

NOVEMBER 1981

\$2.50



ROHDE & SCHWARZ

VHF-UHF-EMF

ham radio magazine

incorporating
**HAM RADIO
HORIZONS**



designer's challenge: RECEIVER OF THE FUTURE

VHF-

FILTER

ABSTIMMG

VERSTÄR

SM 500A

570.50

MHz

KEYBOARD
SPEICHER
MEMORY

EMPF REC FREQ

MARKEN-FREQ

DEMODULATION

SSB AM FM

8 15 30 100

ZF-BANDBREITE kHz
IF BANDWIDTH

ABSTIMMG TUNING

TEST

BETR
OPERA

tempo does it again



THE WORLD'S FIRST 440 MHz SYNTHESIZED HAND HELD RADIO

Tempo was the first with a synthesized hand held for amateur use, first with a 220 MHz synthesized hand held, first with a 5 watt output synthesized hand held...and once again first in the 440 MHz range with the S-4, a fully synthesized hand held radio. Not only does Tempo offer the broadest line of synthesized hand helds, but its standards of reliability are unsurpassed...reliability proven through millions of hours of operation. No other hand held has been so

thoroughly field tested, is so simple to operate or offers so much value. The Tempo S-4 offers the opportunity to get on 440 MHz from where ever you may be. With the addition of a touch tone pad and matching power amplifier its versatility is also unsurpassed.

The S-4...\$349.00
With 12 button touch tone pad...\$399.00
With 16 button touch tone pad...\$419.00
S-40 matching 40 watt output
13.8 VDC power amplifier...\$149.00

Specifications:

Frequency Coverage: 440 to 449.995 MHz
Channel Spacing: 25 KHz minimum
Power Requirements: 9.6 VDC
Current Drain: 17 ma-standby 400 ma-transmit (1 amp high power)
Antenna Impedance: 50 ohms
Sensitivity: Better than .5 microvolts nominal for 20 db
Supplied Accessories: Rubber flex antenna 450 ma ni-cad battery pack, charger and earphone
RF output Power: Nominal 3 watts high or 1 watt low power
Repeater Offset: \pm 5 MHz

Optional Accessories for all models

12 button touch tone pad (not installed): \$39 • 16 button touch tone pad (not installed): \$48 • Tone burst generator: \$29.95
• CTCSS sub-audible tone control: \$29.95 • Leather holster: \$20 • Cigarette lighter plug mobile charging unit: \$6

TEMPO VHF & UHF SOLID STATE POWER AMPLIFIERS

Boost your signal... give it the range and clarity of a high powered base station. VHF (135 to 175 MHz)

Drive Power	Output	Model No.	Price
2W	130W	130A02	\$209
10W	130W	130A10	\$189
30W	130W	130A30	\$199
2W	80W	80A02	\$169
10W	80W	80A10	\$149
30W	80W	80A30	\$159
2W	50W	50A02	\$129
2W	30W	30A02	\$ 89

UHF (400 to 512 MHz) models, lower power and FCC type accepted models also available.



2050 S. Bundy Dr., Los Angeles, CA 90025 (213) 820-1234
931 N. Euclid, Anaheim, CA 92801 (714) 772-9200
Butler, Missouri 64730 (816) 679-3127

TOLL FREE ORDER NUMBER: (800) 421-6631

For all states except California.
Calif. residents please call collect on our regular numbers.
Prices subject to change without notice.

Please note, as of Dec. 1, 1980 we will occupy our new world headquarters building with a new Los Angeles address and phone number.



Tempo S-1

The first and most thoroughly field tested hand held synthesized radio available today. Many thousands are now in use and the letters of praise still pour in. The S-1 is the most simple radio to operate and is built to provide years of dependable service. Despite its light weight and small size it is built to withstand rough handling and hard use. Its heavy duty battery pack allows more operating time between charges and its new lower price makes it even more affordable.



Tempo S-5

Offers the same field proven reliability, features and specifications as the S-1 except that the S-5 provides a big 5 watt output (or 1 watt low power operation). They both have external microphone capability and can be operated with matching solid state power amplifiers (30 watt or 80 watt output). Allows your hand held to double as a powerful mobile or base radio.

S-30...\$89.00*

S-80...\$149.00*

*For use with S-1 and S-5



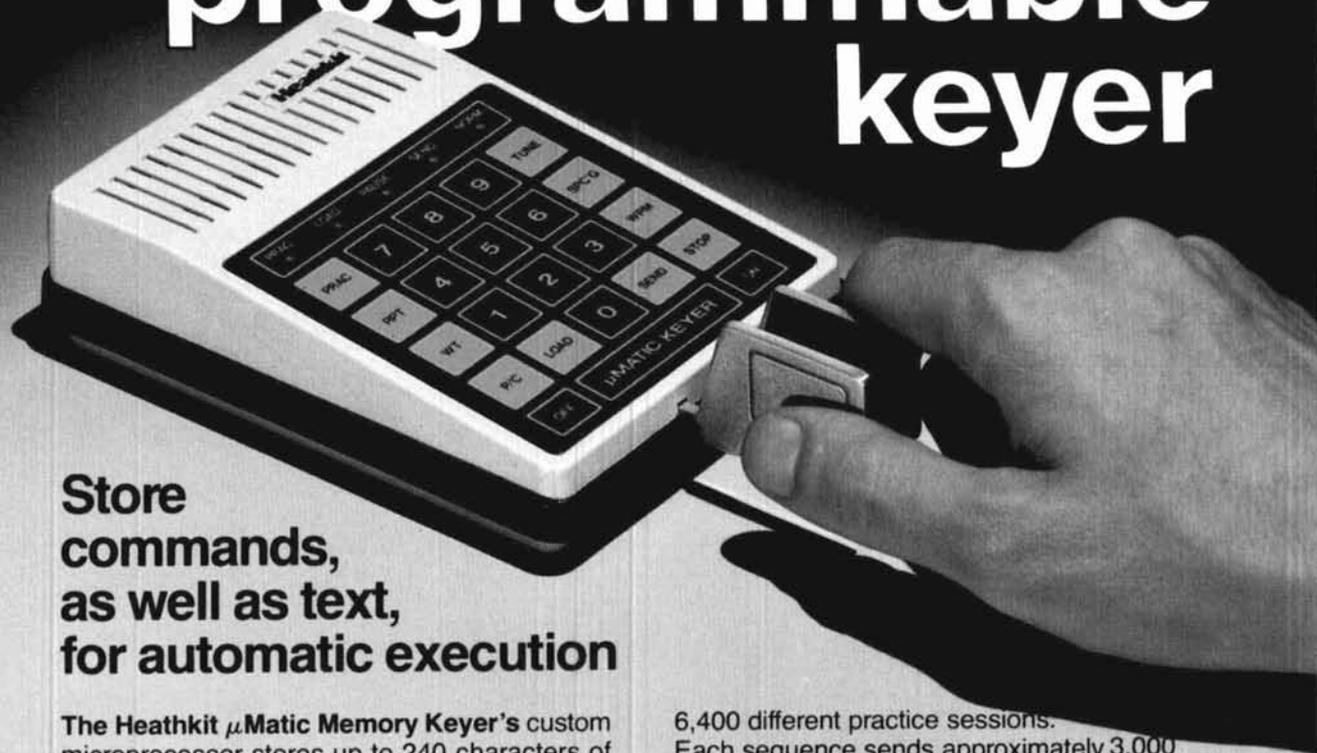
Tempo S-2

With an S-2 in your car or pocket you can use 220 MHz repeaters throughout the U.S. It offers all the advanced engineering, premium quality components and features of the S-1 and S-5. The S-2 offers 1000 channels in an extremely lightweight but rugged case. If you're not on 220 this is the perfect way to get started. With the addition of the S-20 Tempo solid state amplifier it becomes a powerful mobile or base station. If you have a

220 MHz station, the S-2 will add tremendous versatility. Price...\$349.00 (With touch tone pad installed...\$399.00)

S-20...\$89.00

Introducing the first fully programmable keyer



Store commands, as well as text, for automatic execution

The Heathkit μ Matic Memory Keyer's custom microprocessor stores up to 240 characters of text or commands. *Variable-length buffers* eliminate wasted memory space. "Command strings" allow text to be stored in several buffers, then strung together in any sequence for most efficient use of memory. Command strings can also select speed, weight, spacing and auto-repeat count.

No external key to buy

Integral capacitive "touch" paddles unplug and store in their own compartment inside the Keyer when not in use. Left handed? A touch of the keypad and the paddles are reversed. Choose any speed between 1 and 99 words per minute, and any of 11 weight settings. Special rear-panel jack connects mechanical paddle.

Great code practice machine, too

A "practice" mode sends random code groups of random length and selectable types for a total of

6,400 different practice sessions. Each sequence sends approximately 3,000 characters before repeating.

Other features:

Built-in sidetone oscillator and speaker have pitch and volume controls. Phone jack and earphone are included for private listening. Complete details on the great new μ Matic Memory Keyer are in the latest Heathkit Catalog. Or see it at your nearby Heathkit Electronic Center.*



Send for free catalog

Write to Heath Company,
Dept. 122-834, Benton Harbor, MI
In Canada, contact Heath Company,
1480 Dundas Street E., Mississauga, ONT L4X 2R7.

Visit your Heathkit Store

Where Heathkit products are displayed, sold and serviced.

See your telephone white pages for locations.

*Units of Veritechnology Electronics Corporation in the U.S.

Heathkit®

Hear there and everywhere.



Easy tuning, digital display, professional quality

R-1000

The R-1000 is an amazingly easy-to-operate, high-performance, communications receiver, covering 200 kHz to 30 MHz in 30 bands. This PLL synthesized receiver features a digital frequency display and analog dial, plus a quartz digital clock and timer. Its easy-single-knob tuning and high sensitivity, selectivity, and stability make the R-1000 a favorite amongst Radio Amateurs, shortwave listeners, engineers, maritime communicators, and others who demand high quality in a general-coverage communications receiver.

R-1000 FEATURES:

- **Continuous frequency coverage from 200 kHz to 30 MHz**
Receives shortwave, medium-wave, and long-wave bands.
- **30 bands, each 1 MHz wide**
Easy-to-use band switch with large knob.
- **Five-digit frequency display and analog dial**
Accurate digital display with 1-kHz resolution and illuminated analog dial with precise gear dial mechanism.
- **Built-in quartz digital clock with timer**
Precise 12-hour clock with AM and PM indicators. Timer turns on radio for scheduled listening, and even controls a recorder through remote terminal.
- **Up-conversion PLL, wideband RF circuits**
Provide exceptional performance and easy operation without the need for bandspread, preselector, or antenna tuning. Excellent sensitivity, selectivity, and stability.
- **Step attenuator**
0-60 dB in 20-dB steps. Prevents overload.

- **Three IF filters for optimum AM, SSB, CW**
12-kHz and 6-kHz (adaptable to 6-kHz and 2.7-kHz) filters for AM wide and narrow, and 2.7-kHz filter for high-quality SSB (USB and LSB) and CW reception.
- **Communications-type noise blanker**
Eliminates ignition and other pulse-type noise. Superior to noise limiter.
- **Recording terminal**
For external tape recorder.
- **Tone control**
For desired audio response.
- **Built-in 4-inch speaker**
For quality sound reproduction.
- **Dimmer switch**
Controls S-meter and other panel lights and digital-display intensity.
- **Three antenna terminals**
Wire terminals for 200 kHz to 2 MHz and 2 MHz to 30 MHz. Coax (SO-239) terminal for 2 MHz to 30 MHz.
- **Selectable operating voltage**
AC voltage selector for 100, 120, 220 and 240 VAC. Also adaptable to operate on 13.8 VDC (with optional DCK-1 kit).

More information on the R-1000 is available from all authorized dealers of Trio-Kenwood Communications 1111 West Walnut Street, Compton, California 90220.

Matching accessories:

- SP-100 external speaker
 - HS-5 deluxe headphones
- Other accessories not shown:**
- HS-4 headphones
 - DCK-1 easy-to-install modification kit for 12-VDC operation



HC-10 Digital World Clock

- **Two 24-hour displays with quartz time base**
Right display: local (or UTC) hour, minute, second, day. Left display: month, date, world time in various cities, memory time (QSO starting time), and time difference (in hours from UTC).
- **Time in 10 cities around the world**
Plus two additional programmable time zones.
- **"TOMORROW" and "YESTERDAY" indicators**
- **Memorizes present time**
And recalls later, for logging purposes.
- **High accuracy**
±10 seconds/month

KENWOOD
...pacesetter in amateur radio



ham radio

magazine

incorporating

HAM RADIO HORIZONS

NOVEMBER 1981

volume 14, number 11

T. H. Tenney, Jr., W1NLB
publisher and
editor-in-chief

Alfred Wilson, W6NIF
editor

editorial staff

Martin Hanft, WB1CHQ
production editor

Joseph J. Schroeder, W9JUV
Leonard H. Anderson
associate editors

W.E. Scarborough, Jr., KA1DXQ
graphic production manager

Irene Hollingsworth
editorial assistant

W.E. Scarborough, Jr., KA1DXQ
cover

publishing staff

J. Craig Clark, Jr., N1ACH
assistant publisher and
advertising manager

Susan Shorrock
circulation manager

ham radio magazine
is published monthly by
Communications Technology, Inc.
Greenville, New Hampshire 03048-0498
Telephone: 603-878-1441

subscription rates

United States: one year, \$16.50
two years, \$28.50; three years, \$38.50

Canada and other countries (via Surface Mail)
one year, \$21.50; two years, \$40.00
three years, \$57.00

Europe, Japan, Africa (via Air
Forwarding Service) one year, \$28.00

All subscription orders payable in
United States funds, please

foreign subscription agents

Foreign subscription agents are
listed on page 87

Microfilm copies
are available from
University Microfilms, International
Ann Arbor, Michigan 48106
Order publication number 3076

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

Copyright 1981 by
Communications Technology, Inc.
Title registered at U.S. Patent Office

Second class postage
paid at Greenville, N.H. 03048-0498
and at additional mailing offices
ISSN 0148-5989

Postmaster send Form 3579 to *ham radio*
Greenville, New Hampshire 03048-0498



contents

**12 communications receivers
for the year 2000**

Ulrich L. Rohde, DJ2LR

**30 understanding performance
data of hf receivers**

Jan K. Moiler, K6FM

34 ham radio techniques

Bill Orr, W6SAI

**41 add-on selectivity for
communications receivers**

Dr. D.A. Tong, G4GMQ

**54 up-conversion receiver
for the hf bands: part 1**

George Cutsogeorge, W2VJN

**66 hr owners' survey:
the TR7**

Martin Hanft, WB1CHQ

102 advertisers index

6 comments

76 DX forecaster

87 flea market

91 ham calendar

94 ham mart

50 ham notes

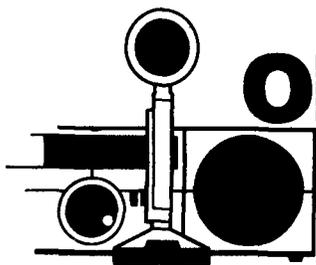
81 new products

**4 observation and
opinion**

10 presstop

102 reader service

84 short circuits



Observation & Opinion

Now is your chance to make a real contribution to Amateur Radio. The FCC has authorized the operation of an experimental beacon on the new WARC bands of 10.100-10.150, 18.068-18.168 and 24.890-24.990 MHz. As you read this, the beacon will have been in operation about a month, and quantitative information is needed regarding the reception of signals.

The experiment is intended to permit Amateurs to become familiar with the characteristics of these bands, which will help to simplify the scheduled future change-over to full Amateur use. The experiment will improve Amateur use of these new parts of the spectrum and will provide data on sharing between different services. An important element is obtaining data on propagation under weak-signal conditions, typical of natural disaster situations. It should be remembered that this use is one of the major reasons for these new authorizations, the first in many years.

The experiments will include two types of emission, three operating modes and two time phases. Basic emission is unmodulated carrier (A0), which will be interrupted each ten minutes for an SSB (2.8A3J) identification and announcement. The voice announcement will occur at 2, 12, 22 . . . minutes past the hour. The announcement will be of the form, "This is FCC-authorized experimental station KK2XJM, Daytona Beach, Florida. QSL via W4MB. Next operation will be repeated on _____ MHz starting on _____," and will be repeated. The announcement will be made by a woman, as the timbre of the female voice makes speech easier to recognize under unfavorable conditions.

Initial operations will commence about the first of October, using 3 watts ERP on the 10-MHz band. Depending on results, the operating schedule will include the 18- and 24-MHz bands. Later phases will include operation at 30 watts ERP, with sequencing from band to band, sometimes weekly and sometimes daily, as needed to make optimum use of the bands for propagation experiments both worldwide and to specific areas.

The licensee for the experiment is Bob Haviland, W4MB. Bob is well qualified for this important task. He has been an Amateur for 50 years and has participated in numerous CCIR and ITU conferences and preparatory work. He was chairman of the 28-1215-MHz allocation subcommittee of the FCC's WARC Advisory Committee for Amateur Radio, project engineer of the program that placed the first radio transmitter beyond the ionosphere, and has worked extensively on communications and broadcast satellites. Bob published the first known proposal for an Amateur Radio experiment on a satellite. Additionally, he has been on a number of DXpeditions, having operated from four continents. And, not incidentally, Bob has been a prolific contributor to *ham radio*, having published some nine articles over the years.

The success of the experiment will depend on participation by Amateurs and shortwave listeners, and on their reports. Information needed is the date, time and location of reception, strength of the beacon signal and other signals on the band, and the type of receiving installation including, of course, the antenna. All reports will be acknowledged by a QSL card.

In addition to reception reports, proposals for special tests will be welcomed, subject to the limitations imposed by the license and by regulations for experimental stations. KK2XJM is not authorized to communicate with Amateur stations; however, reports, requests for schedules and proposals for experiments may be sent to W4MB's *Callbook* address.

This venture is a fine opportunity for everyone to contribute to the advancement of Amateur Radio. A QSL card from W4MB acknowledging participation in the experiment certainly should become a valuable reminder of an important phase of Amateur-Radio development.

Alf Wilson, W6NIF
editor

ICOM IC-720A



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



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



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



General coverage receiver from 0.1 KHz to 29.999.9MHz — Split VFO operation — Frequency memorized in standby VFO.



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

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



The ICOM HF System. We Have You Covered.



HF/VHF/UHF AMATEUR AND MARINE COMMUNICATION EQUIPMENT



ICOM

ICOM AMERICA, INCORPORATED

Sales Service Centers located at:

2112 116th Avenue NE
Bellevue, WA 98004
Phone (206) 454-8155

3331 Towerwood Dr., Suite 307
Dallas, TX 75234
Phone (214) 620-2780

All stated specifications are approximate and subject to change without notice or obligation. All ICOM radios significantly exceed FCC regulations limiting spurious emissions.



comments

work the Pacific

Dear HR:

I would like to inform your readers of the basic Work The Pacific award, which is issued for thirty confirmed contacts on the WTP country list. It's available to any licensed Amateur Radio operator and to SWLs.

Mode, band, power level, and other endorsements will be made upon request with the original application only. The award is printed in four colors on a beautiful parchtone bond.

For more information, please contact me at the address below.

Award Manager, C.H.C.
Scott R. Douglas, Jr., KB7SB
P.O. Box 46032
Los Angeles, California 90046

zero beat

Dear HR:

The July, 1981, issue of *ham radio* arrived today. Naturally, the point of first reading was the "Observation and Opinion" page relative to transceivers and zero beating. Oddly, the timing was in itself a true zero beat for a project completed several weeks ago on a unique (and modified) circuit by Jerry Assard, KA1EVW, which appeared in the March, 1979, issue of *Electronic Design News*, entitled "Lamps Monitor Beat Frequency."

I built the device with modifications stemming directly from my totally home-brewed rig, which demanded some strange and totally unique approaches both to transceive and shift-band transmissions that many of the rare DXers employ.

The basic capability of the Assard

system may well be adapted to any number of other uses related to and stemming from the article. I will be happy to supply the complete circuitry (with full credit to Jerry Assard for his original and fine thinking) to any ham interested in applying this useful tool. Please send a self-addressed, stamped envelope to P.O. Box 6175.

Gene Shapiro, W0DLQ
Leawood, Kansas 66206

more free inductors

Dear HR:

In my recent CW filter articles (*QST*, December, 1980, and *ham radio*, April, 1981), I stated that I was serving as liaison between the Chesapeake and Potomac Telephone Company of Maryland and the Amateur fraternity, assisting in the distribution of surplus telephone line 88-mH loading coils. These inductors are being given to Radio Amateurs free (except for my shipping expenses) as a public service by the C & P Telephone Company.

I've processed more than fifty requests for inductors so far, but now the initial response to these two articles is quieting down. I would appreciate it if you would mention in your magazine that I still have inductors (88-mH inductors in a five-inductor stack form). They are available to anyone interested in applying them to Amateur Radio filtering applications. Write to me at my *Callbook* address explaining your need and proposed application. A stamped, self-addressed envelope must be included for my reply with further instructions.

Ed Wetherhold, W3NQN
Annapolis, Maryland

antenna restrictions

Dear HR:

Most people worry only about the zoning ordinances and building permits that may be needed for the installation of ham antenna systems. But it's necessary to check your deed

and the title to your land to see whether there are any protective covenants that prohibit the placing of any tower, pole, or similar structure on your own property. These restrictions will also appear in the title search of your property when you buy a home.

You may not be aware that you waived your rights (or you may not have been aware of your rights) when you made settlement on your house and land, legally binding yourself to these protective covenants. These covenants were originally designed to protect all the homeowners in your housing development for esthetic reasons, to enhance the neighborhood's appearance and to keep property values from declining. These covenants may be part of the land and deed for as long as 10 to 25 years, and, at that time, they may be automatically renewed for another 10 to 25 years unless changed by the members of your housing development. Violation of any one or more of these covenants could result in litigation against you by a neighbor or neighbors, and much time and money spent in the courtroom.

These covenants are another blow against the ham radio operator, who may not even be able to use his own land for the installation of his dream antenna farm. It appears that more and more single-home housing developments, townhouses, twin homes, duplexes, condominiums, and apartments are placing more and more antenna restrictions on their buildings for esthetic reasons, and in turn these restrictions are slowly taking away your rights.

Take it from one who has been that route and knows from first-hand experience. Check the agreement of sale and deed before you sign on that dotted line. Don't spend hundreds, or thousands, of dollars in the courtroom, or be forced by a judicial court order to dismantle your antenna system.

Robert N. Wilderman, K3SRO
Lansdale, Pennsylvania

SAVE \$13.50* with home delivery

SAVE \$13.50* with home delivery

*One year newsstand cost \$30.00

Here's my address label, enter my subscription.

- Payment enclosed
 Bill me later

\$16.50

\$28.50

\$38.50 U.S. prices

- 1 Year 12 issues
2 Years 24 issues
3 Years 36 issues

Name _____ State _____ Zip _____

Address _____

City _____

Check here if this is your renewal (attach label)

Subscribe to **ham** **radio** magazine

Foreign rates: Europe, Japan and Africa,
\$28.00 for one year by air forwarding service.
All other countries \$21.50 for one year by
surface mail. Please allow 4-6 weeks for
delivery of first issues.

Please
enter my
subscription



BUSINESS REPLY MAIL

First Class Permit No. 1 Greenville, NH

Postage Will Be Paid By Addressee

**ham
radio**

Greenville, NH 03048

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES



MFJ KEYERS

Uses Curtis 8044 IC. Iambic operation, dot-dash memories, weight control, solid state keying. RF proof.



\$79⁹⁵

The MFJ-408 Deluxe Electronic Keyer sends iambic, automatic, semi-automatic, manual. Use squeeze, single lever or straight key.

Speedmeter lets you read speed to 100 WPM. **Socket for external Curtis memory**, random code generator, keyboard. Optional cable, \$4.95.

Iambic operation with squeeze key. Dot-dash insertion. **Semi-automatic "bug" operation** provides automatic dots and manual dashes.

Dot-dash memory, self-completing dots and dashes, jam-proof spacing, instant start. **RF proof.**

Solid-state keying: grid block, solid state xmtrs. **Front panel controls:** linear speed, weight, tone, volume, function switch. 8 to 50 WPM.

Weight control adjusts dot-dash space ratio; makes your signal distinctive to penetrate ORM.

Tone control. Speaker. Ideal for classroom.

Function switch selects off, on, semi-automatic/manual, tune. Tune keys transmitter for tuning.

Uses 4 C-cells. 2.5 mm jack for power (6-9 VDC). Optional AC adapter MFJ-1305, \$9.95.

Eggshell white, walnut sides. 8x2x6 inches.

MFJ-406, \$69.95, like 408 less speedmeter.

\$49⁹⁵



New MFJ-401 Econo Keyer II gives you a reliable, full feature economy keyer for squeeze, single lever or straight key.

Has sidetone, speaker, volume, speed, internal weight and tone controls. Sends iambic, automatic, semi-automatic, manual. Tune function. Dot-dash memories. 8-50 WPM. "On" LED. Use 9V battery, 6-9 VDC, or 110 VAC with optional AC adapter, MFJ-1305, \$9.95. 4x2x3 1/2".

Reliable solid state keying. Keys virtually all solid state or tube type transmitters.



\$64⁹⁵

MFJ-405 Econo Keyer II. Same as MFJ-401 but has built-in single paddle with adjustable travel. Also jack for external paddle. 4x2x3 1/2".

Optional: Bencher Iambic Paddle, \$42.95; 110VAC adapter, MFJ-1305, \$9.95. **Free catalog.**

Order from MFJ and try it. If not delighted, return within 30 days for refund (less shipping).

One year unconditional guarantee.

Order yours today. Call toll free 800-647-1800. Charge VISA, MC. Or mail check, money order. Add \$4.00 each for shipping and handling.

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, INCORPORATED
Box 494, Mississippi State, MS 39762

MFJ VLF CONVERTER

Receive 10-500 KHz on Ham rig or SWL receiver.



\$79⁹⁵

Plug this MFJ VLF Converter between your antenna and Ham transceiver or SWL receiver and tune the VLF 10-500 KHz band.

Hear weather, ship-to-shore CW traffic, RTTY, WWVB, navigation beacons, 1750 meter no license band, European broadcast, and more.

MFJ-332 Ham version converts 10-500 KHz to 28.010 to 28.500 MHz. Also adds standard broadcast band on 28.5 to 29.7 MHz. **MFJ-331 SWL version** converts to 4.010 to 4.500 MHz.

Read frequency directly on your receiver (ignore MHz).

Low noise amplifier, 6 pole lowpass filter, double balanced mixer, crystal oscillator gives very sensitive and stable, BCB interference-free signals.

On/off-Bypass switch. LED for power. SO-239 coax connectors. 3x4x1 inches. Black, eggshell white aluminum cabinet. 9-18 VDC or 110 VAC with optional AC adapter, MFJ-1312, \$9.95.

VLF/MW/SWL Antenna Tuner
Greatly improves 10KHz to 30 MHz reception.

\$69⁹⁵



This MFJ-955 VLF/MW/SWL preselecting antenna tuner greatly improves reception of 10KHz thru 30 MHz signals, especially those below 2 MHz.

Lets you peak desired signals while rejecting interference. Reduces overload, background noise, crossmodulation, and intermodulation. VLF signals come roaring in.

Switch between two antennas and two receivers. Bypass position connects antenna directly to receiver. 5 1/2x2x3 inches. Black, eggshell white aluminum cabinet.



\$79⁹⁵

MFJ-1020 Tuned Indoor Active Antenna. Can often exceed reception of outside longwire. Covers 300 KHz to 30 MHz. Has telescoping antenna. Minimizes intermod, provides RF selectivity, reduces noise. Also use as preselector.

Order from MFJ and try it. If not delighted, return within 30 days for refund (less shipping).

One year unconditional guarantee.

Enjoy VLF. Order yours today. See dealer or call MFJ toll free 800-647-1800. Charge VISA, MC. Or mail check, money order. Add \$4.00 each for shipping and handling.

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, INCORPORATED
Box 494, Mississippi State, MS 39762

MFJ SWR/WATTMETERS

MFJ HF SWR/Wattmeter reads SWR, forward, reflected power from 1.8-30 MHz.



\$49⁹⁵

MFJ-814

New low cost in-line HF SWR/Wattmeter. MFJ-814 lets you monitor SWR, forward, reflected average power in 2 ranges from 1.8 to 30 MHz. Read 200/2000 watts forward, 20/200 watts reflected power. SWR, 1:1-6:1.

Easy push-button switch operation: has power/SWR, high/low range, forward/reflected push-button switches. SWR sensitivity control.

Lighted meter (requires 12V). Rugged aluminum eggshell white, black cabinet. 6 1/4x3 1/4x4 1/4". SO-239 coax connectors, 2 color meter scale.

MFJ VHF SWR/Wattmeter/Field Strength Meters

\$29⁹⁵



MFJ-812

New low cost VHF operating aids. MFJ-812, \$29.95: Read SWR from 14 to 170 MHz to monitor antenna and feedlines.

Read forward and reflected power at 2 meters (144-148 MHz). 2 scales (30 and 300 watts).

Read relative field strength from 1 to 170 MHz. Binding post for field strength antenna.

Easy push-button operation: has forward/reflected and SWR/field strength push-buttons.

Aluminum eggshell white, black cabinet. 4 1/4x2 1/4x2 3/4". SO-239. 2 color meter scale.

MFJ-810, \$24.95: similar to MFJ-812 less field strength function.

MFJ "Dry" 300 W and 1 KW Dummy Loads.

\$64⁹⁵



MFJ-262

\$26⁹⁵

MFJ-260

Air cooled, non-inductive 50 ohm resistor in perforated metal housing with SO-239 connectors. Full load for 30 seconds, de-rating curves to 5 minutes. **MFJ-260 (300 W).** SWR: 1:1:1 to 30 MHz, 1.5:1 for 30-160 MHz. 2 1/2x2 1/2x7". **MFJ-262 (1KW).** SWR 1.5:1-30 MHz. 3x3x13".

MFJ-10, 3 foot coax with connectors, \$4.95.

Order from MFJ and try it. If not delighted, return within 30 days for refund (less shipping).

One year unconditional guarantee.

Order yours today. Call toll free 800-647-1800. Charge VISA, MC. Or mail check, money order. Add \$4.00 each for shipping and handling.

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, INCORPORATED
Box 494, Mississippi State, MS 39762

presstop

THE ARRL DIRECTORS CONSIDERED organizational changes proposed by the Long Range Planning Committee, the Central Division Recall, changes in subbands and bandplans, a new ARRL periodical, its Washington representation, and a host of other topics when it met in Newington September 9-10.

The Long Range Planning Committee proposed an extensive reorganization of the League at the state and local level, with a newly created post of Section Manager for each of the 73 sections, creation of division steering committees, and redesign of the Advisory Committees with a representative from each division serving on each AC. This program was endorsed by the board, which asked for specific plans, cost information, and implementation timetables for consideration at the next board meeting.

The Central Division Recall and Bylaw 20 were both considered at length, but no action was taken on various proposed changes in the recall bylaw because of the pending recall vote. However, the board did vote to permit Director Metzger to include a statement in his own behalf with the recall ballot (along with statements by the ARRL and the Indiana Radio Club Council), an addition that was agreed to by the Executive Committee.

The Proposed 160 Meter Bandplan (August QST) was adopted unanimously based on the very favorable response to the article in QST, but the previously passed motion to expand 40-meter Extra phone privileges was withdrawn. The board also voted unanimously to petition the FCC to expand General-class phone on 75 down to 3860, and to permit the "automatic control" of beacons. It also adopted 20-kHz channel spacing for the 144.5-145.5 repeater subband, and requested completion of bandplans for both 6 meters and 23 cm in time for the 1982 annual meeting of the board.

A New Beginner/Novice Periodical may be in the offing. The General Manager, Membership Affairs Committee, and Plans and Programs Committee were directed to study the feasibility of such a publication with a report due at the first 1982 board meeting. The board also voted to establish a separate ARRL publications price list for members buying them from Headquarters, to go into effect no later than January, 1983.

Improved Washington Liaison efforts, the tightening of the regulations for single-mode DXCC awards, the extension of all current Advisory Committee appointments pending further consideration of the Long Range Planning Committee's recommendations on AC makeup, and even a review of the usefulness of the "T" in RST CW reports were also voted on in this far ranging session.

OBSCENE LANGUAGE ON THE AIR should no longer be an FCC problem, the Commissioners voted September 17 in a wide-ranging recommendation to Congress for changes in the Communications Act. Although most of the Commissioners' proposals dealt with the regulation of broadcasting, proposals pertaining to the question of obscenity will affect the Amateur service (and other services) as well.

The Commissioners Voted unanimously to drop their right to revoke a station license for violation of obscenity statutes, and voted 4 to 2 in favor of amending Section 326 to strip the Commission of "any power of censorship over the content of communications." With obscene or other objectionable language no longer a concern of the Commission, any prosecution of foul-mouthed Amateurs would then go to the Justice Department.

A NEW RFI SOURCE is beginning to cause problems to Amateurs, particularly in rural areas. The troublesome device is the CMH, a multiplexer that provides eight multiplexed voice channels over a conventional phone line. The problem is in its switching-type power supply, which operates at 79 kHz and generates harmonics well into the VHF spectrum. These harmonics are radiated through the phone lines it is tied into.

CMH-Generated Interference shows up on the bands as slightly unstable signals that appear every 79 kHz.

THE "PLAIN LANGUAGE" AMATEUR RULES rewrite may be turning out to be a dead issue. In a letter to a Lincoln, Nebraska, Novice (KAØJYZ), Senator Barry Goldwater, K7UGA, stated that, "The rules changes in language have been stopped for the time being, and I think when we get better acquainted with the new head of the FCC we can forget all about them."

With The ARRL And Many Individual Amateurs lukewarm or even opposed to the rewrite as it is now proposed, the Goldwater opposition may very well be the signal of the demise of the rewritten Amateur rules.

BOB STANKUS (KESWICK SALES) pleaded not guilty to 22 counts of mail fraud at his first appearance before the judge on July 6. After some discussion between the lawyers, however, he decided to change his plea to guilty on 11 of the 22 counts in return for having the other 11 charges dropped. The court is now awaiting a probation report on Stankus, and after the report is received he will be sentenced for his part in the "bargain" TS-520S mail-order sale scheme.

1981 WINNERS OF THE EIGHT SCHOLARSHIPS that were administered by the Foundation for Amateur Radio are KAØDGT, WB7RVP, WAIWFA, WA2CUN, KA7BWC, KA5BOU, and KA2DYC. Congratulations to all.

Introducing incredible tuning accuracy at an incredibly affordable price: The Command Series RF-3100

31-band AM/FM/SW receiver.* No other shortwave receiver brings in PLL quartz synthesized tuning and all-band digital readout for as low a price.† The tuner tracks and "locks" onto your signal, and the 5-digit display shows exactly what frequency you're on.

There are other ways the RF-3100 commands the airways: It can travel the full length of the shortwave band (that's 1.6 to 30 MHz). It eliminates interference when stations overlap by narrowing the broadcast band. It improves reception in strong signal areas with RF Gain Control. And the RF-3100 catches Morse

communications accurately with BFO Pitch Control.

Want to bring in your favorite programs without lifting a finger? Then consider the Panasonic RF-6300 8-band AM/FM/SW receiver (1.6 to 30 MHz) has microcomputerized preset pushbutton tuning, for programming 12 different broadcasts, or the same broadcast 12 days in a row. Automatically. It even has a quartz alarm clock that turns the radio on and off to play your favorite broadcasts.

The Command Series RF-3100 and RF-6300. Two more ways to roam the globe at the speed of sound. Only from Panasonic.

*Shortwave reception will vary with antenna, weather conditions, operator's geographic location and other factors. An outside antenna may be required for maximum shortwave reception.

†Based on a comparison of suggested retail prices.



This Panasonic Command Series™ shortwave receiver brings the state of the art closer to the state of your pocketbook.



With PLL Quartz Synthesized Tuning and Digital Frequency Readout.

Panasonic.
just slightly ahead of our time.

communications receivers



for the year 2000

Part 1: New designs, microprocessors, input filters, and mixers

Some changes have occurred since my paper¹ appeared on optimum design for high-frequency communications receivers:

1. The sunspot cycle has given better propagation conditions.
2. Manually operated receivers have become "intelligent" with the advent of built-in microprocessors.
3. Receiver dynamic range has been increased with better amplifiers and mixers.
4. Blocking problems have diminished with better synthesizers.
5. Better dynamic performance of filters has improved reception on crowded frequencies (note that *dynamic* selectivity is not the same as *static* selectivity, which is discussed later).
6. Frequency resolution and acquisition have increased dramatically.
7. Up conversion avoids gaps in frequency coverage. Many new receiver designs use an LO and intermediate frequency higher than the highest frequency of reception.
8. Lowpass filters in the receiver front end, combined

with suboctave filters, tunable circuits, or both, obtain constant image and i-f suppression. Such design guarantees image-response suppression and substantially reduces LO re-radiation.

9. As the output oscillator in a synthesizer has a range of less than 2:1, design of these oscillators has become simpler.

In retrospect I find that my earlier predictions have been substantially correct and that advances in technology, specifically in digital techniques and microprocessor design, have been much faster than in rf-circuit design.

What can we expect in the future? Let's look at today's communications-receiver technology in terms of the year 2000.

receiver specifications

Communications receivers are best described by their specifications. **Table 1** shows data for a communications receiver covering 10 kHz-30 MHz, and **table 2** shows specifications for a communications receiver covering 20 MHz-1000 MHz. These are clearly general-coverage receivers, and one may ask, What does this have to do with ham radio?

Most engineers working on Amateur receivers have had experience in commercial design, and while I've always said that the crowded ham bands are a greater challenge to the receiver designer (this holds true only for the shortwave area), general-coverage

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

receivers monitor *all* frequencies and, therefore, must be able to survive this hostile environment — a real design challenge.

In terms of energy, there is now really more energy available for injection into the antenna of a VHF/UHF receiver than at the input of a VLF/HF receiver; and the dynamic range requirements for VHF/UHF receivers are now even higher because the noise floor is substantially lower than in receivers for the short-wave bands.

new approaches in design

Fig. 1 is a block diagram of a VLF/HF receiver with microprocessor control and other features. It's not very likely that this receiver will be smaller or better designed in coming years.

As we shall see later, dynamic range is determined by a) the mixer and the LO drive (a question of drive power and therefore power consumption), or by b) the dynamic range of the amplifiers (again, it becomes a question of power consumption versus dynamic range).

Let's look at the block diagram. As the receiver must handle extremely large signals at times (to the point where the input circuit can be burned out), an input attenuator is a good protective device.

Modern receivers should have a self-test circuit and, therefore, we find in the block diagram (from the Rohde & Schwarz EK070 receiver) a built-in noise generator that allows one to monitor the signal over the entire receiver.

One of the ten input filters may be automatically selected and determined by the synthesizer. The incoming frequency is up converted to a first i-f of 81.4 MHz, where a crystal filter (12 kHz) narrows the number of frequencies fed to the second mixer. The two mixers use several filters and amplifiers. The output is taken at the second mixer and is available for a panoramic adapter.

As in all modern receivers, independent sideband detection is required. Two complete i-f strips and two filters are included, one for upper and one for lower sideband. For all other modes, only one channel of the i-f is used.

The AGC must be individually determined for each channel. To be able to have passband tuning and to select different combinations of bandwidths and BFO frequencies, the BFO must be synthesized. Note that the synthesizer for the first and second LO, as well as that for the BFO, are fairly complex. This is a result of the requirement for extreme high dynamic range, low-noise sideband performance, fast switching speed, and spectral purity (high reference-signal suppression and no other unwanted frequencies).

In addition to the familiar modulation schemes,

there are a number of digital modes such as ASCII, Baudot, and pulse-code modulation (both a-m and fm). (In many cases, these signals are scrambled and are not available for immediate detection.)

A clever scheme allows a 12.5-kHz output that can be connected to a tape recorder — unidentified signals can be recorded and stored for later detection. In addition to these features is a built-in RTTY demodulator, including an indication of center frequency for the RTTY demodulator that eliminates the need of an oscilloscope for tuning.

microprocessors and receivers

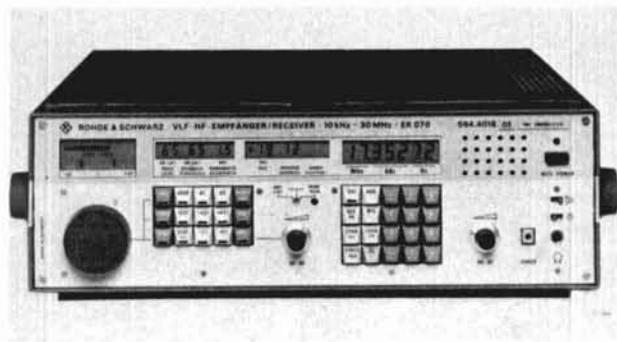
We have heard much about microprocessor applications in receivers, and many of us use 2-meter transceivers or other equipment that incorporates microprocessors. What does the microprocessor actually do for us? The microprocessor automatically handles certain routines such as scanning of frequencies written into memory. After the microprocessor has put these frequencies into the receiver's memory, one can determine the field strength from the AGC line, compute this into absolute microvolts, dB above 1 microvolt, or dBm, as required. Also, the microprocessor can control the synthesizer and take care of all the arithmetic. The synthesizer frequency and the frequency on the display of the receiver are not the same; this offset can be taken into consideration by the microprocessor.

The built-in self-check of a shortwave receiver will allow monitoring of certain functions to make sure the receiver is operating properly. This brings up several important questions:

1. Are we not trading flexibility and reliability for automation?
2. Is the microprocessor now such an important part that, once it fails, nothing will work anymore?
3. Can we repair microprocessor-based communications receivers?

There is no question that test instruments required to service microprocessor-based instruments are more expensive and demand more training for repair technicians, and the price for the components of the computer system are not low enough to justify discarding questionable integrated circuits.

I believe that there are still two extremes that will remain for a while at least. The Rohde & Schwarz EK070 receiver (photo), is designed for the future; and, as mentioned earlier, even in the year 2000 we will not be able to make the rf portion much better, insofar as improvements over the last five years have been much less dramatic than those from 1960 through 1975.



The Rohde & Schwarz EK070 receiver.

Another photo shows the Model HF1030 VLF/HF communications receiver (formerly from Communications Products Corporation — now being manufactured and sold by Cubic Communications Corporation). This receiver is in the \$6,000 price range, while the Rohde & Schwarz EK070, depending upon the options, costs between \$14,000 and \$20,000.

Rf characteristics such as intercept point, image suppression, blocking, and switching speed for both receivers are comparable — only housekeeping and utility functions such as memory, built-in RTTY demodulator, and self-check are different. It is therefore the decision of the user how much he wants to spend and what type of receiver he wants.

The frequency range of 20-1000 MHz requires higher dynamic performance and more scanning and searching capabilities. The absolute bandwidth of this frequency range is much wider; and for frequency searching or frequency hopping, more requirements are demanded of the frequency synthesizer. The fm capability requires more bandwidth choices. A typical example is the Rohde & Schwarz ESM500 receiver. Its performance characteristics are listed in table 2.

We have heard so much about increased performance capability that we will want to look at several circuits and see how these improvements are achieved. But, one note of caution: microprocessors have become a national obsession, and a device not having a built-in microprocessor is not considered modern — a misleading notion! The microprocessor is nothing more than a device that can execute instructions sequentially and at fast speed.

