to come. You'll be happy you did! HAM RADIO BINDERS Beautiful buckram binders complete with date labels. Available in our new large size to accommodate HAM RADIO'S hefty issues.

- HR-BDL Each Just $6.95 3 for $17.95

HAM RADIO MAGAZINE FILES Your collection of HAM RADIO Magazines is a valuable resource. Here’s a brand new, inexpensive way to store them. These sturdy cardboard magazine files keep them clean, neat and up front where you can use them for quick and easy reference.

- HR-HMF $1.95 each 3 for $4.95

HAM RADIO HORIZONES BINDERS Handsome white binders complete with date labels.

- HR-HRDL Each Just $6.95 3 for $17.95

HORIZONES MAGAZINE FILES Your collection of Ham Radio HORIZONES is a valuable resource. Here’s a brand new, inexpensive way to store them. These sturdy cardboard magazine files keep them clean, neat and up front where you can use them for quick and easy reference.

- HR-HRHF $1.95 each 3 for $4.95

ORDER TODAY

Ham Radio's Bookstore GREENVILLE, NEW HAMPSHIRE 03048 OR CALL TOLL FREE 1 (800) 258-5353

BINDERS
- HR-BDL $6.95 ea.
- HR-HMF $1.95 ea.
- HR-HRDL 3/$17.95
- HR-HRHF 3/$4.95

FILES
- CASH
- CHARGE
- MC
- VISA

Exp. Card Number

Name
Address
City State Zip

More Details? CHECK — OFF Page 94
SCANNERS NOW, INTRODUCING SCANNERS

FOR THE COMTRONIX FM80 AND FM200;
KENWOOD TR7400A, TR7600 AND TR7625;
KDK 2015R, KDK 2016A; MIDLAND 13-510, 13-513;
CLEG FM-28; YAESU FT227R; ICOM IC22S

- The scanner continues to expand its list of quality scanners. Each of the above scanners is custom designed for their respective rigs.
- All scanners available in kit form.
- All are easy to assemble and come with complete instruction manual.
- Scanned frequency displayed on digital readout (except IC22S).

In the scanner, the LED lights when scanned. A full wireless display of the scanned frequency pauses for a preset time (about 5 seconds) and then resumes scanning (except IC22S). This gives you the ability to stop on any frequency without lifting a finger. When you hear something interesting, you flip the switch to the LOCK mode and the rig is ready to transmit.

<table>
<thead>
<tr>
<th>AED SCANNER SPECIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COMTRONIX</strong></td>
</tr>
<tr>
<td><strong>FM80/FM200</strong></td>
</tr>
<tr>
<td><strong>KDK 2015R</strong></td>
</tr>
<tr>
<td><strong>SCAN RATE</strong></td>
</tr>
<tr>
<td><strong>SWEEP WIDTH</strong></td>
</tr>
<tr>
<td><strong>SCAN CONTROLS</strong></td>
</tr>
</tbody>
</table>

| PRICE PER UNIT | $49.95 | $39.95 | $64.95 | $59.95 |

ADD $1.50 PER ITEM FOR POSTAGE & HANDLING

AED ELECTRONICS
750 LUCERNE RD., SUITE 120, MONTREAL, QUEBEC, CANADA H3R 2H6
TEL. 514-737-7293

SYNTHESIZED SIGNAL GENERATOR

- Covers 100 to 179.999 MHz in 1 kHz steps with thumb-wheel dial. Accuracy: 0.0001% at all frequencies.
- Internal frequency modulation from 0 to over 100 kHz at a 1 kHz rate. Spurs and noise at least 60 dB below carrier. RF output adjustable from 50 to 500 mV across 50 ohms.
- Operates on 12Vdc @ 0.5 amp. Price $239.95 plus shipping.

In stock for immediate shipping. Overnight delivery available at extra cost. Phone: (212) 468-2720.

VANGUARD LABS
195-23 Jamacia Ave. Hollis, NY 11423

2 watts QRP go a long way!