Standard circuits with normal gate decoding do everything in parallel; for practical purposes there is no execution delay. As the microprocessor becomes overloaded speed and flexibility are lost. To write extremely long programs for microprocessors in assembly language requires substantial knowledge in programming and debugging. As a result, the present tendency is to break up the tasks by using a central

microprocessor; for reasons of speed, a 16-bit unit such as the Motorola 68000 is used, as well as several independent processors in slave mode — the most popular are the 8085 or, for smaller tasks, the 8748 or 8749.

The microprocessor is not always a necessity, and the tradeoff between cost and speed introduces another hazard. Every microprocessor requires an internal clock. Sometimes these clocks are at frequencies that cannot be generated from the master standard and, therefore, additional frequencies occur, generating radio interference and spikes inside the receiver. It becomes a major task to shield and insulate one or more microprocessors and their switching noise from the outside.

The HF1030 receiver is a good example where flexibility is obtained by a parallel BCD bus that controls the entire receiver and does not require a microprocessor. Even the LED display is not multiplexed. A receiver that can go down to 10 kHz will probably pick up this switching noise, then the additional shielding required can be more expensive than the reduction in cost by using a microprocessor over conventional logic. Some companies offer programmable logic-array ICs, which would take an intermediate position between the logic and the microprocessor system.

input filters

Current receiver designs generally use a high-pass/lowpass filter combination. Typically, a 1.6-MHz highpass is used to suppress incoming signals, and a 30-MHz lowpass filter is used to provide image rejection and prevent oscillator re-radiation. We therefore have a window almost 30 MHz wide that can lead to several second-order intermodulation distortion products.



Cubic Communications HF1030 receiver.

table 1. Specifications of a modern VLF/HF receiver.

frequency range	10 kHz to 30 MHz	
frequency setting	a. quasi-continuously by rotary switch in increments of 10 Hz/100 Hz/1 kHz b. digital entry via keyboard c. remote control via data interface (setting time 50 ms)	
readout resolution	7-digit liquid crystal display 10 Hz	
frequency drift		
after 10 minute warmup	$< 3 \times 10^{-7}$ at $+ 25^{\circ}\text{C}$	
within one day	$< 3 \times 10^{-8}$	
caused by aging	$< 1 \times 10^{-6}/\text{year}$	
in rated temperature range	$< 3 \times 10^{-7}$	
types of emission	A1 (CW), A2 (MCW), A3 (a-m) A2H, A3H (AME) } (SSB) upper A2A, A3A } and lower A2J, A3J } sideband A3B, (ISB), F1 (FSK) F4 (facsimile) F6	
with telegraphy demodulator		
antenna input	$Z_{in} = 50$ ohms, BNC female connector	
VSWR	< 3	
permissible input voltage	≤ 10 V EMF	
oscillator reradiation	$< 10\mu\text{V}$ at antenna input with 50-ohm termination	
sensitivity*	for 10 dB (S + N)/N, 0.2 = 30 MHz	
with A1, B = 300 Hz	$< 3\mu\text{V}$ EMF	
with A3, B = 6 kHz, m = 60%	$< 2.0\mu\text{V}$ EMF	
with A3J, B = 3.1 kHz	$< 0.75\mu\text{V}$ EMF	
preselection	0 to 0.5 MHz; lowpass filter 0.5 to 1.5 MHz; bandpass filter — 8 suboctave filters between 1.5 and 30 MHz	
intermediate frequencies		
1st i-f	81.4 MHz, B = 12 kHz	
2nd i-f	1.4 MHz	
i-f selectivity	3dB bandwidth (minimum)	60 dB bandwidth (maximum)
	± 75 Hz	± 225 Hz
	± 150 Hz	± 375 Hz
	± 300 Hz	± 750 Hz
	± 750 Hz	± 1875 Hz
	± 1.5 kHz	± 3.75 kHz
	± 3 kHz	± 7.5 kHz
	± 6 kHz	± 50 kHz
	+ 0.3 to + 3.4 kHz	- 0.3 to + 4.0 kHz
	- 0.3 to - 3.4 kHz	+ 0.3 to - 4.0 kHz
interference immunity, nonlinearities		
intermodulation*		
d_3 within A3J sideband	> 46 dB down, wanted signals 2×10 mV EMF	
d_3 , $\Delta f \geq 30$ kHz	> 70 dB down, unwanted signals 2×100 mV EMF	
d_2 (1.5 to 30 MHz), $\Delta f \geq 30$ MHz	> 70 dB down, unwanted signals 2×100 mV EMF	
blocking*	< 3 dB signal attenuation, wanted signal 1 mV EMF, m = 30%/1 kHz; unwanted signal 1 mV EMF, $\Delta f \geq 30$ kHz	

table 1. Specifications of a modern VLF/HF receiver (cont.)

cross-modulation*	< 10% modulation transfer; unwanted signal 200 mV EMF, $m = 30\% / 1 \text{ kHz}$; wanted signal 1 mV EMF, $\Delta f \geq 20 \text{ kHz}$
desensitization*	20 dB SINAD; wanted signal 30 μV EMF, $B = 3.1 \text{ kHz}$; unwanted signal 300 mV EMF, $\Delta f \geq 30 \text{ kHz}$
inherent spurious signals	< 0.5 μV equivalent EMF
spurious responses	> 90 dB down at $\Delta f \geq 30 \text{ kHz}$
image frequency rejection	> 80 dB
i-f rejection	> 90 dB
rf gain control, switchable	MGC MGC + AGC AGC
control range	> 100 dB
AGC error	< 4 dB (1 μV to 100 mV EMF)*
attack time	5 ms (level jump + 60 dB)
decay time (switchable)	0.4 s / 1.8 s (level jump - 60 dB)
BFO	variable in 100-Hz steps over $\pm 3.1 \text{ kHz}$
attenuation at i-f output	> 50 dB referred to i-f level
F1 demodulator	
limiting factor	> 40 dB
line spacing	50 to 1000 Hz
keying speed	1 to 100 bauds
signal distortion	< 5% at 100 bauds
single current	40 to 60 mA, variable; EMF = 60V
double current	in compliance with CCITT V.28
outputs	
1st oscillator 81.4 to 111.4 MHz	0 dBm, 50 ohms
2nd oscillator 80 MHz	0 dBm, 50 ohms
1-MHz output	50 mV into 50 ohms
switchable to 1-MHz	
external reference input	30 to 500 mV into 50 ohms
2nd i-f 1.4 MHz	50 mV into 50 ohms
recording output 12.5 kHz	0 dBm, 600 ohms
panoramic output 1.4 MHz	$B = 12 \text{ kHz}$
af line outputs 600 ohms	floating
output level	- 10 to + 3 dBm, adjustable
distortion	< 1% with A3J
af output 5 ohms (headphones output	
100 ohms)	
output level	1 W (12 mW, can be attenuated)
distortion	< 5%
signal characteristics	
af response (overall)	< 3 dB from 300 to 3400 Hz
af S/N ratio	> 40 dB SINAD with 1 mV EMF
phase noise ratio with A3J	> 75 dB with > 300 Hz spacing and 1 Hz measuring bandwidth, 1 mV signal EMF
remote control	interface in compliance with IEC and CCITT
IEC bus	IEC 625-1, 24-way connector (Amphenol); functions: T5, L3, SR1, RL2
or (depending on order number)	
RS232C	CCITT V.24, switchable to CCITT V.10 (RS 423) 110/200/300/600/1200/2400/4800/9600 bauds
code	ASCII 7 bits

*without 20-dB attenuator pad

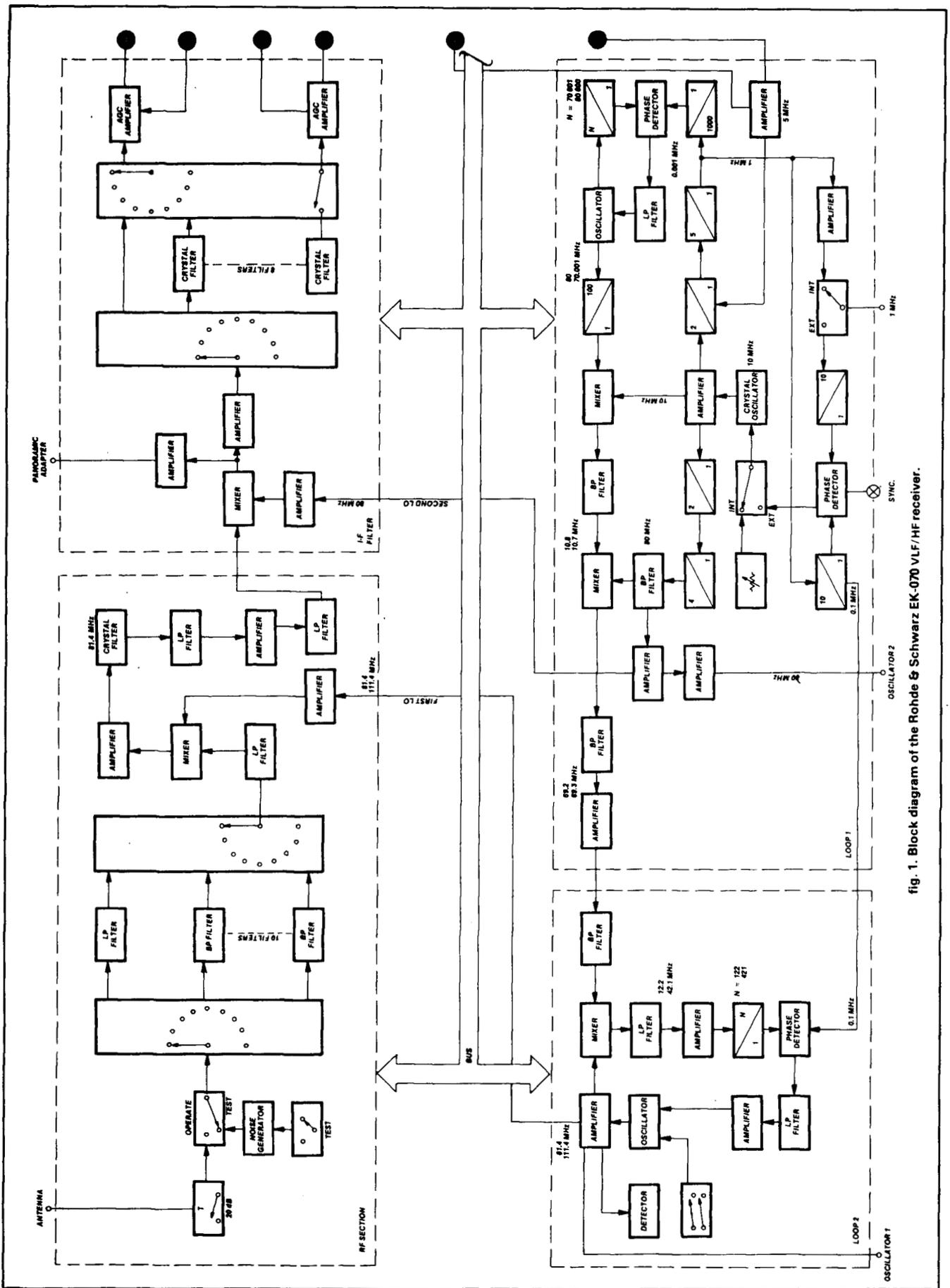


fig. 1. Block diagram of the Rohde & Schwarz EK-070 VLF/HF receiver.

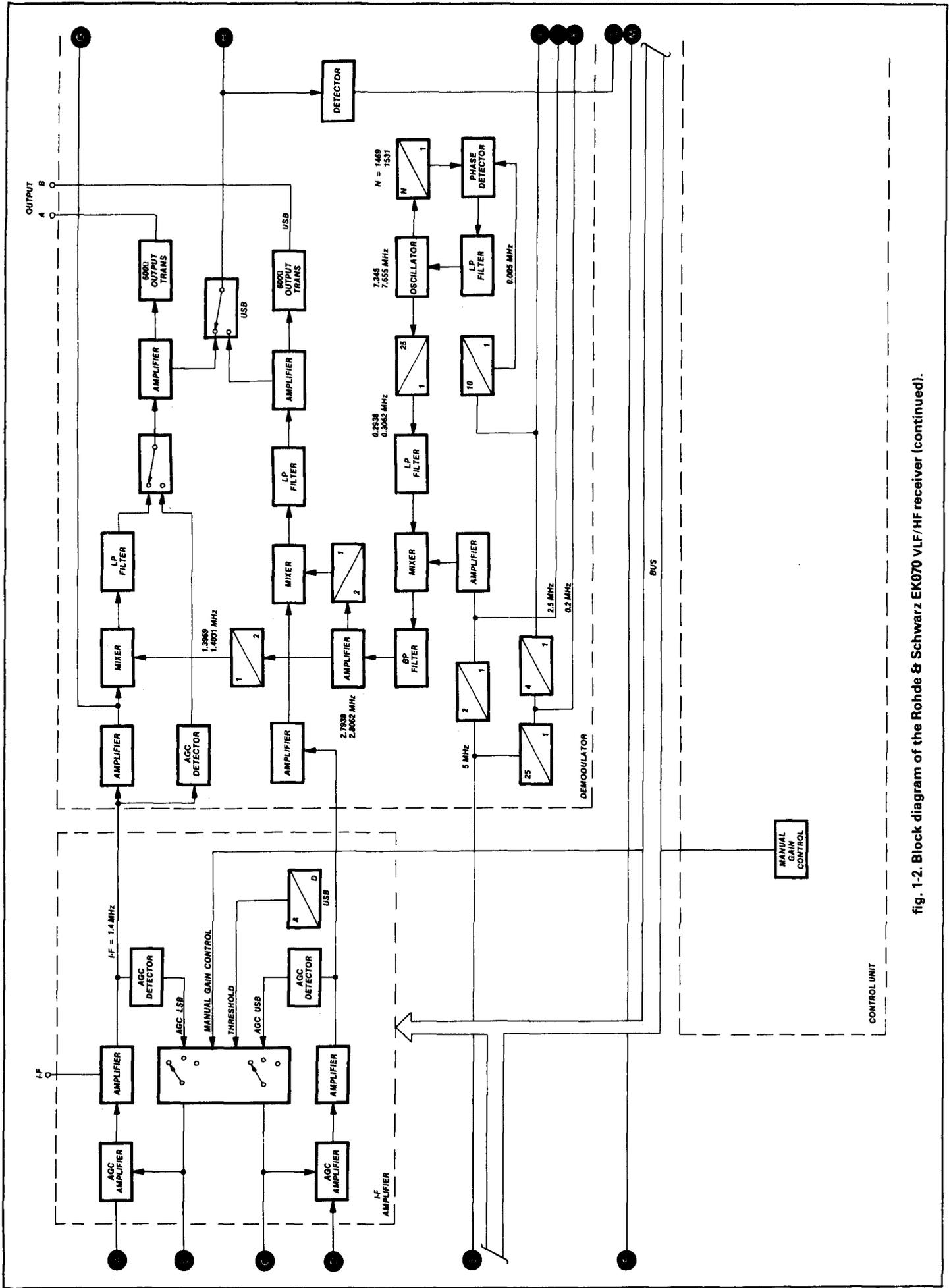


fig. 1-2. Block diagram of the Rohde & Schwarz EK070 VLF/HF receiver (continued).

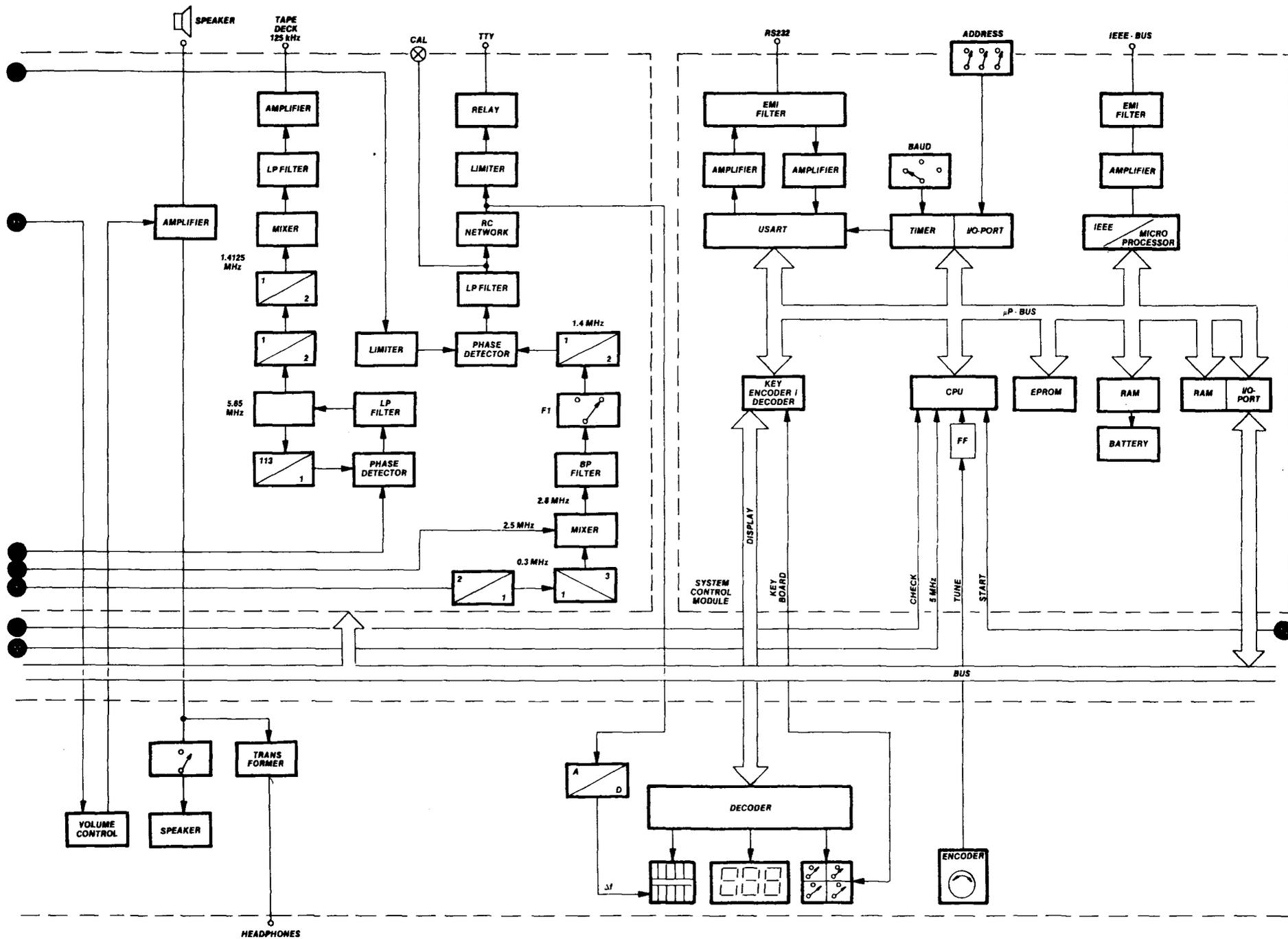


fig. 1-3. Block diagram of the Rohde & Schwarz EK070 VLF/HF receiver (continued).

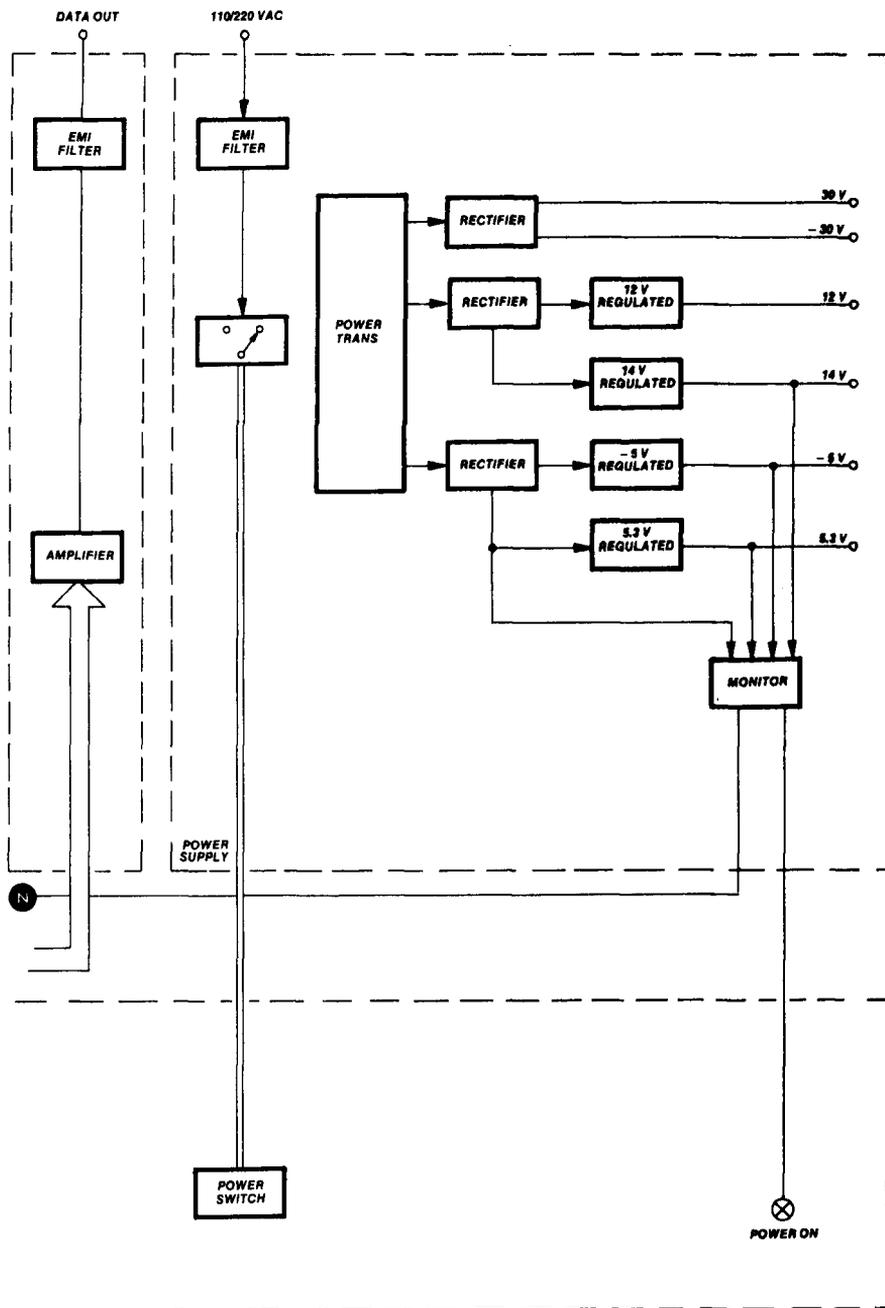


fig. 1-4. Block diagram of the Rohde & Schwarz EK070 VLF/HF receiver (continued).

The second-order intermodulation distortion, defined as $F_1 \pm F_2$ or $F_2 \pm F_1$, can be filtered with suboctave bandpass filters. The third-order intermodulation distortion products generated from $2 \times F_1 \pm F_2$ and/or $2 \times F_2 \pm F_1$ for close spacing, such as 10 kHz or closer, cannot be filtered. However, since there are so many signals present at the same time, the input bandwidth should be as narrow as possible.

Fig. 2 shows a solution that combines bandpass filters from 1.5-10 MHz and two input tracking filters from 10-30 MHz. Note the large number of tuning diodes in parallel. This is because no diodes are avail-

able that have the required high capacitance. In addition, intermodulation distortion products are reduced if the energy is distributed over more capacitance. Four-to-one stepdown transformers are used.

Because the tuned circuit operates at low impedance, both sides of the tuned circuit operate at 50 ohms. This input filter, despite the tuning diodes, does not degrade the 30-dBm intercept point of the following stage. Therefore this preselector is transparent as far as intermodulation distortion of any kind is concerned. Relays are necessary to avoid distortion from the switching diodes.

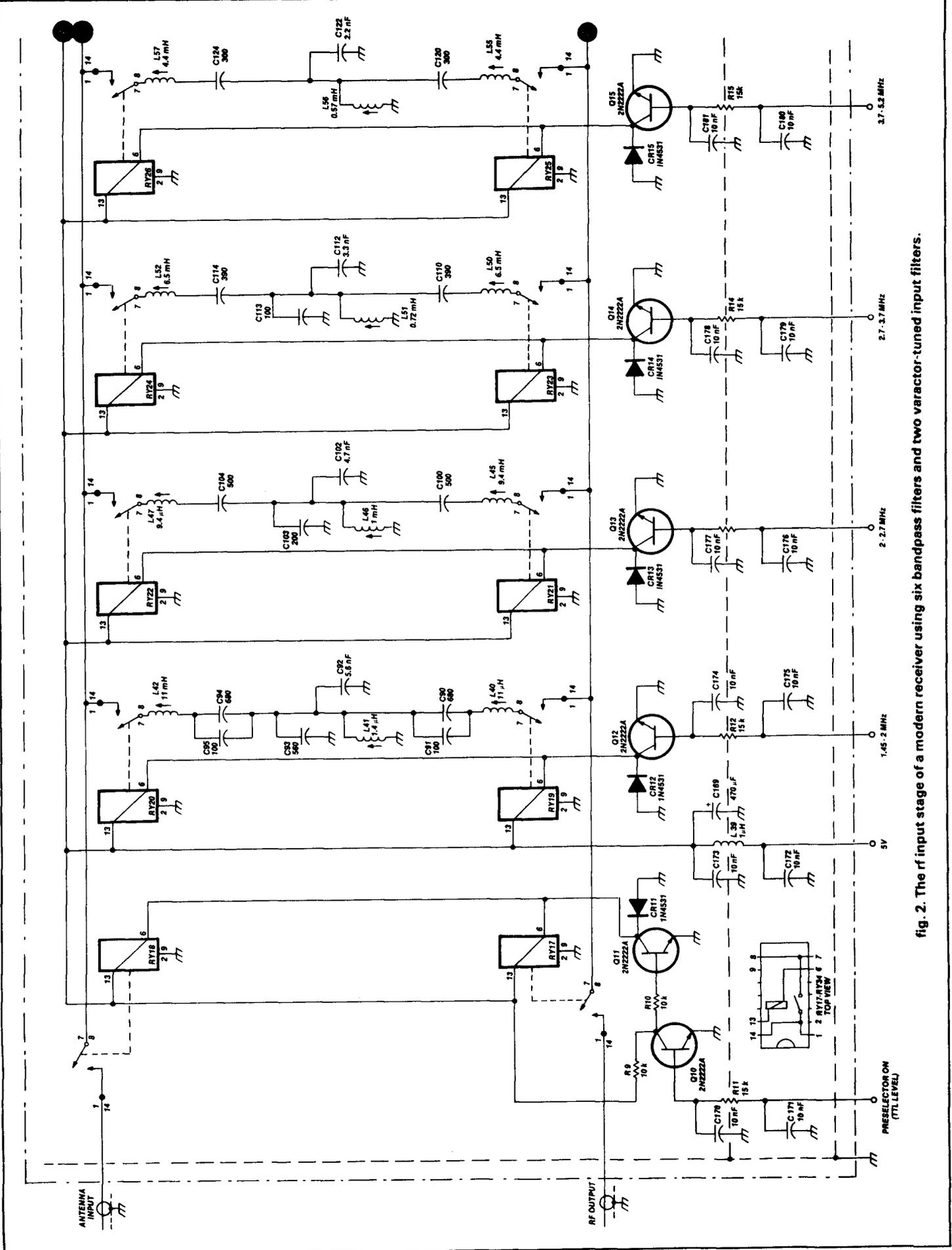


fig. 2. The rf input stage of a modern receiver using six bandpass filters and two varactor-tuned input filters.

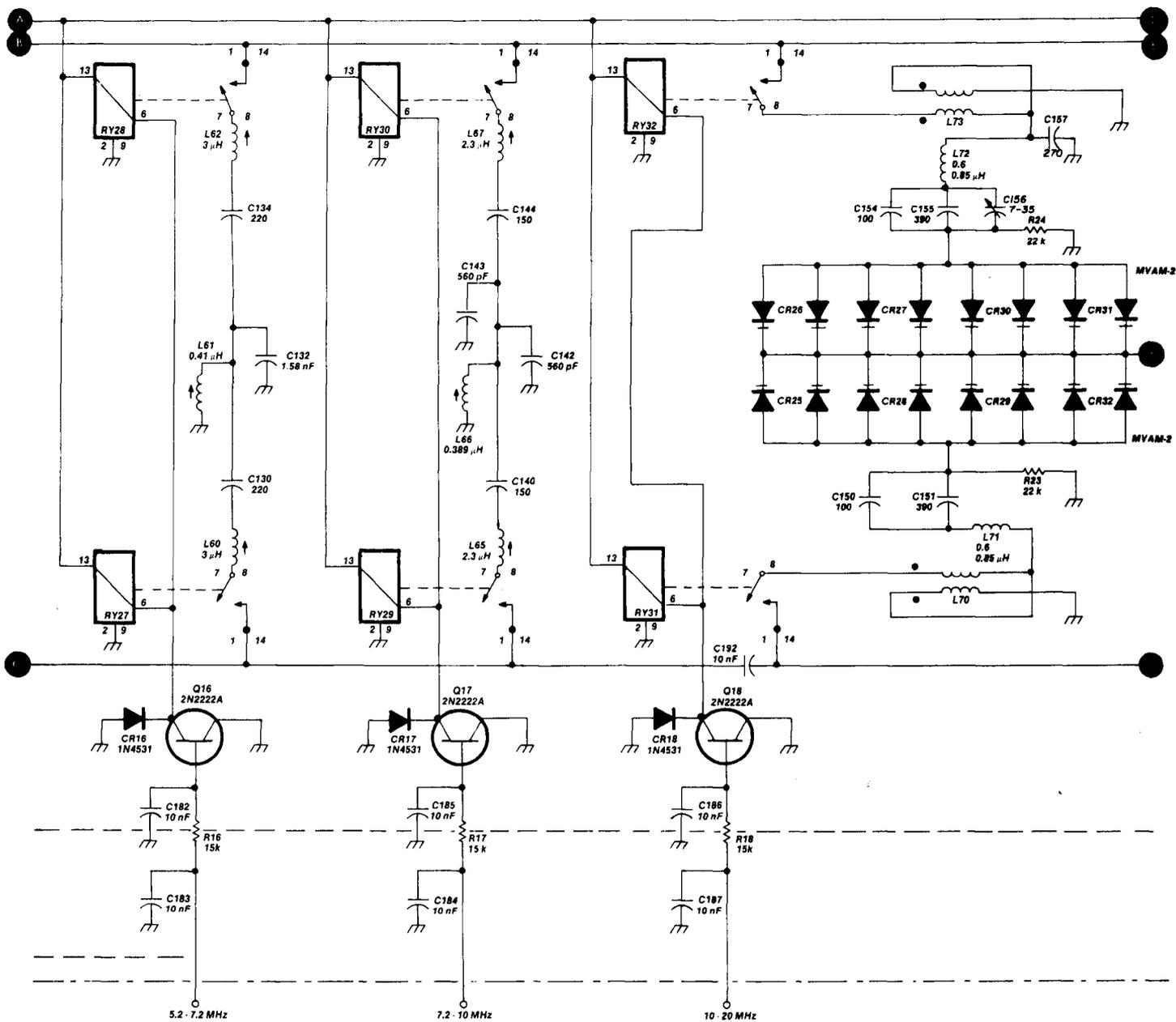


fig. 2-2. The rf input stage of a modern receiver using six bandpass filters and two varactor-tuned input filters (continued).

Similar input tracking filters are possible in the VHF/UHF range. The general finding is that PIN-diode attenuators, as sometimes used, limit the dynamic range to about +10 or +15 dBm. In transceiver application, it's possible to use the lowpass sections of the transmitter, and one has only to add highpass filter sections to obtain bandpass characteristics. The

highpass sections must be calculated so that they operate together with the lowpass section (see reference 2).

input mixers

We now find a major struggle between semiconductor manufacturers and rf engineers regarding the

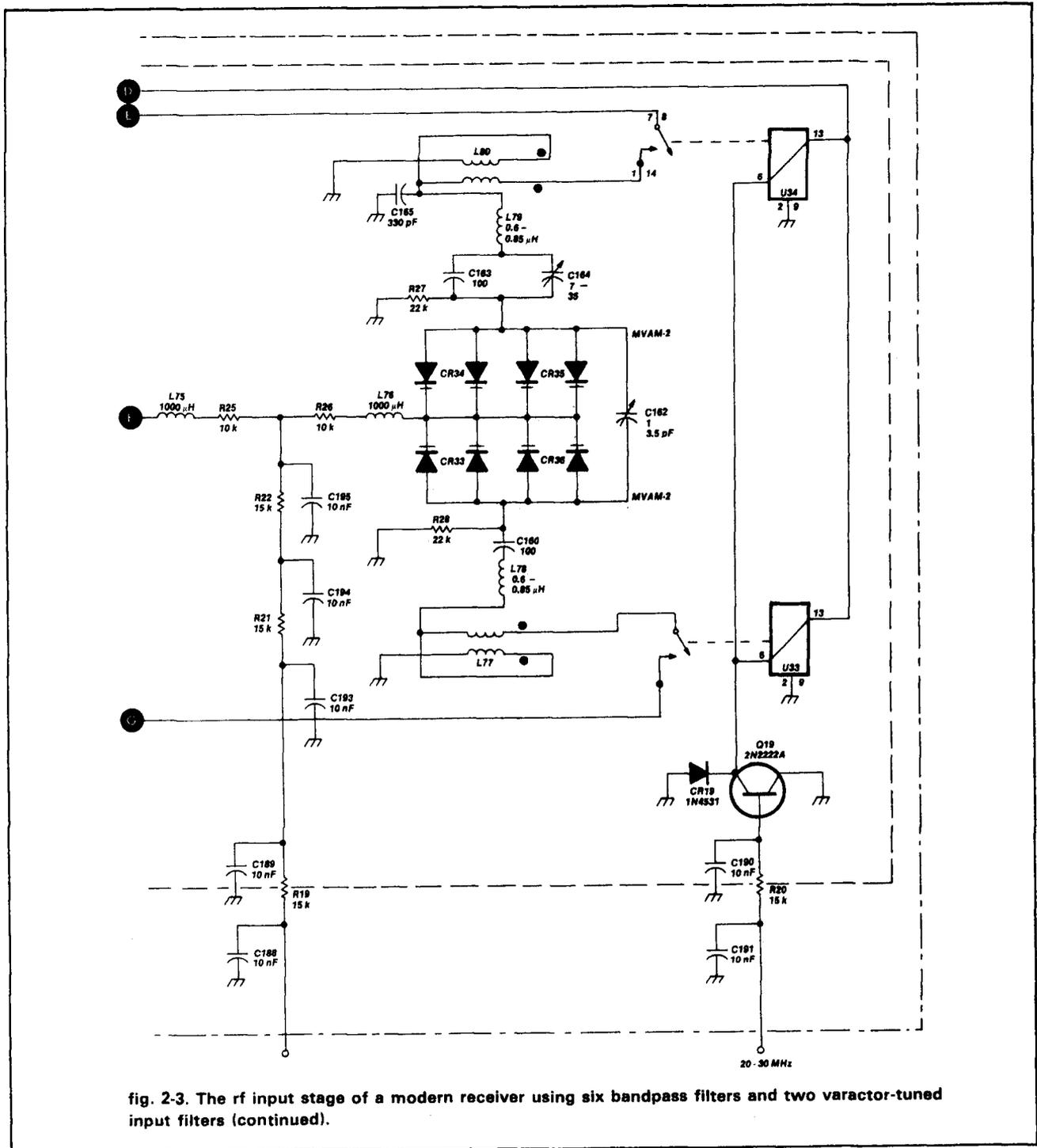


fig. 2-3. The rf input stage of a modern receiver using six bandpass filters and two varactor-tuned input filters (continued).

best mixer design. There is no question that we must use a double-balanced mixer to minimize the number of unwanted frequencies at the mixer output. Four solutions are currently available. These include the use of:

1. Bipolar active mixers.

2. Diode mixers.

3. FET active mixers.

4. Passive FET mixers in the switching mode.

Plessey has recently introduced the first really high-level double-balanced mixer, and several attempts

have been made to use it. (Probably the best summary is published in the January, 1981, issue of *QST* by Doug DeMaw.) It appears that, while the Plessey SL6440C is suitable for synthesizer or other application, its use in high-performance receivers is limited. The reason for this is discussed in the following paragraphs.

Mixer noise figure. Let's assume that the manufacturer's specifications for this Plessey device are valid: noise figure 10 dB, gain 4 dB, and intercept point +30 dBm. The mixer must operate into a stage that has a noise figure of less than, say, 3 dB. If a crystal filter or other device is inserted between the two stages, the mixer will have unity gain, as the filter losses will compensate for the mixer gain. We therefore can add the two noise figures and obtain a noise figure of 13 dB. This is done under the assumption that the stage following the first amplifier after the mixer does not contribute to the noise figure.

Let's do the same with a diode mixer, such as that developed for the HF1030 receiver, which contains two diode bridges, as shown in fig. 3. This mixer has an intercept point of +30 dBm, and with two signals of zero dBm applied to the input it generates two in-

termodulation distortion products of more than 60 dB, attenuated relative to the input signal. The mixer requires +17 dBm LO drive and has 6-dB insertion loss. The following amplifier again will have 3-dB noise figure, and, to make absolutely sure that the mixer is always terminated precisely with 50 ohms, no filters are inserted between the two devices.

As shown in my previous papers, a field-effect

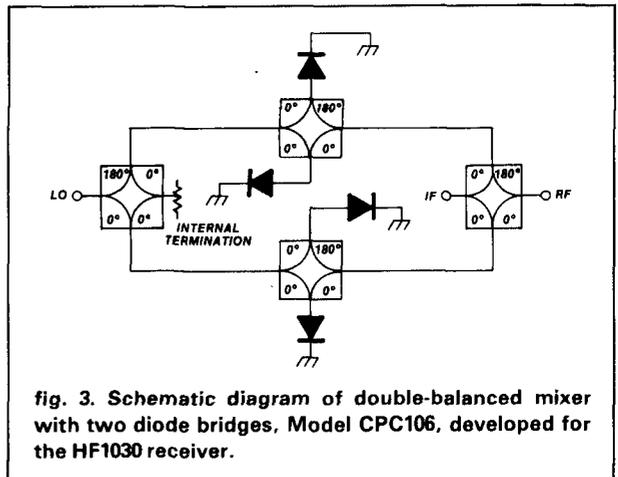


fig. 3. Schematic diagram of double-balanced mixer with two diode bridges, Model CPC106, developed for the HF1030 receiver.

table 2. Specifications of a modern VHF/UHF receiver.

frequency range	20 to 1000 MHz
frequency setting	a. quasi-continuous with rotary knob; the tuning speed increases with the speed of rotation b. from keyboard on front panel c. entered from internal memory d. entered from external computer
resolution	1 kHz/10 Hz (SSB)
readout, digital (can be shifted by 3 digits in SSB operation)	6-digit display for receive frequency, 6-digit display for frequency entered from keyboard or stored frequency value, 2-digit display for storage location
error of frequency setting	$\pm 1 \times 10^{-8}$ (or external standard frequency, 10 MHz)
antenna input	50-ohm, type-N socket
oscillator reradiation with 50-ohm termination	$< 1\mu\text{V}$ corresponding to -107 dBm
input filters	tracking filters
frequency setting storage capacity	99 frequencies and their respective type of demodulation and i-f bandwidth
loading of storage	frequency entered from keyboard or current receive frequency, including type of demodulation; i-f bandwidth
scanning operation	up to 99 stored frequencies can be continually scanned; halts automatically if frequency is occupied; scanning operation continued after preselected period of time at the push of a button
scanning time	Typically 50 ms per stored frequency
S/N ratio	
($V_{in} = 1\mu\text{V}$, $f_{mod} = 1$ kHz, i-f bandwidth 30 kHz, af filter on)	

Synthesized Hand-Held Scanner!

Chances are the police, fire and weather emergencies you'll read about in tomorrow's paper are coming through on a scanner right now. All scanners sold by **Communications Electronics** bring the real live excitement of action news into your home or car. With your scanner, you can monitor the exciting two-way radio conversations of police and fire departments, intelligence agencies, mobile telephones, energy/oil exploration crews, drug enforcement agencies and more.

Some scanners can even monitor aircraft transmissions! You can actually hear the news before it's news. If you do not own a scanner for yourself, now's the time to buy your new scanner from **Communications Electronics**. Choose the scanner that's right for you, then call our toll-free number to place your order with your Master Card or Visa. A scanner is an excellent holiday gift.

We give you excellent service because **CE** distributes more scanners worldwide than anyone else. Our warehouse facilities are equipped to process thousands of scanner orders every week. We also export scanners to over 300 countries and military installations. Almost all items are in stock for quick shipment, so if you're a person who prefers fact to fantasy and who needs to know what's really happening around you, order your scanner today from **CE!**

NEW! Bearcat® 350

The Ultimate Synthesized Scanner!
Allow 30-60 days for delivery after receipt of order due to the high demand for this product.
List price \$599.95/CE price \$419.00
7-Band, 50 Channel • Alpha-Numeric • No-crystal scanner • AM Aircraft and Public Service bands. • Priority Channel • AC/DC Bands: 30-50, 118-136 AM, 144-174, 421-512 MHz.
The new Bearcat 350 introduces an incredible breakthrough in synthesized scanning: Alpha-Numeric Display. Push a button—and the Vacuum Fluorescent Display switches from "numeric" to word descriptions of what's being monitored. 50 channels in 5 banks. Plus, Auto & Manual Search, Search Direction, Limit & Count, Direct Channel Access, Selective Scan Delay, Dual Scan Speeds, Automatic Lockout, Automatic Squelch, Non-Volatile Memory. Reserve your Bearcat 350 today!

Bearcat® 300

List price \$549.95/CE price \$339.00
7-Band, 50 Channel • Service Search • No-crystal scanner • AM Aircraft and Public Service bands. • Priority Channel • AC/DC Bands: 32-50, 118-136 AM, 144-174, 421-512 MHz.
The Bearcat 300 is the most advanced automatic scanning radio that has ever been offered to the public. The Bearcat 300 uses a bright green fluorescent digital display, so it's ideal for mobile applications. The Bearcat 300 now has these added features: Service Search, Display Intensity Control, Hold Search and Resume Search keys, Separate Band keys to permit lock-in/lock-out of any band for more efficient service search.



NEW! Bearcat® 350

More Details? CHECK — OFF Page 102

Bearcat® 250

List price \$429.95/CE price \$269.00
6-Band, 50 Channel • Crystalless • Searches Stores • Recalls • Digital clock • AC/DC Priority Channel • Delay • Count Feature
Frequency range 32-50, 146-174, 420-512 MHz.
The Bearcat 250 performs any scanning function you could possibly want. With push button ease you can program up to 50 channels for automatic monitoring. Push another button and search for new frequencies. There are no crystals to limit what you want to hear. A special search feature of the Bearcat 250 actually stores 64 frequencies and recalls them, one at a time. Overseas customers should order the Bearcat 250FB at \$379.00 each. This model has 220 V AC/12 V DC power supply and 66-88 MHz low band coverage.

NEW! Bearcat® 20/20

List price \$449.95/CE price \$279.00
7-Band, 40 Channel • Crystalless • Searches AM Aircraft and Public Service bands • AC/DC Priority Channel • Direct Channel Access • Delay
Frequency range 32-50, 118-136 AM, 144-174, 420-512 MHz.
The Bearcat 20/20 automatic scanning radio replaces the Bearcat 220 and monitors 40 frequencies from 7 bands, including aircraft. A two-position switch, located on the front panel, allows monitoring of 20 channels at a time.

Bearcat® 210XL

List price \$349.95/CE price \$219.00
6-Band, 18 Channel • Crystalless • AC/DC
Frequency range: 32-50, 144-174, 421-512 MHz.
The Bearcat 210XL scanning radio is the second generation scanner that replaces the popular Bearcat 210 and 211. It has almost twice the scanning capacity of the Bearcat 210 with 18 channels plus dual scanning speeds and a bright green fluorescent display. Automatic search finds new frequencies. Features scan delay, single antenna, patented track tuning and more!

Bearcat® 160

List price \$299.95/CE price \$184.00
5-Band, 16 Channel • AC only • Priority Dual Scan Speeds • Direct Channel Access
Frequency range: 32-50, 144-174, 440-512 MHz.
Would you believe...the Bearcat 160 is the least expensive Bearcat crystalless scanner.
This scanner presents a new dimension in scanning form and function. Look at the smooth keyboard. No buttons to punch. No knobs to turn. Instead, finger-tip pads provide control of all scanning operations, including On/Off, Volume and Squelch. Of course the Bearcat 160 incorporates other advanced Bearcat features such as Priority, Direct Channel Access, Dual Scan Speeds, Lockout, Scan Delay and more.

NEW! Bearcat® 100

The first no-crystal programmable handheld scanner.
Allow 60-120 days for delivery after receipt of order due to the high demand for this product.
List price \$449.95/CE price \$299.00
8-Band, 16 Channel • Liquid Crystal Display Search • Limit • Hold • Lockout • AC/DC
Frequency range: 30-50, 138-174, 406-512 MHz.
The world's first no-crystal handheld scanner has compressed into a 3" x 7" x 1 1/4" case more scanning power than is found in many base or mobile scanners. The Bearcat 100 has a full 16 channels with frequency coverage that includes all public service bands (Low, High, UHF and "T" bands), the 2-Meter and 70 cm. Amateur bands, plus Military and Federal Government frequencies. It has chrome-plated keys for functions that are user controlled, such as lockout, manual and automatic scan. Even search is provided, both manual and automatic. Wow...what a scanner!

The Bearcat 100 produces audio power output of 300 milliwatts, is track-tuned and has selectivity of better than 50 dB down and sensitivity of 0.6 microvolts on VHF and 1.0 microvolts on UHF. Power consumption is kept extremely low by using a liquid crystal display and exclusive low power integrated circuits.

Included in our low CE price is a sturdy carrying case, earphone, battery charger/AC adapter, six AA ni-cad batteries and flexible antenna. For earliest delivery from **CE**, reserve your Bearcat 100 today.

Bearcat® 5

List price \$134.95/CE price \$94.00
4-Band, 8 Crystal Channels • Lockout • AC only
Frequency range: 33-50, 146-174, 450-508 MHz.
The Bearcat 5 is a value-packed crystal scanner built for the scanning professional — at a price the first-time buyer can afford. Individual lockout switches. Order one crystal certificate for each channel.

Bearcat® Four-Six ThinScan™

List price \$189.95/CE price \$124.00
Frequency range: 33-47, 152-164, 450-508 MHz.
The incredible, Bearcat Four-Six Thin Scan™ is like having an information center in your pocket. This four band, 8 channel crystal controlled scanner has patented Track Tuning on UHF, Scan Delay and Channel Lockout. Measures 2 3/4 x 6 1/4 x 1 1/4". Includes rubber ducky antenna. Order crystal certificate for each channel. Made in Japan.

TEST ANY SCANNER

Test any scanner purchased from **Communications Electronics** for 31 days before you decide to keep it. If for any reason you are not completely satisfied, return it in original condition with all parts in 31 days, for a prompt refund (less shipping/handling charges and rebate credits).

Fanon Slimline 6-HLU

List price \$169.95/CE price \$109.00
Low cost 6-channel, 4-band scanner!
The Fanon Slimline 6-HLU gives you six channels of crystal controlled excitement. Unique Automatic Peak Tuning Circuit adjusts the receiver front end for maximum sensitivity across the entire UHF band. Individual channel lockout switches. Frequency range 30-50, 146-175 and 450-512 MHz. Size 2 3/4 x 6 3/4 x 1 1/4". Includes rubber ducky antenna. Order crystal certificates for each channel. Made in Japan.

Fanon Slimline 6-HL

List price \$149.95/CE price \$99.00
6-Channel performance at 4-channel cost!
Frequency range: 30-50, 146-175 MHz.
If you don't need the UHF band, get this model and save money. Same high performance and features as the model HLU without the UHF band. Order crystal certificates for each channel. Made in Japan.

OTHER SCANNERS & ACCESSORIES

NEW! Regency† D810 Scanner \$319.00
NEW! Regency† D300 Scanner \$219.00
NEW! Regency† D100 Scanner \$169.00
NEW! Regency† H604 Scanner \$129.00
Regency† M400 Scanner \$259.00
Regency† M100 Scanner \$199.00
Regency† R1040 Scanner \$149.00
SCMA-6 Fanon Mobile Adapter/Battery Charger \$49.00
CHB-6 Fanon AC Adapter/Battery Charger \$15.00
CAT-6 Fanon carrying case with belt clip \$15.00
AUC-3 Fanon auto lighter adapter/Battery Charger \$15.00
PSK-6 Base Power Supply/Bracket for SCMA-6 \$20.00
SP50 Bearcat AC Adapter \$9.00
SP51 Bearcat Battery Charger \$9.00
SP58 Bearcat 4-6 ThinScan™ carrying case \$12.00
MA506 Regency carrying case for H604 \$15.00
FB-E Frequency Directory for Eastern U.S.A. \$12.00
FB-W Frequency Directory for Western U.S.A. \$12.00
FFD Federal Frequency Directory for U.S.A. \$12.00
TSG "Top Secret" Registry of U.S. Government Freq. \$10.00
B-4 1.2 V AAA Ni-Cad batteries (set of four) \$9.00
A-135c Crystal certificate \$3.00
Add \$3.00 shipping for all accessories ordered at the same time.

INCREASED PERFORMANCE ANTENNAS

If you want the utmost in performance from your scanner, it is essential that you use an external antenna. We have six base and mobile antennas specifically designed for receiving all bands. Order #A60 is a magnet mount mobile antenna. Order #A61 is a gutter clip mobile antenna. Order #A62 is a trunk-clip mobile antenna. Order #A63 is a 3/4 inch hole mount. Order #A64 is a 3/8 inch snap-in mount, and #A70 is an all band base station antenna. All antennas are \$35.00 and \$3.00 for UPS shipping in the continental United States.

BUY WITH CONFIDENCE

To get the fastest delivery from **CE** of any scanner, send or phone your order directly to our Scanner Distribution Center. Be sure to calculate your price using the CE prices in this ad. Michigan residents please add 4% sales tax. Written purchase orders are accepted from approved government agencies and most well rated firms at a 10% surcharge for net 10 billing. All sales are subject to availability, acceptance and verification. All sales on accessories are final. Prices, terms and specifications are subject to change without notice. Out of stock items will be placed on backorder automatically unless **CE** is instructed differently. Most products that we sell have a manufacturer's warranty. Free copies of warranties on these products are available prior to purchase by writing to **CE**. International orders are invited with a \$20.00 surcharge for special handling in addition to shipping charges. All shipments are F.O.B. Ann Arbor, Michigan. No COD's please. Non-certified and foreign checks require bank clearance. Minimum order \$35.00.

Mail orders to: **Communications Electronics**, Box 1002, Ann Arbor, Michigan 48106 U.S.A. Add \$7.00 per scanner or phone product for U.P.S. ground shipping and handling, or \$14.00 for faster U.P.S. air shipping to some locations. If you have a Visa or Master Card, you may call anytime and place a credit card order. Order toll free in the U.S.A. Dial 800-521-4414. If you are outside the U.S. or in Michigan, dial 313-994-4444. Dealer inquiries invited. Order without obligation today!

Scanner Distribution Center™ and CE logos are trademarks of **Communications Electronics**.

† Bearcat is a federally registered trademark of Electra Company, a Division of Masco Corporation of Indiana.

‡ Regency is a federally registered trademark of Regency Electronics Inc.

Copyright ©1981 **Communications Electronics™**



COMMUNICATIONS ELECTRONICS™

854 Phoenix □ Box 1002 □ Ann Arbor, Michigan 48106 U.S.A.
Call TOLL-FREE (800) 521-4414 or outside U.S.A. (313) 994-4444

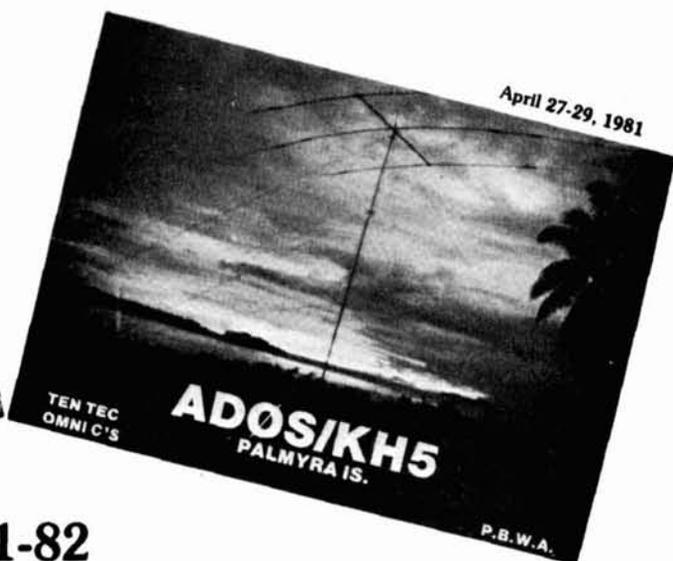
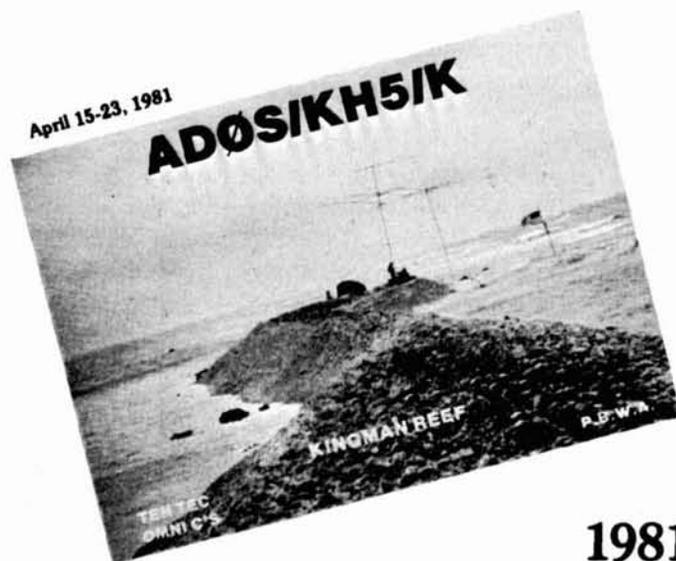
We're first with the best.™

November 1981 25

table 2. Specifications of a modern VHF/UHF receiver (cont.).

a-m ($m = 0.5$)	≥ 10 dB
fm (deviation 10 kHz)	≥ 20 dB
total noise figure (including af section)	9 dB typical
oscillator phase noise (at 20 kHz from the carrier)	120 dB/Hz typical
fm noise suppression (3-kHz deviation, $f_{\text{mod}} = 1$ kHz, $V_{\text{in}} = 1$ mV)	50 dB typical
intercept point 2nd order	50 dBm typical
3rd order	12 dBm typical
image frequency rejection	> 90 dB
i-f rejection	> 90 dB
i-f bandwidth (3 dB)	2.3 kHz, 8 kHz, 15 kHz, 30 kHz, 100 kHz, 300 kHz, 2 MHz
demodulation	a-m, fm, SSB
squelch	S/N ratio and adjustable carrier squelch circuits (both can be switched off)
af filter	300 Hz to 3.3 kHz; can be switched out
gain control AGC	i-f control for $V_{\text{in}} < 80$ dB (μV) rf/i-f control for $V_{\text{in}} < 120$ dB (μV)
MGC	i-f control 80 dB
AFC	rf 40 dB; can be switch selected digital tracking of signals of unstable frequency (can be switch off)
indication	
level	on moving-coil meter in dB (μV)
frequency offset	on moving-coil meter; sensitivity of offset meter matched to bandwidth
panoramic display	
i-f panoramic display	
sweep width	200 kHz
resolution	4.5 kHz
amplitude display	logarithmic approximately 80 dB
screen area	4 cm \times 3 cm
rf panoramic display and broadband i-f display	
rf sweep width	entire reception range (500 MHz, maximum) and/or a particular section of it; superposition of frequency marker for receiver tuning
i-f sweep width	2 MHz maximum
amplitude display	linear or logarithmic 80 dB (10 dB/cm)
internal testing facilities	
continual test	monitoring of subassemblies; error signaled with code number
loop test	triggered by pressing a button; automatic testing of complete receive section including the af section and all LED displays
outputs	level, offset, af (600 ohms); a-m video, fm video, i-f (10.7 MHz, 2-MHz broadband, 50 ohms, 10 dB above input level, without AFC) i-f (10.7 MHz, narrowband, with AFC, 50 ohms, 10 mV), inputs/outputs for panoramic adapter EZP, COR (Carrier Operated Relay): coupled with squelch; dropout time internally adjustable
inputs	external control voltage, squelch response threshold
remote control (via IEC bus or RS232C interface)	all important functions, input and output

**“all other gear gave us trouble...
the TEN-TECs just kept working great.”**



**1981-82
Trans Pacific DX Expedition
used TEN-TEC OMNI-C transceivers.**

**KINGMAN REEF, PALMYRA, TOKELAU —
33,000 contacts without a miss.**

As George Carleton (ADØS ex KH5K) said in a letter to TEN-TEC... "12,100 QSO's from Kingman, 8100 for me, 3100 in the first sitting with the rig on a continuous 33 hours except for 2 minute gas breaks... all other gear gave us trouble due to salt spray — the TEN-TECs just kept working great.

"This is the most QSO's ever from Kingman and all were barefoot. A few times generators ran out of gas during rainstorms with rigs operating on TX... no problem with voltage drop, and no damage. No tuners were used... only your rigs and (antennas). The wind blew continuously from 20 knots to 50-60 knots and we literally had to open the tent to let the rain out, salt water and spray everywhere, watches quit, keyers and linear (other brands) quit after the first QSO — arcing due to salt spray, but the TEN-TECs never even got warm when the tent was around 100°F.

"... American gear is best."

The TEN-TEC OMNI-Cs went on to serve on Palmyra and Tokelau with equally impressive results and we thank the group for their letters—we couldn't have said it better.

**See your TEN-TEC dealer
for the great All-American
transceiver — TEN-TEC OMNI-C.**



The spectacular performance of the TEN-TEC OMNI-C results from these fine features:

- 9 hf bands • Total solid state—from the pioneer • Broadband—from the pioneer • 3-mode, 2-range offset tuning—receiver, transmitter or transceiver • Optimized receiver sensitivity • Greater dynamic range • Optimized bandwidth—seven response curves—up to 16 poles of filtering • Notch filter • Noise blanker • "Hang" agc for smoother operation • Full or semi break-in (QSK) • WWV reception on 10 MHz band • Digital readout • Separate receive antenna input • Automatically switched S/SWR meter • 200 watts input all bands • VOX and PTT • Phone patch jacks • Zero-beat switch • Adjustable volume and pitch sidetone • Adjustable threshold ALC • Front panel band switch also controls linear or antenna • Automatic sideband selection • Super audio quality—less than 2% THD • Impeccable signal—exceeds FCC requirements • High stability—less than 15 cycles change per degree F temp. change • High articulation keying—set to 3 msec. rise and decay time • Compression loaded speaker • Plug-in circuit boards • Operates on 12-14 V dc mobile, 115/230 V ac with external supply • Made in U.S.A. by pioneers in solid state amateur radio—TEN-TEC.

TEN-TEC, INC.
SEVIERVILLE, TENNESSEE 37862
EXPORT: 5715 LINCOLN AVE., CHICAGO, ILL. 60646

Hatry Electronics

500 Ledyard St. (South) Hartford, Ct. 06114

203-527-1881 (Ask for Ham Dept.)

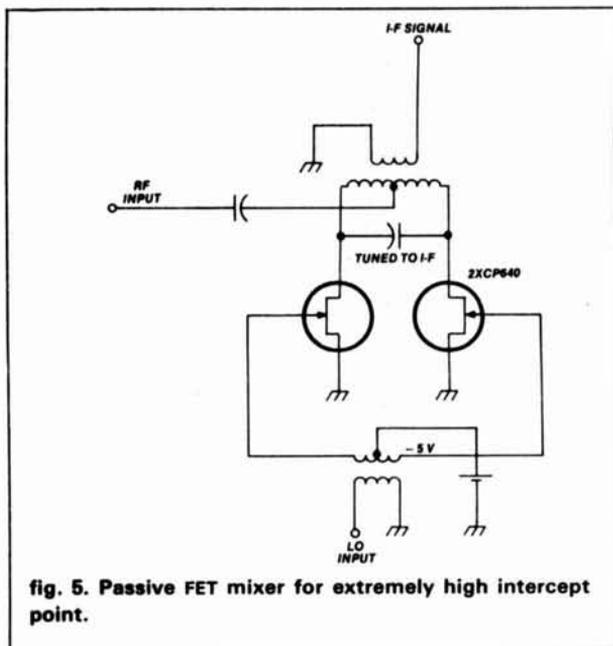


fig. 5. Passive FET mixer for extremely high intercept point.

With suitable bias applied, the intercept point can be as high as +40 dBm with little difficulty in reproduction. This technique is currently used by the Racal RA6790 receiver and by the AGC Telefunken E1700 receiver.

The disadvantage of this circuit is cost, as the LO-drive level must be as high as 23 dBm, and the matching of the device is fairly critical.

VMOS transistors have been used lately in mixers. It appears that these devices are slightly unstable. I had Doug DeMaw's mixer on loan and had some difficulties with it. Unfortunately, the ARRL wanted it for other projects, and I couldn't finish my testing; but I understand that it was tested by an independent source and they confirmed the instability if the mixer is not terminated with a pure resistance. In addition, the VMOS device, being an enhancement field-effect transistor, is slightly more noisy than the junction field-effect transistor. We are now beginning to try new circuits, including a combination of power field-effect transistors, such as the U320 or the CP640, which should give promising results.

In the second part of this article, we will look at feedback amplifiers, including the noiseless feedback circuit; i-f filters; i-f detectors; and frequency synthesizers including the fractional-N design.

references

1. Ulrich L. Rohde, DJ2LR, "Optimum Design for High-Frequency Communications Receivers," *ham radio*, October, 1976, pages 10-25.
2. Anatone Zverev, *Handbook of Filter Synthesis*, John Wiley & Sons, New York, New York.

ham radio

ICOM 720A



Dual VFOs, receives .1 to 30 MHz; 200 Watt PEP input, SSB, CW, AM, and RTTY modes, speech processor, PBT, VOX, finals protected, dual lock, broad-banded, full metering, quadruple conversion receiver. The New Standard in Ham Radio.

\$1349.00 Call for quote

TEN-TEC OMNI C



Nine Bands: All Solid-State: Broadbanded. Digital Readout, 100% Duty Cycle, 200 Watts Input, Finals Protected, Built-in VOX, PTT, Notch Filter, Noise Blanker, 2 speed Break in, Automatic Sideband Selection. Full line of Accessories.

\$1289.00 Call for quote

ICOM 730



Compact, affordable, convenient, 200 Watt PEP Input, built-in receiver preamp, VOX, noise blanker, RIT, 10-80 M including WARC bands, speech processor, IF Shift, finals protected, full solid state.

\$829.00 Call for quote

TEN-TEC DELTA 580



160-10 Meter including three new hi bands (10, 18 & 24.5 MHz). Low noise double conversion design, 200 watts input on all bands, 100% duty cycle Offset tuning Full break-in. Built-in VOX and PTT.

\$869.00 Call for quote

ICOM 22U



VHF Mobile Performance at a budget price. Easy to operate, versatile, compact, 10 watts, 100% duty, Finals protected, Hi/Low power, remote frequency selection option.

\$299.00 Call for quote

ASK ABOUT
OUR CURRENT
STOCK OF
USED GEAR!

ICOM 251A



FM, SSB, CW; Two VFOs; Squelch on SSB; Three memories; Memory Scan; Programmable Band Scan; Repeater Offsets; Noise Blanker; VOX, RIT; Variable Repeater Splits; Mobile or Station Reg. Loaded!

\$749.00 Call for quote

Other fine lines we carry:

Ameco	MFJ
Amidon	J.W. Miller
Antenna Specialists	Mirage
ARRL	Murch
Astatic	Radio Amateur Callbook
Barker & Williamson	Regency
Bash	Rohn
Belden	Sams
Bencher	Saxton
Cushcraft	Signals
Daiwa	Telex
DenTron	Trac
Drake	Turner
Global Specialties	Unadilla/Reyco
Gold Line	Valor
Ham-Key	Van Gorden Engineering
Hayden	Vibroplex
Hustler	VoCom
Hy-Gain	W2AU
Larsen	



SHIPPING F.O.B. HARTFORD

COD

understanding performance data of high-frequency receivers

Check over these definitions
before you buy a new receiver

When reading manufacturer's data sheets or product reviews for receiving equipment, one encounters terms such as dynamic range and intermodulation distortion, covering essential features of high-frequency receivers but not generally known to Amateurs. Let's go through an example of high-frequency transceiver or receiver specifications and see what the terms really mean.

sensitivity

First we read that the "receiver sensitivity is 0.25 μV at 10-dB S/N," where S/N stands for signal-to-noise ratio. This information tells us that we need a 0.25- μV signal at the receiver antenna input to obtain an audio-output signal, S, of 10 times (10 dB) the audio-output power of the internally generated receiver noise, N. This value (0.25 μV) is typical for the sensitivity of a good receiver; much lower figures (higher sensitivity) are rare except in commercial grade equipment.

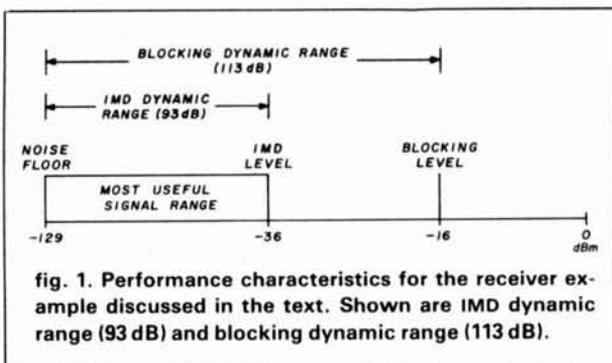
noise floor

The internally generated circuit noise in the receiver is usually represented as the rf input signal level that produces the same audio output power as the noise. This level is, for practical purposes, the minimum-discernible signal that can be detected in a receiver. This signal level is called the noise floor and is generally expressed in decibels below one milliwatt power, or -dBm. Since 0.25 μV from a 50-ohm antenna into a receiver whose input is matched to 50 ohms impedance equals -119 dBm, the noise-floor level in the example case is about -129 dBm, a common value for a manufactured Amateur high-frequency receiver. Homebuilt equipment can sometimes improve on this figure, and values below -140 dBm have been measured.

receiver noise

Receiver noise is a function of, among other things, receiver bandwidth. If we assume that the sensitivity of 0.25 μV was specified for a bandwidth (passband) of 2.5 kHz as used for SSB work, the

By Jan K. Moller, K6FM, 3653 Texas Avenue,
Simi Valley, California 93063



reduction of the bandwidth with a filter for CW, say, 500 Hz, will improve the receiver's apparent sensitivity. The reason is that, by reducing the bandwidth five times, you reduce the amount of noise coming through the receiver and effectively lower the noise floor 7 dB. The new level, in our example -136 dBm, makes it possible for you to receive a correspondingly weaker CW signal, about 0.1 μ V, with the same 10-dB signal-to-noise ratio as the SSB signal first mentioned. Anyone who has operated such a narrow bandwidth receiver will remember how quiet it seems and how you can pick out really weak ones.

IMD and desensitization

The ability of a receiver to handle a wanted signal in the presence of strong adjacent signals is of greatest importance in today's crowded Amateur bands. Two phenomena are most significant, intermodulation distortion, or IMD, and blocking, or desensitization of the receiver. IMD is caused by the mixing, because of imperfections in the receiver front end, of wanted with unwanted signals outside but near the receiver passband. The result is interfering signals in the passband; most dominantly they are the third-order mixing product of two unwanted signals. (Example: two unwanted signals with frequencies f_1 and f_2 , mixing product $f_i = 2f_1 - f_2$; if $f_1 = 14,060$ kHz and $f_2 = 14,040$ kHz, then $f_i = 14,080$ kHz. The same is true for $f_i = 2f_2 - f_1 = 14,020$ kHz.)

IMD dynamic range

Returning to the sample specs — they state that "third order IMD is better than -36 dBm." According to definition, this says that, if the receiver is tuned to frequency f_i , a resulting signal of this frequency will be audible 3 dB above the receiver's noise level when incoming signals f_1 and f_2 are at the -36 dBm level (about 50 dB over S9). Such a weak f_i signal is just barely recognizable in the noise. This information permits the calculation of IMD dynamic range, the

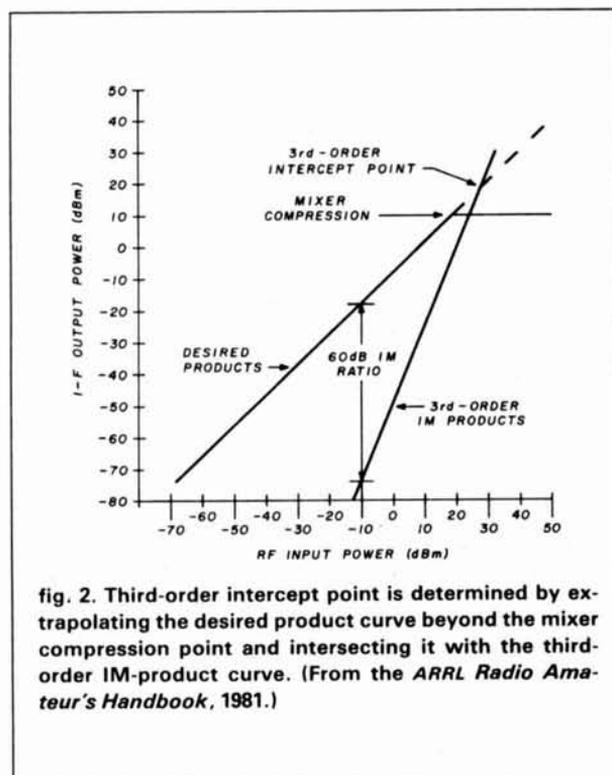
difference between the noise-floor level and the IMD measured level; here it is 93 dB for an SSB bandwidth.

This number is one of the most important characteristics of a receiver in that it specifies the range of signals that can be handled with essentially no undesired spurious responses. Other effects, such as blocking and crossmodulation, occur mainly outside this range of signals, see fig. 1. A good receiver is expected to have an IMD dynamic range of at least 80-85 dB, and slightly better for a CW bandwidth.

The IMD effect is basically caused by the mixer, and one measure of receiver performance is obtained in the following manner. If the mixer i-f output of the desired signals, as well as the IMD product, are plotted against rf input, the two lines will intersect at a certain output level, fig. 2. Note that the two straight lines will have to be extrapolated to intersect, as this usually occurs at such high rf input levels that mixer gain compression (see below) takes place. The intersection level of output is called the third-order or IMD intercept (point), and is expressed in dBm. This point defines essentially the intermodulation performance of the receiver front end for all signal levels and thus becomes a figure of merit. Typical IMD intercept values range between -5 and 25 dBm — the higher numbers indicating better performance.

gain compression and blocking

Blocking, or desensitization, is the result of a very



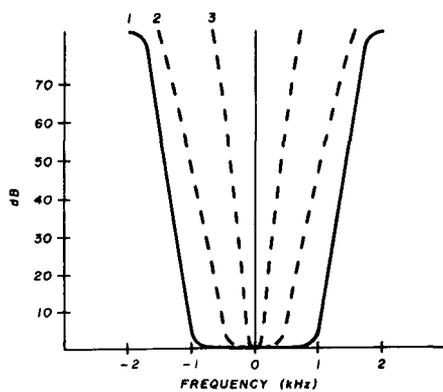


fig. 3. Typical i-f response curves. Curve 1: Built-in 2.4-kHz filter. Curve 2: Added 500-Hz filter. Curve 3: Alternate 250-Hz filter.

strong signal outside the receiver's i-f passband causing loss of gain; that is, gain compression. The blocking signal level is defined as the rf input voltage 20 kHz off frequency that causes the audio output of a weak desired signal (S5 or so) to drop by 1 dB. Typical signal levels are 20-25 dB above the third-order IMD level but this quantity is rarely stated in receiver specifications. Sometimes the expression "blocking dynamic range" is used. This is the difference between the noise floor level and blocking signal level. In the example case, this value typically would be 113-118 dB (related bandwidth should be stated).

cross modulation

Cross modulation occurs when the modulation of an adjacent strong signal appears on a desired strong signal in the millivolt range. The effect is rarely measured for Amateur receivers, where the interest is centered on small-signal performance. Also, IMD products would probably have been encountered in the receiver during such operating conditions. Many modern receivers contain a switchable front-end attenuator to minimize the unwanted effects of strong-signal reception.*

SSB selectivity

The sample receiver specs state that the receiver SSB selectivity is "2.4 kHz at -6 dB and 3.6 kHz at -60 dB." These numbers show a) the width of the receiver passband at 6 dB below the peak of the i-f curve (2.4 kHz) and 60 dB down from the peak (3.6 kHz) and b) the depth and the shape or form factor of the gate through which your desired signals can pass, fig. 3. The shape factor is defined as the ratio between the receiver bandwidth at -60 dB and -6

dB; in this case it is 1.5.

Receiver selectivity is largely established in the i-f circuits and, depending upon the characteristics of the i-f filters and signal leakage, the passband curve can be quite narrow and have steep sides down to 80 or 90 dB below the peak. A steep curve with sides going as low as possible before flattening out is desirable in that adjacent i-f signals are better suppressed, causing less interference and background hash. A receiver with a square-shaped passband curve down to -90 dB will appear much quieter than one that begins to flatten out at -60 dB.

CW selectivity

For CW operation, most high-quality receivers offer a number of narrow passband options, which are achieved by installing additional i-f filters. One of the example receiver options provides a selectivity of 500 Hz at -6 dB and 820 Hz at -60 dB. These values are average narrowband figures, and an experienced CW operator may even choose a higher selectivity such as 250 Hz at -6 dB and 500 Hz at -60 dB. Similar options exist for SSB operation by i-f filter replacement, but the bandwidth is rarely reduced below 1.8 kHz at -6 dB because of loss of voice quality. Instead, efforts are made to make the i-f passband steeper and improve out-of-band i-f signal suppression with more complex filters, possibly cascading several units.

image suppression

Because most Amateur communications receivers are superhets, two specifications relate directly to their conversion design. In the mixer, the undesired sum (or difference) of incoming-signal and local-oscillator frequencies, the image signal, is suppressed by the combined action of a high first i-f, the tuned circuits preceding the mixer, and good shielding. The sample specs state, "Image ratio better than 60 dB," which is entirely sufficient for Amateur use, in which most antennas are tuned to the operating frequency or a harmonic thereof.

i-f rejection

The receiver i-f is also susceptible to false signal pickup. The i-f circuit shielding and the tuned circuits before the mixer (tuned to the desired signal frequency) prevent outside signals at the intermediate frequency from entering the receiver. According to the sample specs, "i-f rejection better than 80 dB," a very satisfactory value, as the i-f is not a harmonic of, nor does it fall on, any Amateur band.

frequency stability

One essential quality is frequency stability. Modern solid-state oscillators have largely overcome stability

*Try reducing the rf gain. Most receivers have an rf gain control. Editor

problems in Amateur equipment. The example receiver specifies frequency stability as, "Within 100 Hz during any 30-minute period after 1 hour of warm-up." This magnitude of drift would, at most, appear as a very, very slow change of tone pitch, barely noticeable on CW, and would be entirely satisfactory.

summing up

Of all these performance characteristics, which are the most important? Well, I live near Los Angeles, where a lot of strong local signals seem to fill every DX band.

After I determined that the transceivers I was interested in comparing had the desired bands, digital frequency readout, and other general features, the first special consideration I looked for became the receiver's blocking characteristics and IMD dynamic range. Fortunately, this matter has recently been given a great deal of attention by two competing manufacturers of high-frequency transceivers, as well as the ARRL product review team. Consequently, the data were readily available in *QST* and from the manufacturers and their data sheets.

My second special consideration was receiver selectivity. A basic SSB passband curve with a shape factor of 1.5 or less and straight sides down to -90 dB or lower would be most desirable. Additionally, a front-panel, switchable, narrowband CW filter with narrow bandwidth is a must. Should the receiver also have variable i-f bandwidth control, so much the better. The third special consideration is mechanical rigidity and front-panel layout.

I gave items such as sensitivity, image and i-f rejection secondary consideration, mostly because, in today's competitive market, solid-state circuits have almost universally forced to the fore good designs. The better high-frequency transceivers all seem to have more than enough sensitivity and, instead, become limited by atmospheric and manmade noise when in actual use.

bibliography

James R. Fisk, W1DTY, "Receiver Sensitivity and Dynamic Range," *ham radio*, October, 1975, p. 8.
 Wes Hayward, "Defining and Measuring Receiver Dynamic Range," *QST*, July, 1975.
 Ulrich L. Rohde, DJ2LR, "Effects of Noise in Receiving Systems," *ham radio*, November, 1977.
 Ulrich L. Rohde, DJ2LR, "Optimum Design for High-Frequency Communications Receivers," *ham radio*, October, 1976, p. 10.
 R.F.A. Winn, "Synthesized Communications Receiver," *Wireless World* (England), October, 1974, p. 413.

ham radio



TALK TURKEY WITH KITTY

Barry Will Meet
All Legitimate
Prices

November Specials — CALL TODAY
GET YOUR NEW RECEIVER FROM BARRY
YAESU FRG-7700 • DRAKE R-7

- | | | | |
|-----------------|----------------|------------------|------------------|
| UHF | | HANDBELDS | VHF |
| • TEMPO S-4 | • ICOM IC-2AT | • SANTEC HT-1200 | • TEMPO S4T & S5 |
| • YAESU FT-708R | • YAESU FT-208 | | |
| • SANTEC ST-7T | | | |

- UHF & VHF BASE STATIONS**
- ICOM IC-451A, IC-251A, IC-25A, IC-290, & IC-224
 - YAESU FT-720RVH, FT-720RU, FT-480, & FT-780R

- HF TRANSCEIVERS**
- YAESU FT-707, FT-902DM, FT-107, & FT-10120 MKII
 - CUBIC Astro Diplomat 150 — STATION IN A SUITCASE
 - ICOM IC-720A & IC-730
 - DRAKE TR-7 with DR-7

- AMPLIFIERS**
- DRAKE L7 & L75
 - ALPHA 76CA — 3 ceramic tubes, high load transformers
 - VHF MIRAGE, VOCOM & KLM
 - DENTRON Clipperton HF & VHF models, GLA-1000B

CW OPS — We've got NYE KEY, Vibroplex bugs, Bencher Paddles, and AEA Electronic keys; MT-1, CK-1, MM1, MK1, & KT-1. Readers for CW & RTTY Kantronics Field Day & Mini Reader and the new AEA MBA Reader.

NEW DRAKE TELETYPE

ANTENNAS HF — VHF — UHF — BARRY'S HAS 'EM ALL. Slinky Dipoles, Hy-Gain, Cushcraft, AEA, Antenna Specialists, SWAN, VOCOM AND MORE. HAM IV and Alliance rotators. MURCH UT 2000B, DENTRON AT-2K.

RPT REPEATERS in stock for immediate delivery. Completely interchangeable with VHF Engineering Models. 144-174 MHz 25W, 210-240 MHz 15W, and 430-440 MHz. Full line of accessories.

OTHER HAM SPECIALS FROM BARRY
Good Deal on ROBOT 400 SSTV • STACO TRANSFORMERS

TVRO — SATELLITE TV
Full line Distributor of Satellite TV Receivers, LNA's Antennas, and other accessories.

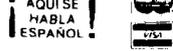
SET UP YOUR HOME STATION TODAY
Our lines include:

- | | | | |
|----------------------------|-------------|---------------------|-------------|
| AEA | CUSHCRAFT | KANTRONICS | TEMPO |
| ALLIANCE | DENTRON | MFJ | TRI-EX |
| ASTRON | DRAKE | MIRAGE | VIBROPLEX |
| AVANTI | ETO | MURCH | VOCOM |
| B & W | EIMAC | PALOMAR | WACOM |
| BIRD | ENCOMM | ROBOT | YAESU |
| COLLINS | HUSTLER | SHURE | AND MORE... |
| COMMUNICATIONS SPECIALISTS | HY-GAIN KLM | STANDARD SWAN/CUBIC | |

~~~~~  
**BOATERS:** Satellite Navigation Equipment.  
Call for info on "SATNAV."

**BUSINESSMEN:** Ask about BARRY'S line of business-band equipment. We've got it!

**Amateur Radio License Classes:**  
Wednesday & Thursday: 7-9 pm, Saturday 10 am-noon


 The Export Experts Invite Overseas orders  
— We ship Worldwide

**BARRY ELECTRONICS**  
512 BROADWAY  
NEW YORK, N.Y. 10012-4493  
TELEPHONE (212) 925-7000  
TELEX 12-7670

# ham radio TECHNIQUES

Bill W6SAI

One of the nicest aspects of writing for *ham radio* is the interesting mail I receive. There's always something new in antennas, and this column is partially devoted to unusual antenna designs sent to me by other Amateurs. Let's start with an interesting 2-meter antenna from "down under."

## the SLY beam

The SLY (Suspended Long Yagi) beam for 2 meters was developed by VK4ALE (now a Silent Key) and described in a recent issue of *Amateur Radio*, the excellent journal of the Wireless Institute of Australia. Briefly, the SLY beam is an inexpensive, portable Yagi antenna for Field Day operation. A plan view of the SLY antenna is shown in **fig. 1**. The supporting structure is made of two spreaders between which lengths of Dacron line are strung. (Nylon line

should not be used because it stretches and causes the antenna to sag. It is also expensive.)

The Yagi elements are spaced along the two lines as shown and are held in position by small elastic rings cut from neoprene tubing (or similar dielectric material). The elements can be slipped into position and adjusted, as the rings provide a positive grip to the line yet permit easy movement of the element if required.

The two lines are attached to wooden spreaders, which are suspended in position with rope halters. The beam is pulled up into position between two fixed points and the halter ropes tied off.

Number of elements and feed system? Well, VK4ALE used 20, 25, and 30 elements at various times and even tried 32 elements—the overall length of the Yagi being about 75 feet (23 meters). Measurements on the 32-

element job indicated a power gain of about 21 dB over a dipole, and the measured beam pattern at a distance of 200 miles was 35 miles wide (322 and 56 meters respectively). Not bad performance for an inexpensive, portable antenna.

One-eighth-inch (3-mm) aluminum tubing is suggested for the elements, or aluminum clothesline wire can be used. Element lengths and spacings used by VK4ALE are given in **fig. 1**, or Yagi dimensions provided in the various publications<sup>1,2</sup> can be used. Any of the common feed systems are applicable.

VK4ALE suggests that the completed beam be rolled up on a lightweight drum or cylinder for ease of transport, otherwise problems may be encountered in unravelling the assembly.

**help for the beginner?**

# INTRODUCING SONY'S NEW DIGITAL DIRECT ACCESS RECEIVER!



only **\$299<sup>95</sup>** plus \$5.00 shipping

In stock for immediate delivery

## Revolutionary Instant Access Digital Shortwave Scanner

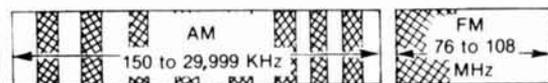
- Continuous Scanning of LW, MW, SW, & FM Bands
- Instant Fingertip Tuning—No More Knobs!
- 6 Memories for Any Mode (AM,SSB/CW, & FM)
- Dual PLL Frequency Synthesized—No Drift!

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

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

**DUAL PLL SYNTHESIZER CIRCUITRY** covers entire 150 KHz to 29,999 MHz band. PLL<sub>1</sub> circuit has 100 KHz step while PLL<sub>2</sub> handles 1 KHz step, both of which are controlled by separate quartz crystal oscillators for precise, no-drift tuning. **DUAL CONVERSION SUPERHETERODYNE** circuitry assures superior AM reception and high image rejection characteristics. The 10.7 MHz IF of the FM band is utilized as the 2nd IF of the AM band. A new type of crystal filter made especially for this purpose realizes clearer reception than commonly used ceramic filters. **ALL FET FRONT END** for high sensitivity and interference rejection. Intermodulation, cross modulation, and spurious interference are effectively rejected. **FET RF AMP** contributes to superior image rejection, high sensitivity, and good signal to noise ratio. Both strong and weak stations are received with minimal distortion.

### EXTENDED SPECTRUM CONTINUOUS TUNING



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

### OPERATIONAL FEATURES

**INSTANT FINGERTIP TUNING** with the calculator-type key board enables the operator to have instant access to any frequency in the LW, MW, SW, and FM bands. And the LCD digital frequency display confirms the exact, drift-free signal being received. **AUTOMATIC SCANNING** of the above bands. Continuous scanning of any desired portion of the band is achieved by setting the "L<sub>1</sub>" and "L<sub>2</sub>" keys to define the range to be scanned. The scanner can stop automatically on strong signals, or it can be done manually. **MANUAL SEARCH** is similar to the manual scan mode and is useful for quick signal searching. The "UP" and "DOWN" keys let the tuner search for you. The "FAST" key increases the search rate for faster signal detection. **MEMORY PRESETS.** Six memory keys hold desired stations for instant one-key tuning in any mode (AM, SSB/CW, and FM), and also, the "L<sub>1</sub>" and "L<sub>2</sub>" keys can give you two more memory slots when not used for scanning. **OTHER FEATURES:** Local, normal, DX sensitivity selector for AM; SSB/CW compensator; 90 min. sleep timer; AM Ant. Adjust.

### SPECIFICATIONS

**CIRCUIT SYSTEM:** Fm Superheterodyne; AM Dual conversion superheterodyne. **SIGNAL CIRCUITRY:** 4 IC's, 11 FET's, 23 Transistors, 16 Diodes. **AUXILIARY CIRCUITRY:** 5 IC's, 1 LSI, 5 LED's, 25 Transistors, 9 Diodes. **FREQUENCY RANGE:** FM 76-108 MHz; AM 150-29,999 KHz. **INTERMEDIATE FREQUENCY:** FM 10.7 MHz; AM 1st 66.35 MHz., 2nd 10.7 MHz. **ANTENNAS:** FM telescopic, ext. ant. terminal; AM telescopic, built-in ferrite bar, ext. ant. terminal. **POWER:** 4.5 VDC/120 VAC **DIMENSIONS:** 12 1/4 (W) X 2 1/4 (H) X 6 3/4 (D). **WEIGHT:** 3 lb. 15 oz. (1.8 kg)



**SPECTRONICS, INC.**  
1009 GARFIELD ST. OAK PARK, IL. 60304

PHONE  
**(312) 848-6777**



Alas, life grows more complex, even against our best intentions. VK5EK brings our attention to that particular folly in his letter to the editor published in a recent issue of *Amateur Radio*. Al speaks about a low-power, solid-state transmitter design, similar to the one shown in chapter 6 of ARRL *Handbook*.

Al says, "If we are trying to overcome the 'black box' syndrome by inducing people to build their own equipment, then we will maximize our chances of success by presenting simple, cheap projects.

"Good applied engineering is concerned primarily with securing a stipulated design objective in the simplest and cheapest manner.

"Your 5-watt CW transmitter fails dismally in this regard, and is a stunning example of solid-state technology gone berserk.

"I present an alternative circuit which will do the same job (fig. 2). Your circuit has about 100 components, mine has fewer than 25. Most of your components would be purchased new; most of mine can be salvaged from an old black and white TV set (save the crystal and plate-tuning capacitor). I could build mine from scratch and have it working in one hour if I set my mind to it, or I would take two or three hours if I wanted a pretty appearance. Yours could hardly be built in less than four

or five nights. You price yours at \$50 (including crystal). I price mine at nil cost (excluding crystal and assuming a modest junk box).

"Your rig has a VXO and the capability for battery operation, which mine does not; but mine will readily work into any standing-wave ratio.

"Solid-state technology affords commercial manufacturers cheap, large-scale production and it is ideally suited to logic and nonlinear applications. But for transmitters, transverters, receivers and converters of practical simplicity, valves (tubes) remain incomparably superior for one-of-a-kind, home-built projects."

### yesterday's technology

An interesting viewpoint indeed!

It is certainly true that tubes and old-time components, including defunct television receivers, are readily available at flea markets. In fact, *QST* magazine has run several articles in the past on using TV components salvaged from old, defunct receivers to build ham gear. And it is also true that some circuits can be built more inexpensively and quickly using tubes.

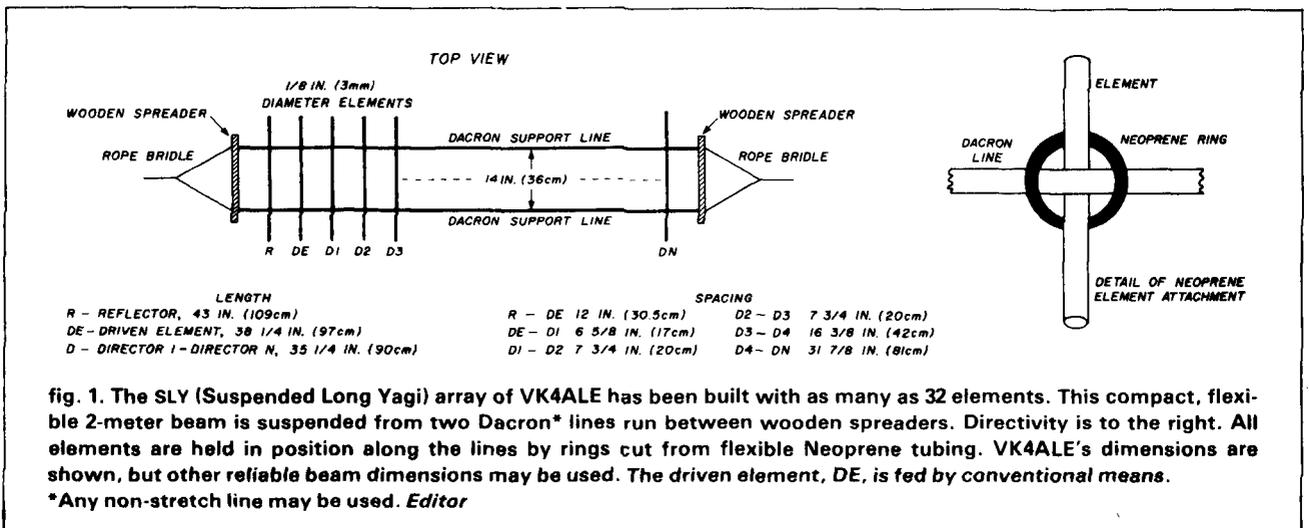
However, VK5EK misses one important fact of life that cannot be denied, and that is that the great majority of today's Amateurs have been brought up in a solid-state world and vacuum-tube technology is alien to them. It may seem simple to old

timers, but tube technology can be puzzling and obscure to many of today's younger Amateurs. Vacuum-tube technology is no longer taught in colleges, and information on tubes is rapidly disappearing from Amateur magazines and handbooks. So while VK5EK has a valid point in extolling vacuum-tube simplicity, he is talking to an audience that, sadly, is deaf to his plea.

While I am on the soap-box, I might as well discuss another *bête noire* of Amateur Radio: amplitude modulation. A-m, or "ancient modulation" as it is derisively called by some, has largely disappeared from the Amateur bands. That allows a great improvement in spectrum conservation, and the loss of heterodyne interference between phone carriers is a tremendous step forward in improved communications ability.

But an unwanted effect of side-band use is that amplitude-modulation techniques are largely unknown by today's Amateurs. How many recently licensed Amateurs have knowledge of a class-B plate modulation system? Or the more recently developed pulse-duration modulation technique? Or the various high-efficiency amplitude-modulation systems including grid modulation? Or the famous Doherty-modulated amplifier?

Like it or not, a large percentage of



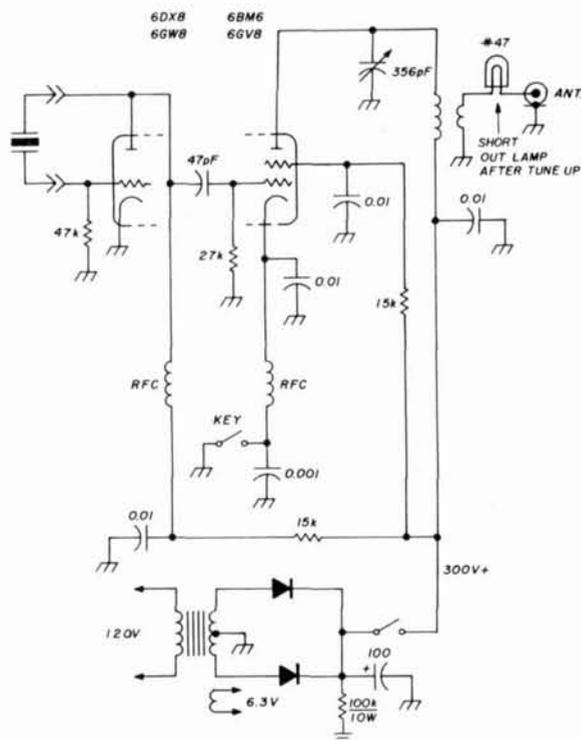


fig. 2. VK5EK's tongue-in-cheek reply to the modern QRP solid-state transmitter. Why use six expensive transistors and about 100 components when one tube and two diodes, plus a handful of flea-market components will do the job? Old-timers will certainly remember low-power transmitters of this general type. (Drawing adapted from *Amateur Radio* magazine, a publication of the Wireless Institute of Australia.)

communication in today's world is carried on by amplitude modulation. You don't believe me? Then just tune across the broadcast band or the many shortwave broadcast bands. All of these signals are amplitude modulated.

Banning amplitude-modulated signals from the Amateur bands might be a movement toward spectrum conservation, but it would further restrict the Amateur's knowledge in an important technology that forms a large portion of today's communication world. Plenty of space exists on 160, 10, and 6 meters for amplitude-modulation equipment, and it would be unwise to ban this basic form of intelligence transmission from the world of Amateur Radio.

### a 5-band sloper antenna

Here's an antenna that works well on all bands. It was shown in *The Canadian Amateur* magazine<sup>3</sup> and designed by VE3CPU (fig. 3). Basically, it is one-half of a regular trap dipole antenna. A metal tower is used as a ground counterpoise. Only one trap is required, so a trap kit can be split with a friend who also wants to build this simple antenna. The antenna is fed with a coaxial line, the shield of which is grounded to the tower and the inner conductor is attached to the sloper wire.

VE3CPU points out that the antenna is quite directive on the higher-frequency bands, and swinging the bottom of the antenna about 90 degrees makes a big difference in

signal strength at a distant location. He estimates the power gain over a dipole to be about 2.5 to 3.0 dB on 20, 15, or 10 meters.

As with all slopers and multi-band antennas, adjustment of the length of the tip section may be required to resonate the antenna at the design frequency on 80 meters.

### radio-frequency interference (RFI)

RFI! It's hell if you have it. It can ruin your enjoyment of Amateur Radio by interfering with television and radio reception, disrupting communication circuits, causing false beats in electronic heart pacers, and by causing all other manner of equipment malfunction. Radio Amateurs are at once the cause and victim of RFI, as are CBers and all other users of electronic equipment.

Look at these numbers. In the United States in 1980 there were more than:

- 8,200 broadcast and fm stations
- 970 television stations
- 15,000,000 CB transmitters
- 360,000 Amateur Radio stations
- 210,000 aviation transmitters
- 7,800 radar transmitters
- 300,000 industrial radio transmitters
- 115,000 police and fire department radio transmitters
- 36,000,000 two-way portable radio transceivers plus millions of microwave ovens, X-ray machines, electric motors, light flashers and dimmers, welding machines, neon signs, diathermy machines, plastic formers, industrial welders, and so on.

And that's not all. Radio and television receivers themselves can cause objectionable RFI! The problem is that all radio receivers, transmitters, and pieces of electronic equipment are potential sources and victims of RFI. Anything run by electricity can cause RFI.

No wonder that electronic bedlam surrounds us, and it is a wonder that anybody can hear anything on the radio or see anything on television

considering the vast number of interference-generating devices in our environment.

### the sources of RFI and the victim

Remember, all cases of RFI involve two things: the source of the interference and the victim of the interference. For a complete cure of RFI, the interference must be suppressed at the source and the victim (the receiver, stereo equipment, or whatever) must be protected, or otherwise modified in such a way as to reject the interference. This is a large order, and little is being done to solve the growing problem. Information about RFI and its cures is hard to come by, RFI sources are obscure, and a lot of misinformation compounds an otherwise complex problem.

### the RFI investigator

In recent years a whole new industry has grown up, largely unknown to most Radio Amateurs: the investigation and suppression of RFI. Electromagnetic compatibility studies

and control standards have been created, largely by the military, to safeguard their communications circuits. Courses are available on electromagnetic compatibility and a new career opportunity — that of RFI investigator — has opened up for select, knowledgeable individuals. The job of the investigator is to investigate RFI complaints, track the interference to its source and resolve the problem. Only a handful of RFI investigators are at work in the United States today.

One of the pioneers in this field is a Radio Amateur, Bill Nelson, WA6FQG, who is well known nationwide for his extensive work in RFI investigation, encompassing over two decades of experience. During his long career, WA6FQG has tracked down countless sources of RFI and has lectured to Amateur and CB clubs and conventions on the causes and cures of RFI. Bill is now a consultant to power utilities on RFI problems, including RFI suppression and training of RFI investigators.

Just recently Bill completed an all-inclusive handbook on RFI, which

covers the subject in detail.\* It is an indispensable reference for all Radio Amateurs, CBers, and the everyday citizen troubled by RFI.

I've personally known WA6FQG for many years and have been greatly interested in his career in this unique work. And I have helped him arrange his handbook and get it published. It's now ready — over 240 pages of valuable information dealing with all facts of RFI.

An advance copy of the *Interference Handbook* was sent to Barry Goldwater, K7UGA, (U.S. Senator from Arizona and Chairman, Senate Communications Subcommittee). After reading the book, Barry said, "This informative handbook covers the entire field of RFI from A to Z. It will be a tremendous help to me and my staff as we work on communications legislation in Congress. Thanks for your help in this matter."

Another accolade for the new *Interference Handbook* came from David Fogarty, Senior Vice President of Southern California Edison Company. He said, "Written by a power-company investigator with 33 years of experience, this book is a reliable guide to the causes and cures of power line interference . . . contains absorbing case histories."

So there you are. Perhaps this new handbook will help you with your RFI problems. As I said before, RFI is hell if you have it. And if you don't have it today, chances are you will have it tomorrow!

*\*Interference Handbook*, by William R. Nelson, WA6FQG; Editor William I. Orr, W6SAI; 247 pages; \$8.95 plus \$1.00 shipping — available from Ham Radio's Bookstore, Greenville, New Hampshire 03048.

### references

1. William I. Orr, W6SAI, *Radio Handbook*, 22nd edition, Editors & Engineers Division of Howard W. Sams Co., Indianapolis, Indiana.
2. *The Radio Amateur's Handbook*, 58th edition, American Radio Relay League, Newington, Connecticut.
3. *The Canadian Amateur*, Box 356, Kingston, Ontario K7L 4W2, Canada.

ham radio

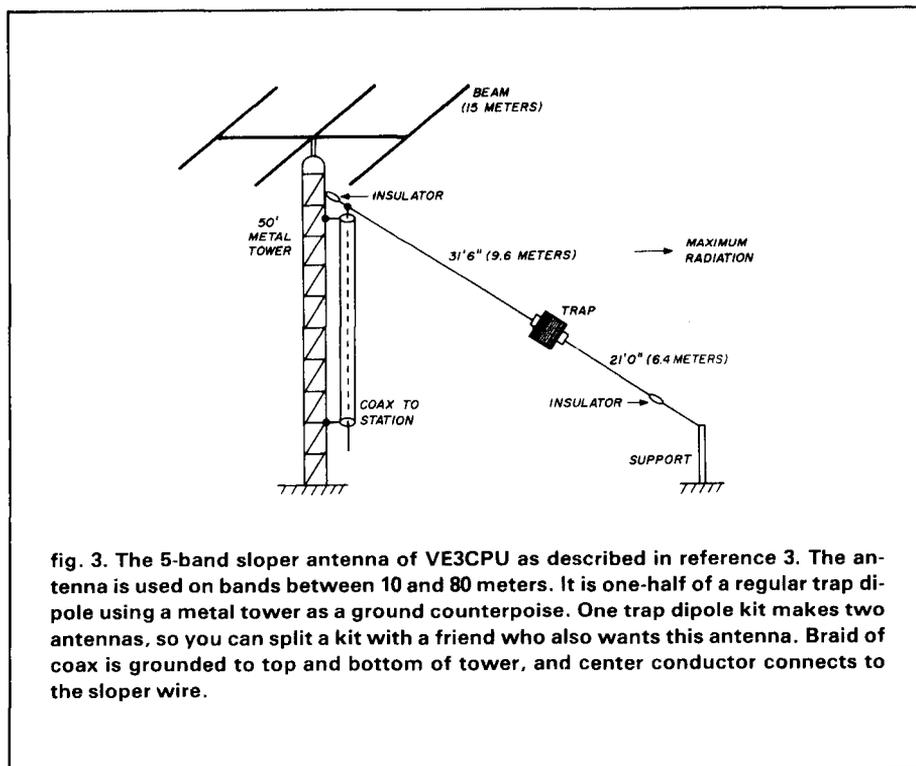


fig. 3. The 5-band sloper antenna of VE3CPU as described in reference 3. The antenna is used on bands between 10 and 80 meters. It is one-half of a regular trap dipole using a metal tower as a ground counterpoise. One trap dipole kit makes two antennas, so you can split a kit with a friend who also wants this antenna. Braid of coax is grounded to top and bottom of tower, and center conductor connects to the sloper wire.

# World-Wide Amateur Radio Center Inc.

Formerly Cohoon Amateur Supply

## New ownership and management

- Fact: Our prices are for you!
- Fact: We serve what we sell or others sell!
- Fact: Most major lines in stock in quantity!
- Fact: We ship **world-wide!**
- Fact: You will miss the best deal and service around if you don't buy from us!

CALL OR WRITE TODAY

**World-Wide Amateur Radio Center Inc.**

502-886-4534

307 McLean Avenue

Hopkinsville, Kentucky 42240

## ANOTHER AEA BREAKTHROUGH! PRICES 20% LOWER FOR ISOPOLE™ ANTENNAS

The IsoPole antenna has the reputation for high quality, unique design and superior performance. IsoPoles have become the "standard of performance" in VHF/UHF base station antennas.

The demand for IsoPole antennas has grown steadily since their introduction. To meet the demand, AEA has installed an automated production line. We've actually improved the quality of construction but most importantly we have lowered production costs. This lower cost is now passed on to you with the price of IsoPole antennas **20% lower**.

The IsoPole is designed for ease of installation. You can customize your mounting by using low cost TV masting up to 1 1/4" diameter. (*Mast not supplied.*) More than ever, the IsoPole is the logical choice for a VHF/UHF base station or repeater antenna.

The IsoPole antenna gives you exceptionally broad frequency coverage. You obtain maximum gain attributable to the antenna's length, plus a zero angle of radiated power. The unique cone design (*pat. pend.*) assures superior resistance to icing and wind. IsoPole antennas are weather proofed and made of top quality components. They use stainless steel hardware, Amphenol connectors, corrosion resistant aluminum alloys and a dielectric material with excellent mechanical and electrical properties.

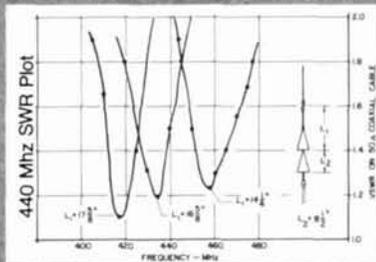
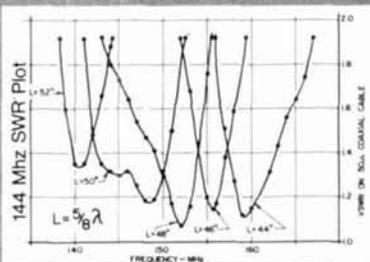
Note the typical SWR plots for the IsoPole-144 and the new IsoPole-440.

There is an IsoPole antenna for 220 MHz also. See these fine antennas at your favorite dealer, or contact

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

**AEA** Brings you the  
Breakthrough!

Prices and specifications subject to change without notice or obligation

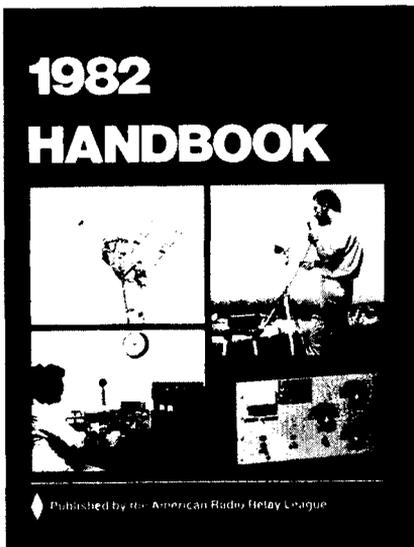


# THE 1982 HANDBOOK

## The Standard Manual of rf communication

The best gets even better! Each year the RADIO AMATEUR'S HANDBOOK is updated to reflect changes in the state-of-the-art. The 1982 edition is no exception. More emphasis is placed on digital communications techniques than ever before. Also making an appearance for the first time are tables and charts covering the new "WARC" Amateur Radio Bands.

- Amateur Radio
- Electrical Laws and Circuits
- Radio Design Technique and Language
- Solid State Fundamentals
- AC-Operated Power Supplies
- HF Transmitting
- VHF and UHF Transmitting
- Receiving Systems
- VHF and UHF Receiving Techniques
- Mobile, Portable and Emergency Equipment
- Code Transmission
- Single Sideband



- Frequency Modulation and Repeaters
- Specialized Communications Systems
- Interference with Other Services
- Test Equipment and Measurements
- Construction Practices and Data Tables
- Wave Propagation
- Transmission Lines
- Antennas for High Frequency

New projects added to the new Handbook include:

- Code Practice Oscillator
- QSK kw HF Linear Amplifier
- 250-Watt Linear Amplifier Covering 30-M Band
- Two-Tone Generator
- High-Performance SSB Speech Processor
- Simple Switching Regulator
- General-Purpose RTTY Demodulator
- 50-MHz Transmitting Converter
- 8-Band Communications Receiver

New topics included in the 59th edition include:

- 10-MHz Info Added to Several Construction Projects
- Introduction to Packet Radio and Spread Spectrum
- New RFI Chart Showing Frequency Relationships Between Amateur Bands (including WARC) and Other Services (including CATV)
- 10-GHz Gunnplexer, Communications
- New Antennas for VHF FM
- Updated Parts Supplier List

### ORDER TODAY!

NO INCREASE IN PRICE  
SINCE LAST YEAR'S EDITION

ARRL

225 Main Street  
Newington, CT 06111

Enclosed is my check (or charge my  VISA  Mastercard) in U.S. funds the amount of

- \$10 in the U.S. - paper edition
- \$11 in Canada - paper edition
- \$12.50 elsewhere - paper edition
- \$15.75 U.S. - cloth edition
- \$18 elsewhere - cloth edition

Signature \_\_\_\_\_

Printed name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State or Province \_\_\_\_\_

Zip or Postal Code \_\_\_\_\_

Charge account number \_\_\_\_\_

Expiration Date \_\_\_\_\_

My 1982 *Handbook* will be shipped to me once copies are off the press in November.

HR

# add-on selectivity for communications receivers

## A new audio filter design featuring sharper cutoff for SSB and better skirt selectivity for CW

**The message of this article** is that really effective audio filtering can work wonders to improve the performance of today's high-frequency receivers. First, however, we must consider just what the problems are that have to be solved.

A fact of life in high-frequency communications today, especially on the Amateur bands, is congestion. The problem is probably most acute for Amateur SSB transmissions. For a number of reasons, ranging from changing propagation conditions to sheer congestion, it's rare for an SSB station to have an undisturbed channel for long.

### **SSB interference**

*Normally, one SSB signal overlaps to a greater or lesser extent with others. The overlap can vary all the way from two stations being on identical frequencies to a medium overlap, where the off-tune interfering*

station causes characteristic high-pitched "monkey chatter." This can be either in the background or the foreground, depending on the relative strengths of the desired and undesired signals. Off-tune interference on the other side of the passband similarly causes a low-pitched version of monkey chatter. Other interference frequently encountered during SSB operation includes overlap with out-of-band intermodulation products (splatter) from over-driven and hence nonlinear SSB power amplifiers, single heterodyne whistles, CW and RTTY transmission, and broadcast stations operating in Amateur bands (particularly on the 40-meter band). Other kinds of strange noises come and go, ranging from the notorious Russian woodpecker to common interference from local electrical equipment.

### **CW interference**

The effect of congestion on CW Morse code transmissions is similar in the sense that all the same interference sources are common. A difference is that CW transmissions don't actually overlap each other to any noticeable extent (sending speeds are low enough that sideband spread is very slight). On the

**By Dr. D. A. Tong, G4GMQ, Datong Electronics Limited, Spence Mills, Mill Lane, Bramley, Leeds LS13 3HE, England**

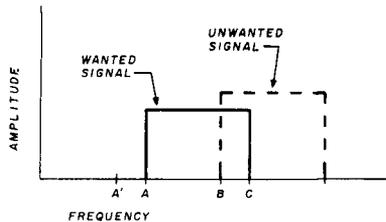


fig. 1. Solid curve shows frequency band (A to C) occupied by desired signal. The dashed curve represents the band occupied by a partially overlapping interfering signal. For optimum separation of the two signals, the receiver should accept only signals between A and B, and the cutoff at frequency B must be as sharp as possible. Point A' is the distance that the lower cutoff, A, would move in so-called passband tuning (see text).

other hand, congestion causes the separate CW transmissions to be very close together and spacings of 200 Hz and less are not uncommon.

Users of other less-common transmission modes, such as radioteletype (RTTY) and slow-scan television (SSTV), are also affected by the same interference sources and are possibly even more vulnerable since the raw data is not prefiltered by the human brain before its message content is processed.

Another important source of interference is pulse noise, typically from car ignition systems, but this will not be considered further here since noise-blanking systems handle this kind of interference very effectively.

From the discussion above we can distinguish the following separate interference situations:

1. Broadband interference affecting a broadband transmission.
2. Narrowband interference affecting a broadband transmission.
3. Broadband interference affecting a narrowband transmission.
4. Narrowband interference affecting a narrowband transmission.

Each of these four cases requires different countermeasures if the receiver is to give the best possible separation of desired from undesired signals. Let's now consider these requirements in turn.

### case 1 — broadband signals, broadband interference

This situation presents the most difficult problem and is typified by an SSB speech signal with other off-tune SSB signals superimposed. The situation

can be represented as in fig. 1, in which the solid curve shows the typical frequency band occupied by the wanted signal, while the dashed line shows that of an interfering signal. Clearly, the amount of interference experienced will depend on the receiver bandwidth. The distance from A to C represents the normal receiver bandwidth (typically 2.1 kHz). If the bandwidth were reduced to AB, then all the interference would be eliminated with only slight effect on the desired signal.

To obtain maximum benefit from a bandwidth reduction under these conditions, it's essential that the cutoff at the edge of the passband be very sharp. A slow cutoff would give a greater reduction in the wanted signal for a given reduction in the interfering signal. A cutoff at least as sharp as that of a multi-pole crystal filter is desirable.

An alternative to merely shifting the upper cutoff frequency of the filter passband (that is, C to B as above) is to shift the whole filter passband. This is the so-called i-f shift, or passband tuning technique. Then, if the upper cutoff point moves from C to B, the lower cutoff would move an identical distance (that is, A to A' in fig. 1). This will remove the interfering signal; but it will also allow signals on the other side of the desired signal to enter the passband. Since the desired signal will normally have interference on both sides, i-f shift is only a partial solution.

We conclude, therefore, that for receiving broadband signals in the presence of broadband noise we need:

1. Independently adjustable upper and lower cutoff frequencies.
2. Very steep sides to the overall response curve — at least as steep as those in SSB-type crystal filters and preferably steeper.

### case 2 — broadband signals, narrowband interference

Here the typical example is SSB reception in the presence of a loud whistle. If the frequency of the whistle is near the edge of the desired audio frequency response, a filter of the type discussed in the previous section can be used. However, if the whistle is near the middle of the audio band, decreasing the upper cutoff frequency (or increasing the lower one) will remove the whistle — but will also eliminate too much of the desired signal.

A better solution here is to use a notch filter. This is a filter that passes all frequencies except a narrow range centered on the notch frequency. By moving the notch until it coincides with the undesired whistle, the latter can be removed without significantly affecting the desired signal.

The conclusion is, therefore, that we need a narrow-bandwidth notch filter whose center frequency can be tuned over the full receiver bandwidth. A self-tuning notch filter designed especially for this purpose, the Datong Model FL1, has been described (reference 1).

### **case 3 — narrowband signal, broadband interference**

The narrower the desired signal, the easier it is to filter it from broadband interference. Consider, for example, two transmissions with equal peak power. One is a CW signal; the other a SSB speech signal. The energy in the latter is, on average, spread over a bandwidth of typically 2.4 kHz (the so-called speech bandwidth), while that in the former is concentrated on *one* frequency (assuming normal sending speeds). If the CW signal is passed through a filter of 200-Hz bandwidth, all of the CW signal will pass through, but only 200/2400, or one twelfth, of the SSB signal will emerge.

Now, if the bandwidth is then narrowed to only 50 Hz, the ratio becomes 1:48. The point is that, provided the bandwidth reduction does not encroach on the frequency components in the desired signal, a continuous improvement in signal-to-noise ratio will result as the bandwidth is reduced.

In the case of CW signals, the minimum usable bandwidth depends on the sending speed. Reducing the bandwidth increases the rise and fall times of the dots and dashes. When these rise and fall times become comparable to the duration of a dot, the dots merge into each other and the signal becomes a blur. At typical sending speeds this blurring effect does not cause problems until the bandwidth is below 50 Hz, so that, compared with a receiver using a SSB-width filter (say, 2.4 kHz), an improvement approaching 50 to 1 is practicable through bandwidth reduction. This is why a good CW filter can easily retrieve a CW signal that's almost buried in a SSB signal when listening using only the SSB filter.

### **case 4 — narrowband signal, narrowband interference**

The most common example of this condition is two closely spaced CW signals. Any of the filtering methods described so far are suitable in principle. For example, a wide passband could be used but positioned to just cut off the undesired signal; or a notch filter could be used to remove it. However, conditions seldom remain constant for more than a few seconds, and one interfering signal can soon be joined by many others. Because of this problem, it's convenient to use a narrowband filter centered on the signal of interest. Some operators prefer to use a

passband with a pointed top, while others may prefer a more rectangular shape. The latter can be useful in net operations where not every station is exactly on the correct frequency.

Also subject to personal preference is the question of skirt selectivity. Some operators prefer to hear only the signal of interest (that is, single-signal reception); others prefer to have some indication of what is present on adjacent frequencies.

Before summarizing the requirements for a CW filter, we must consider the question of how the filter is controlled. For SSB reception, separate adjustment of the upper and lower cutoff frequency is desirable. For CW reception, this is not ideal. It's much better if the center frequency of the passband and the passband width can be separately and smoothly varied and in such a way that the two controls *do not interact*. Thus one should be able to select a particular bandwidth and move this constant-width window to any point in the overall receiver passband. Because of the very wide range of conditions that are likely to be encountered, CW filters having continuous adjustment are far more effective and pleasant to use than those with a limited number of switched settings.

In summary, for CW reception the following features are desirable:

1. The receiver bandwidth should be continuously and independently adjustable in width and center frequency.
2. The filter pass-band shape should be selectable between flat and peaked.

### **selectivity at i-f or af?**

Conventionally, most of the selectivity in a receiver is concentrated at the intermediate frequency (i-f). This is a matter of practical convenience. It's easier to make an effective high-frequency filter if its frequency is fixed, and this is why the superheterodyne receiver rapidly superseded the tuned-radio-frequency (TRF) type.