- **Rockhound**
  Two full watts CW output! Choose 40 or 80 meter models. Weighs less than 6 ounces. $199.95

- **8040 B**
  Covers the Novice portion and more on 40 and 80 meters for cw receiving. Only 3" by 5" by 7" and 24 ounces! $89.95

- **Freedom**
  Free yourself from crystals with this VFO for 40, 80 and 15 meters. Great for many old transmitters! $64.95

Please add $2 per order, or $5 for combinations, for shipping/handling.
ARE YOU HAVING CONTROL PROBLEMS??

Help solve them with one of "Creative Electronics"
Repeater Control and Timer Boards
or Tone Pad Decoder Board!

RCT 101 - REPEATER CONTROL & TIMER

- PROGRAMMABLE ANALOG TONE DECODERS
- CONTROL LOGIC
- ADJUSTABLE TIME LIMIT
- ADJUSTABLE DELAYED DROP OUT
- OPERATES ON FROM 8 - 20 VOLTS D.C.

COMPLETE KIT $ 59.95
ASSEMBLED UNIT $ 79.95

TPD 204 - TONE PAD DECODER

- 8 ANALOG TYPE FILTER TONE DECODERS
- FULL 4 X 4 MATRICES
- INDIVIDUAL TTL LOGIC OUTPUT FOR EACH TONE
- INDIVIDUAL TTL LOGIC OUTPUT FOR EACH DIGIT
- TTL BCD OUTPUT FOR DIGITS 0 - 9 INCLUDING STROBE
- SEVEN SEGMENT DISPLAY OF BCD OUTPUT

COMPLETE KIT $109.95
ASSEMBLED UNIT $139.95

MICROWAVE GUN OSCILLATORS

Inexpensive microwave power sources for amateur and experimental applications. Standard waveguide flanges. Removes weight from police radar units.

X-BAND: 10.525GHz, mech. tunable ±50MHz, Input + 10VDC @600mA max.
OUT: 25mA

OUTPUT (min) 25mW 50mW 100mW
EACH $35.00 $40.00

K-BAND: 24.150GHz, mech. tunable ±50MHz, Input + 6VDC @800mA
OUT: 40mW 70mW 100mW

EACH $60.00 $67.50

\[**\] SPINNER HANDLE AVAILABLE

IN-LINE RF Wattmeter

Military Type TS - 3499 / URM

Identical to ELECTRO IMPULSE DW - 1000

A rugged portable instrument for measuring forward or reflected CW power. Wide power range and broad coverage is accomplished by panel mounted switches, no plug-in elements required:

Fwd Power: 10, 50, 100, 500, 1000 watts; Refl. Power: 10, 50, 100, 500 watts; Freq. 2-30 250 200 1000MHz; VSWR 1.10 max., 500 kHz; Accuracy ±1% FS; Connectors N/F; Size 14" x 9" x 7"; Weight 13 lbs.

Brand New $299.00, 3 for $750.00

PUSH-TO-TALK MICROPHONE: King Radio, hand held, low impedance, carbon push-to-talk microphone, with coiled cord and mounting bracket.

....Brand New $5.95

Complete stock of microwave components for prompt delivery

We Buy surplus Test instruments, microwave components & equipment, and military electronic equipment.

Check or Money Order with order. C.O.D.'s enclosed 25% deposit. Open Accounts to firms favorably rated in D & B. F.O.B. Camden, N.J., New Jersey residents add 5% sales tax.

ELECTRONIC RESEARCH LABS., INC.
1423 Ferry Ave., Camden, N.J. 08104
Phone 609-541-4206

HRB's new LOG BOOK is here — and it is unquestionably the finest one you'll ever use. 80 big, double-sided pages of clear, legibly ruled stock, all spiral bound to lie flat for easy writing. More than 2000 entries give you twice the space for less money than the log book you probably use now. Order yours today! 8-3/8" x 10-7/8", 80 pages.

ONLY $1.75 each (plus $1.00 shipping)

Order 3 or more logs and we'll ship postpaid.

Send check or money order to:

HAM RADIO'S BOOKSTORE
Greenville, NH 03048

REPEATERS UNLIMITED

GROTH-Type

COUNTS & DISPLAYS YOUR TURNS

- 99.99 Turns
- One Hole
- Panel Mount
- Handy Logging Area
- Spinner Handle Available

Case: 2x4"; shaft 1/4"x3"

Model TC2: Skirt 2-1/8"; Knob 1-5/8"

Model TC3: Skirt 3"; Knob 2-3/8"

TC2 $10.00
TC3 $11.00
Spin Knob $1.50
Prices include UPS or Parcel Post

IN-LINE RF WATTMETER

Military Type TS - 3499 / URM

Identical to ELECTRO IMPULSE DW - 1000

A rugged portable instrument for measuring forward or reflected CW power. Wide power range and broad coverage is accomplished by panel mounted switches, no plug-in elements required:

Fwd Power: 10, 50, 100, 500, 1000 watts; Refl. Power: 10, 50, 100, 500 watts; Freq. 2-30 250 200 1000MHz; VSWR 1.10 max., 500 kHz; Accuracy ±1% FS; Connectors N/F; Size 14" x 9" x 7"; Weight 13 lbs.

Brand New $299.00, 3 for $750.00

PUSH-TO-TALK MICROPHONE: King Radio, hand held, low impedance, carbon push-to-talk microphone, with coiled cord and mounting bracket.

....Brand New $5.95

Complete stock of microwave components for prompt delivery

We Buy surplus Test instruments, microwave components & equipment, and military electronic equipment.

Check or Money Order with order. C.O.D.'s enclosed 25% deposit. Open Accounts to firms favorably rated in D & B. F.O.B. Camden, N.J., New Jersey residents add 5% sales tax.

ELECTRONIC RESEARCH LABS., INC.
1423 Ferry Ave., Camden, N.J. 08104
Phone 609-541-4206

HRB's new LOG BOOK is here — and it is unquestionably the finest one you'll ever use. 80 big, double-sided pages of clear, legibly ruled stock, all spiral bound to lie flat for easy writing. More than 2000 entries give you twice the space for less money than the log book you probably use now. Order yours today! 8-3/8" x 10-7/8", 80 pages.

ONLY $1.75 each (plus $1.00 shipping)

Order 3 or more logs and we'll ship postpaid.

Send check or money order to:

HAM RADIO'S BOOKSTORE
Greenville, NH 03048

NEW ELECTRONIC PARTS

Brand name, first line components. Stocked in depth 24 hour delivery. Low prices and money back guarantee on all products we carry.

STAMP BRINGS CATALOG

SPECIALS

<table>
<thead>
<tr>
<th>Component</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keyboard Enclosures</td>
<td>$22.13</td>
</tr>
<tr>
<td>14&quot; x 8.3&quot; 3&quot;</td>
<td>$22.13</td>
</tr>
<tr>
<td>3&quot; x 11.3&quot; 3&quot;</td>
<td>$28.50</td>
</tr>
<tr>
<td>20&quot; x 8.3&quot; 3&quot;</td>
<td>$28.50</td>
</tr>
<tr>
<td>Add $2 for Shipping &amp; Handling</td>
<td></td>
</tr>
</tbody>
</table>

RTTY

<table>
<thead>
<tr>
<th>Component</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>UMT SPEED CRYSTAL BOARD KIT</td>
<td>$109.95</td>
</tr>
<tr>
<td>BOARD ALONE</td>
<td>$77.95</td>
</tr>
<tr>
<td>AUTO CW ID KIT</td>
<td>$37.90</td>
</tr>
<tr>
<td>Daytapro Electronics, Inc.</td>
<td>3029 W. WILSHIRE BLVD., ARLINGTON HTS., ILL. 60004</td>
</tr>
<tr>
<td>Phone 312-870-0555</td>
<td></td>
</tr>
</tbody>
</table>

More Details? CHECK — OFF Page 94
COMING IN
MAY HORIZONS

- New use for an old friend 813 amplifier
- Novel approach to keyer design
- Introducing K5FUV’s DX Horizons column
- Illustrated guide to PC board fabrication

AND MORE!