Provided a receiver is linear throughout, the overall selectivity is the product of *all the separate sections in the system*. Thus, in a SSB/CW receiver all stages, including the final detector are, in theory at least, linear; and the selectivity could be located in the rf, i-f, or audio sections with equal effect. In practice, however, it's desirable to have *as much selectivity as possible as near to the input as possible*. This is because real circuits, especially mixers, are not perfectly linear, and strong unwanted signals can combine to form mixing products that can interfere or obscure the desired signals.

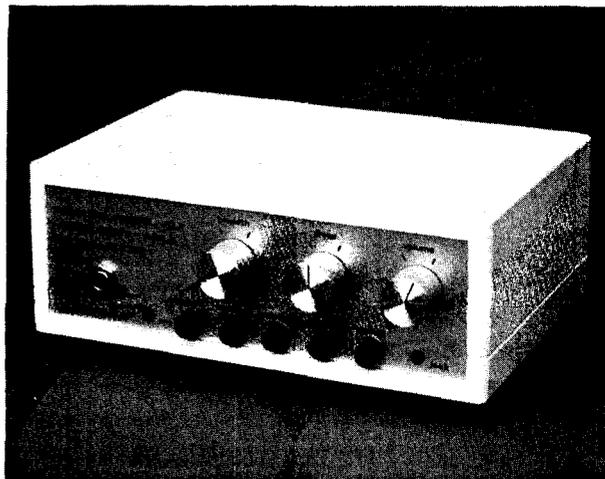
In most modern receivers, a good filter is used at the i-f, and an automatic gain control system is used to control the gain ahead of the main filter to avoid

overload effects. This means that extra selectivity can be placed at *any point* in the receiver system *after* the main filter without running into problems caused by overload. Thus, by taking advantage of the protection afforded by a good SSB crystal filter and good AGC, an audio filter can be used very successfully at the output of a receiver. If the audio filter's bandwidth is less than that of the main filter, the overall receiver bandwidth will then be controllable by the audio filter.

### is audio filtering really as effective as i-f filtering?

The short answer to this question is yes, whenever a product detector is in use (for example, for CW, SSB, RTTY, or a-m received as SSB). When a linear detector is used (that is, a product detector), selectivity after the detector is exactly equivalent to selectivity before the detector. So that, for example, if you wish to separate two signals of slightly different frequency you could do it equally well before or after such a detector. On the other hand, when the same signals are processed by an envelope detector (as for normal a-m), the two signals emerge mixed with sum and difference products. Thus, although very useful results are obtained, a complete separation is not possible using filtering after an envelope detector.

One other difference between pre- and post-detector filtering is that in the latter case the bandwidth of the receiver as presented to the AGC circuit is wider than the overall bandwidth. This means, for example, that if you are selecting one CW signal from the receiver's output using a narrow audio filter, another



The Datong Model FL1 audio filter, as well as being a variable CW filter with noninteracting center frequency and bandwidth controls, can also automatically locate, track and notch out single interfering heterodynes. It continually searches from 300 to 3000 Hz and needs only about two seconds to achieve lock. Notch bandwidth in the AUTO mode can be only 20 Hz. The notch is therefore inaudible while searching.

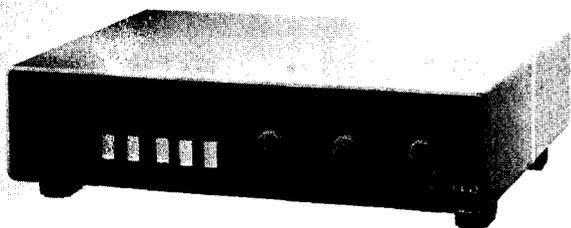
stronger signal inside the receiver's i-f passband could cause the apparent strength of the desired signal to vary due to AGC action. The effect causes no particular problem, however, since even when it does occur it sounds very similar to fading caused by normal propagation effects.

### a new audio filter design for communications receivers

We have discussed the basic filtering requirements for communications receivers and have established that conventional SSB crystal filters by no means represent the last word in performance capability. We have also established that extra selectivity can be conveniently and effectively added to a receiver in its audio output circuit.

We now discuss a new audio filter design, Model FL2, which has recently been introduced by Datong Electronics Limited specifically to improve existing communications receivers in the ways already outlined. Model FL2 contains three quite complex and independent active audio filters. Each is tuned by a control voltage, and the linear frequency versus voltage curves are accurately matched to allow ganged operation. The filters comprise:

1. A five-pole elliptic-function lowpass filter.
2. A five-pole elliptic-function highpass filter.
3. A two-pole filter with independent peak and notch (that is, band-pass and band reject) outputs.



Datong's Model FL2 contains three linearly voltage-tuned filters: a five-pole elliptic function lowpass, a similar highpass, and a two-pole peak or notch. The three filters can be tuned independently with separate knobs, or ganged to simulate a bandpass filter with independent center frequency and bandwidth controls. Precise tracking by all twelve poles of filtering is achieved by using pulse-width modulation techniques to simulate twelve identical voltage-controlled resistors.

Five pushbutton switches select any of the various operating modes previously discussed. The switches connect the three filters in the correct combinations and also determine how the three filter control voltages are to be derived from the three panel controls.

Each filter is built from state-variable multiple op amp subsections using 1 percent metal-film resistors and polystyrene capacitors. Such filters have excellent immunity to variations in the active elements. This, and the precision passive components, give good tracking capability and long-term stability. A total of twenty-two op amps are involved in the filter sections, and an additional six op amps are involved in the control functions.

The nominal over-all gain of the filter is unity, and a 2-watt audio power stage is included. This means that the complete filter can be easily installed between the loudspeaker and audio output stage of existing receivers. Altogether, the system uses twenty-one integrated circuits, most of which contain multiple functions.

### performance details

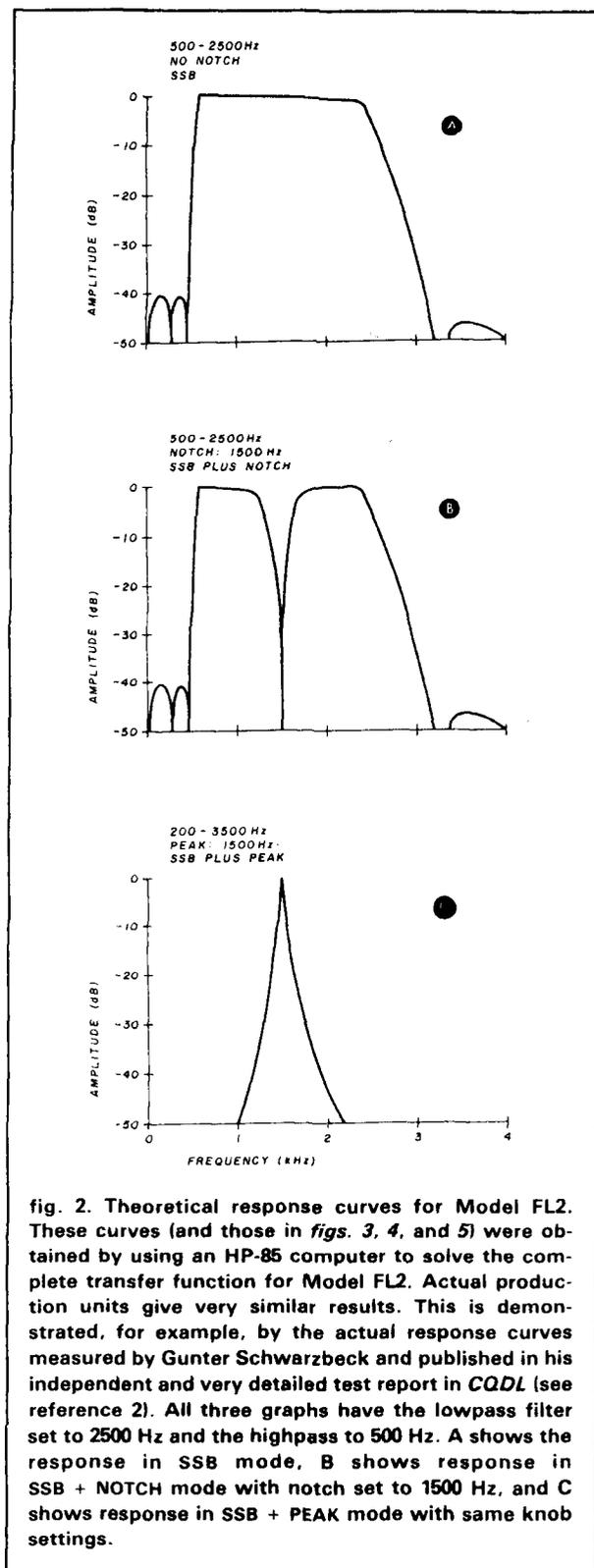
The five-pole elliptic-function low and highpass filters were designed to have a minimum stop-band rejection of 40 dB. Each filter has two frequencies of infinite attenuation in the stop-band. If the filter cut-off frequency (that is, the  $-1$  dB point) is given by  $f_c$ , then for the lowpass filter the infinite attenuation frequencies are at  $1.29 f_c$  and  $1.85 f_c$ ; and for the highpass filter they are at  $0.55 f_c$  and  $0.78 f_c$ . Similarly the  $-40$  dB points on the filter responses are reached at  $1.25 f_c$  for the lowpass and  $0.8 f_c$  for the highpass.

These filter responses are illustrated in **fig. 2A**, which shows the calculated response for high and lowpass filters in cascade, with cutoff frequencies at 500 Hz and 2500 Hz respectively. In both cases it is clear how the closeness of the first null response to the cutoff frequency gives a high rate of cutoff.

At a cutoff frequency of 2 kHz, for example, the rate of cutoff is 40 dB in 500 Hz for the lowpass filter. Similarly, if the highpass filter is set to a cutoff frequency of 500 Hz, the rate of cutoff below 500 Hz is 40 dB in only 100 Hz. For comparison, commercial SSB crystal filters tailored to good-quality Amateur-band communications receivers have typical rates of cutoff of 40 dB in 600 Hz. Model FL2 therefore has an appreciably sharper cutoff than typical SSB crystal filters.

### application to SSB reception

When the **SSB** button is pressed, the high and low-pass filters are connected into the circuit and their cutoff frequencies are independently controlled by the center and right-hand knobs respectively



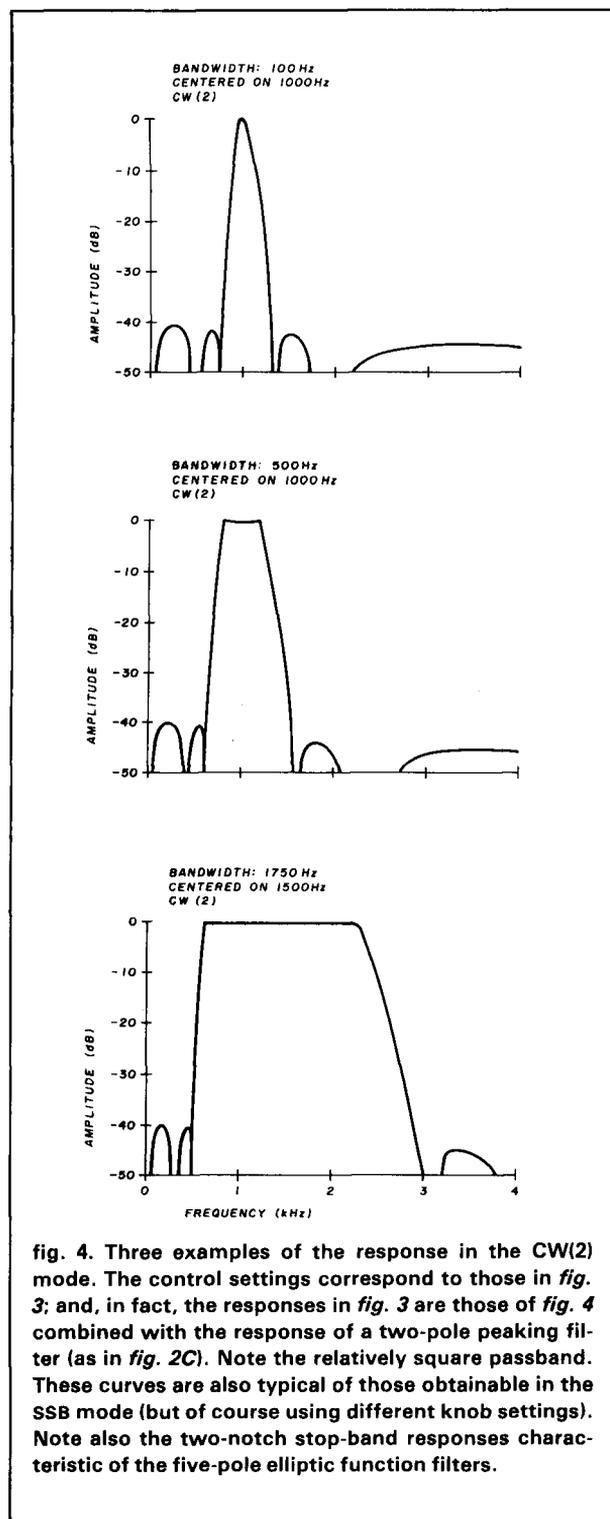
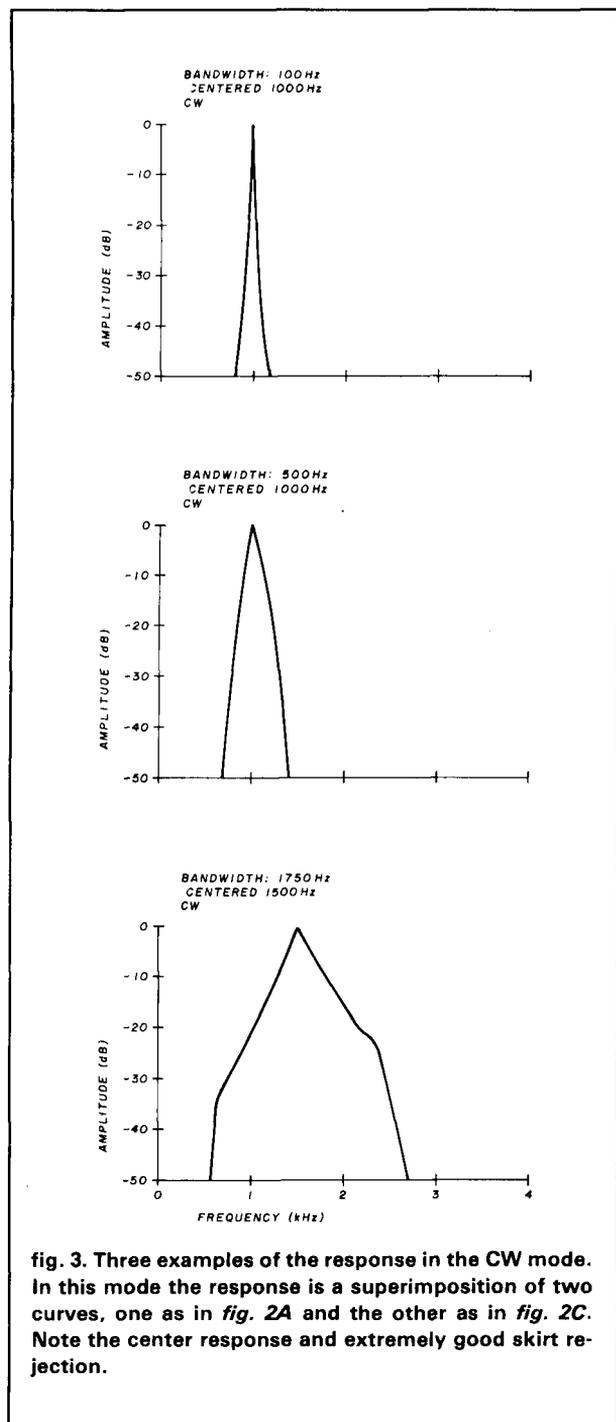
**fig. 2. Theoretical response curves for Model FL2.** These curves (and those in *figs. 3, 4, and 5*) were obtained by using an HP-85 computer to solve the complete transfer function for Model FL2. Actual production units give very similar results. This is demonstrated, for example, by the actual response curves measured by Gunter Schwarzbeck and published in his independent and very detailed test report in *CQDL* (see reference 2). All three graphs have the lowpass filter set to 2500 Hz and the highpass to 500 Hz. **A** shows the response in SSB mode, **B** shows response in SSB + NOTCH mode with notch set to 1500 Hz, and **C** shows response in SSB + PEAK mode with same knob settings.

(photo). The tuning range for each filter is 200 to 3500 Hz, so that any desired bandpass characteristic can be obtained with the same general shape as that of **fig. 2A**.

When the **SSB + NOTCH** button is pressed, the high and lowpass filters behave in the same way; but in addition, the notch filter is connected in series and can itself be independently tuned by the left-hand knob over the same range of 200 to 3500 Hz. The notch width is fixed at 200 Hz at the -6 dB point and remains constant as the notch frequency is varied. An example of this mode is shown in **fig. 2B**.

Tuning a notch to a weak heterodyne can be difficult, and in such cases **SSB + PEAK** can be select-

ed. In this mode, the peak output from the notch/peak filter is selected, and the filter can then easily be tuned onto the unwanted whistle. The 6-dB bandwidth in this mode is 200 Hz. After tuning onto the whistle, **SSB + NOTCH** would be reselected. The **SSB + PEAK** response corresponding to **fig. 3B** is shown in **fig. 2C**.



The SSB mode would also normally be the correct choice for a-m and fm reception and possibly also for SSTV. It could, of course, also be used for any other mode such as CW and RTTY, but a more convenient tuning method is provided for these modes as described in the next section.

### application to CW and RTTY reception

Two CW modes are provided. They differ primarily in the shape of the response curves. Common to the

two CW modes is that the high and lowpass cutoff frequencies are controlled by analog circuitry to simulate a composite bandpass filter whose center frequency and bandwidth are independently controllable. In these modes the center knob controls the center frequency from 200 to 3500 Hz, and the right-hand knob controls the bandwidth from 100 to 1750 Hz. As the center frequency is varied, the bandwidth remains constant; and similarly, the center frequency is independent of the bandwidth (subject always to the condition that the lower cutoff frequency can never go lower than 200 Hz and the upper cutoff frequency cannot exceed 3500 Hz).

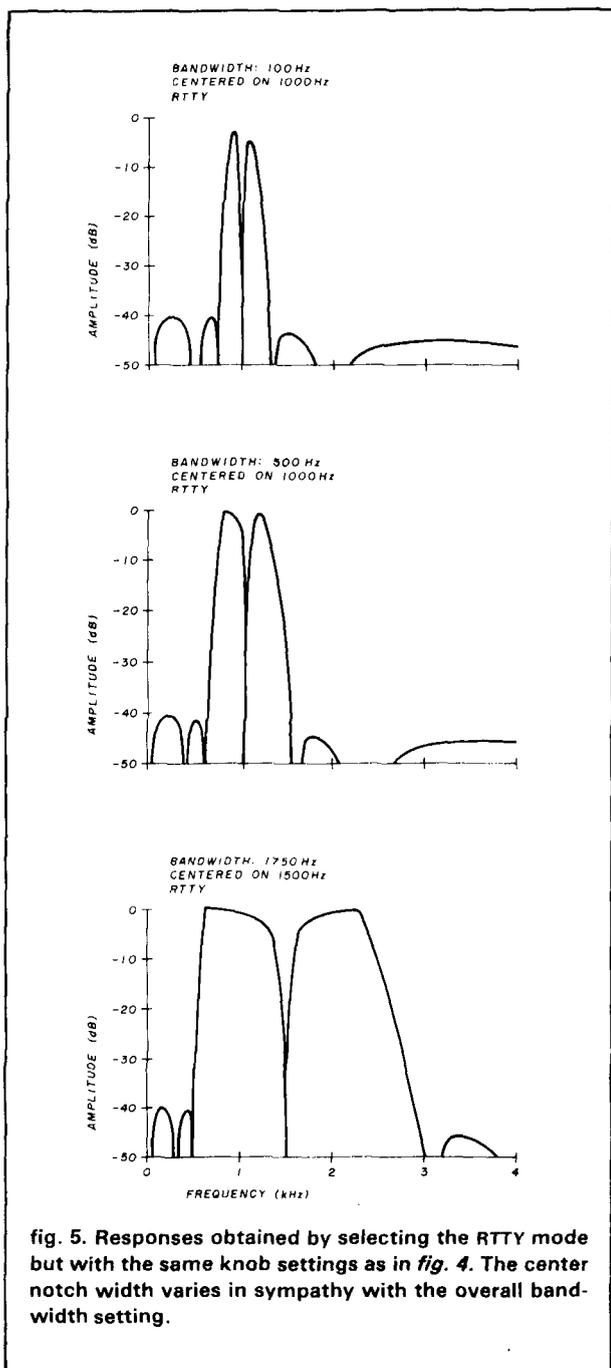
To prevent confusion in panel markings, those which apply only to tuning of the type just described are printed in yellow, while those referring to SSB-type tuning or to both are in white.

The main CW mode is selected by pressing the **CW** button. This connects the two-pole peaking filter in series with the high and lowpass filters. The bandwidth of the peaking filter is ganged with the separation between the high and lowpass cutoff frequencies, and both are controlled by the bandwidth control (right-hand knob).

Composite response curves are illustrated in **fig. 3**, which shows the overall responses at skirt bandwidths of 100, 500, and 1750 Hz. In all cases a domed center response is combined with extremely good far-out stop-band rejection. The domed center response makes it easy to tune a CW signal to the center of the filter passband, since one merely tunes for maximum signal. The bandwidth can then be widened or narrowed symmetrically about the signal as desired without the need to retune. The 6-dB bandwidth varies from 70-700 Hz as the skirt bandwidth moves between its extreme values of 100 and 1750 Hz.

This passband shape is considered optimum for most CW reception, but an alternative, CW(2), is provided by simultaneously pressing the two buttons **CW** and **SSB**. The high and low filters are then controlled as in CW, but the peaking filter is disconnected. The result is a rectangular response shape exactly as obtained in the SSB mode; but since it is a "yellow" mode, the filters are still controlled by the center frequency and bandwidth controls. This effect is shown in **fig. 4** for the same control settings as for the CW curves. The CW(2) mode is especially suitable for use with CW nets or for RTTY reception.

A third "yellow"-mode RTTY is obtained by pressing both **CW** and **SSB + NOTCH** buttons. Here the filters are controlled in the same way as for the CW mode, but the two-pole filter is now used as a notch filter, and the notch width is ganged with the bandwidth function. The result is the passband shape shown in **fig. 5**. This is suitable for wide-deviation



RTTY signals — the central notch giving increased immunity to interference.

### other features

When using Model FL2 it is interesting to be able to determine the improvement due to the filter by comparing the signal before and after filtering. Once a desired filter mode is selected, by simultaneously pressing the two buttons **SSB + PEAK** and **SSB**, only the high and lowpass filters are left in circuit, and their cutoff frequencies are held at their lower and upper limits respectively. In other words, the bandwidth is expanded to maximum, and the effect is virtually equivalent to no filtering when used with normal communications receivers. Alternatively, when the **OFF** button is pressed the input signal is connected straight through to the output terminal, and power is removed from the filter. Since the overall gain is unity, no changes to volume level will be required.

A front panel headphone jack is included on the FL2; the loudspeaker output terminal is disconnected when phones are used. A second output connector is also included to allow a tape-recorder connection.

### closing remarks

It is traditional that most passband shaping in communications receivers be carried out by the i-f filter. However, now that virtually all communications receivers feature good basic selectivity, effective AGC, and linear product detectors, it makes good sense to perform final bandwidth shaping in the receiver's audio section. Model FL2 was designed to take full advantage of this situation and offers a versatility of performance that would be very difficult to achieve at i-f. Yet, since it is an audio filter, it can be retrofitted to any existing receiver without any internal connections required.

Compared with previous audio filters, Model FL2 gives far sharper cutoff for SSB and better skirt selectivity for CW. This results from the comparatively large number of filter sections — twelve — all of which track precisely together to maintain the desired elliptic function response. Previous filters approaching this level of complexity have not been freely tunable, while previous tunable filters have been restricted to only relatively few sections.

### references

1. D.A. Tong, G4GMQ, "Audio Filters as an Aid to Reception — With Special Reference to the Datong Frequency-Agile Audio Filter Model FL1," *Radio Communication*, February, 1978, pages 114-118.
2. Gunter Schwarzbeck, DL1BU, "Testbericht: NF — Filter Datong FL2," *CQDL*, February, 1981, pages 56-59.

ham radio

# NOW!

## HAL Communications Is Proud To Announce That Our Amateur Radio Products Are Being Stocked At The Following Leading Amateur Dealer Stores:

### EASTERN UNITED STATES:

**AMATEUR ELECTRONICS SUPPLY**  
28940 Euclid Ave.  
Wickliffe, OH 44092  
(216) 585-7388

**ELECTRONICS INTERNATIONAL SERVICE CORP.**  
11305 Elkin Street  
Wheaton, MD 20902  
(301) 946-1088

• • • •

### MIDWEST UNITED STATES:

**AMATEUR ELECTRONICS SUPPLY**  
4828 W. Fond du Lac Ave.  
Milwaukee, WI 53216  
(414) 442-4200

**DIALTA AMATEUR RADIO SUPPLY**  
212 - 48th Street  
Rapid City, SD 57701  
(605) 343-6127

**UNIVERSAL AMATEUR RADIO**  
1280 Aida Drive  
Reynoldsburg, OH 43068  
(614) 866-4267

• • • •

### WESTERN UNITED STATES:

**AMATEUR ELECTRONICS SUPPLY**  
1072 N. Rancho Drive  
Las Vegas, NV 89106  
(702) 647-3114

**CW ELECTRONICS**  
800 Lincoln Street  
Denver, CO 80203  
(303) 832-1111

**HENRY RADIO, INC.**  
2050 S. Bundy Dr.  
Los Angeles, CA 90025  
(213) 820-1234

### SOUTHERN UNITED STATES:

**ACK RADIO SUPPLY COMPANY**  
3101 4th Ave. South  
Birmingham, AL 35233  
(205) 322-0588

**AGL ELECTRONICS**  
13929 N. Central Expwy  
Suite 419  
Dallas, TX 75243  
(214) 699-1081

**AMATEUR ELECTRONIC SUPPLY**  
621 Commonwealth Ave.  
Orlando, FL 32803  
(305) 894-3238

**AMATEUR ELECTRONIC SUPPLY**  
1898 Drew Street  
Clearwater, FL 33515  
(813) 461-4267

**AMATEUR RADIO CENTER**  
2805 N.E. 2nd Ave.  
Miami, FL 33137  
(305) 573-8383

**BRITT'S TWO-WAY RADIO**  
2508 N. Atlanta Rd.  
Bellmount Hills  
Shopping Center  
Smyrna, GA 30080  
(404) 432-8006

**GISMO COMMUNICATIONS**  
2305 Cherry Road  
Rock Hill, SC 29730  
(803) 366-7157

**MADISON ELECTRONICS**  
1508 McKinney Ave.  
Houston, TX 77010  
(713) 658-0268

**N & G DISTRIBUTING CORP.**  
7201 N.W. 12th Street  
Miami, FL 33126  
(305) 592-9685

**RAY'S AMATEUR RADIO**  
1590 US Highway 19 South  
Clearwater, FL 33156  
(813) 535-1416

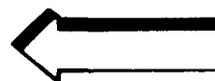
## Call Or Stop-In And See HAL Equipment At Your Favorite Amateur Dealer.

Write today for HAL's latest RTTY catalog.



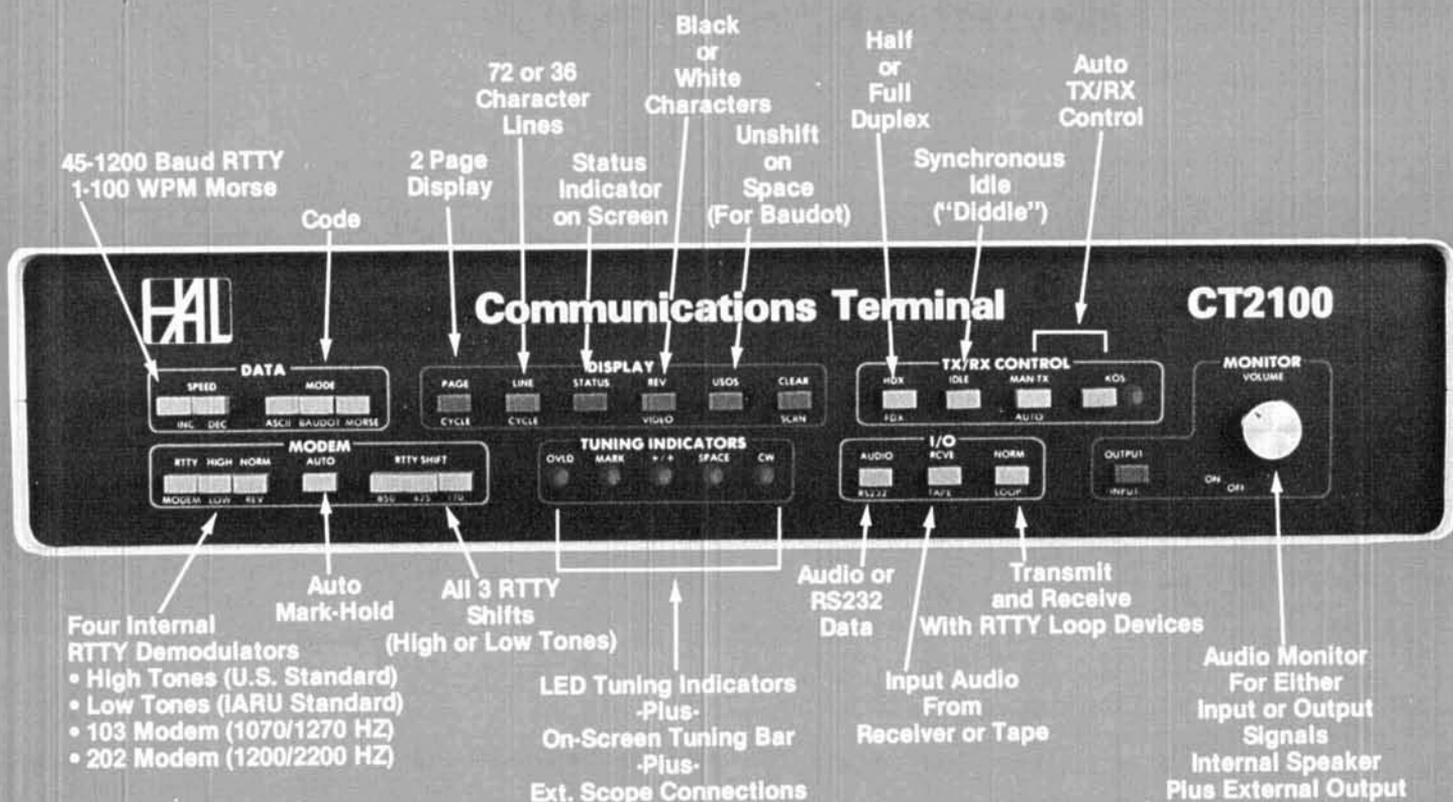
**HAL COMMUNICATIONS CORP.**

Box 665  
Urbana, Illinois 61801  
217-367-7373



# CT2100

## HAL Puts MORE Behind The Buttons



### CT2100 System:

- CT2100 Communications Terminal
- KB2100 Keyboard
- Video Monitor
- Printer (300Bd Serial ASCII-MPI-88G)
- RM2100 Rack Adapter
- MSG2100 2000 Character "Brag Tape" ROM

- 24 Line Display
- 2 Pages of 72 Character Lines
- or-
- 4 Pages of 36 Character Lines
- Split Screen (with KB2100)



9" TV Monitor  
KB2100



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

**NOW! HAL Equipment is in stock at leading Amateur Dealers.**

## interesting preamplifier for 144 MHz

What's so interesting about this 2-meter preamp? It doesn't have the lowest noise figure of any of the 2-meter preamps I've tested. It doesn't have the highest gain, although it has more than enough gain for any practical application. And it doesn't have the sharpest bandpass characteristic, although it's better than many other low-noise preamplifiers.

The interesting feature of this preamp is that it combines low noise figure, reasonable gain, and good bandpass characteristics with *low cost*. The NE73437 bipolar transistor (Q1, fig. 1) sells for only \$1.75 (in 1-9 quantities), and the entire preamp can be built for under \$10.

### performance

The schematic is shown in fig. 1; the layout in fig. 2. Specifications, when tuned for *minimum noise figure*, are:

1. Noise figure, 1.0 dB.
2. Forward gain, 22 dB.
3. Reverse gain, 40 dB, with a gain margin (reverse gain minus forward gain, a measure of stability) of 18 dB.

The gain response (bandwidth) is shown in fig. 3. Note the expanded plot showing the region between 140 and 150 MHz. Overload and intermodulation characteristics are shown in fig. 4.

My experience has been that the first stage of a receiver is almost never overloaded (except in very special and rare situations, which most

Q1 NE73437  
 C1,2,4 5-25 ceramic variable  
 C3 1-10 air variable  
 L1,2 5 turns No. 20 (0.8 mm) AWG  
 1/4" x 3/8" (6.5 x 9.5 mm)  
 CA, B, C, D 500 pF disc  
 CE 0.01  $\mu$ F disc  
 NF 1.03 dB  
 G<sub>fs</sub> 22 dB  
 G<sub>r</sub> -40 dB

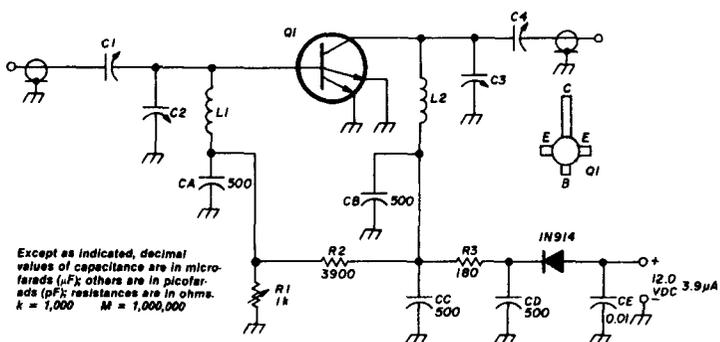


fig. 1. Schematic diagram of preamplifier.

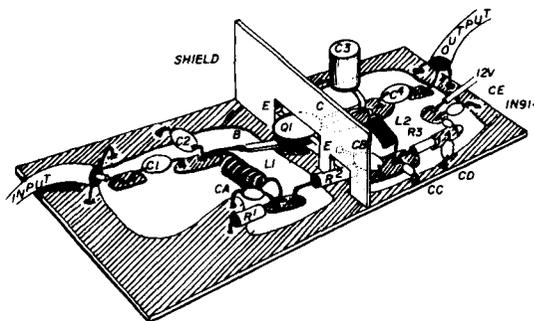
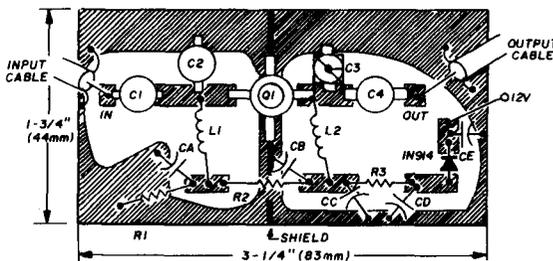


fig. 2. PC board and component layout. Note that the NE73437 device package has three equal-length leads and a longer (collector) lead. The base lead is opposite the collector lead.

of us never have to worry about), and that a  $-1$  dB point,  $P_{-1}$ , of  $-20$  dBm of input power, with a third-order intercept point at  $I_3$  of 18 dBm is, at least, adequate for most stations. The gain and noise figure of

this preamplifier are good enough for all but moonbounce work, in which situation this unit makes an excellent second stage. You can use several feet of coaxial cable between first and second stages, and at least 100 feet

of RG-8/U between this preamp as a second stage and a receiving converter without concern over insufficient gain or second-stage degradation of system noise.

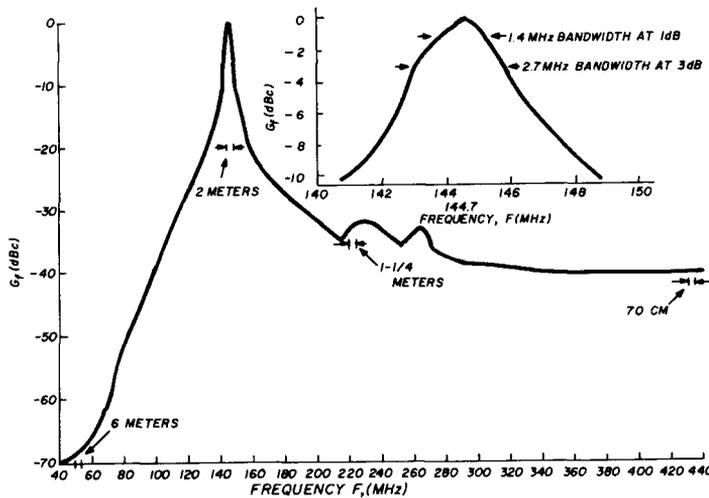


fig. 3. Preamplifier frequency response.

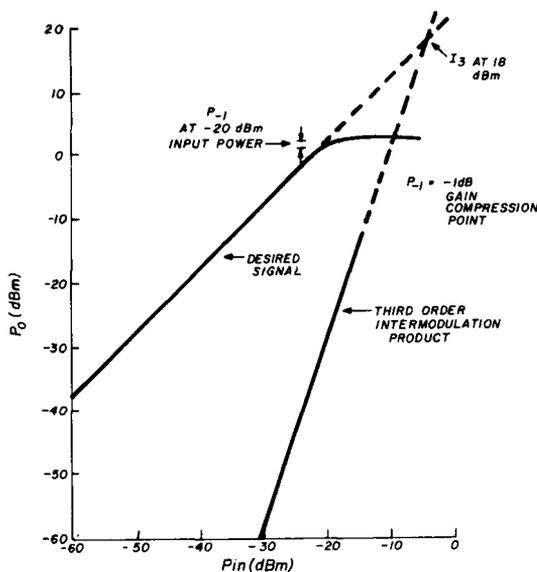


fig. 4. NE73437 preamplifier input/output and intermodulation response.

## construction

A single-sided PC board layout is shown in **fig. 2**. Use good vhf wiring practices (short leads) and make sure a shield is used as shown; a shield box should also be used around the unit.

The NE73437 is built in a plastic package, having a collector lead longer than the pair of emitter leads to either side of it, or the base lead opposite it. Make sure to solder both of the emitter leads to ground and to place the shield over the emitter leads, but only after soldering the rest of the components in place. No other special precautions were found to be necessary.

## tune up

Connect a 12 Vdc source to the preamp and set the bias pot (R1) for a total preamp current of about 4 mA. Adjust C1, C2, C3 and C4, in any order, for maximum gain. If you have access to a noise generator setup, tweak C1 and C2 for lowest noise figure. The weak-signal reception method can also be used to tweak for best noise figure. The preamp can be modified for use at 220 and 432 MHz.

The device is available from California Eastern Labs, 3005 Democracy Way, Santa Clara, California 95050 (CEL supplied much appreciated data and samples for the prototype of this preamplifier). I will answer all questions upon receipt of a self-addressed, stamped envelope.

Geoffrey H. Krauss, WA2GFP



## TR-7730

**Miniaturized,  
5 memories, memory/  
band scan**

The TR-7730 is a very compact 25 watt, 2-meter FM mobile transceiver, reasonably priced.

### TR-7730 FEATURES:

- Dimensions: 5-3/4 W x 2 H x 7-3/4 D, inches. Weighs 3.3 lbs.

- Extended frequency coverage, 143.900-148.995 MHz, in 5 or 10 KHz steps.
- 25 watts RF output power, with HI/LOW power switch.
- 5 memories for operation in simplex or repeater modes.
- Memory scan, plus automatic band scan.
- UP/DOWN manual scan on microphone (supplied).
- Four digit LED frequency display.
- S/R/F bar meter. LED indicators for BUSY, ON-AIR,

### REPEATER offset.

- Tone switch for internal tone encoder (not Kenwood supplied).
  - Offset switch,  $\pm 600$  kHz. Non-standard offset uses fifth memory.
- OPTIONAL ACCESSORIES:**
- MC-46 16 button autopatch (DTMF) UP/DOWN microphone.
  - SP-40 compact mobile speaker.
  - KPS-7 fixed station power supply.



## TR-8400

### Synthesized 70-cm FM mobile rig

- Covers 440-450 MHz, in 25 KHz steps, with two VFOs.
- Transmit offset switch for  $\pm 5$  MHz. Non-standard offset uses fifth memory.
- HI/LOW power switch selects 10 or 1 watt RF output.
- Similar to TR-7730 in other features, including five memories, memory scan, automatic band scan, UP/DOWN manual scan, four digit display, S/R/F bar meter, LED indicators, tone switch, and same optional accessories.



- MC-46 16 button autopatch (DTMF) UP/DOWN microphone.

## TR-9000

### "New 2-meter direction"... compact rig with FM/SSB/CW, scan, five memories

The TR-9000 combines the convenience of FM with long distance SSB and CW. It is extremely compact... perfect for mobile operation. Matching accessories are available for optimum fixed-station operation.

### TR-9000 FEATURES:

- FM, USB, LSB, and CW.
- Only 6-11/16 inches wide, 2-21/32 inches high, 9-7/32 inches deep.

- Two digital VFOs, with selectable tuning steps of 100 Hz, 5 kHz, and 10 kHz.
- Digital frequency display. Five, four, or three digits, depending on selected tuning step.
- Covers 143.9000-148.9999 MHz.
- Band scan... automatic busy stop and free scan.
- SSB/CW search of selectable 9.9-kHz bandwidth segments.

- Five memories... four for simplex or  $\pm 600$  kHz repeater offsets and the fifth for a non-standard offset (memorizes transmit and receive frequency independently).
- UP/DOWN microphone (standard) for manual band scan.
- Noise blanker for SSB and CW.
- RIT (receiver incremental tuning) for SSB and CW.
- RF gain control.
- CW sidetone.
- Selectable RF power outputs... 10 W (HI)/1 W (LO).
- Mobile mounting bracket with quick-release levers.
- LED indicators... ON AIR, BUSY, and VFO.

### OPTIONAL ACCESSORIES:

- PS-20 fixed-station power supply.
- SP-120 fixed-station external speaker.
- BO-9 System Base... with power switch, SEND/RECEIVE switch (for CW), memory-backup power supply, and headphone jack.
- MC-46 16 button autopatch (DTMF) UP/DOWN microphone.



PS-20

TR-9000

BO-9

SP-120



# KENWOOD

TRIO-KENWOOD COMMUNICATIONS

1111 West Walnut, Compton, California 90220

# "Comm-packed."

# NEW

**BIG performance...  
small size...  
smaller price!!!**

## TR-2500

The TR-2500 is a compact 2 meter FM handheld transceiver featuring an LCD readout, 10 channel memory, lithium battery memory back-up, memory scan, programmable automatic band-scan, Hi/Lo power switch and built-in sub-tone encoder.

### TR-2500 FEATURES:

- **Extremely compact size and light weight**  
Measures 66 (2-5/8) W x 168 (6-5/8) H x 40 (1-5/8) D, mm (inches). Weighs 540 grams (1.2 lbs) with Ni-Cd pack. (Photo shown, actual size).
- **LCD digital frequency readout**  
Easy to read in direct sunlight or dark (with lamp switch). Low current drain. Shows frequencies and memory channels, plus four "Arrow" mode indicators.
- **Ten channel memory**  
Nine memories for simplex or  $\pm 600$  KHz offset. "M0" memory for non-standard split frequency repeaters.
- **Lithium battery memory back-up**  
Built-in Lithium battery (estimated 5 year life) maintains memory when Ni-Cd pack is fully discharged or removed.

### CONVENIENT TOP CONTROLS



- **HI/LO power output selection**  
Allows operation at 2.5 watts or 300 mw RF output.



Actual size

- **Memory scan**  
Scans only channels in which frequency data is stored. Stops on busy channel, resumes scan approximately 2 seconds after signal ceases.
- **Programmable automatic band scan**  
Upper and lower frequency limits and scan steps of 5 KHz and larger (5, 10, 15, 20, 30 KHz, etc.) may be programmed. Scan locks on busy channel, resumes approximately 2 seconds after signal ceases.
- **UP/DOWN manual scan**  
Up/Down manual scan in 5 KHz steps.
- **Built-in tuneable sub-tone encoder**  
Sub-tone encoder, with activate switch, tuneable (variable resistor) to desired CTCSS tone. Optional TU-1 programmable (DIP-switch) encoder accessory available.
- **Built-in 16 key autopatch encoder**  
16 keys provide telephone dual tone modulation.
- **"SLIDE-LOC" battery pack**  
Slides into position, locks into place.
- **Reverse operation**  
Shifts receiver to transmit frequency, and transmitter to receive frequency.
- **Keyboard frequency selection**  
Sets operation frequency across full range.
- **Extended frequency coverage**  
Covers 143.900 to 148.995 MHz in 5 KHz steps.
- **Optional power source**  
Using optional MS-1 mobile or ST-2 AC charger/power supply, radio may be operated while charging. (Automatic drop-in connections.)
- **High impact plastic case**  
Provides extra strength to resist damage.
- **Battery status indicator**  
Flashes to indicate low battery charge level.
- **Two lock switches**  
Prevent accidental frequency change and accidental transmission.
- **Standard accessories included:**
  - Flexible rubberized antenna with BNC connector
  - 400 mA heavy-duty Ni-Cd battery pack
  - AC charger
  - Plugs for external microphone and speaker

More information on the TR-2500 is available from all authorized dealers of Trio-Kenwood Communications 1111 West Walnut Street, Compton, California 90220.

### Optional accessories:

- ST-2 Base station power supply and quick charger (approx. 1 hr)
- MS-1 Mobile stand/charger/supply
- TU-1 Programmable sub-tone (CTCSS) encoder
- SMC-25 Speaker microphone
- LH-2 Deluxe top grain cowhide leather case
- PB-25 Extra Ni-Cd battery pack, 400 mA, heavy duty
- BH-2 Belt hook
- WS-1 Wrist strap
- EP-1 Earphone
- \_\_\_\_\_ RF power amplifier (To be announced later.)

**KENWOOD**  
...pacesetter in amateur radio



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



## up-conversion receiver for the high-frequency bands: part one

Build it — try it out.  
Does it set a new standard  
for performance?  
You be the judge

### author's note

The object of this two-part construction project is strictly educational. I wanted to see if it was possible to produce a fairly good unit with readily available parts and, if so, to go on to design and construct a transceiver. Because of this, the module construction was done in breadboard fashion. There are no board layouts available, but some of the photos show typical construction techniques used throughout.

After a ten-year hiatus of little Amateur Radio activity, my S-line equipment started to look old when compared with the transceiver ads in the magazines. Surely, radios that looked this good must outperform my 20-year-old units. But which one to buy? With a well-equipped lab at my disposal, I decided to check out some available units. The results were generally disappointing, in my opinion. Except for third-order intermod performance, my old box full of tubes ran rings around the new solid-state units.

One of the new units I checked out had a strong front end but lacked sensitivity, very poor AGC characteristics, and produced a lot of hum and noise if an external audio filter wasn't used.

Another unit had excellent sensitivity, adequate overload characteristics, and good AGC; but synthesizer phase noise was excessive.

A third unit had an excellent operating "feel" and sound for DXing and contesting but had a soft front end.

A fourth unit wasn't considered for testing because of its poor reliability, as reported by a number of owners. Little testing was performed on the transmitters, although two of the units had key clicks and one had a slight chirp on CW; also its ALC characteristic was poor.

The digital readout and no-tuning features sold me on the solid-state rigs, but I couldn't decide on which compromise to make. So I constructed this receiver as a breadboard project to see if a full-blown transceiver effort was feasible. By constructing this receiver, I could concentrate on the *basic performance* characteristics and leave the frills for later, or leave them out completely.

### design

The basic configuration is shown in **fig. 1**. Up conversion eliminates the need for tunable filters at the front end. With this conversion method, adequate image rejection can be obtained with a simple low-

By George Cutsogorge, W2VJN, Plasma Physics Laboratory, Princeton University, P.O. Box 451, Princeton, New Jersey 08544

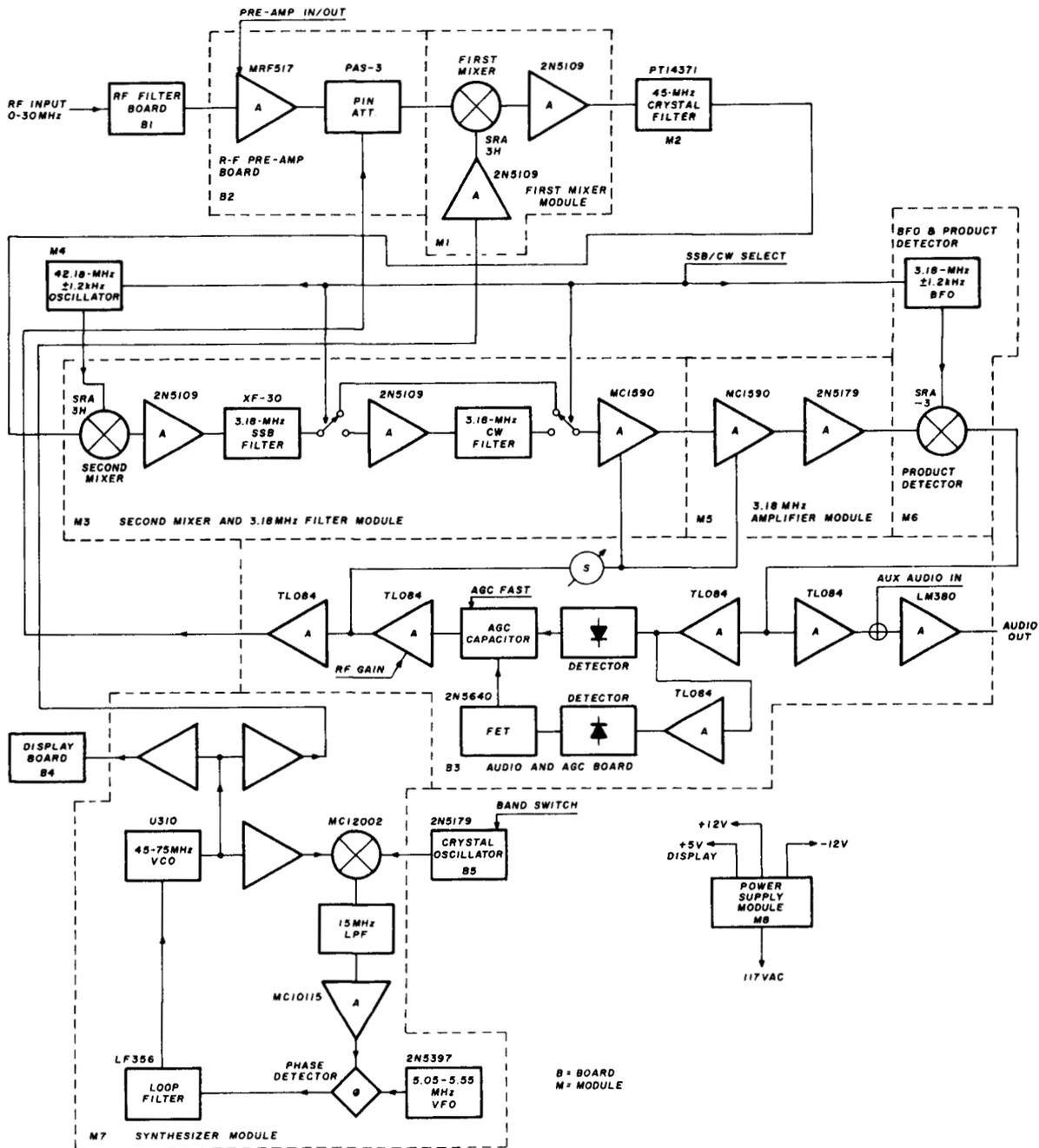


fig. 1. Block diagram of the up-conversion receiver. Breadboard construction techniques were used to allow changes in circuitry as the design developed.

pass filter. The input filters are followed by an rf stage. This stage may be switched in when high sensitivity is required, or it may be switched out when maximum resistance to overload is needed. The high sensitivity is useful on a quiet 10-meter band or when an inefficient antenna is used.

An electronically variable attenuator between the

rf amplifier and first mixer reduces the signal level for high-amplitude signals. The first mixer uses 17-dBm injection and provides a third-order intercept of 25 dBm. The first i-f is at 45 MHz. A small amount of gain is inserted to maintain an adequate front-end noise figure.

A monolithic crystal filter at 45 MHz protects the

# 440 SYNTHESIZED

## INTRODUCING SANTEC'S ST-7/T

SANTEC•NOLOGY breaks into the 440 band with style! The new ST-7/T synthesizes the entire band in 5 kHz steps, works both up and down repeater splits and does it all right from your hand, with versatile power options of 3 watts, 1 watt or even 50 milliwatts (all nominal), to reach out to where you want. The high power mode of 3 watts radiates on 440 like 5 watts on 2 meters ... and that's a handfull!

Tones? This one has them ... tones and subtones! The 16 button tone

pad is a SANTEC Standard at no extra cost, and the ST-7/T's optional synthesized subtone encoder is controlled by the radio's front panel switch.

All the regular SANTEC accessories used with your HT-1200 fit the ST-7/T as well, meaning that you can enjoy both bands fully with a smaller cash investment. Grab the new SANTEC ST-7/T and join the fun on 440 MHz. See your SANTEC Dealer for delivery details.



# 146

STILL THE LEADER



### HT-1200

SANTEC'S popular HT-1200 is the incomparable 2 meter leader. This little rig is handing over quality, power and features that you'd expect from something nearer the size of a bread box. SANTEC packs a 2 meter ham shack into the palm of your hand!

You can carry scan, search, 10 memories and fully synthesized key pad control around with you and still get out with a big 3.5 watts (nominal). Compare them apples to anything you want, and settle for nothing less.

SANTEC radios exceed FCC regulations limiting spurious emissions.



Both the SANTEC ST-7/T and the SANTEC HT-1200 are certified under FCC Part 15.

© 1981, **Encomm, Inc.**  
2000 Avenue G, Suite 800, Plano, Texas 75074  
Phone (214) 423-0024 • INTL TLX 203920 ENCOMM UR

Encomm, Inc.  
2000 Avenue G  
Suite 800  
Plano, TX 75074

Please send me more information about

- SANTEC HT-1200  
 SANTEC ST-7/T  
 Authorized SANTEC Dealers

NAME

CALL

ADDRESS

CITY

STATE

ZIP

YOU MAY SEND A DUPLICATE OF THIS FORM.

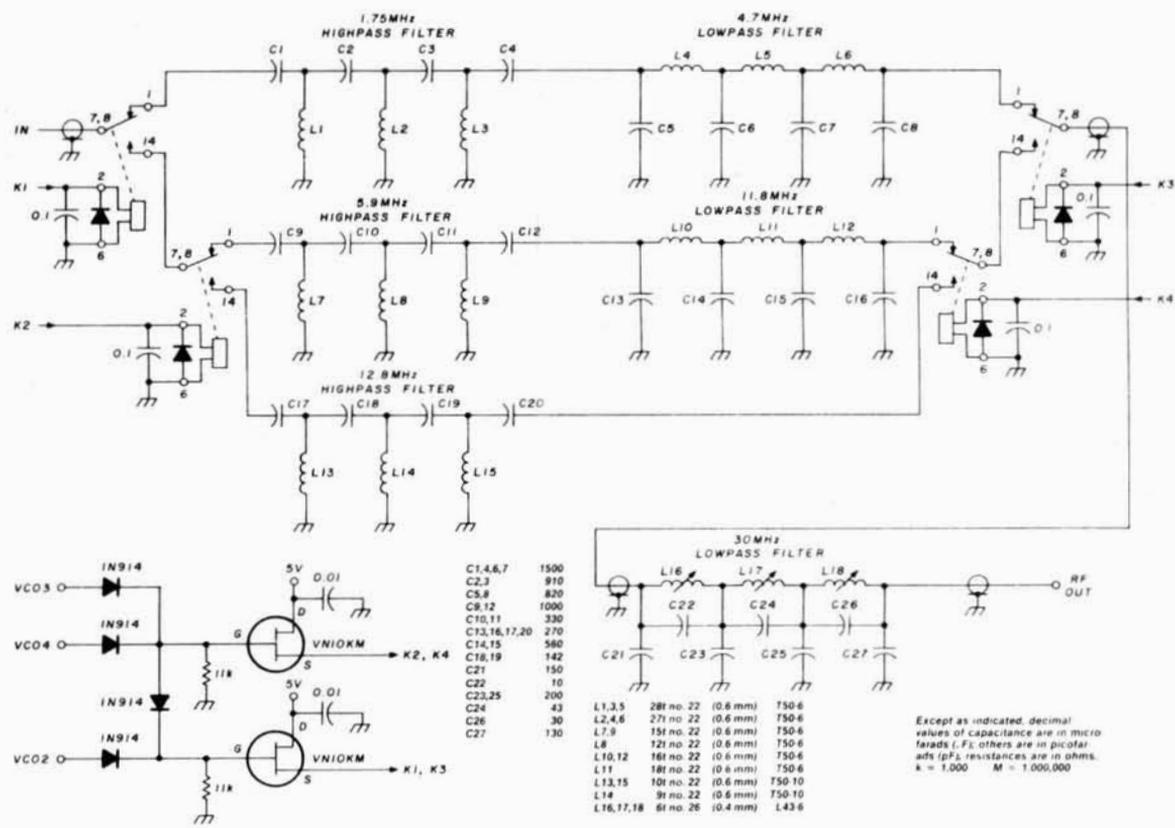


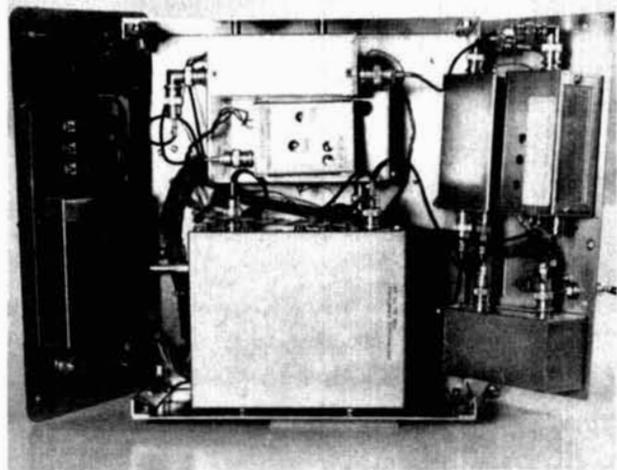