HAM RADIO
HORIZONS
GREENVILLE, NH 03048

MOVING?
KEEP HAM RADIO COMING...

If possible let us know four to six weeks before you move and we will make sure your HAM RADIO Magazine arrives on schedule. Just remove the mailing label from this magazine and affix below. Then complete your new address (or any other corrections) in the space provided and we’ll take care of the rest.

ham radio
Magazine
Greenville, NH 03048

Thanks for helping us to serve you better.

Here’s my new address:
Name: ____________________________
Address: _________________________
City: _____________________________
State: ____________________________
Zip: _____________________________

Call: _____________________________
Affix Label Here

More Details? CHECK — OFF Page 94

------

ERG Promises Up To The Minute State-Of-The-Art Design and Performance

Four Simultaneous Filters in One for Unparalleled QRM Free Reception (SSB & CW)

* Plus a Special Patented CW Processor *

The brand new SL-56 Audio Active Filter supercedes our SL-55 in both concept and performance. Consolidation of many components has allowed us to make 13 operational amplifiers (compared to 6 in the SL-55) into a filter guaranteed to out perform any other at a cost only slightly higher than the SL-55. The features of the SL-56 are so advanced from its predecessor that calling it the SL-55A is not justified. Unlike other filters that simply offer a choice of one or two filter types at a time (notch, bandpass, etc.) SL56 provides what is really needed — the simultaneous action of a 6 pole 200 Hz fixed highpass filter and a 6 pole 1600 Hz fixed lowpass filter with a 60 dB notch which is tunable over the 200-1600 Hz range. This filter combination is unbeatable for the ultimate in QRM free SSB reception. Adjacent channel QRM is eliminated on the high and low sides at the same time and does not introduce any hollowness to the desired signal. On CW the SL-56 is a dream. The lowpass, highpass and notch filters are engaged along with the tunable bandpass filter (400-1600 Hz) providing the needed action of 4 simultaneous filter types. The bandpass may be made as narrow as 14 Hz (3dB) providing a signal to “gate itself” through to the speaker or headphones (8-2000 OHMS). Receiver noise, ring and other signals are rejected. This is not a regenerator, but a modern new concept in CW reception. The SL-56 connects in series with the receiver speaker output and drives any speaker or headphones with one watt of audio power. Requires 115 VAC. Easily converted to 12 VDC operation. Coal black cabinet and wrinkle gray panel.

Warranted One Full Year Fully RFI Proof Fully Wired and Tested Available Now $79.00 Postpaid in the USA and Canada Virginia Residents Add 4% Sales Tax Attention SL-55 Owners: The Circuit Board of the SL-56 is Completely Compatible with the SL-55 Chassis. Our Retrofit Kit is Available at $40.00 Postpaid.

Electronic Research Corp. of Virginia
P. O. Box 2394 • Virginia Beach, Virginia 23452 • Telephone (804) 463-2669

MILITARY SURPLUS WANTED

Highest prices ever on recent U.S. Military surplus, especially on Collins equipment or parts. We pay freight. Call collect for high offer. (201) 440-8787. 35 Ruta Court, S Hackensack, N.J. 07606

SPACE ELECTRONICS CO.

TRouble Free TOUCH TONE ENCODER

POSITIVE TOUCH (KEYS DEPRESS) • MOBILE • HANDHELD • POSITIVE MOUNT • NO RFI • NO POTTED PARTS (SERVICEABLE) • MIL-SPEC COMPONENTS • SELF CONTAINED • XTAL CONTROLLED • LEVEL ADJUSTMENT FROM FRONT • 4.5 - 60 V.D.C. • WILL OPERATE ANY SYSTEM • LETTERING OPTIONAL

Supplied with: Instructions, schematic, template, hardware. PP-1A designed for Standard Communications Handhelds. (California orders add 6% sales tax.)

NEW PRICES

PP-1 = $49.00 PP-2 = $53.00 PP-1A = $58.00
PP-1K = $55.00 PP-2K = $59.00 K-series = Self Contained Delay Relay
M-series = Detached Frame for irregular installations

Available at: Ham Radio Center (800) 325-3636
Henry Radio, Los Angeles (213) 272-0861
Electronic Equipment, Virginia (703) 938-3350
CW Electronics, Denver (303) 893-5525
C & A Electronics, Long Beach (213) 834-5966

Send For Complete Dealers List & Catalog

Piro Communications
P.O. Box 3435
Hollywood, California 90028
213/852-1515

More Details? CHECK — OFF Page 94

april 1980 93
EASTER EGGS

ALPHA 76, 374, 78 In Stock............ Call
Cushman Nibb "Egg" Kit........... 69.95
OMNI-J 2 Meter Antenna......... 39.95
Bird 43 and slugs, UPS paid in USA...stock
Microwave Modules, Less 10% off list stock
Telrex TBS9N, in stock........... 415.00
Telbem.................. 520.00

Monobanders in stock
New Telrex TBS8, 2KW Pep version... 351.00
New Palomar Transceiver Preamps...
Bencher Paddles.................. 39.95
Vibroplex Paddles in stock, & bags....
call
Lunar 6M 2M 220 In-Line Preamps... stock
Javel QSA.................. 41.95
HAMS Tailtwin Rotor............ 189.00
HAMS 4 Rotor................... 139.00
Certron or GE 572B.............. 32.00/ea
AE, AMPGREX, Raytheon G146B........ 9.95
Motorola HEP170.................. 0.29
Mallory 2.5A/1000V Piezo diode.... 0.19
Sprague 100MFD/450VDC Cap........ 2.00
Aeroxon 1000PF/500V Feithru Cap.... 1.95
Aibel Nibbling Tool............. 8.45
Technical books: Ameco, ARRL, Sams,
TAB, Rider, Radio Pub., Callbook,
Cowen, WRTVH, etc.............. Call
New Belden 9405 (216)!#18) 8 wire
Rotor cable, heavy duty for long runs........ 0.32/lf
4848 8 wire Rotor Cable........ 0.20/lf
968 cable shield RG8 Foam........ 0.46/lf
8214 RG8 Foam.................. 0.26/lf
8237 RG Regular.................. 0.23/lf
8267 RG213................... 0.30/lf
9251 RGA AU.................... 0.35/lf
Belden #8000 14GA
Stranded Antenna wire............ 0.06/lf
Ampli/Graphite Silver PL259 (8315P)........ 0.69
Berkley RG8X 52ohm, KW...... 0.16/lf
Robot "Slow Scan" 400........... 499.00

Telrex antennas? In Stock?
Monobanders?
You bet!
Looking for antenna parts?
Write specific need to W65J.

THIS MONTH'S SPECIALS:
New ICT/71, AC, MC $195.00,
New ICT/71, 2M $299.00,
IC561D 4M 10M $599.00,
IC561 $399.00

Denton G/LA1000B.................. 295.00
Denton Clipperton L............ 499.00
Bearcat 250, 220............. 299.00
300.................. 399.00

MASTERCHARGE • VISA

All prices fob Houston except where indicated.
Prices subject to change without notice, all items
guaranteed: Some items subject prior sale. Please send
letterhead for Dealer price list. Texas residents add 6% tax. Please add postage estimate $1.00 minimum.

Adverti sers v
check-off

...for literature, in a hurry—we'll rush your name to the companies
whose names you "check-off".

Place your check mark in the space between
name and number. Ex: Ham Radio V 234

INDEX

AED 710
Advisors

Alaska Microwave Labs 826
Alcan 700
Alinco 896
Ammet 605
Amtron 733
Antenna Mart 609
Astra 734
Atlantic Surf & Sport 775
Avanti 775
Barry 817
Banjuan 917
Banner 629
Bial 817
Bird Elec 918
Budwigm 233
Comm. Concepts 797
Comm. Spec. 330
Continental Spec. 348
Creative Elec. 751
Curio Electro 404
DCO 324
DSI 456
Data Signal 720
Dave 918
Daytop 918
Dayton Harn costing 223
Debo Elec 828
Digitrex 423
Drake 10
E. T. O. 27
Elec. Research Virginia 27
Fox-Tango 657
G & C Comm. 794
GLB 552
Greenway 832
Gregory 93
Hai 150
H. R. B. Magazine
Hamronics 246
Henry 967
Hildreth 263
Hustler 171
Icom 179

*Please contact this advertiser directly.
Limit 15 inquiries per request.