fig. 2. Rf-filter schematic (B1 board). Reed relays, which select the front-end filters, are controlled by the band switch.

second mixer from out-of-band signals. If good SSB and CW filters were available for 45 MHz, a second mixer wouldn't be necessary. This is not the case, however, so the main receiver selectivity is obtained at 3.18 MHz in the second i-f. The second mixer is also a high-level mixer and is driven at 13 dBm. Crystal filters are readily available for many different bandwidths at 3.18 MHz. A pair of MC1590s provide more than enough i-f gain and AGC range.

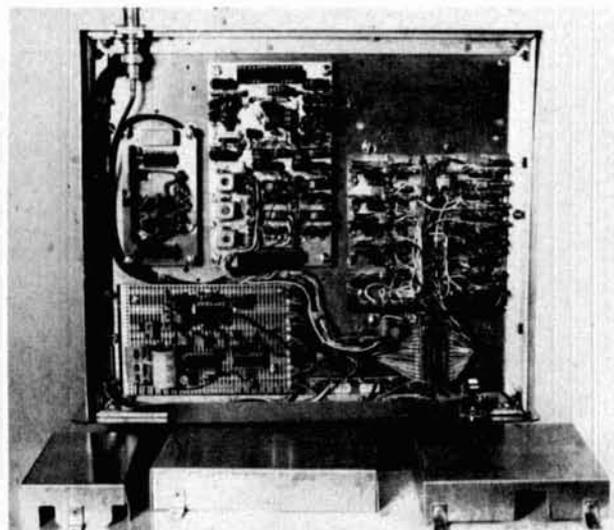
A 7-dBm drive-level, double-balanced mixer is used for the product detector. An audio amplifier completes the signal-path circuit. AGC voltage is derived from the audio signal and controls the second i-f amplifier gain and the front-end attenuator. A hang-type circuit is used.

Main receiver tuning is accomplished with a 5-MHz VFO. A 45- to 75-MHz VCO is phase-locked to the VFO in one-half megahertz bands. The VFO is heterodyned with a crystal oscillator operating 5.05 MHz below the minimum injection frequency required for the selected band.

For example, to cover the 7.0- to 7.5-MHz band the injection frequency must be 45.0 MHz higher, or 52.0 to 52.5 MHz. The crystal frequency required



Top view of receiver removed from its cabinet. The front and rear panels may be swung away from the main assembly for maintenance. Most modules above the deck are built in miniboxes. The large box houses the VFO, VCO, and phase detector board. On the left is the front panel showing the display module and the various controls. On the right is the rear panel holding the 45-MHz crystal filter, the first mixer and the BFO modules. At the top center are the second mixer, 48.18-MHz oscillator and 3.18-MHz amplifier modules.



Bottom view of receiver with shields removed. Small board in the upper left is the rf preamplifier. To its right is the filter board. On the right side is the crystal-oscillator board, and in the lower left is the audio-AGC board. All except the audio board are normally covered with aluminum shield boxes.

would be 46.95 MHz. The second-mixer injection is provided by a 48.12-MHz crystal-oscillator signal. Switching is incorporated to move the frequency to either 1.2 kHz or -1.2 kHz for upper- or lower-side-band selection. The BFO provides 3.18 MHz  $\pm$  1.2 kHz for the product detector, and the switching is ganged with the 48.12-MHz crystal oscillator. A digital counter that subtracts 450,000 from the measured frequency monitors the VCO and provides a digital

table 1. Measured performance characteristics of the up-conversion receiver.

|                          | frequency or mode | preamp out  | preamp in   |
|--------------------------|-------------------|-------------|-------------|
| noise floor              | SSB               | -128 dBm    | -132 dBm    |
|                          | CW                | -133        | -141        |
| blocking, CW:            | 2 kHz             | 148         | 146         |
| desired signal - 70 dBm; | 20 kHz            | 151         | 148         |
| dB above noise floor     | 100 kHz           | 151         | 148         |
| two-tone intermod, CW:   |                   | 50 dBm      |             |
| second-order intercept   | 10 kHz            | -1 dBm      | -12 dBm     |
| third order intercept    | 100 kHz           | 17 dBm      | 4.5 dBm     |
| phase-noise degradation  | 3 kHz             | 2 dB        |             |
| of noise floor for       | 10 kHz            | 2 dB        |             |
| 100 dB signal            | 20 kHz            | 3 dB        |             |
|                          | 100 kHz           | 2 dB        |             |
|                          | 250 kHz           | 0 dB        |             |
| image rejection          |                   | 85 dB       |             |
| first i-f rejection      |                   | 88 dB       |             |
| second i-f rejection     |                   | > 100 dB    |             |
| AGC threshold            |                   | 2.8 $\mu$ V | 0.3 $\mu$ V |

readout. The display may also be used externally as a test frequency counter.

## performance characteristics

Table 1 shows the receiver's measured performance. Noise-floor measurements indicate a noise figure of 8 dB with the preamplifier in. While this is adequate for normal high-frequency operation, it could be reduced by minimizing the losses ahead of the first mixer.

The blocking performance is very good, and a rather large desired signal level was used to eliminate the effects of phase noise on the measurement. The third-order intercept was measured at two-tone spreads to show the effect of the 45-MHz crystal filter. The second-order intercept varies, depending on the front-end filter attenuation, but the number shown is typical.

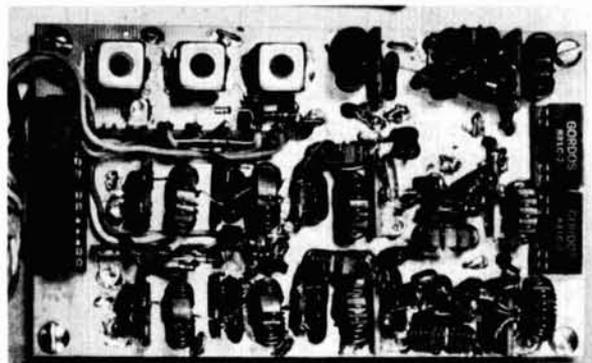
The receiver's phase-noise degradation is substantially less than that of other modern synthesized receivers I tested. This is due to this receiver's wide loop bandwidth in the synthesizer and the high-Q components in the 5-MHz VFO.

Image and i-f rejection are quite good although not as high as the filter alone should provide. Better shielding of the front-end modules and the use of miniature hardline to couple them would bring the rejection to greater than 100 dB.

## front end

Front-end filters minimize out-of-band interference. See fig. 2. A 30-MHz Cauer lowpass filter is in line at all times. It is designed to provide 80-dB image rejection by itself and has a notch at the first i-f of 45 MHz.

A highpass, lowpass filter combination is switched in for frequencies below 1.75 and 4.7 MHz. This filter has 0.5-dB attenuation from 1.8 to 4.5 MHz and is down 50 dB below 1.1 MHz and above 7.4 MHz. A



Typical board construction as shown on the filter board. Terminal strips are soldered to PC material directly. Components are supported on strips and groundplane. Breadboard rf circuitry may be constructed rapidly with this technique.

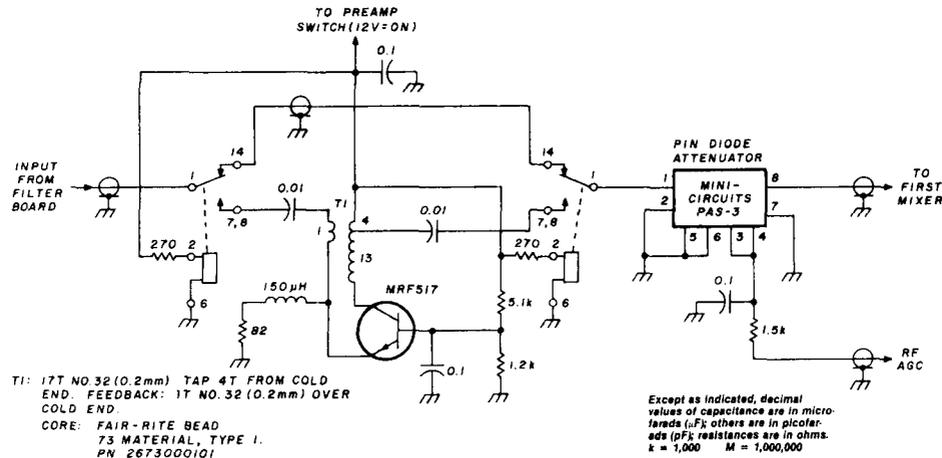


fig. 3. Rf pre-amplifier schematic (B2 board). Circuit uses transformer-coupled negative feedback and has a gain of 10 dB.

second set of highpass, lowpass filters covers 5.9 MHz to 11.8 MHz with 0.6-dB attenuation from 6.5 MHz to 11 MHz. This set is more than 50 dB down below 2.5 MHz and above 21 MHz. Finally, a high-pass filter is used for frequencies above 12.8 MHz. The filter has less than 0.4-dB attenuation above 14 MHz and more than 50 dB below 7.5 MHz.

These filters are constructed on double-sided copper-clad board using Amidon coil forms. Reed relays are used to select filters and are controlled by the band switch. Relay drivers are VN10KM FETs (fig. 2).

The MRF517 amplifier, fig. 3, uses transformer-coupled negative feedback. It has a gain of 10 dB and is flat beyond 100 MHz. Reed relays switch the amplifier in and out.

AGC is applied with a Mini-Circuits PAS-3 PIN diode attenuator following the rf amplifier. This unit is not activated unless the signal level exceeds a threshold set on the audio-AGC board. It is adjusted to start attenuating if the input signal exceeds 100  $\mu$ V. This attenuation reduces the signal level in the stages ahead of the 3.18-MHz i-f filters.

### first mixer

The first-mixer-module schematic is shown in fig. 4. It contains a Mini-Circuits SRA3H mixer and two 2N5109 feedback amplifiers. One is used as an i-f post amplifier, and the other increases the synthesizer injection signal to 17 dBm. These 2N5109 amplifiers operate at 55 mA collector current. Clip-on heat-sinks keep the transistor operating temperature down. Amplifier gain is about 14 dB, and the output compression point is 23 dBm. Input and output impedances are approximately 50 ohms. Frequency response is very flat, being down about 0.5 dB at 110 MHz, the upper limit of my test equipment. Third-

order intercept measurements on this module indicate a level of 24 dBm. This is to be expected for this mixer amplifier combination. No degradation is apparent when the 45-MHz crystal filter is introduced. I had some concern that the feedback amplifier would

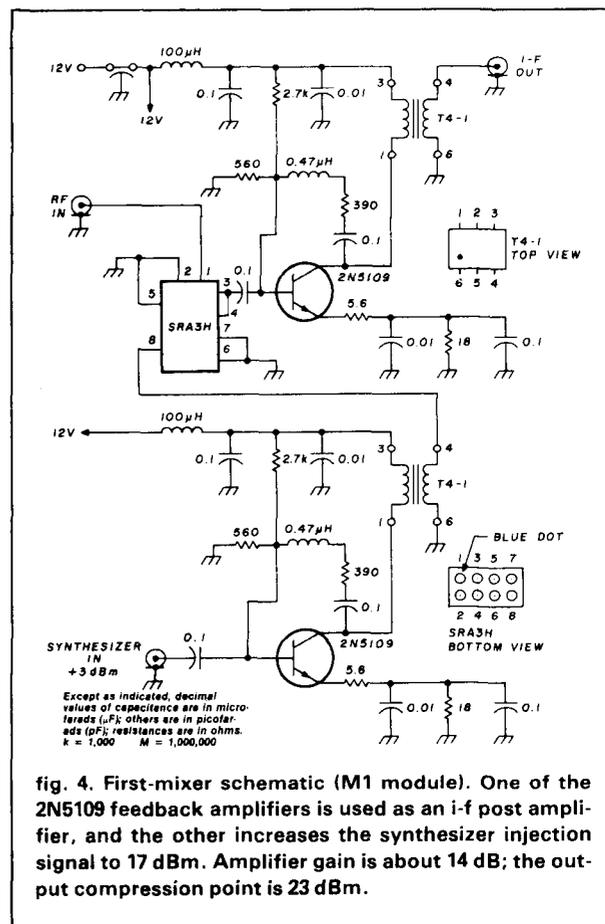


fig. 4. First-mixer schematic (M1 module). One of the 2N5109 feedback amplifiers is used as an i-f post amplifier, and the other increases the synthesizer injection signal to 17 dBm. Amplifier gain is about 14 dB; the output compression point is 23 dBm.

reflect an improper load for the mixer, out of the filter passband; however, the amplifier input impedance does not vary enough from 50 ohms to degrade the intercept point.

### first i-f filter

The first i-f was placed at 45 MHz to enable the use of a standard Piezo Technology, Inc., monolithic fil-

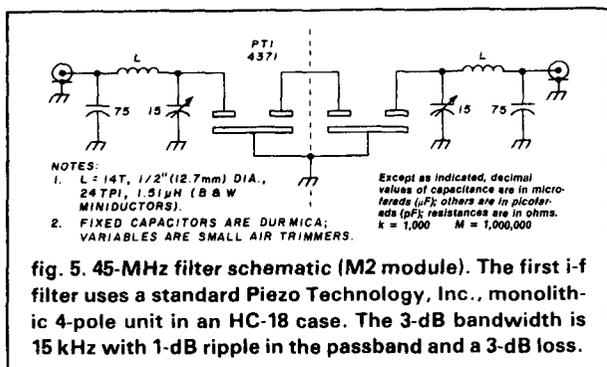


fig. 5. 45-MHz filter schematic (M2 module). The first i-f filter uses a standard Piezo Technology, Inc., monolithic 4-pole unit in an HC-18 case. The 3-dB bandwidth is 15 kHz with 1-dB ripple in the passband and a 3-dB loss.

ter. Their model 4371 is a four-pole unit in an HC-18 case. It has an advertised 3-dB bandwidth of 15 kHz with 1-dB ripple in the passband and a 3-dB loss. Aside from some sharp spurious responses, its ultimate rejection exceeds 50 dB. This filter has 7000-ohm input and output impedances, so networks are required to make it usable. See fig. 5. Considerable experimenting showed that achieving low insertion loss and good ultimate rejection at 45 MHz is not easy.

The insertion loss is important to minimize the receiver noise figure while maintaining large signal capabilities. If the filter loss is excessive, the gain preceding the filter must be high enough to give a good noise figure, but that would reduce the large signal-handling capabilities of the receiver.

Pi matching networks were used at the filter input and output. Coils and capacitors of very high Q must be used to minimize insertion loss. B&W miniductors were used with small air trimmers and Dur Mica capacitors. Over-all loss, input to output, was held to

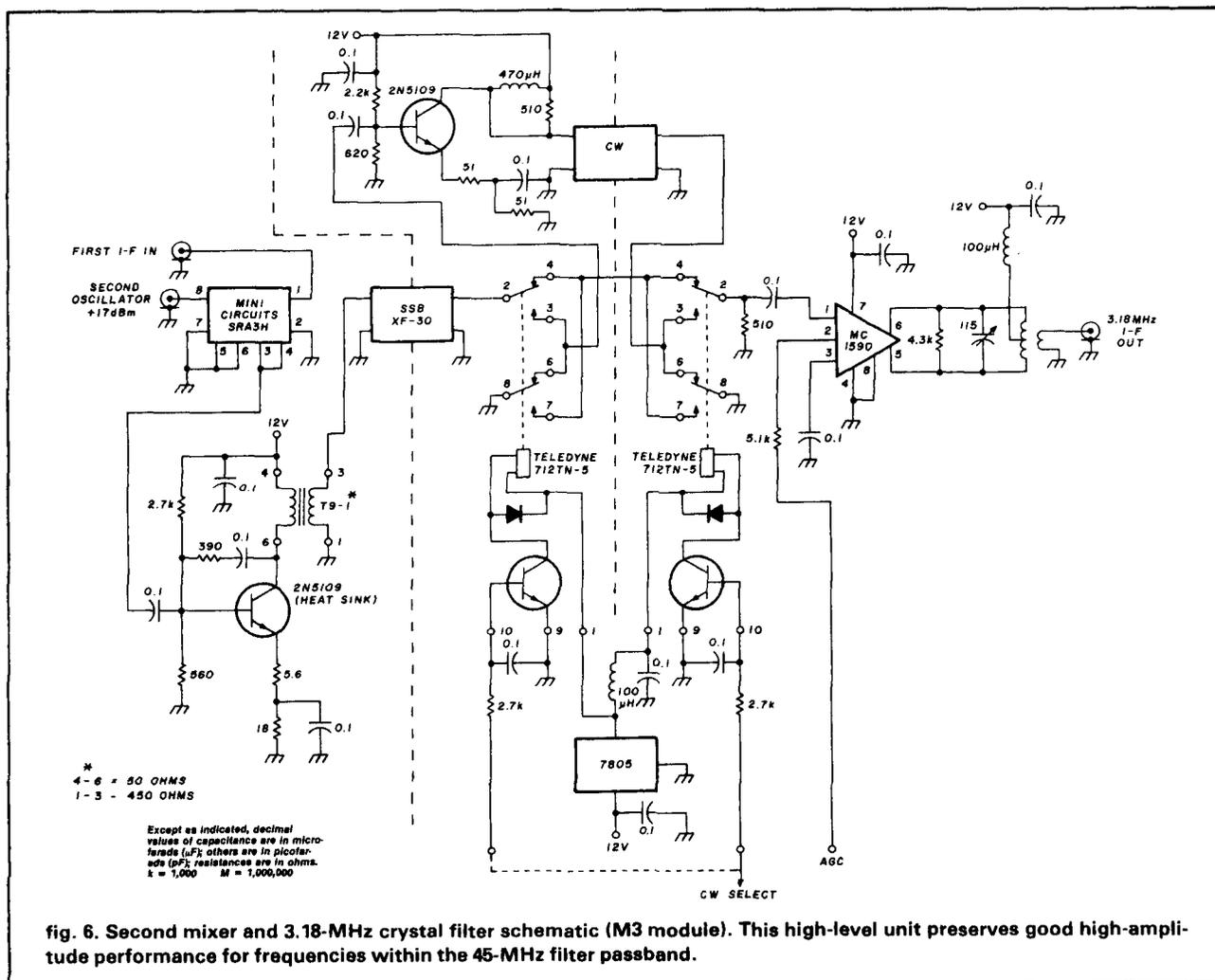


fig. 6. Second mixer and 3.18-MHz crystal filter schematic (M3 module). This high-level unit preserves good high-amplitude performance for frequencies within the 45-MHz filter passband.



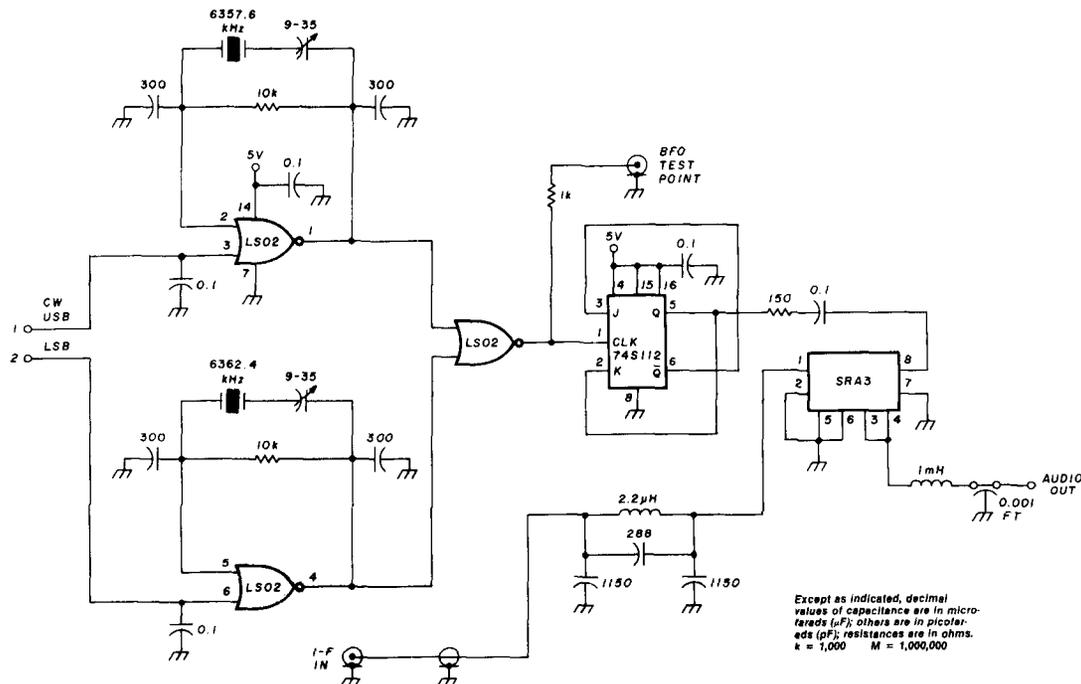


fig. 9. BFO and product-detector schematic (M6 module). The BFO consists of two crystal oscillators, one for LSB and one for USB/CW. An SRA-3 double-balanced mixer is used as the product detector. Unit gives excellent results when driven with a square-wave carrier.

## second mixer injection

The second mixer injection is from a crystal oscillator operating at a nominal frequency of 48.18 MHz. See fig. 8. An offset equal to the BFO offset must be applied to this oscillator for USB/LSB selection to keep the signal frequency constant. By placing a small inductor and capacitor in series with the crystal the output frequency can be shifted 1.2 kHz. A second capacitor switched in with a PIN diode can then pull the frequency to 48,180-1.2 kHz. A buffer amplifier provides the power output to drive the second mixer.

## BFO and product detector

An SRA-3 double-balanced mixer is used as the product detector. When driven with a square-wave carrier, this unit will give excellent results. For a -10 dBm input signal, the harmonic distortion is 44 dB down; with a -20-dBm input, the harmonics are better than 60 dB down. A Cauer filter is used on the i-f port to attenuate any harmonics generated in the i-f amplifier. If they are allowed into the product detector, they would be heterodyned to audio frequencies and create harmonic distortion.

The BFO consists of two crystal oscillators, as shown in fig. 9, one for LSB and one for USB/CW. Low-power Shottky two-input gates are used for the active elements. One input is biased into the linear region. The crystal is connected from gate output to input with a series frequency-adjusting capacitor. The two 300-pF mica capacitors complete the Colpitts configuration. The other gate input is used in the normal manner, to select the BFO frequency.

These oscillators run at twice the desired output rate so that a divider can be used to obtain a good square wave. A 74S112 flip-flop is used because of its small difference in propagation delay for positive- and negative-going edges. This unit drives the LO port on the SRA-3 through a dc blocking capacitor and a 150-ohm resistor. This is a simple but effective way to drive a mixer from a logic signal. A good square wave is necessary to minimize harmonic distortion. The third-order intercept of the mixer is increased somewhat by this technique.

Next month, in the second half of this two-part article, I will describe the construction of the audio and AGC board, the synthesizer, and power supply.

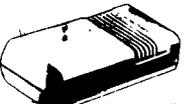
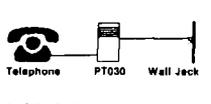
ham radio

7400

|         |      |         |      |          |      |
|---------|------|---------|------|----------|------|
| SN7400N | .20  | SN7472N | .29  | SN74156N | .79  |
| SN7401N | .20  | SN7473N | .25  | SN74157N | .89  |
| SN7402N | .25  | SN7474N | .35  | SN74160N | .89  |
| SN7403N | .25  | SN7475N | .45  | SN74161N | .89  |
| SN7404N | .25  | SN7476N | .50  | SN74162N | .89  |
| SN7405N | .25  | SN7477N | 5.00 | SN74163N | .89  |
| SN7406N | .35  | SN7478N | .50  | SN74164N | .89  |
| SN7407N | .35  | SN7479N | .59  | SN74165N | .89  |
| SN7408N | .35  | SN7480N | .59  | SN74166N | 1.25 |
| SN7409N | .29  | SN7481N | .69  | SN74167N | 2.75 |
| SN7410N | .25  | SN7482N | .35  | SN74170N | 4.95 |
| SN7411N | .35  | SN7483N | 1.75 | SN74172N | 4.95 |
| SN7412N | .35  | SN7484N | .49  | SN74173N | 1.39 |
| SN7413N | .45  | SN7485N | .59  | SN74174N | 1.39 |
| SN7414N | .49  | SN7486N | .45  | SN74175N | .89  |
| SN7415N | .25  | SN7487N | .45  | SN74176N | .89  |
| SN7416N | .29  | SN7488N | .69  | SN74177N | .79  |
| SN7417N | .29  | SN7489N | .69  | SN74179N | 1.49 |
| SN7418N | .25  | SN7490N | .69  | SN74180N | .79  |
| SN7419N | .29  | SN7491N | 3.00 | SN74181N | 2.25 |
| SN7420N | .45  | SN7492N | 1.49 | SN74182N | .79  |
| SN7421N | .25  | SN7493N | .89  | SN74184N | 2.49 |
| SN7422N | .45  | SN7494N | .89  | SN74185N | 2.49 |
| SN7423N | .25  | SN7495N | .35  | SN74186N | 1.25 |
| SN7424N | .25  | SN7496N | .35  | SN74187N | 1.25 |
| SN7425N | .25  | SN7497N | .35  | SN74189N | 1.25 |
| SN7426N | .25  | SN7498N | .35  | SN74190N | 1.25 |
| SN7427N | .25  | SN7499N | .35  | SN74191N | 1.25 |
| SN7428N | .49  | SN7500N | .39  | SN74192N | 1.25 |
| SN7429N | .49  | SN7501N | .39  | SN74193N | .89  |
| SN7430N | .49  | SN7502N | .39  | SN74194N | .89  |
| SN7431N | .49  | SN7503N | .39  | SN74195N | .89  |
| SN7432N | .49  | SN7504N | .39  | SN74196N | .89  |
| SN7433N | .49  | SN7505N | .39  | SN74197N | .89  |
| SN7434N | .49  | SN7506N | .39  | SN74198N | .89  |
| SN7435N | .49  | SN7507N | .39  | SN74199N | .89  |
| SN7436N | .49  | SN7508N | .39  | SN74200N | 1.25 |
| SN7437N | .49  | SN7509N | .39  | SN74201N | 1.25 |
| SN7438N | .49  | SN7510N | .39  | SN74202N | 1.25 |
| SN7439N | .49  | SN7511N | .39  | SN74203N | 1.25 |
| SN7440N | .49  | SN7512N | .39  | SN74204N | 1.25 |
| SN7441N | .49  | SN7513N | .39  | SN74205N | 1.25 |
| SN7442N | .49  | SN7514N | .39  | SN74206N | 1.25 |
| SN7443N | 1.10 | SN7515N | .39  | SN74207N | 1.25 |
| SN7444N | 1.10 | SN7516N | .39  | SN74208N | 1.25 |
| SN7445N | .89  | SN7517N | .39  | SN74209N | 1.25 |
| SN7446N | .79  | SN7518N | .39  | SN74210N | 1.25 |
| SN7447N | .69  | SN7519N | .39  | SN74211N | 1.25 |
| SN7448N | .79  | SN7520N | .39  | SN74212N | 1.25 |
| SN7449N | .79  | SN7521N | .39  | SN74213N | 1.25 |
| SN7450N | .20  | SN7522N | .39  | SN74214N | 1.25 |
| SN7451N | .20  | SN7523N | .39  | SN74215N | 1.25 |
| SN7452N | .20  | SN7524N | .39  | SN74216N | 1.25 |
| SN7453N | .20  | SN7525N | .39  | SN74217N | 1.25 |
| SN7454N | .20  | SN7526N | .39  | SN74218N | 1.25 |
| SN7455N | .20  | SN7527N | .39  | SN74219N | 1.25 |
| SN7456N | .20  | SN7528N | .39  | SN74220N | 1.25 |
| SN7457N | .20  | SN7529N | .39  | SN74221N | 1.25 |
| SN7458N | .20  | SN7530N | .39  | SN74222N | 1.25 |
| SN7459N | .20  | SN7531N | .39  | SN74223N | 1.25 |
| SN7460N | .20  | SN7532N | .39  | SN74224N | 1.25 |
| SN7461N | .20  | SN7533N | .39  | SN74225N | 1.25 |
| SN7462N | .20  | SN7534N | .39  | SN74226N | 1.25 |
| SN7463N | .20  | SN7535N | .39  | SN74227N | 1.25 |
| SN7464N | .20  | SN7536N | .39  | SN74228N | 1.25 |
| SN7465N | .20  | SN7537N | .39  | SN74229N | 1.25 |
| SN7466N | .20  | SN7538N | .39  | SN74230N | 1.25 |
| SN7467N | .20  | SN7539N | .39  | SN74231N | 1.25 |
| SN7468N | .20  | SN7540N | .39  | SN74232N | 1.25 |
| SN7469N | .20  | SN7541N | .39  | SN74233N | 1.25 |
| SN7470N | .20  | SN7542N | .39  | SN74234N | 1.25 |

## Phone Tunes

As Seen on "Good Morning America"  
Replaces the Telephone Ringer Bell with a Selection of 30 Familiar Tunes

**Each Unit Will play any of the following Tunes:**

- Rule Britannia
- Close Encounters
- Pump & Circumstance
- O Canada
- Wedding Bells
- William Tell Overture
- Colonel Bogey
- Happy March
- Back To Back in D Minor
- Westminster Chimes
- Jingle Bells
- Star Spangled Banner
- Mermaid Hair Dance
- Aud Lang Syne
- Oranges and Lemons
- Winkie Twinkie Little Star
- Soldiers Chorus
- Wilhelmus
- Beethoven's 5th
- Deutschlandlied
- Sailor's Hornpipe
- Mozart Sonata
- La Marseillaise
- The Queen's Chair

Replaces monotonous telephone ringer bell easily connects to any standard telephone. Can be used alongside regular phone or replace a remote ringer elsewhere in building or outside FCC approved can be used on any telephone system - worldwide. Use a different tune to identify extension phones. Microprocessor controlled. Adjustable volume control and variable tone speed control. Operates on two 9-volt batteries or AC Adapter (not included).

**PT030 Phone Tunes \$49.95**  
**AD30 AC Adapter \$8.95**

### DISCRETE LEDS

| Part No. | Color       | Size | Price                   |
|----------|-------------|------|-------------------------|
| XC556R   | 200' red    | 5/51 | MV50 085' red 6/51      |
| XC556G   | 200' green  | 4/51 | XC209R 125' red 6/51    |
| XC556Y   | 200' yellow | 4/51 | XC209G 125' green 4/51  |
| XC556C   | 200' clear  | 4/51 | XC227R 200' red 5/51    |
| XC227R   | 200' red    | 5/51 | XC256G 185' green 4/51  |
| XC27G    | 200' green  | 4/51 | XC256Y 185' yellow 4/51 |
| XC27Y    | 200' yellow | 4/51 | XC256C 185' clear 4/51  |
| MY10B    | 1.0" red    | 4/51 |                         |

**Diffused Bi-Color LED**  
Part No. 1.99 100+  
XC5491 79 69

**RL2** - 1/2" x 1/4" x 1/8" METAL  
MIL H.W. 2.25  
\$3.99 ea. or \$31.00

### DISPLAY LEDS

| Part No. | Color          | Size | Price |
|----------|----------------|------|-------|
| MAN 1    | C.A. red       | 270  | 2.95  |
| MAN 2    | 5x7 D.C.M. red | 300  | 4.95  |
| MAN 3    | C.C. red       | 125  | 25    |
| MAN 4    | C.A. green     | 200  | 99    |
| MAN 5    | C.C. green     | 300  | 99    |
| MAN 6    | C.A. red       | 300  | 75    |
| MAN 7    | C.A. red       | 300  | 75    |
| MAN 8    | C.A. red       | 300  | 75    |
| MAN 9    | C.A. yellow    | 300  | 49    |
| MAN 10   | C.C. yellow    | 300  | 49    |
| MAN 11   | C.A. orange    | 300  | 49    |
| MAN 12   | C.A. orange    | 300  | 99    |
| MAN 13   | C.A. orange    | 400  | 99    |
| MAN 14   | C.A. orange    | 400  | 99    |
| MAN 15   | C.A. orange    | 500  | 99    |
| MAN 16   | C.A. orange    | 500  | 99    |
| MAN 17   | C.A. orange    | 500  | 99    |
| MAN 18   | C.A. orange    | 500  | 99    |
| MAN 19   | C.A. orange    | 500  | 99    |
| MAN 20   | C.A. orange    | 500  | 99    |
| MAN 21   | C.A. orange    | 500  | 99    |
| MAN 22   | C.A. orange    | 500  | 99    |
| MAN 23   | C.A. orange    | 500  | 99    |
| MAN 24   | C.A. orange    | 500  | 99    |
| MAN 25   | C.A. orange    | 500  | 99    |
| MAN 26   | C.A. orange    | 500  | 99    |
| MAN 27   | C.A. orange    | 500  | 99    |
| MAN 28   | C.A. orange    | 500  | 99    |
| MAN 29   | C.A. orange    | 500  | 99    |
| MAN 30   | C.A. orange    | 500  | 99    |

### SOCKETS

#### ZERO INSERTION FORCE

• Nickel Plated Body • G.F. PSF Plastic Body

| Part No. | Pins   | Price | Part No. | Pins   | Price |
|----------|--------|-------|----------|--------|-------|
| 214-3333 | 14 pin | 5.95  | 222-3343 | 22 pin | 9.95  |
| 216-3340 | 16 pin | 6.49  | 224-3344 | 24 pin | 9.75  |
| 218-3341 | 18 pin | 6.95  | 226-3345 | 26 pin | 11.95 |
| 220-3342 | 20 pin | 8.95  | 228-3346 | 40 pin | 12.95 |

### LOW PROFILE (TIN) SOCKETS

| Part No.  | Pins | Price |
|-----------|------|-------|
| 8 pin LP  | 17   | 16 15 |
| 16 pin LP | 20   | 19 18 |
| 18 pin LP | 22   | 21 20 |
| 20 pin LP | 24   | 23 22 |
| 22 pin LP | 26   | 25 24 |
| 24 pin LP | 28   | 27 26 |
| 26 pin LP | 30   | 29 28 |
| 28 pin LP | 32   | 31 30 |
| 30 pin LP | 34   | 33 32 |
| 32 pin LP | 36   | 35 34 |
| 34 pin LP | 38   | 37 36 |
| 36 pin LP | 40   | 39 38 |
| 38 pin LP | 42   | 41 40 |
| 40 pin LP | 44   | 43 42 |

### SOLDERTAIL (GOLD) STANDARD

| Part No.  | Pins | Price   |
|-----------|------|---------|
| 8 pin SG  | 29   | 25 41   |
| 16 pin SG | 45   | 41 57   |
| 18 pin SG | 54   | 49 65   |
| 20 pin SG | 59   | 53 69   |
| 24 pin SG | 69   | 65 81   |
| 28 pin SG | 100  | 100 100 |
| 36 pin SG | 165  | 140 126 |
| 40 pin SG | 175  | 159 145 |

### 1/4 WATT RESISTOR ASSORTMENTS - 5%

| ASST.    | Value                                   | Quantity                                                              | Price          |
|----------|-----------------------------------------|-----------------------------------------------------------------------|----------------|
| ASST. 1  | 5 ea.                                   | 10 Ohm 12 Ohm 15 Ohm 18 Ohm 22 Ohm 27 Ohm 33 Ohm 39 Ohm 47 Ohm 56 Ohm | 50 pcs. \$1.95 |
| ASST. 2  | 5 ea.                                   | 10 Ohm 12 Ohm 15 Ohm 18 Ohm 22 Ohm 27 Ohm 33 Ohm 39 Ohm 47 Ohm 56 Ohm | 50 pcs. \$1.95 |
| ASST. 3  | 5 ea.                                   | 1.2K 1.5K 1.8K 2.2K 2.7K                                              | 50 pcs. \$1.95 |
| ASST. 4  | 5 ea.                                   | 2.2K 3.3K 4.7K 6.8K 10K 15K 18K                                       | 50 pcs. \$1.95 |
| ASST. 5  | 5 ea.                                   | 56K 68K 82K 100K 120K                                                 | 50 pcs. \$1.95 |
| ASST. 6  | 5 ea.                                   | 150K 180K 220K 270K 330K                                              | 50 pcs. \$1.95 |
| ASST. 7  | 5 ea.                                   | 390K 470K 560K 680K 820K                                              | 50 pcs. \$1.95 |
| ASST. 8R | Includes Resistor Assts. 1-7 (350 pcs.) |                                                                       | \$10.95 ea.    |

### Jameco ELECTRONICS

MAIL ORDER ELECTRONICS - WORLDWIDE  
1355 SHOREWAY ROAD, BELMONT, CA 94002  
PRICES SUBJECT TO CHANGE

NEW 1982 CATALOG

## INTERSI

| Part No.     | Function                         | Price     |
|--------------|----------------------------------|-----------|
| 70651PI      | CMOS Precision Timer             | 14.95     |
| 7065V/KIT*   | Stopwatch Chip, XTL              | 24.95     |
| 7065V/KIT*   | 3 1/2 Digit A/D (LED Drive)      | 74.95     |
| 7065V/KIT*   | 1C, Circuit Board, Display       | 34.95     |
| 7107CPL      | 3 1/2 Digit A/D (LED Drive)      | 15.95     |
| 7107V/KIT*   | 1C, Circuit Board, Display       | 29.95     |
| 7116CPL      | 3 1/2 Digit A/D LCD DS, H.L.D.   | 18.95     |
| 7116V/KIT*   | 3 1/2 Digit A/D LCD DS, H.L.D.   | 12.95     |
| 7201DRI      | Low Battery Volt Indicator       | 2.25      |
| 7205IPG      | CMOS LED Stopwatch/Timer         | 12.95     |
| 7205V/KIT*   | Stopwatch Chip, XTL              | 19.95     |
| 7206CJPE     | Tone Generator                   | 5.15      |
| 7206EV/KIT*  | Tone Generator Chip, XTL         | 13.95     |
| 7201AIPD     | Oscillator Controller            | 6.90      |
| 7201AEV/KIT* | Freq. Counter Chip, XTL          | 11.95     |
| 7201PI       | Seven Decade Counter             | 13.95     |
| 7201PIA      | Clock Generator                  | 3.75      |
| 7215IPG      | 4 Func. CMOS Stopwatch CKT       | 13.95     |
| 7215EV/KIT*  | 4 Func. Stopwatch Chip, XTL      | 19.95     |
| 7216A1J1     | 8-Digit Univ. Counter C.A.       | 32.00     |
| 7216C1J1     | 8-Digit Freq. Counter C.A.       | 26.95     |
| 7216D1J1     | 8-Digit Freq. Counter C.G.       | 21.95     |
| 7217J1       | 4-Digit Up/Down Counter          | 12.95     |
| 7218J1       | 8-Digit Univ. LED Drive          | 10.95     |
| 7224J1PL     | LCD 4 1/2 Digit Up Counter DRI   | 11.25     |
| 7224J1       | 8-Digit Univ. Counter            | 31.95     |
| 7228AEV/KIT* | 5-Function Counter/Chip, XTL     | 4.95      |
| 7228J1       | CMOS 5 Bit Up/Down Counter       | 4.95      |
| 7242J1AE     | CMOS Divide-by-256 RC Timer      | 2.00      |
| 7250J1       | CMOS BCD Prog. Timer/Counter     | 5.05      |
| 7260J1       | CMOS BCD Prog. Timer/Counter     | 5.20      |
| 7262J1       | CMOS 5 Bit Prog. Timer           | 2.25      |
| 7265J1PD     | CMOS 556 Timer (4 pin)           | 2.00      |
| 7611BCPA     | CMOS Op Amp Comparator           | 5MV 2.25  |
| 7612BCPA     | CMOS Op Amp Ext. Cnvtr.          | 5MV 2.95  |
| 7613BCPA     | CMOS Dual Op Amp Comp.           | 5MV 3.95  |
| 7613CCPE     | CMOS Tri Op Amp Comp.            | 10MV 5.50 |
| 7614CCPE     | CMOS Quad Op Amp Comp.           | 10MV 7.50 |
| 7614CCPD     | CMOS Quad Op Amp Comp.           | 10MV 7.50 |
| 7615CCPD     | Voltage Detector                 | 2.95      |
| 8038CCPD     | Waveform Generator               | 4.95      |
| 8048CCPD     | Monolithic Logarithmic Amp       | 21.95     |
| 8050CCPD     | 8050 Dual Op Amp Volt Ref. Diode | 74.50     |
| 8211CPE      | Volt Ref/Indicator               | 2.60      |
| 8212CPE      | Volt Ref/Indicator               | 2.95      |

### 74C

| Part No. | Price | 74C   | Price |
|----------|-------|-------|-------|
| 74C00    | .39   | 74C95 | 1.59  |
| 74C01    | .39   | 74C10 | 1.89  |
| 74C02    | .39   | 74C11 | 1.89  |
| 74C03    | .39   | 74C12 | 1.89  |
| 74C04    | .39   | 74C13 | 1.89  |
| 74C05    | .39   | 74C14 | 1.89  |
| 74C06    | .39   | 74C15 | 2.25  |
| 74C07    | .39   | 74C16 | 1.69  |
| 74C08    | .39   | 74C17 | 1.69  |
| 74C09    | .39   | 74C18 | 1.49  |
| 74C10    | .39   | 74C19 | 1.95  |
| 74C11    | .39   | 74C20 | 1.95  |
| 74C12    | .39   | 74C21 | 1.95  |
| 74C13    | .39   | 74C22 | 1.95  |
| 74C14    | .39   | 74C23 | 1.95  |

State  
of the art



by

K.V.G.

**NEW CRYSTAL FILTERS**

KVG announces a new series of 9 MHz crystal filters complementing the standard XF-9xx model series. The new XFM-9xx series are Monolithic Crystal Filters with characteristics equivalent to the classical discrete crystal filters with corresponding part numbers.

| Discrete model | Application | Monolithic Part No. | Termination ohms | Termination pF | Bandwidth -6 dB |
|----------------|-------------|---------------------|------------------|----------------|-----------------|
| XF-9A          | SSB         | XFM-9A              | 500              | 30             | 2.4 kHz         |
| XF-9B          | SSB         | XFM-9B              | 500              | 30             | 2.4 kHz         |
| XF-9C          | AM          | XFM-9C              | 500              | 30             | 3.75 kHz        |
| XF-9D          | AM          | XFM-9D              | 500              | 30             | 5.0 kHz         |
| XF-9E          | FM          | XFM-9E              | 1200             | 30             | 12.0 kHz        |
| XF-9B-01       | LSB         | XFM-9B-01           | 500              | 30             | 2.4 kHz         |
| XF-9B-02       | USB         | XFM-9B-02           | 500              | 30             | 2.4 kHz         |

Also NEW standard filters:

- A new 10-pole SSB filter, model XF-9B-10  
Shape factor: 1.5:1, 60 dB/6 dB
- A new 8-pole CW filter, model XF-9P, 250 Hz BW  
Shape factor: 2.2:1, 60 dB/6 dB

Write for Data Sheets, Price & Delivery

Export Inquiries Invited.

**1296 MHz EQUIPMENT**

Announcing the new 1296 MHz units by Microwave Modules.

|                                |              |          |
|--------------------------------|--------------|----------|
| Low Noise RECEIVE Converter    | MMx 1296-144 | \$139.95 |
| Low Noise RECEIVE Preamplifier | MMa 1296     | 64.95    |
| Low Power LINEAR TRANSVERTER   | MMI 1296-144 | 399.95   |

Plus all our regular 1296 MHz items: antennas, filters, triplers

**TRANSVERTERS FOR ATV OSCARS 7, 8 & PHASE 3**

Transverters by Microwave Modules and other manufacturers can convert your existing Low Band rig to operate on the VHF & UHF bands. Models also available for 2M to 70cm and for ATV operators from Ch2/Ch3 to 70cms. Each transverter contains both a Tx up-converter and a Rx down-converter. Write for details of the largest selection available.

Prices start at \$189.95 plus \$6.50 shipping.

**SPECIFICATIONS**

|               |           |
|---------------|-----------|
| Output Power  | 10 W      |
| Receiver N.F. | 3 dB typ  |
| Receiver Gain | 30 dB typ |
| Prime Power   | 12V DC    |



Attention owners of the original MM1432-28 models. Update your transverter to operate OSCAR 8 & PHASE 3 by adding the 434 to 436 MHz range. Mod kit including full instructions \$26.50 plus \$1.50 shipping, etc.

**ANTENNAS (FOB CONCORD, VIA UPS)**

**144-148 MHz J-SLOTS**

|                          |            |             |         |
|--------------------------|------------|-------------|---------|
| 8 OVER 8 HORIZONTAL POL. | + 12.3 dBd | D8/2M       | \$63.40 |
| 8 BY 8 VERTICAL POL.     |            | D8/2M-VERT. | \$76.95 |
| 8 + 8 TWIST              |            | 8XY/2M      | \$62.40 |

**420-450 MHz MULTIBEAMS**

For local, DX, OSCAR, and ATV use.

|        |                 |          |          |
|--------|-----------------|----------|----------|
| 48 EL. | GAIN + 15.7 dBd | 70/MBM48 | \$75.75  |
| 88 EL. | GAIN + 18.5 dBd | 70/MBM88 | \$105.50 |

**UHF LOOP YAGIS**

|               |               |                          |         |
|---------------|---------------|--------------------------|---------|
| 28 LOOPS      | GAIN + 20 dBi | 50-ohm, Type N Connector |         |
| 1250-1340 MHz | 1296-LY       | 8 ft. boom               | \$64.70 |
| 1650-1750 MHz | 1691-LY       | 6 ft. boom               | \$70.90 |

Send 36¢ (2 stamps) for full details of KVG crystal products and all your VHF & UHF equipment requirements.

|                      |                     |                  |  |
|----------------------|---------------------|------------------|--|
| Pre-Selector Filters | Amplifiers          | SSB Transverters |  |
| Varactor Triplers    | Crystal Filters     | FM Transverters  |  |
| Decade Pre-Scalers   | Frequency Filters   | VHF Converters   |  |
| Antennas             | Oscillator Crystals | UHF Converters   |  |



**Spectrum International, Inc.**  
Post Office Box 1084  
Concord, Mass. 01742, USA

**Dan's Got It All!**



**ICOM IC-730, IC-720A**



**MIRAGE B-108**

IC-2AT



**AEA ISOPOLE 144 220 144JR 220JR**

**YAESU 902 DM**



**KENWOOD TS-830S**

Also In Stock:  
B & W - Telex - CDR - MFJ - Nye - CushCraft - Bencher - HyGain - Larsen - Amphenol - Cubic

**Dan C. Britt, K4URK**  
**Britt's 2-Way Radio**

Sales & Service

2508 Atlanta St., Smyrna, GA 30080

Belmont Hills Shopping Center

(404) 432-8006

**CHRISTMAS GIFT IDEAS**

**THE RADIO AMATEUR ANTENNA HANDBOOK**  
by William I. Orr, W6SAI and Stuart Cowan, W2LX

This book contains lots of well illustrated construction projects for vertical, long wire and HF/VHF beam antennas. You'll also get information not usually found in antenna books. There is an honest judgment of antenna gain figures, information on the best and worst antenna locations and heights, a long look at the quad vs. the yagi antenna, information on balloons and how to use them, and new information on the popular Sierpien and Delta Loop antennas. The text is based on proven data plus practical, on the air experience. **The Radio Amateur Antenna Handbook** will make a valuable and often consulted reference. 190 pages. © 1978.

RP-AH

Softbound \$6.95

**INTERFERENCE HANDBOOK**  
by William R. Nelson, WA6FQG

RFI is a very sticky problem. It can ruin your operating fun and worse. This brand new book covers every type of RF interference that you are likely to encounter. Emphasis is placed on Amateur Radio, CB and power line problems. The author has spent over 33 years investigating RFI difficulties. Author Nelson solves the mystery of power line interference — how to locate it, cure it, safety precautions and more. He also gives you valuable steps on how to eliminate TV and stereo problems. To help you understand this perplexing problem even more, this new book gives you interesting RFI case histories, filters to buy or build, mobile, telephone, CATV, and computer problems and ideas on how to solve them. Profusely illustrated and packed with practical, authoritative information. ©1981. 247 pages, first edition.

RP-IH

Softbound \$8.95

Please add \$1.00 to cover shipping and handling.

**HAM RADIO'S BOOKSTORE**  
GREENVILLE, N. H. 03048

# THE BIG SIGNAL® BALUN

- 160-6 meter spectrum coverage
- First with built-in lightning arrestor
- Unconditionally guaranteed
- More efficient coverage than any competitive balun