April, 1980

Please use before May 31, 1980

Tear off and mail to
HAM RADIO MAGAZINE – "check-off"
Greenville, N. H. 03048

NAME........ CALL........ STREET..... CITY....... STATE....... ZIP.....

Adverti sers index

AED Electronics 91
Alaska Microwave Labs 90
Alinco Mfg. Co. 92
Aluma Tower Co. 74
Ammet Associates 76
Antenna Mart 78
Astra Corporation 78
Atlantic Surplus Sales 90
Barry Electronics 69
R. H. Bauman Sales Co 92
Bencher, Inc. 76
Bitel Company 91
Budwigm Mfg. Co. 90
Communication Concepts, Inc. 91
Communications Specialists 91
Continental Specialists 91
Creative Electronics 92
Curis Electro Devices 75
DCO, Inc. 82
DEI Technologies, Inc. 83
Data Signal, Inc. 74
Dave 90
Daytop Electronics 92
Dayton Harn costing 95
Digitrex Electronics 78
Drake Co., R. L. 1
Ehrenreich Technical Operations 75
Electronic Research Co. of Virginia 69
Fox-Tango Corp. 69
G & C Communications 81
GLB Electronics 86
Gregory Elec. Co. 68
Hal Communications Corp. 7
Hall-Tronix 50
Ham Radio's Bookstore 83, 84, 90, 92, 93
Ham Radio Magazine 81
Henry Radio Stores 81, 82
Hidden Electronics Engineering 93
Hustler, Inc. 66
Icom 75
International Crystal Mfg. Co. 8
Jameco Electronics 76
Jones, Martin P. & Associates 85
Kantronics 91
Tric-Kennwood Communications, Inc. 91
Larsen Antennas 43
Lees Electronic Labs. 92
Long's Electronics 96
MFI Enterprises 2
Madison Electronic Supply 98, 92, 94
Marine Radio Co. 86
Microfase Corporation 76
Microwave Filter, Inc. 81
Morse Pak, Inc. 80
Oak Hill Academy Amateur Radio Sessions
Oak Hill Academy Amateur Radio Sessions
P. C. Electronics 89
Pico Communications 93
Radio Amateur Callbook 71
Radio & Electronics Construction 80
Radio Systems Technology Inc. 91
Radio World 78
Ramsey Electronics 31
Sem Com, Inc. 87
Skytec 78
Space Electronics 93
Spectrums 81
Spectrum International 25
Tedco 89
Telemetry Communications & Instrumentation, Inc. 90
Telex Laboratories 90
Ten Tec 9
Vanguard Labs 91
Varian, Ema Division 91
Webster Associates 89
Western Electronics 80
Wilson Electronics 87
Wilson Systems, Inc. 64, 65, 66, 67
Yaesu Electronics Corp. 88
York Electronics 87

94 April 1980
April 25, 26, 27, 1980
Hara Arena and Exhibition Center Dayton, Ohio

Meet your amateur radio friends from all over the world at the internationally famous Dayton HAMVENTION.

Banquet speaker Saturday evening will be Senator Barry M. Goldwater, K7UGA. Seating will be limited so please make reservations early.

If you have registered within the last 3 years you will receive a brochure in late February. If not write Box 44, Dayton, OH 45401.

Nominations are requested for Radio Amateur of the Year and Special Achievement Awards. Nomination forms are available from Awards Chairman, Box 44, Dayton, OH 45401.

For special motel rates and reservations write to Hamvention Housing, 1980 Winters Tower, Dayton, OH 45423. NO RESERVATIONS WILL BE ACCEPTED BY TELEPHONE.