- Can withstand 600 lb. pull
- Handles 2,000 watts
- Weatherproofed



Call or write today!



A Division of Microwave Filter Company, Inc.

NY/Hawaii/Alaska/Canada  
Collect 1-315-437-3953

Toll Free  
1-800-448-1666

6743 Kinne Street, East Syracuse, NY 13057

## MAXI TUNER SOLVES ANTENNA PROBLEMS



### THE FINEST ANTENNA TUNER AVAILABLE

Coax, Random Wire and Balanced Antennas

- Presents 50-75 Ohm Resistive Load to Your Transmitter Using Virtually Any Antenna System (Balun Optional...\$19.95)
- Continuous 1.7-30 MHz Coverage
- Rotary Inductor (28  $\mu$ H)
- Rugged Cast Aluminum Turns Counter
- Handles 3 KW PEP 2 KW with Balun
- Velvet Smooth 6 to 1 Vernier Tuning
- 0-100 Logging Scale on 500 pF Capacitors

continental FREE SHIPMENT U.S.

Maxi without SWR — \$259.95

Maxi with SWR — \$299.95

Wisconsin residents add 4% Sales Tax

FOR COLOR BROCHURE  
OPERATING HINTS  
CALL OR WRITE

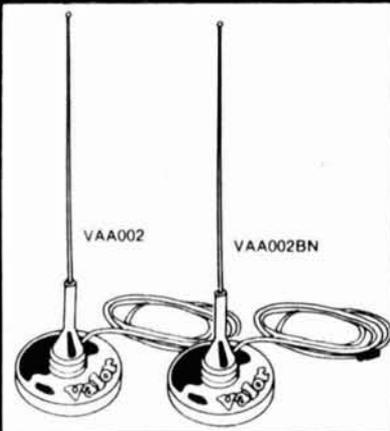
RF POWER  
COMPONENTS

1249 GARFIELD ST.  
NIAGARA, WIS 54151  
(715) 251-4118



## Portable Communications Antennas

For amateur and commercial services, the Val-Duckie communication antennas boast 48 different models, from 144 to 512 MHz. Encapsulated in high gloss PVC plastic for weather resistance, all Val-Duckie antennas are 100% factory tuned for minimum VSWR and have a power rating of 35 watts at 50 ohms.



## 1/4 Wave Mobile Antennas

A quality 2-meter antenna, with 200 watts of power, can be cut for 220 and 450 MHz. Valor's 1/4 wave mobile antennas are equipped with stainless steel whip, 12 ft. RG58 Valor-Flex™ cable, and PL-259 connector. 3 models available with surface mount, magnet mount, and magnet mount with BNC connector.

valor

185 W. Hamilton St., West Milton OH 45383, PH: (513) 698-4194, Outside Ohio: 1-800-543-2197

# owners' survey — TR7

## A survey of owners' opinions of the Drake TR7

This month, the *ham radio* readers' survey deals with the popular Drake TR7, certainly one of the most desirable high-frequency transceivers in recent years. One hundred and ninety-five completed and usable questionnaires were returned by our readers.

The Drake TR7 is a synthesized transceiver that provides continuous receive coverage from 1.5 to 30 MHz, and transmits on all Amateur frequencies currently assigned within this range. The circuit combines a frequency synthesizer with a PTO, and there is a 1-kHz dial and 100-Hz digital readout resolution. The receiver has full passband tuning, with a first i-f of 48.05 MHz. The radio features solid-state, no tune-up operation.

### the good features of the TR7 . . .

In response to the question, What is the rig's best feature?, the most frequent answer was the general coverage aspect of the radio. Thirty-six percent of the respondents mentioned this capability and the high quality of the TR7 receiver, which was praised for both its sensitivity and selectivity. (Note that, with the optional Range Program Board, the TR7 will tune 0 through 30 MHz, and programmable, out-of-band transmit capability is available for other frequencies such as MARS, Embassy, Government, and the new WARC bands.) Several Amateurs said how much they enjoy being able to use the TR7 for SWLing.

Thirty-one percent of the respondents mentioned the broadband characteristics of the radio as among

its best features (many — in fact, most, respondents listed more than one "best feature.") Because the radio is solid-state, there is no need for preselection tuning or transmitter adjustments. Many of the respondents to the questionnaire who had been accustomed to operating only tube-type radios were appreciative of this aspect of the TR7.

Other "best features" frequently mentioned were ease of operation (16 percent), flexibility (9 percent), good audio (9 percent), portability (8 percent), and the digital readout (7 percent). Here are some representative replies to the question, What is the rig's best feature?:

"Flexibility — it does everything! A-m is clear, and accessories all plug in together and work well." — AKØU

"General coverage receiver, ease of operation, passband tuning." — WD8JUB

"Hard-hitting, pleasing, clean CW receive note; ease of alignment." — KL7T

"Continuous coverage from 0 to 30 MHz." — AG8T

"Receiver is excellent, especially filters and passband tuning. Good physical layout, and easy to manipulate the controls. I like the full frequency ability — I do SWLing. Most flexible receiver to use: it's a real pleasure!" — AE2J

"The 0-30 MHz receiver. The receiver has excellent sensitivity and dynamic range. I often get solid copy after other stations give up. The no-tune QSX feature of the transmitter is excellent. Also very rugged output. My transceiver was once key down (at reduced power) for 20 hours with no detectable change to either the TR7 or its power supply." — AF4B

"Digitally programmed frequency selection. The rig will never be obsolete." — WB6QDS

"Flexibility: the ability to use many modes of oper-

By Martin Hanft, WB1CHQ, Production Editor, *ham radio* magazine

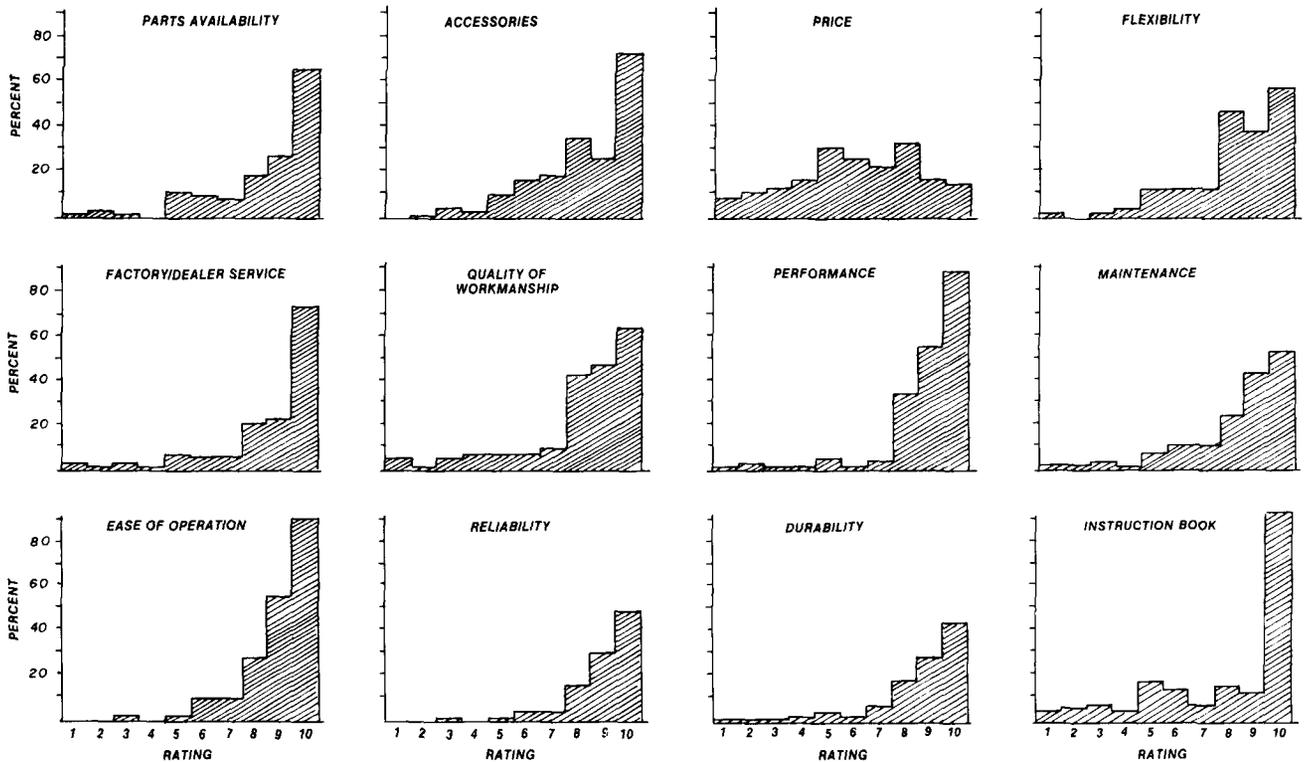


fig. 1. How the TR7 was rated, from 1 (poor) to 10 (perfect).

ation, wide frequency coverage, and the possibility of connecting many external components, such as receiver and linear amps, making the TR7 the central control point of the station."

"No tune-up. I use the passband tuning and the RIT often to get rid of QRM. I also use the STORE pushbutton for DX pileups." — N6XL

"Ease of operation. Transmit audio: Many stations comment that my audio is better than most and even more readable than others with the same signal strength." — W9KFQ

"Excellent receiver with passive front end and choice of receiver i-f filters. General coverage capability. Plug-in circuit boards. Ability to use digital display as frequency counter. Passband tuning. VOX controls on front of unit. Covers new bands and MARS." — W9UI

"Excellent skirt selectivity and dynamic range." — AA50

"No tuning of output stages; RIT; built-in frequency meter; continuous coverage." — W4UI

"160-meter capability." — W6GAW

"Excellent receiver: Freedom from overload, IMD, and cross-modulation distortion. Flexibility: Can transmit and receive over whole hf spectrum; can also receive VLF." — N2MS

"Super receiver section. I have owned most of the popular rigs and I consider the TR7 the best transceiver available." — K3OX

"Good read-out, good passband tuning, and easy to work on or modify. Good general coverage performance; very stable; no warm-up or drift. Runs very cool with fan, which is very quiet." — W7UC

"It's hard to say which is best, it's got so many great features. Easy to operate; can be quickly disconnected from home station and put in car; great audio on transmit and receive. Easy to operate mobile: Very stable VFO on rough roads." — KA7AWS

table 1. Best feature. The percentage refers to the number of respondents who listed that feature as best. Note that many respondents listed more than one "best feature."

|                                   | percent |
|-----------------------------------|---------|
| general coverage receiver         | 36      |
| broadband qualities               | 31      |
| ease of operation                 | 16      |
| good audio                        | 9       |
| flexibility                       | 9       |
| no tune-up                        | 8       |
| battery operation and portability | 8       |
| digital readout                   | 7       |
| stability                         | 6       |
| built-in frequency counter        | 6       |
| clean CW                          | 5       |
| power output                      | 4       |
| good accessory connections        | 4       |

**table 2. Worst feature. The percentage refers to the number of respondents who listed that feature as worst.**

|                                  | percent |
|----------------------------------|---------|
| PTO drift                        | 10      |
| poor metering                    | 9       |
| auxiliary programming            | 7       |
| service manual                   | 6       |
| front panel appearance           | 5       |
| noisy receiver at minimum volume | 5       |
| size of pushbuttons              | 4       |
| price                            | 4       |
| AGC always on                    | 4       |
| sensitivity to SWR               | 3       |

**table 3. Problems. The percentage refers to the number of respondents who listed the problem on their survey form.**

|                    | percent |
|--------------------|---------|
| no problems        | 32      |
| frequency drift    | 10      |
| bad solder joints  | 6       |
| PIN diode problems | 6       |
| tuning dial        | 5       |
| bad transistor     | 4       |
| rf in audio        | 2       |
| low audio output   | 2       |
| voltage regulator  | 1       |

**table 4. Accessories. The percentage refers to the number of respondents who bought the accessory listed.**

|                    | percent |
|--------------------|---------|
| additional filters | 31      |
| remote VFO         | 18      |
| fan                | 16      |
| service manual     | 9       |
| noise blanker      | 8       |
| speech processor   | 8       |
| external speaker   | 7       |
| matching network   | 6       |
| amplifier          | 4       |
| wattmeter          | 4       |

**table 5. Desirable additional features. The percentage refers to the number of respondents who would like to see the feature incorporated into the TR7.**

|                                                        | percent |
|--------------------------------------------------------|---------|
| notch filter                                           | 18      |
| second VFO (now available as outboard accessory)       | 13      |
| speech processor (now available as outboard accessory) | 9       |
| noise blanker (now available as accessory)             | 5       |
| fixed sidetone volume adjust                           | 5       |
| phone patch jack                                       | 4       |
| built-in power supply                                  | 4       |
| fm mode                                                | 3       |
| programmable memory                                    | 3       |
| microcomputer interface                                | 2       |

"Versatility — it works MARS on many out-of-band frequencies. The TR7's ability to reach anything from 1.5-30 MHz with no need for transmitter adjustments or receiver preselection makes it a great pleasure to operate." — WA4SHP

"Extremely accurate frequency readout — can operate with confidence, knowing I'm on frequency. Passband tuning operates just great! Comes in handy most of the time I'm operating. General coverage receiver adds to the enjoyment." — VE3LIQ

"Wide frequency range. The XYL enjoys SW broadcasts and I like to copy ship-to-shore CW on lf and hf. Very convenient for use in our travel trailer." — W8BH

### ... and the bad

In response to the question, *What is the rig's worst feature?*, the highest percentage of respondents, 10 percent, reported drift in the PTO. Nine percent complained about the metering on the rig — being not calibrated well or being ineffective — and about 7 percent did not like the STORE (frequency display) capability, finding no use for it. Other votes for the worst feature of the TR7 went to the service manual (for providing too little information), the looks of the front panel, the small size of the pushbuttons, and the price.

Here are some sample replies to the question, *What is the rig's worst feature?*:

"The lack of explanation in the owners' manual on the best ways to use the passband tuning feature. I still have not convinced myself that I am using it properly on SSB. The owners' manual should offer more technical information on the rig. I had to purchase the service manual in order to find out what's inside the rig." — AI0W

"Has small, slow, frequency drift during the first hour from a cold start. After that it is very stable." — W7FSP

"Click in phones when switching from CW to SSB." — K5AS

"Price. Doesn't have fm mode. Doesn't have notch filter. Doesn't come with mike or 12-volt power plug." — WD8PAQ

"Haven't found any! I really can't say anything bad about this rig." — WA2MNG

"No break-in. No possibility of switching the AGC off." — OZ8SO

"No notch filter. Price." — AB6X

"SWR protection circuit is very sensitive and a really good matching network (tuner) is a must to achieve maximum output." — KM4U

"Price: A real nice radio but I think it is priced too high now at \$1495.00." — KA2HYV

"Af gain control doesn't quiet the receiver." — DL7GK

"Drift during warm-up." — N2AQS

"There are just *no* bad features." — KH6JRZ

"No memories on second VFO. Poor quality dial mechanism."

"PTO drift."

"Counter reads out to only the nearest 100 Hz. Readout to nearest 10 Hz would be useful to meet military frequency standards (most are  $\pm 50$  or  $\pm 25$  Hz)." — WB2BOO

"Analog dial is hard to read." — Ed Clabough, Birmingham, Alabama.

"No phone-patch connection. I had to have mine modified." — K9ERO

"Low audio output." — K5FZ

"Weak audio." — W1OFZ

"Sensitivity to antenna SWR."

"No built-in notch filter. No way to completely defeat the AGC circuit." — W5AYZ

"As with all broadband solid-state no-tune radios, an antenna tuner/matchbox is required to match antenna, or rf shutdown will start about 3:1 SWR." — WB9HBH

"Sidetone not adjustable." — W3ODN

"Frequency creep." — W1AY

"Volume control can't completely cut off audio. Digital display hold button is useless. Auxiliary VFO shifts frequency when spot button is depressed." — WB9IWN

## problems

Thirty-two percent of those completing questionnaires said they've had no problems with the TR7.

The most common problem encountered with the TR7, mentioned by 10 percent of the respondents to the questionnaire, was frequency drift. Other problems that cropped up were bad solder joints, leaky PIN diodes, problems with the tuning dial, and an occasional bad transistor. Bad solder joints were referred to by about 6 percent of those who replied. No other problems received significant attention from our respondents.

## additional features

To the question, What additional features would you like to see built into a rig of this type?, the most frequent response was a notch filter, mentioned by 18 percent of the respondents. Next to the addition of a notch filter, the addition of a speech processor ranked high in the estimation of Amateurs responding. About 9 percent said that they would want to see some sort of speech processing incorporated into a rig of this type.

Other additional features that were mentioned were a phone-patch jack, programmable memories, a noise blanker, fm mode capability, a sidetone vol-

ume adjustment, an SSB squelch, and a built-in power supply.

## accessories and related findings

The most popular accessory among owners of the TR7 is filters, which were purchased by about a third of those replying to the survey. However, we believe that about 75 percent of TR7 owners have actually purchased filters, which indicates that most of those responding to the survey didn't consider the filters as accessories. These include a-m, CW, and SSB filters. Next in popularity (18 percent) was a remote VFO, followed by speech processors, noise blankers, external speakers, and the service manual.

To the question, Have you had the rig serviced?, 51 percent answered yes and 49 percent no. Eighty-two percent of those whose rigs had been serviced said that the servicing was satisfactory. To the question, Have you been able to obtain all the accessories and parts you need?, 98 percent answered yes, indicating that Drake is certainly making their parts and accessories available to Amateurs. Ninety-four percent of those who purchased accessories were happy with them.

By license class, 45 percent of those responding to the questionnaire held an Advanced class ticket, 38 percent were Extras, 15 percent were Generals, and 2 percent were Technicians.

To the question, What antenna do you use most, 51 percent answered *beam*, 33 percent answered *wire*, 13 percent said *vertical*, and 3 percent replied *other*.

The following twelve categories were scored from 1 to 10 (with 1 being poorest, 4 to 6 average, and 10 perfect): Ease of Operation, Reliability, Durability, Instruction Book, Factory/Dealer Service, Quality of Workmanship, Performance, Maintenance, Parts Availability, Accessories (ease of connection), Price and Flexibility. The scores are reported in fig. 1.

## would you buy one again?

That's the big question, and over 88 percent of the Amateurs responding answered yes. That's the highest positive response we've received thus far on any piece of high-frequency Amateur gear we've asked our readers about. Owners of the Drake TR7 are obviously very happy with their choice.

Next month, *ham radio* will present the results of its readers' survey on the Kenwood 520. This is a rig many Amateurs have asked to have reviewed, and the results should be interesting. Thanks to all who have participated by sending in a completed questionnaire.

**ham radio**

# CALL TOLL FREE

For the best deal on

- AEA • Alliance • Ameco • Apple • ASP
- Avanti • Belden • Bench • Bird • CDE
- CES • Communications Specialists
- Collins • Cushcraft • Daiwa • DenTron
- Drake • Hustler • Hy-Gain • Icom • IRL • KLM
- Kenwood • Larsen • Macrotronics • MFJ
- Midland • Mini-Products • Mirage • Mosley
- NPC • Newtronics • Nye • Panasonic
- Palomar Engineers • Regency • Robot
- Shure • Standard • Swan • Tempo
- Ten-Tec • Transcom • Yaesu

## Your Best Buys for November!

TRIONYX TR-1000 600 MHz  
Frequency Counter \$139.95

ICOM IC-730 HF Xcvr...

Now only \_\_\_\_\_ \$749.95

ICOM IC-2A 2M Hand-Held...

Limited special — \$219.50

KENWOOD TR-7730, TS-830S

In stock, immediate delivery!

YAESU's New FT-208R... Now  
delivering from stock...

ROBOT 800 ASCII, Baudot and  
CW Terminal — \$799.95

APPLE Disk Based System:  
Apple II or II Plus with 48k  
RAM installed, Disk II with  
controller, DOS 3.3 — \$1899

APPLE Game Paddles available

Quantities limited... all prices subject to  
change without notice

We always have an excellent  
assortment of fine used equip-  
ment in stock... Come in or call

CALL TOLL FREE  
(outside Illinois only)

(800) 621-5802

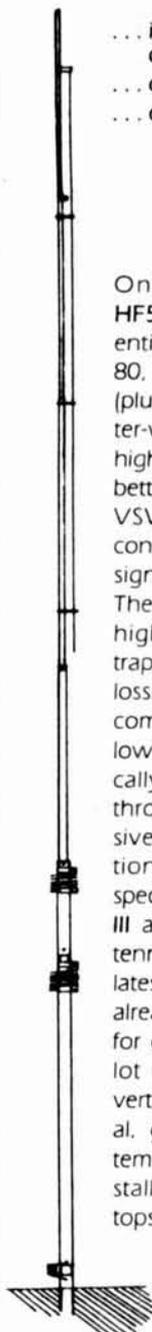
HOURS: 9:30-5:30 Mon., Tues., Wed. & Fri.  
9:30-9:00 Thursday  
9:00-3:00 Saturday

**ERICKSON  
COMMUNICATIONS**  
Chicago, IL 60630  
5456 North Milwaukee Ave.  
(312) 631-5181 (within Illinois)

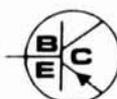
## WHY PAY

FULL PRICE FOR  
AN 80-10 METER  
VERTICAL

- ... if you can use only 1/3  
of it on 107
- ... or only 1/2 of it on 207
- ... or only 3/4 of it on 407



Only Butternut's new HF5V-III lets you use the entire 26-foot radiator on 80, 40, 20 and 10 meters (plus a full unloaded quarter-wavelength on 15) for higher radiation resistance, better efficiency and greater VSWR bandwidth than conventional multi-trap designs of comparable size. The HF5V-III uses only two high-Q L-C circuits (not traps) and one practically lossless linear decoupler for completely automatic and low VSWR resonance (typically below 1.5:1) on 80 through 10 meters, inclusive. For further information, including complete specifications on the HF5V-III and other Butternut antenna products, ask for our latest free catalog. If you've already "gone vertical," ask for one anyway. There's a lot of information about vertical antennas in general, ground and radial systems, plus helpful tips on installing verticals on rooftops, on mobile homes, etc.



**BUTTERNUT  
ELECTRONICS  
CO.**

356E Route 2  
San Marcos, Texas 78666  
Phone: (512) 396-4111

GOT A BATTERY EATER??



YOU NEED A  
BATTERY-BEATER!!!

(Radio not included)

## BEAT YOUR BATTERIES!

OPERATE your SYNTHESIZED HT CONTINUOUSLY from any 12-30V D.C. source: Auto, Truck, RV, Light Aircraft (12 or 28V system), Home D.C. Power Supply!!!

STEWART's New "BATTERY-BEATER" provides the proper REGULATED voltage for your rig and plenty of current for CONTINUOUS FULL POWER TRANSMIT! All day travel, all evening StimpTex Net with NO QRT TO RE-CHARGE! TRANSMIT EVEN WITH DEAD NiCads!!!!

- NOT a battery charger but a FULL POWER SOURCE with TWO PROTECTION CIRCUITS!
  - RUGGED ALUMINUM CASE! NEW, IMPROVED MODEL FOR ICOM! SO TOUGH THE AVERAGE MAN CAN STAND ON IT!
  - YOUR NiCads REMAIN IN PLACE! Simply unplug for INSTANT PORTABILITY!!
  - DESIGNED by an engineer from NASA's Jet Propulsion Laboratory with components rated 50% beyond requirements!
  - PRE-WIRED JACK for your radio with detailed, step-by-step installation instructions.
  - TWO 5 FT. POWER CORDS - 10 FT. TOTAL REACH! VELCRO pads to mount anywhere! 1 FULL YEAR WARRANTY!!!
  - NO INTERFERENCE with PL's! LONGER LIFE FOR NiCads!
  - THE ONLY accessory power supply that can claim all these exciting features, and more!!
  - NOW AVAILABLE FOR TEMPO S-1, 2, 5;
  - YAESU FT-207R; ICOM IC-2A/T; WILSON MK II, MK IV; SANTEC HT-1200! (MEMORY RIGS RETAIN MEMORY!!!)
  - PRICE: ALL MODELS - \$30.00 Post Paid. Ca. Res. add \$1.80 Tax. C.O.D.'s - You pay Postage and COD fees.
  - PHONE: 1-213-357-7875 for C.O.D.
- STEWART QUADS P.O. Box 2335 IRVINGDALE, CA. 91706

## RECEIVERS

R-1143/WRR-3 - 14-600

Khz AM-CW-FS in five bands;

mechanical digital tuning.

8 1/4 x 17 1/4 x 16 1/4", 80 lbs.

Used, checked: \$295.

Manual, partial repro: \$15.

R-388/URR - 0.5-30.5

Mhz in 30 bands; rackmount. Mil-Collins 51J3;

10 1/2 x 19 x 13", 55 lbs. Used, checked: \$400.

Manual, partial repro: \$10.

HAMMARLUND SP-600JX - 0.54-54 Mhz AM-

CW in seven bands; rackmount. 10 1/2 x 19 x 17", 85 lbs.

Used, checked: \$285 Manual, partial repro: \$10.

R-648/ARR-41 - 190-550 Khz and 2-25 Mhz AM-CW

in 25 bands; mechanical digital tuning. Requires 24 VDC

4 amps; 7 1/2 x 16 x 13 1/4", 35 lbs. Used, checked: \$205.

Manual, partial repro: \$15.

Prices F.O.B. Lima, O. • VISA, MASTERCARD Accepted.

Allow for Shipping • Write for New 1981 CATALOG

Address Dept. HR • Phone: 419/227-6573

## FAIR RADIO SALES

1016 E. EUREKA • Box 1105 • LIMA, OHIO • 45802

## SYNTHESIZED SIGNAL GENERATOR



MADE IN  
USA

MODEL  
SG 100C  
\$329.95  
plus shipping

- Covers 100 to 179.999 MHz in 1 kHz steps with thumb-wheel dial • Accuracy .00001% at all frequencies • Internal frequency modulation from 0 to over 100 kHz at a 1 kHz rate • Spurs and noise at least 60dB below carrier • RF output adjustable from 5-500mV across 50 ohms • Operates on 12vdc @ 1/2 amp. In stock for immediate shipping. \$329.95 plus shipping. Overnight delivery available at extra cost. • Range Extender (phase-locked mixer/divider) for above unit. Extends the range from .1 to 580 MHz. Same size as SG-100. Mounts piggyback. Price: \$299.95.

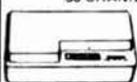
## VANGUARD LABS

196-23 Jamaica Ave., Hollis, NY 11423  
Phone: (212) 468-2720

# ETCO

## CABLE TV CONVERTERS AND OTHER GOOD STUFF!

SMASHING ALL SALES RECORDS - OUR NEW 30 CHANNEL CABLE TV CONVERTER!



Converts mid & super band cable channels for viewing on your TV set.  
No. 352AE047

**39<sup>95</sup>**  
\$34.95 ea / 5

HOT NEW IMPORT! REMOTE CONTROL 30 CHANNEL CABLE TV CONVERTER!



Includes remote TV on-off switch and fine tuning control!  
No. 352VA275

**89<sup>95</sup>**  
\$79.95 ea / 5  
\$74.95 ea / 10

ETCO MKII WIRELESS - THE ULTIMATE CABLE TV CONVERTER!



Set TV to channel 3 and the hand held remote control does the rest!  
No. 352A008

**189<sup>00</sup>**

VIDCOR 2000 CONVERTER ELIMINATES PROBLEMS WHEN VIDEOTAPING FROM CABLE TV



Restores your VCR's ability for programming. Restores remote channel control. Enables videotaping of fine cable program while watching another.

**89<sup>95</sup>**  
No. 352VA800

UNUSUAL FACTORY SURPLUS MID BAND - SUPER BAND CABLE TV TUNER



Converts cable channels to a common IF frequency. Experimental work building cable TV converters etc. No. 352VA342

**19<sup>95</sup>**  
\$17.50 ea / 10

FACTORY SURPLUS UHF TUNERS



Brand new production surplus. All legal state. Ideal for experimental work building cable TV converters etc. No. 352U0094

**4<sup>95</sup>**  
\$3.95 ea / 10

MINIATURE FM WIRELESS MICROPHONE



Hides in the palm of your hand! Reception on any standard FM radio or receiver. No. 352VA482

**29<sup>95</sup>**  
\$27.50 ea / 5  
\$24.95 ea / 10

QUARTER MILE WIRELESS MICROPHONE & RECEIVER SYSTEM



FCC approved crystal oscillator. Stereo mike & receiver. All battery operated. 8-needle work range regions. VU meter. No. 352VA093

**69<sup>95</sup>**  
\$49.95 ea / 5

FACTORY SURPLUS VHF / UHF "TWIN" VARACTOR TUNERS!



Adapted to NC 3143 1 BRAND NEW! For building home made or commercial transmitters. 2 - RDS-1 F2025 - 8 band. Full test at a standard frequency. No. 352VC308

**39<sup>95</sup>**  
\$34.95 ea / 5

DUMPING! NORESCO ENDLESS LOOP CASSETTES!



Impossible to find at any price!  
3 minutes - No. 352VA605  
6 minutes - No. 352VA606

**4<sup>95</sup>**  
\$4.49 ea / 10

IN STOCK - THE MURA CORDLESS TELEPHONE SYSTEM!



100% reliable. No cord. No. 352VA274

**144<sup>88</sup>**  
\$129.95 ea / 5

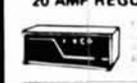
SALE OF QUARTZ BATTERY OPERATED CLOCK MOVEMENTS!



100% reliable. No cord. No. 352VA561

**9<sup>95</sup>**  
\$8.95 ea / 5

20 AMP REGULATED 12VDC POWER SUPPLY!



12V regulated. 100% reliable. No. 352VA394

**69<sup>88</sup>**  
\$59.88 ea / 5

OUR LATEST 98 PAGE FASCINATING CATALOG



Free! No charge. No obligation. No. 352VA561

**FREE**

ETCO ELECTRONICS NORTH COUNTRY SHOPPING CENTER PLATTSBURGH, N.Y. 12901

Check with order please. Visa & Mastercard OK. Sorry no L.O.D. - Add 5% for UPS & handling (Extra refunded). N.Y. State residents add 7% sales tax. Dealer & export inquiries invited. This telephone order book covers items. Call 1-818-563-8700.

# NRI will train you at home to be an electronics professional in the growing world of communications.

Learn to service, repair, and install everything from microwave antennas to two-way radios... from radar sets to TV transmitters.



Microwave

No other home-study course gives you such complete, professional training in so many fields of communication. No other gives you such advanced equipment, selected for state-of-the-art design and features. Only NRI gives you the thorough preparation and training you need to achieve professional competence in the wide world of communications.

### Learn at Home in Your Spare Time

Learn at your own pace, right in your own home. There's no need to quit your job or tie up your evenings with night classes. No time or gas wasted traveling to school; NRI brings it all to you. You learn with NRI-developed fast-track training methods, a clearly and logically organized program using advanced techniques for learning at home.

### Includes 2-Meter Transceiver or Bearcat Automatic Scanner

Your training is built around your choice of this high technology equipment. The synthesized two-meter transceiver represents the latest advance in portable communications. Microprocessor-based



Train with professional instruments and equipment that's yours to keep.



Marine Communications



TV Broadcasting



AM & FM Broadcasting



CB Radio

circuitry and LED digital readout mean precision operation and high efficiency. The scanner also features microprocessor basing with both programmable and scanning functions covering the HF, VHF, and UHF mobile bands. Using NRI Action Audio cassette training units, you learn not only how to operate these units, but study their advanced circuitry in detail.

Also included for both training and professional use is a six-function Beckman LCD digital multimeter, a Heathkit portable frequency counter, the NRI Antenna Applications Lab, and the NRI Discovery Lab, where you build and test the "leading-edge" circuitry found in your transceiver or scanner.

### FCC License or Full Refund

In addition to all lessons, equipment, and instruments, you get special training for the FCC radio-telephone license you need to work in this exciting field. You pass your FCC examination or your tuition will be refunded in full. No ifs, ands, or buts...this money-back warranty is valid for six months after completion of your course.

### Free Catalog, No Salesman Will Call

NRI's free 100-page catalog shows all the equipment you get, describes each lesson in full, and tells about other electronic training in fields like TV/Audio/Video, Microcomputers, and Digital Electronics. Mail the coupon and see how we can make you a pro. If coupon has been removed, please write to NRI Schools, 3939 Wisconsin Ave., Washington, D.C. 20016.

**NRI Schools**  
McGraw-Hill Continuing Education Center  
3939 Wisconsin Avenue  
Washington, D.C. 20016

We'll give you tomorrow

NO SALESMAN WILL CALL

Name (Please Print) Age

Street

City/State/Zip

Accredited by the Accrediting Commission of the National Home Study Council



Please check for one free catalog only

- Communications Electronics • FCC Licenses
- Mobile • CB • Aircraft • Marine
- Color TV, Audio, and Video System Servicing
- Electronics Design Technology
- Computer Electronics including Microcomputers
- Digital Electronics
- Basic Electronics
- Small Engine Servicing
- Appliance Servicing
- Automotive Servicing
- Auto Air Conditioning
- Air Conditioning, Heating, Refrigeration, & Solar Technology
- Building Construction

All career courses approved under GI bill  
 Check for details.

20-111

# SEMICONDUCTORS SURPLUS

2822 North 32nd Street, #1 • Phoenix, Arizona 85008 • Phone 602-956-9423

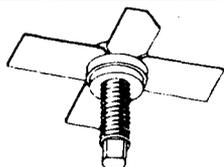
## ARCO CAPS

|     |           |      |      |            |      |
|-----|-----------|------|------|------------|------|
| 304 | 100-550pF | 1.50 | 469  | 170-780pF  | 1.40 |
| 400 | .9-7pF    | 1.00 | 4615 | 390-1400pF | 2.02 |
| 402 | 1.5-20pF  | 1.00 | 404  | 8-60pF     | 1.00 |
| 420 | 1-12pF    | 1.00 | 405  | 10-80pF    | 1.00 |
| 423 | 7-100pF   | 1.00 | 422  | 4-40pF     | 1.00 |
| 426 | 37-250pF  | 1.01 | 424  | 16-150pF   | 1.00 |
| 464 | 25-280pF  | 1.00 | 427  | 55-300pF   | 1.00 |
| 465 | 50-380pF  | 1.39 | 462  | 5-80pF     | 1.50 |
| 467 | 110-580pF | 1.03 |      |            |      |

## TUBES

|                 |        |            |        |
|-----------------|--------|------------|--------|
| 6KD6            | 5.00   | 6939       | 7.99   |
| 6LQ6/6JE6       | 6.00   | 6146       | 5.00   |
| 6MJ6/6LQ6/6JE6C | 6.00   | 6146A      | 5.69   |
| 6LF6/6MH6       | 5.00   | 6146B/8298 | 7.95   |
| 12BY7A          | 4.00   | 6146W      | 12.00  |
| 2E26            | 4.69   | 6550A      | 8.00   |
| 4X150A          | 29.99  | 8908       | 9.00   |
| 4CX250B         | 45.00  | 8950       | 9.00   |
| 4CX250R         | 69.00  | 4-400A     | 145.00 |
| 4CX300A         | 109.99 | 4-400C     | 145.00 |
| 4CX350A/8321    | 100.00 | 572B/T160L | 44.00  |
| 4CX350F/J/8904  | 100.00 | 7289       | 9.95   |
| 4CX1500B/8660   | 300.00 | 3-1000Z    | 229.00 |
| 811A            | 20.00  | 3-500Z     | 141.00 |
| 6360            | 4.69   |            |        |

## RF Transistors



|         |          |         |       |                  |             |
|---------|----------|---------|-------|------------------|-------------|
| MRF203  | P. O. R. | MRF449  | 12.65 | BFR91            | 1.25        |
| MRF216  | 19.47    | MRF449A | 12.65 | BFR96            | 1.50        |
| MRF221  | 8.73     | MRF450  | 11.00 | BFW92A           | 1.00        |
| MRF226  | 10.20    | MRF450A | 11.77 | BFW92            | .79         |
| MRF227  | 2.13     | MRF452  | 15.00 | MMCM918          | 14.30       |
| MRF238  | 10.00    | MRF453  | 13.72 | MMCM2222         | 15.65       |
| MRF240  | 14.62    | MRF454A | 21.83 | MMCM2369         | 15.00       |
| MRF245  | 28.87    | MRF455  | 14.08 | MMCM2484         | 15.25       |
| MRF247  | 28.87    | MRF455A | 14.08 | MMCM3960A        | 24.30       |
| MRF262  | 6.25     | MRF474  | 3.00  | MWA120           | 7.80        |
| MRF314  | 12.20    | MRF475  | 2.90  | MWA130           | 8.08        |
| MRF406  | 11.33    | MRF476  | 2.25  | MWA210           | 7.46        |
| MRF412  | 20.65    | MRF477  | 10.00 | MWA220           | 8.08        |
| MRF421  | 27.45    | MRF485  | 3.00  | MWA230           | 8.62        |
| MRF422A | 38.25    | MRF492  | 20.40 | MWA310           | 8.08        |
| MRF422  | 38.25    | MRF502  | .93   |                  |             |
| MRF428  | 38.25    | MRF604  | 2.00  | NEW MRF472       |             |
| MRF428A | 38.25    | MRF629  | 3.00  | 12.5 VDC, 27 MHz |             |
| MRF426  | 8.87     | MRF648  | 26.87 | 4 Watts output   |             |
| MRF426A | 8.87     | MRF901  | 3.99  | 10 dB gain       |             |
|         |          | MRF902  | 9.41  |                  | 1.69 ea.    |
|         |          | MRF904  | 3.00  |                  | 10/9.50     |
|         |          | MRF911  | 4.29  |                  | 100/69.00   |
|         |          | MRF5176 | 11.73 |                  | 1000/480.00 |
|         |          | MRF8004 | 1.39  |                  |             |
|         |          | BFR90   | 1.00  |                  |             |

TO-3 TRANSISTOR SOCKETS  
Phenolic type..... 6/\$1.00

NEW SIMPSON 260-7 \$99.99

RG174/U - \$15.00 per 100 ft.  
Factory new

PL259 TERMINATION  
52 Ohm 5 Watts \$1.50 each

TORIN TA700 FANS NEW \$29.99 each  
Model A30340  
230 VAC @ .78 Amps  
Will also work on 115 VAC

## CRYSTAL FILTERS

|                     |       |
|---------------------|-------|
| EFCL455K13E         | 3.99  |
| EFCL455K40B2        | 2.99  |
| FX-07800L, 7.8 MHz  | 12.99 |