All other inquiries write Box 44, Dayton, OH 45401 or phone (513) 296-1165 - 5-10 P.M. EST.

Rates for ALL 3 Days:

- Admission: $5 in advance, $6 at door.
- Flea Market Space: $11 in advance, $13 at gate.
- Banquet: $12 in advance, $14 at door.

Make checks payable to Dayton HAMVENTION, Box 333, Dayton, OH 45405.

Bring your family and enjoy a great weekend in Dayton.

Sponsored by the Dayton Amateur Radio Association, Inc.
NEW! YAESU
FT-107M HF SSB transceiver
Covers 160-10 meters with 2 aux. bands available for future expansion. Input power 240 W SSB/CW, 80WAM/FSK. Features digital plus analog freq. display, VOX, RF speech processor, SWR meter and variable band width. Remote scanning possible with YM-35 mic if radio is equipped with optional Digital Memory Shift (DMS). Power required 13.5V DC at 20 amps.
1045.00 List Price. Call for quote.

Dentron Clipperton L 2KW PEP linear amplifier
The Clipperton L covers 160-15 meters and most MARS frequencies. Delivering on continuous duty, 2000 watts PEP SSB and 1000 watts DC CW. RTTY, OR SSTV. Features include four 572B triodes operating in grounded grid, forced air cooling for longer tube life, and a built-in continuous duty power supply-2500 volt idle SSB-1800 volt idle CW approximately with rear panel section of 117 volts or 234 volts primary transformer taps and adjustable ALC. Also features stand-by switch, tune and load control, meter function, switch, plate current and plate voltage meter, and 50 ohm output impedance.
699.50 List Price. Call for quote.
The introduction of the "WAYFARER" by Yaesu is the beginning of a new era in compact solid state transceivers. The FT-707 "WAYFARER" offers you a full 100 watts output on 80-10 meters and operates SSB, CW, and AM modes. Don't let the small size fool you! Though it is not much larger than a book, this is a full-featured transceiver which is ideally suited for your home station or as a traveling companion for mobile or portable operation.

The receiver offers sensitivity of .25 uV/10 dB SN as well as a degree of selectivity previously unavailable in a package this small. The "WAYFARER" comes equipped with 16 poles of IF filtering, variable bandwidth and optional crystal filters for 600 Hz or 350 Hz. Just look at these additional features:

**FT-707 with Standard Features**
- Fast/slow AGC selection
- Advanced noise blanker
- Built-in calibrator
- WWV/JJY Band
- Bright Digital Readout
- Fixed crystal position
- 2 auxiliary bands for future expansion
- Unique multi-color bar metering—monitors signal strength, power output, and ALC voltage.

**FT-707 with Optional FV-707DM & Scanning Microphone**
- Choice of 2 rates of scan
- Remote scanning from microphone
- Scans in 10 cycle steps
- Synthesized VFO
- Selection of receiver/transmitter functions from either front panel or external VFO
- "DMS" (Digital Memory Shift)

Impressive as the "WAYFARER" is its versatility can be greatly increased by the addition of the FV-707DM (optional). The FV-707DM, though only one inch high, allows the storage of 13 discrete frequencies and with the use of "DMS" (Digital Memory Shift) each memory can be band-spread 500 KHz. These 500 KHz bands may be remotely scanned from the microphone at the very smooth rate of 10 Hz steps.

The FT-707 "WAYFARER" is a truly unique rig. See it today at your authorized Yaesu Dealer.
EIMAC's 3-500Z is first choice for Henry's 1KD-5 linear amplifier.

A winning combination since 1965.

The 1KD-5 is one of the most popular amplifiers in the series of equipment that continues the fine tradition established since 1965 by Henry Radio.

This reliable 1200 watt PEP linear amplifier uses the EIMAC 3-500Z to provide the user with a winning combination of reliability and long tube life.

Reliable, high-mu power triode.

In 1965 Henry Radio knew all about EIMAC's reliable power grid tubes and the first amplifier used EIMAC high-mu power triodes. That's why 15 years later EIMAC still powers the new generation Henry Radio Amplifiers.

Complete data available.

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