| FHA 103-4, 10.7 MHz | 12.99 |

## ORDERING INSTRUCTIONS

Check, money order, or credit cards welcome. (Master Charge and VISA only.) No personal checks or certified personal checks for foreign countries accepted. Money order or cashiers check in U.S. funds only. Letters of credit are not acceptable.

Minimum shipping by UPS is \$2.35 with insurance. Please allow extra shipping charges for heavy or long items.

All parts returned due to customer error or decision will be subject to a 15% restock charge. If we are out of an item ordered, we will try to replace it with an equal or better part unless you specify not to, or we will back order the item, or refund your money.

PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE. Prices supersede all previously published. Some items offered are limited to small quantities and are subject to prior sale.

We now have a toll free number, but we ask that it be used for *charge orders only*. If you have any questions *please use our other number*. We are open from 8:00 a.m. - 5:00 p.m. Monday thru Saturday.

Our toll free number for *charge orders only* is 800-528-3611.

### MINIMUM ORDER \$10.00

NEW CHERRY BCD SWITCH  
New end plates  
Type T-20..... 1.29 each

## Johnson AIR Variables

\$1.00 each

|             |               |
|-------------|---------------|
| T-3-5       | 1 to 5 pF     |
| T-6-5       | 1.7 to 11 pF  |
| T-9-5       | 2 to 15 pF    |
| 189-6-1     | .1 to 10 pF   |
| 189-502-Y   | 1.3 to 6.7pF  |
| 189-503-105 | 1.4 to 9.2pF  |
| 189-504-5   | 1.5 to 11.6pF |
| 189-505-5   | 1.7 to 14.1pF |
| 189-505-107 | 1.7 to 14.1pF |
| 189-506-103 | 1.8 to 16.7pF |
| 189-507-105 | 2 to 19.3pF   |
| 189-508-5   | 2.1 to 22.9pF |
| 189-509-5   | 2.4 to 24.5pF |
| 545-043     | 1.8 to 11.4pF |

# Johnson AIR Variables

1/4 x 2 1/2" shaft  
\$2.50 each

193-10-6            2.2 to 34 pF  
193-                1.5 to 27.5pF  
193-                .6 to 6.4pF

\$1.00 each

160-107-16        .5 to 12 pF  
193-10-9           2.2 to 34 pF  
193-10-104       2.2 to 34 pF  
193-4-5            3 to 30 pF

## RF Power Device

MRF454 Same as MRF458  
12.5 VDC, 3-30 MHz  
80Watts output, 12dB gain  
\$17.95 ea.

## E.F. JOHNSON TUBE SOCKETS

#124-0311-100..... 6.99 each  
For 8072 etc.

#124-0107-001..... 13.99 each  
For 4CX250B/R, 4X150A etc.

#124-0111-001..... 4.99 each  
Chimney for 4CX250B/R and  
4X150

#124-0113-001 and 124-0113-021  
\$12.99 each  
Capacitor for #124-0107-001

#123-209-33 Sockets... 6.99 each  
For 811A, 572B, 866, etc.

## UNELCO CAPS

|       |                     |
|-------|---------------------|
| 6.8pF | 47pF                |
| 8.2pF | 62pF                |
| 10pF  | 100pF               |
| 12pF  | 160pF               |
| 13pF  | 180pF               |
| 14pF  | 200pF               |
| 20pF  | 240pF               |
| 24pF  | 380pF               |
| 33pF  | 470pF               |
| 36pF  | 100pF               |
| 43pF  | 350V    \$1.00 each |

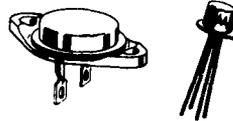
86 Pin Motorola Bus Edge Connectors

Gold plated contacts  
Dual 43/86 pin .156 spacing  
Solder tail for PCB.....\$3.00 each

### 110VAC MUFFIN FANS

New ..... \$11.95  
Used ..... \$5.95

## Transistors



|             |       |              |       |
|-------------|-------|--------------|-------|
| 2N3960JANTX | 10.00 | 2N5645       | 10.00 |
| 2N4072      | 1.60  | 2N5842       | 8.00  |
| 2N4427      | 1.10  | 2N5849       | 20.00 |
| 2N4429      | 7.00  | 2N5942       | 40.00 |
| 2N4877      | 1.00  | 2N5946       | 14.00 |
| 2N4959      | 2.00  | 2N5862       | 50.00 |
| 2N4976      | 15.00 | 2N6080       | 7.00  |
| 2N5070      | 8.00  | 2N6081       | 10.00 |
| 2N5071      | 15.00 | 2N6082       | 11.00 |
| 2N5108      | 4.00  | 2N6083       | 13.00 |
| 2N5109      | 1.50  | 2N6084       | 14.00 |
| 2N5179      | 1.00  | 2N6095       | 11.00 |
| 2N5583      | 4.00  | 2N6096       | 20.00 |
| 2N5589      | 6.00  | 2N6097       | 28.00 |
| 2N5590      | 8.00  | 2N6166       | 38.00 |
| 2N5591      | 11.00 | 2N6368       | 22.99 |
| 2N5635      | 5.44  | A 210/MRF517 | 2.00  |
| 2N5636      | 11.60 | BLY38        | 5.00  |
| 2N5637      | 20.00 | 40280/2N4427 | 1.10  |
| 2N5641      | 5.00  | 40281/2N3920 | 7.00  |
| 2N5643      | 14.00 | 40282/2N3927 | 10.48 |
| 2N2857JAN   | 2.50  |              |       |
| 2N2949      | 3.60  |              |       |
| 2N2947      | 15.00 |              |       |
| 2N2950      | 4.60  |              |       |
| 2N3375      | 8.00  |              |       |
| 2N3553      | 1.57  |              |       |
| 2N3818      | 5.00  |              |       |
| 2N3866      | 1.00  |              |       |
| 2N3866JAN   | 2.50  |              |       |
| 2N3866JANTX | 4.00  |              |       |
| 2N3925      | 10.00 |              |       |
| 2N3948      | 2.00  |              |       |
| 2N3950      | 25.00 |              |       |
| 2N3959      | 3.00  |              |       |

## CRYSTALS

\$4.95 each

|        |        |         |        |        |        |        |
|--------|--------|---------|--------|--------|--------|--------|
| 5.120  | 7.4825 | 9.565   | 10.150 | 11.155 | 11.905 | 17.315 |
| 7.3435 | 7.4865 | 9.575   | 10.160 | 11.275 | 11.955 | 17.355 |
| 7.4585 | 7.4925 | 9.585   | 10.170 | 11.700 | 12.000 | 17.365 |
| 7.4615 | 7.4985 | 10.000  | 10.180 | 11.705 | 12.050 | 37.600 |
| 7.4625 | 7.5015 | 10.010  | 10.240 | 11.730 | 12.100 | 37.650 |
| 7.4665 | 7.5025 | 10.020  | 10.245 | 11.750 | 16.965 | 37.700 |
| 7.4685 | 7.5065 | 10.030  | 10.595 | 11.755 | 17.015 | 37.750 |
| 7.4715 | 7.7985 | 10.040  | 10.605 | 11.800 | 17.065 | 37.800 |
| 7.4725 | 7.8025 | 10.0525 | 10.615 | 11.850 | 17.165 | 37.850 |
| 7.4765 | 9.545  | 10.130  | 10.625 | 11.855 | 17.215 | 37.900 |
| 7.4785 | 9.555  | 10.140  | 10.635 | 11.900 | 17.265 | 37.950 |
| 7.4815 |        |         |        |        |        | 38.000 |

## High Voltage Caps

|                     |        |
|---------------------|--------|
| 30 MFD @ 500 VDC    | 1.69   |
| 22 MFD @ 500 VDC    | 1.69   |
| 100 MFD @ 450 VDC   | 2.29   |
| 150 MFD @ 450 VDC   | 3.29   |
| 225 MFD @ 450 VDC   | 4.29   |
| .001/1000pF @ 10 KV | .89    |
| .001 @ 3 KV         | 4/1.00 |
| .0015 @ 3 KV        | 3/1.00 |
| .01 @ 4 KV          | .79    |
| .01 @ 1.6KV         | 4/1.00 |
| .02 @ 8 KV          | 2.00   |
| .01 @ 1 KV          | 6/1.00 |

NEW 2" ROUND SPEAKERS  
100 Ohm coil            \$ .99 each

PLASTIC TO-3 SOCKETS  
4/\$1.00

### CRYSTAL FILTERS

Tyco 001-19880 Same as 2194F  
10.7 MHz narrow band  
3 dB bandwidth 15 KHz min.  
20 dB bandwidth 60 KHz min.  
40 dB bandwidth 150 KHz min.  
Ultimate 50 dB insertion loss 1 dB max.  
Ripple 1 dB max. Cl. 0+/-5 pF 3600 Ohms  
\$3.99 each

78M05  
Same as 7805 but only 1/2 Amp  
5 VDC            .49 each or 10/\$3.00

## TRIMMER CAPS

Sprague. Stable Polypropylene.  
.50 each or 10/4.00  
not sold mixed  
1.2 to 13pF  
2 to 30pF  
3.9 to 18pF  
3.9 to 40pF  
3.9 to 55pF

Carbide Circuit Board Drill Bits  
for PCB Boards  
5 mix for \$5.00

## J-Fet

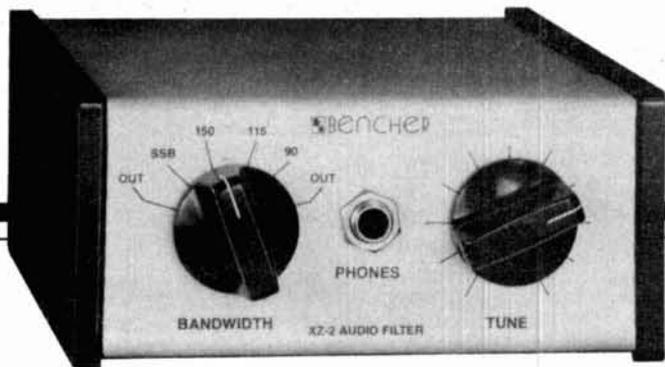
J310 N-CHANNEL J-FET 450 MHz  
Good for VHF/UHF Amplifier,  
Oscillator and Mixers    3/\$1.00

### MURATA CERAMIC FILTERS

|            |          |      |
|------------|----------|------|
| SFD 455D   | 455 KHz  | 2.00 |
| SFB 455D   | 455 KHz  | 1.60 |
| CFM455E    | 455 KHz  | 5.50 |
| CFU 455H   | 455 KHz  | 3.00 |
| SFE 10.7MA | 10.7 MHz | 2.99 |

TEXAS INSTRUMENT TIL-305P  
5 x 7 array alphanumeric display  
\$3.85 each

MINIMUM ORDER \$10.00



## XZ-2 AUDIO CW FILTER

... THE COPY MACHINE

- 4 active stages, true bandpass filter
- Tunable center frequency
- 4 bandwidths—90Hz, 115Hz, 150Hz & SSB
- Simple to operate
  - Especially designed for the CW operator, useful as well on SSB
- Low Q design
- One-watt+ available audio output
- Matches any impedance

**XZ-2 Audio Filter \$69.95**  
**12V Power Supply \$ 9.95**

WRITE FOR LITERATURE

At selected dealers or add  
 \$2.00 handling. Quotation for  
 overseas postage on request.

**BENCHER, INC.**

333 West Lake St., Chicago, IL 60606 (312) 263-1808.



## The HAM SHACK

808 N. Main  
 Evansville, IN 47711

### TEN-TEC

|                        |           |
|------------------------|-----------|
| 546 Omni C             | \$1060.00 |
| 580 Delta              | 760.00    |
| 525 Argosy             | 485.00    |
| 280 Power Supply       | 150.00    |
| 255 Power Supply/Spkr. | 170.00    |
| 243 Vfo—Omni           | 169.00    |
| 283 Vfo—Delta          | 169.00    |
| 444 Hercules Amp.      | 1340.00   |

### ICOM

Icom 730 \$700.00

|                                 |           |
|---------------------------------|-----------|
| Azden PCS3000/TTPkit            | \$ 295.00 |
| AEA READER CW/RTTY/ASCII        | 275.00    |
| Alliance HD-73 Rotator          | \$99.00   |
| CUBIC Astro 103                 | 1175.00   |
| Daiwa CNA-2002 2.5 kw autotuner | 425.00    |
| HyGain Antenna Specials         | call      |
| ICOM 720/A Power Sup./Mic.      | 1299.00   |
| KANTRONICS Mini-Reader          | 265.00    |
| KLM KT-34 XA                    | \$475.00  |
| MFJ 496 Keyboard                | 295.00    |
| MIRAGE B108                     | 150.00    |
| SANTEC HT1200 & ST7/T           | call      |
| SHURE 444D                      | 48.00     |

**812-422-0231**

MON-FRI 9AM-6PM • SAT 9AM-4PM

Write for our new and used equipment list

## DIRECTION FINDERS

If you're serious about direction finding, you want the best, most dependable and proven equipment for a fast find, whether it's for a downed aircraft or a repeater jammer.

If your needs are in the 100-300 MHz range, think of L-Tronics for ground, air, or marine DF. We also have equipment that gives dual capability, such as search & rescue/amateur radio, 146/220 amateur, and air/marine SAR.

Our units will DF on AM, FM, pulsed signals and random noise. The meter reads left-right in the DF mode for fast, accurate bearings, and left to right signal strength in the RECeive mode (120 dB total range with the sensitivity control). Its 3 dB antenna gain and .06 uV typical DF sensitivity allow the crystal-controlled unit to hear and positively track a weak signal at very long ranges. It has no 180° ambiguity.

Over 3,000 of our units are in the field being used to save lives, catch jammers, find instrument packages, track vehicles. Prices start at under \$250 for factory-built equipment backed by warranty, money-back guarantee, and factory service and assistance. Write today for a free brochure and price list.



L-TRONICS (Attention Ham Dept.)  
 5546 Cathedral Oaks Rd.  
 Santa Barbara, CA 93111

**HIGH STABILITY  
 CRYSTALS FOR  
 FREQUENCY OR TIME**  
**USE THE BEST  
 BUY  
 JAN CRYSTALS**

- CB
  - CB standard
  - 2 meter
  - Scanners
  - Amateur Bands
  - General Communication
  - Industry
  - Marine VHF
  - Micro processor crystals
- Send 10¢ for our latest catalog.  
 Write or phone for more details.

Jan Crystals  
 P.O. Box 06017  
 Ft. Myers, Florida 33906  
 all phones (813) 936-2397  
 easy to charge



# BARKER & WILLIAMSON'S PORTABLE ANTENNA

MODEL  
370-10



Designed for  
APARTMENTS — MOTELS — VACATIONS  
Quick Simple Installation. Operates on 2, 6,  
10, 15, 20 and 40 meters. All coils supplied.  
Only 22-1/2 inches long. Weighs less than  
2 lbs. Supplied with 10 ft. RG 58 coax and  
counter poise. Whip extends to 57 inches.  
Handles up to 300 watts.  
VSWR—1.1:1 when tuned  
Write for more details and other B&W products



BARKER & WILLIAMSON, INC.  
10 CANAL STREET  
BRISTOL, PA 19007  
215-788-5581

## 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 slocan.
- 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/Converter** . . . .  
Plug in camera, ant., mic, and TV  
and you are on the air. Contains  
AC supply, T/R sw, 4 Modules  
below . . . . . \$ 399 ppd

### PUT YOUR OWN SYSTEM TOGETHER



**TXA5 ATV Exciter** contains  
video modulator and xtal on 434  
or 439.25 mHz. All modules  
wired and tested . . . . . \$ 89 ppd

**PA5 10 Watt Linear** matches  
exciter for good color and sound.  
This and all modules run on  
13.8 vdc. . . . . \$ 89 ppd

**TVC-2 Downconverter** tunes  
420 to 450 mHz. Outputs TV  
ch 2 or 3. Contains low noise  
MRF901 preamp. . . . . \$ 55 ppd

**PACKAGE SPECIAL** all  
four modules \$ 249 ppd

**FMA5 Audio Subcarrier** adds  
standard TV sound to the  
picture . . . . . \$ 29 ppd

### SEND SELF-ADDRESSED STAMPED ENVELOPE FOR OUR LATEST CATALOG INCLUDING:

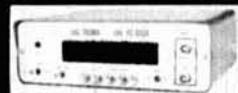
Info on how to best get on ATV, modules for the builder,  
complete units, b&w and color cameras, antennas, monitors,  
etc. and more. 20 years experience in ATV.  
Credit card orders call (213) 447-4565. Check, Money  
Order or Credit Card by mail.

## P.C. ELECTRONICS

Maryann  
WB6YSS 2522 PAXSON  
ARCADIA, CA 91006 Tom  
WB6ORG



## HAL'S FALL SALE



**HAL 2304 MHz DOWN CONVERTERS** (FREQ. RANGE 2000/2500 MHz)  
**2304 MODEL #1 KIT** BASIC UNIT W/PREAMP LESS HOUSING & FITTINGS . . . \$49.95  
**2304 MODEL #2 KIT** (with preamp) . . . . . \$59.95  
**2304 MODEL #3 KIT** (with High Gain preamp) . . . . . \$69.95

MODELS 2 & 3 WITH COAX FITTINGS IN & OUT AND WITH WEATHER-PROOFED DIE CAST HOUSINGS.  
FACTORY WIRED & TESTED . . . . . \$50 additional  
BASIC POWER SUPPLY . . . . . \$19.95  
POWER SUPPLY KIT FOR ABOVE WITH CASE . . . . . \$24.95  
FACTORY WIRED & TESTED . . . . . \$34.95

### ANTENNAS & OTHER ACCESSORIES AVAILABLE. SEND FOR MORE INFO

**COMPLETE KITS:** CONSISTING OF EVERY ESSENTIAL PART NEEDED TO MAKE YOUR COUNTER COMPLETE. **HAL-600A** 7-DIGIT COUNTER WITH FREQUENCY RANGE OF ZERO TO 600 MHz. FEATURES TWO INPUTS, ONE FOR LOW FREQUENCY AND ONE FOR HIGH FREQUENCY; AUTOMATIC ZERO SUPPRESSION; TIME BASE IS 1.0 SEC OR 1 SEC GATE WITH OPTIONAL 10 SEC GATE AVAILABLE. ACCURACY ± 001%. UTILIZES 10-MHZ CRYSTAL 5 PPM. **COMPLETE KIT \$129**

**HAL-300A** 7-DIGIT COUNTER (SIMILAR TO 600A) WITH FREQUENCY RANGE OF 0-300 MHz. **COMPLETE KIT \$109**

**HAL-50A** 8-DIGIT COUNTER WITH FREQUENCY RANGE OF ZERO TO 50 MHz OR BETTER. AUTOMATIC DECIMAL POINT, ZERO SUPPRESSION UPON DEMAND. FEATURES TWO INPUTS: ONE FOR LOW FREQUENCY INPUT, AND ONE ON PANEL FOR USE WITH ANY INTERNALLY MOUNTED HALTRONIX PRE-SCALER FOR WHICH PROVISIONS HAVE ALREADY BEEN MADE. 1.0 SEC AND 1 SEC TIME GATES. ACCURACY ± 001%. UTILIZES 10-MHZ CRYSTAL 5 PPM. **COMPLETE KIT \$109**

**FREE:** HAL-79 CLOCK KIT PLUS AN INLINE RF PROBE WITH PURCHASE OF ANY FREQUENCY COUNTER.

### PRE-SCALER KITS

**HAL 300 PRE** . . . . . (Pre-drilled G-10 board and all components) . . . . . \$14.95  
**HAL 300 A/PRE** . . . . . (Same as above but with preamp) . . . . . \$24.95  
**HAL 600 PRE** . . . . . (Pre-drilled G-10 board and all components) . . . . . \$29.95  
**HAL 600 A/PRE** . . . . . (Same as above but with preamp) . . . . . \$39.95

### TOUCH TONE DECODER KIT

HIGHLY STABLE DECODER KIT. COMES WITH 2 SIDED, PLATED THRU AND SOLDER FLOWED G-10 PC BOARD, 7-567's, 2-7402, AND ALL ELECTRONIC COMPONENTS. BOARD MEASURES 3-1/2 x 5-1/2 INCHES. HAS 12 LINES OUT. ONLY \$39.95

**NEW — 16 LINE DELUXE DECODER** . . . . . \$69.95

**DELUXE 12-BUTTON TOUCHTONE ENCODER KIT** UTILIZING THE NEW ICM 7206 CHIP. PROVIDES BOTH VISUAL AND AUDIO INDICATIONS! COMES WITH ITS OWN TWO-TONE ANODIZED ALUMINUM CABINET. MEASURES ONLY 2-3/4" x 3-3/4". COMPLETE WITH TOUCH-TONE PAD, BOARD, CRYSTAL CHIP AND ALL NECESSARY COMPONENTS TO FINISH THE KIT. **PRICED AT \$29.95**

**NEW — 16 LINE DELUXE ENCODER** . . . . . \$39.95

FOR THOSE WHO WISH TO MOUNT THE ENCODER IN A HAND-HELD UNIT, THE PC BOARD MEASURES ONLY 9/16" x 1-3/4". THIS PARTIAL KIT WITH PC BOARD, CRYSTAL CHIP AND COMPONENTS. **PRICED AT \$14.95**

**ACCUKEYER (KIT)** THIS ACCUKEYER IS A REVISED VERSION OF THE VERY POPULAR WB4VVF ACCUKEYER ORIGINALLY DESCRIBED BY JAMES GARRETT, IN QST MAGAZINE AND THE 1975 RADIO AMATEUR'S HANDBOOK. **\$16.95**

**ACCUKEYER — MEMORY OPTION KIT** PROVIDES A SIMPLE, LOW COST METHOD OF ADDING MEMORY CAPABILITY TO THE WB4VVF ACCUKEYER. WHILE DESIGNED FOR DIRECT ATTACHMENT TO THE ABOVE ACCUKEYER, IT CAN ALSO BE ATTACHED TO ANY STANDARD ACCUKEYER BOARD WITH LITTLE DIFFICULTY. **\$16.95**

**BUY BOTH** THE MEMORY AND THE KEYS AND **SAVE**. COMBINED PRICE ONLY \$32.00

### PRE-AMPLIFIER

**HAL-PA-19 WIDE BAND PRE-AMPLIFIER**, 2-200 MHz BANDWIDTH (—3dB POINTS), 19 dB GAIN. **FULLY ASSEMBLED AND TESTED \$6.95**



**CLOCK KIT — HAL 79 FOUR-DIGIT SPECIAL — \$7.95.**  
OPERATES ON 12-VOLT AC (NOT SUPPLIED) PROVISIONS FOR DC AND ALARM OPERATION

### 6-DIGIT CLOCK • 12/24 HOUR

COMPLETE KIT CONSISTING OF 2 PC G-10 PRE-DRILLED PC BOARDS, 1 CLOCK CHIP, 6 FND COMM, CATH. READOUTS, 13 TRANS, 3 CAPS, 9 RESISTORS, 5 DIODES, 3 PUSH-BUTTON SWITCHES, POWER TRANSFORMER AND INSTRUCTIONS. DON'T BE FOOLED BY PARTIAL KITS WHERE YOU HAVE TO BUY EVERYTHING EXTRA. **PRICED AT \$12.95**

**CLOCK CASE** AVAILABLE AND WILL FIT ANY ONE OF THE ABOVE CLOCKS. REGULAR PRICE \$6.50 BUT ONLY \$4.50 WHEN BOUGHT WITH CLOCK.

**SIX-DIGIT ALARM CLOCK KIT** FOR HOME, CAMPER, RV, OR FIELD-DAY USE. OPERATES ON 12-VOLT AC OR DC, AND HAS ITS OWN 60-Hz TIME BASE ON THE BOARD. COMPLETE WITH ALL ELECTRONIC COMPONENTS AND TWO-PIECE, PRE-DRILLED PC BOARDS. BOARD SIZE 4" x 3". COMPLETE WITH SPEAKER AND SWITCHES. IF OPERATED ON DC, THERE IS NOTHING MORE TO BUY. **PRICED AT \$16.95**

\*TWELVE-VOLT AC LINE CORD FOR THOSE WHO WISH TO OPERATE THE CLOCK FROM 110-VOLT AC. **\$2.50**

**SHIPPING INFORMATION** — ORDERS OVER \$20.00 WILL BE SHIPPED POSTPAID EXCEPT ON ITEMS WHERE ADDITIONAL CHARGES ARE REQUESTED. ON ORDERS LESS THAN \$20.00 PLEASE INCLUDE ADDITIONAL \$1.50 FOR HANDLING AND MAILING CHARGES. SEND SASE FOR FREE FLYER

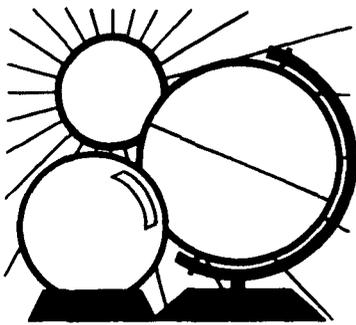
DISTRIBUTOR FOR  
**Aluma Tower • AP Products**  
(We have the new Hobby-Blox System)



"HAL"  
HAROLD C. NOWLAND  
WBZHX

## HAL-TRONIX

P. O. BOX 1101  
SOUTHGATE, MICH. 48195  
PHONE (313) 285-1782



# DX FORECASTER

Garth Stonehocker, KØRYW

## last-minute forecast

The low-frequency bands, 160 through 40, will be the favored DX bands for the first two weeks of the month. The higher frequencies will then begin to improve and be very good for DX for the last week and a half. That means a good DX holiday, as well as the holiday of the plentiful harvest, for which we can be thankful. Disturbances, however, may develop about the 6th, 15th, and 26th. Remember: even though disturbance means signal strength and QSB problems on some paths, others may be a DX harvest of plenty. Keep looking.

November is a month of plentiful meteor showers going on from October 26 to November 22, with the shower maximum of ten per hour on the 3rd through the 10th. This shower is known as the Taurids. Lunar perigee is on the 12th, and full moon is the day before, the 11th.

November is often of special significance geophysically because of the quiet conditions of the geomagnetic field. November and December vie for being the quietest month of the year. By quietest is meant steadiness of the magnitude and direction at a point in the magnetic field as measured by a magnetometer (a very sensitive compass).

The variations of the geomagnetic field are described by the A figure on a daily basis. It is made from eight three-hour K figures. The K figure is the displacement from an average diurnal curve for an observing station during the three hours. Why does the geomagnetic field become more stable in winter (November, Decem-

ber, January)? One reason is the solar wind pressure against the earth's magnetic field (magnetosphere). Since the earth is closer to the sun in winter, the pressure at that time increases. This higher pressure around the magnetosphere holds it still — or tends to. In fact, the solar flux and geomagnetic field more often than not move opposite each other — except when the sun flares.

November is also the first month of the winter DX season. Although the hours of daylight in the Northern Hemisphere are quite short now, the ionospherically propagated frequencies rise rapidly with the rising sun each day. This maximum usable frequency (MUF) becomes very high, giving the 6-, 10-, and 15-meter bands a few afternoon and some evening hours of good DX.

The sunspot number (SSN) or solar flux is still high enough, now at the beginning of the decline of the SSN cycle, to produce openings on these bands. The high ionization piles up on both sides ( $\pm 20$  degrees) of the geomagnetic equator. A mound of ionosphere above Central America and northern Argentina allows trans-equatorial one-long-hop signals into the southern populated areas of South America. The late evening hours, 2000-2300 local time, are the optimum times for DX to our friends down south. A bit of geomagnetic disturbance even makes this type of propagation better.

The noise (QRN of the spring, summer, and fall thunderstorms) is about over by now. This lack of QRN now makes DXing in the lower bands of 80 and 160 meters a pleasure. So you

can see why November ushers in the winter DX season, and now you have more time indoors to enjoy it.

## band-by-band summary

*Six meters* will open occasionally for F2 long skip propagation with hops 1000 to 2500 miles long, and with many hops usable. The openings will follow the sun during the day and early evening.

*Ten and fifteen meters* will have openings similar to those on 6 meters, but more often and lasting longer. Worldwide DX is usual from after sunrise until well after sunset during periods of the 27-day solar flux maxima. Short skip of 1200 miles maximum distance is also possible, and will also be following the sun across the earth.

*Twenty meters* will be open most all days and nights to some area of the globe, with long skip, and some short skip. Distances and number of hops will be much like those on the 15-, 10-, and 6-meter bands.

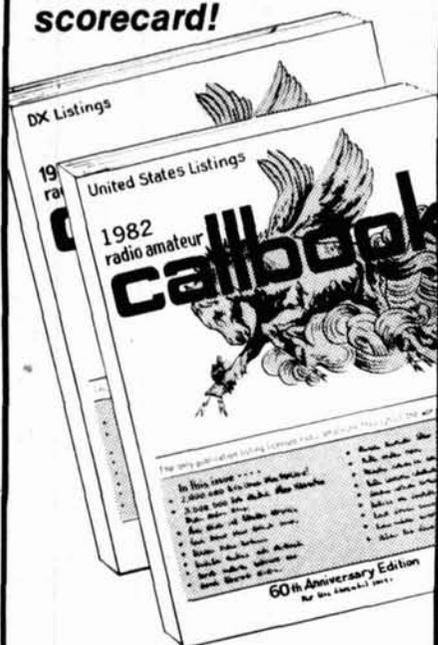
*Forty and eighty meters* will be the most usable night-time bands for DX. Most areas of the world can be worked from dusk till just before sunrise. Hops shorten on these bands to about 2000 miles for 40 and 1500 miles for 80 meters, but the number of hops can increase since signal absorption in the ionospheric D region is low during the night. The path direction follows the darkness across the earth, similar to the higher bands following the sun. Daytime short skip can be used during the day and at night if low-height horizontal antennas (high take-off angle) are used. Vertical antennas over good ground systems give the lowest take-off angles for long skip on these bands.

*One-sixty meters* will be about like 80 meters and provide good stuff for the enthusiastic DXer who likes to work into the wee hours of the night and early morning hours — maybe you retired folks or swing shift workers.

ham radio



**You can't  
tell the players  
without a  
scorecard!**



**Order today!  
NEW 1982  
RADIO AMATEUR CALLBOOKS  
READY DECEMBER 1ST!**

The latest editions will be published soon! 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 U.S. Edition features over 400,000 listings, with over 70,000 changes from last year. The Foreign Edition has over 370,000 listings, over 60,000 changes. The new 1982 Callbooks will be available on December 1, 1981. Place your order now.

|                                           | Each    | Shipping | Total   |
|-------------------------------------------|---------|----------|---------|
| <input type="checkbox"/> US Callbook      | \$18.95 | \$3.05   | \$22.00 |
| <input type="checkbox"/> Foreign Callbook | \$17.95 | \$3.05   | \$21.00 |

Order both books at the same time for \$39.95 including shipping.

Order from your dealer or directly from the publisher. All direct orders add shipping charge. Foreign residents add \$4.55 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.

**RADIO AMATEUR  
callbook INC.**  
Dept. F  
925 Sherwood Drive  
Lake Bluff, IL 60044, USA

**Alaska Microwave Labs**  
4335 E. 5TH STREET - DEPT. HM  
ANCHORAGE, ALASKA 99504  
(907) 338-0340

### TRANSISTORS

|                        |          |         |
|------------------------|----------|---------|
| MRF901                 | FT4 5GHZ | \$3.00  |
| MRF911                 | FT5 0GHZ | \$4.00  |
| BRF90                  | FT5 0GHZ | \$3.00  |
| BRF91                  | FT5 0GHZ | \$3.50  |
| NEC 02137              | FT4 5GHZ | \$3.25  |
| NEC 02135              | FT4 5GHZ |         |
| TYPE NF 2.7DB MAG 12DB | @ 2.0GHZ | \$5.00  |
| NEC 64535              | FT8 5GHZ |         |
| NF 2.0DB MAG 15DB      | @ 2.0GHZ | \$14.00 |

### HOT CARRIER DIODES

|             |             |         |
|-------------|-------------|---------|
| MBD101      | UHF-MICRO   | \$1.50  |
| ND4131 4GHZ | NF - 5.75DB | \$21.00 |
| HN-1 4GHZ   | NF 6.5DB    | \$2.00  |

### CHIP CAPACITORS

|                           |  |       |
|---------------------------|--|-------|
| 1.2 2.2 3.3 4.7 6.8 10 18 |  |       |
| 22 27 47 100 120 180      |  |       |
| 220 270 330 390 470 560   |  |       |
| 680 820 1K 1.2K 1.8K      |  |       |
| 3.9K 8.2K 10K 100K        |  | \$ 60 |

### TEFLON CIRCUIT BOARD

|                            |         |
|----------------------------|---------|
| APPROX 3.25 x 5.0' x .010  | \$5.50  |
| APPROX 3.25 x 5.0' x .312  | \$6.50  |
| APPROX 3.25 x 5.0' x .0625 | \$10.50 |

### FEED-THRU CAPACITORS

|                     |       |
|---------------------|-------|
| 1000 P1 SOLDER TYPE | \$ 50 |
| 470 P1 SOLDER TYPE  | \$ 50 |

### DUAL GATE MOSFET

|           |        |
|-----------|--------|
| RCA 40673 | \$1.50 |
|-----------|--------|

### GaAs FETS

|                  |  |         |
|------------------|--|---------|
| MGF1400 NF 2.0DB |  |         |
| @ 4GHZ MAG 15DB  |  | \$28.50 |
| MGF1412 NF 0.8DB |  |         |
| @ 4GHZ MAG 18 DB |  | \$75.00 |

### CHIP RESISTORS

|                                                            |        |
|------------------------------------------------------------|--------|
| SET OF 3 1% CHIP RESISTORS FOR<br>50 OHM T NETWORK 3DB PAD | \$6.00 |
|------------------------------------------------------------|--------|

### COAX CONNECTORS

|                                   |        |
|-----------------------------------|--------|
| SMA Chassis Mount Square Flange   | \$6.10 |
| SMA Chassis Mount Plug sq. Flange | \$8.50 |
| SMA Chassis Mount Strip-Line Tab  | \$6.75 |
| SMA Plug for RG-58                | \$6.75 |
| SMA Plug for RG-174               | \$6.75 |
| SMA Plug for 141 Semi-rigid       | \$3.98 |

### X BAND COMPONENTS

|                                                           |         |
|-----------------------------------------------------------|---------|
| GUNN SOURCE 10.525 GHZ 10-5MW<br>WR-90 WAVEGUIDE MOUNTING | \$37.00 |
| IMPATT SOURCE 10.5 to 10.55GHZ<br>50-20MW WR-90 MOUNTING  | \$39.00 |
| FILTER MIXER 8.2 to 12.4GHZ<br>WR90 MOUNTING              | \$30.00 |
| HORN ANTENNA 18-1DB GAIN AT<br>10.525GHZ WR-90 MOUNTING   | \$13.75 |
| WAVE GUIDE FLANGE WR-90                                   | \$4.00  |

### SILVER PLATING KIT

|                                                                                                |         |
|------------------------------------------------------------------------------------------------|---------|
| Will plate Copper, Brass, Bronze,<br>Nickel, Tin, Pewter, Gold and most<br>white metal alloys. | \$30.00 |
|------------------------------------------------------------------------------------------------|---------|

### RF CABLE

|                                                                                                                                                 |        |
|-------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| 141 Semi-rigid Cable, Approx. 24 DB<br>Loss per 100 ft @ 4GHZ. Price is per<br>ft. - inch max length is 5 ft.<br>Other lengths by special order | \$4.00 |
|-------------------------------------------------------------------------------------------------------------------------------------------------|--------|

### PISTON TRIMMERS

|                                      |        |
|--------------------------------------|--------|
| TRIKO 201-01M 3-1.8 pt 5-3 pt 1-8 pt | \$2.50 |
| NO WARRANTY ON SEMI-CONDUCTORS       |        |



**OPEN AT 8PM EST  
CLOSED AT 8PM PST**

**IF YOU DO NOT SEE  
WHAT YOU WANT ASK**

**ORDERS ARE POSTAGE PAID  
COD-VISA-MASTERCHARGE**

# I WANT YOU

**TO GET YOUR LICENSE**



**Just in time for  
licensing classes!!  
NEW — REVISED —  
COMPLETELY UP-TO-DATE**

**TUNE IN THE WORLD  
WITH HAM RADIO**

by ARRL Staff

This package contains THE goodies needed by the beginner to get started in Amateur Radio. Assuming that you have no prior knowledge of radio, the reader is taught how to pass the Novice exam, both code and theory, and how to set up a station. Unique code study method makes learning the Morse code easy as 1-2-3. And it's full of illustrations to help clarify difficult technical points. 160 pages. ©1981. 3rd edition.

**AR-HR \$8.50**  
plus \$1 shipping

**INSTRUCTORS —  
Call about ISP Program**

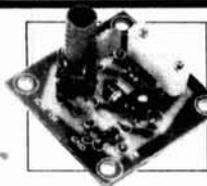
## HAM RADIO'S BOOKSTORE

Greenville, NH  
03048  
(603)  
878-1441

**ORDER NOW  
FOR  
WINTER  
CLASSES**

# FOR THE EXPERIMENTER

CRYSTALS & KITS/OSCILLATORS • RF MIXERS • RF AMPLIFIER • POWER AMPLIFIER



### OX OSCILLATOR

Crystal controlled transistor type. 3 to 20 MHz, OX-Lo, Cat. No. 035100. 20 to 60 MHz, OX-Hi, Cat. No. 035101.

*Specify when ordering.*

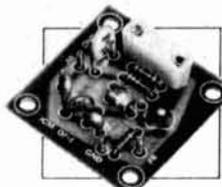
\$6.31 ea.

### MXX-1 TRANSISTOR RF MIXER

A single tuned circuit intended for signal conversion in the 3 to 170 MHz range. Harmonics of the OX or OF-1 oscillator are used for injection in the 60 to 170 MHz range. 3 to 20 MHz, Lo Kit, Cat. No. 035105. 20 to 170 MHz, Hi Kit, Cat. No. 035106.

*Specify when ordering.*

\$7.02 ea.



### OF-1 OSCILLATOR

Resistor/capacitor circuit provides osc over a range of freq with the desired crystal. 2 to 22 MHz, OF-1 LO, Cat. No. 031108, 18 to 60 MHz, OF-1 H Cat. No. 035109.

*Specify when ordering.*

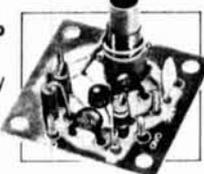
\$5.42 ea.

### PAX-1 TRANSISTOR RF POWER AMP

A single tuned output amplifier designed to follow the OX oscillator. Outputs up to 200 mw, depending on frequency and voltage. Amplifier can be amplitude modulated 3 to 30 MHz, Cat. No. 035104.

*Specify when ordering.*

\$7.34 ea.



### SAX-1 TRANSISTOR RF AMP

A small signal amplifier to drive the MXX-1 Mixer. Single tuned input and link output. 3 to 20 MHz, Lo Kit, Cat. No. 035112. 20 to 170 MHz, Hi Kit, Cat. No. 035103.

*Specify when ordering.*

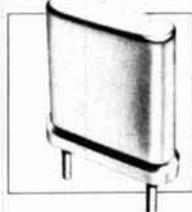
\$7.02 ea.

### BAX-1 BROADBAND AMP

General purpose amplifier which may be used as a tuned or untuned unit in RF and audio applications. 20 Hz to 150 MHz with 6 to 30 db gain. Cat. No. 035107.

*Specify when ordering.*

\$7.34 ea.



### .02% Calibration Tolerance EXPERIMENTER CRYSTALS (HC 6/U Holder)

| Cat. No. | Specifications                       |            |
|----------|--------------------------------------|------------|
| 031080   | *3 to 20 MHz — For use in OX OSC Lo  | \$6.88 ea. |
| 031081   | *20 to 60 MHz — For use in OX OSC Hi | \$6.88 ea. |
| 031300   | *3 to 20 MHz — For use in OF-1L OSC  | \$6.88 ea. |
| 031310   | *20 to 60 MHz — For use in OF-1H OSC | \$6.88 ea. |

*\*Specify when ordering*

Shipping and postage (inside U.S., Canada and Mexico only) will be prepaid by International Prices quoted for U.S., Canada and Mexico orders only. Orders for shipment to other countries will be quoted on request.



INTERNATIONAL CRYSTAL MFG. CO., INC.  
10 North Lee Oklahoma City, Okla. 73102

**KENWOOD**

**\$\$SAVES\$**



**\$CALL TOLL FREE\$**



**ICOM**

**\$\$SAVES\$**



**\$CALL TOLL FREE\$**



**apple computer**  
Sales and Service

**\$\$SAVE!\$**



**\$CALL TOLL FREE\$**



**TEN-TEC  
ARGOSY**



**\$499<sup>00</sup> DELIVERED!\$**



**THE  
COMM  
CENTER  
INC.**

Laurel Plaza  
Route 198  
Laurel, Md.  
20810

MD.: 301-792-0600  
OPEN TUES. THROUGH SAT.

**CALL TOLL FREE  
1-800-638-4486**

# MIDCOM



**NOW IN STOCK...  
FULL LINE OF AEA KEYERS  
SUPER EFFICIENT ISOPOLE ANTENNAS**



**LINES:**

|          |         |           |         |               |          |             |             |
|----------|---------|-----------|---------|---------------|----------|-------------|-------------|
| AEA      | ALPHA   | CUSHCRAFT | DENTRON | KLM           | MOR GAIN | PALOMAR ENG | UNIVERSAL   |
| AVANTI   | BEARCAT | COLLINS   | HY GAIN | KENWOOD       | MIRAGE   | REGENCY     | UNARCO-ROHN |
| ASTRON   | BIRD    | CDE       | HUSTLER | MICROLOG      | MFJ      | SWAN        | VIBROPLEX   |
| ALLIANCE | BENCHER | DRAKE     | ICOM    | MINI-PRODUCTS | NYE      | TEN TEC     | KANTRONICS  |

**CALL TOLL FREE 1-800-325-3609** IN MISSOURI **314-961-9990**  
MID-COM ELECTRONICS • 8516 MANCHESTER ROAD • BRENTWOOD, MO 63144



**NEW!**

## FROM H-TRONIKS

### DC-2 DOWNCONVERTER

*SUPER PERFORMANCE AT A FAIR PRICE*

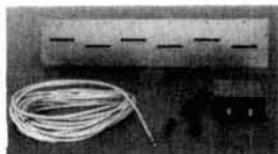
**BOASTING:**

- 22 dB FRONT END • 2 dB NF
- 2 STAGE CAVITIES • 50 dB SYSTEM GAIN
- Unit comes complete and ready to install. Nothing else to buy to get on 2.15-2.3 GHz.
- Rugged gold chrome conversion coated for years of trouble free operation.
- Guaranteed for 1 full year. Satisfaction or your money back.
- There is no better performing unit on the market. Our quality is second to none. Compare before you buy! Beware of bargain priced units.
- Additional specifications: 100 kHz/degree cent. drift, temperature compensated. Outputs to standard TV channels 2 through 6.

**\$179.95** postpaid. Free call on orders (\$1.50 refund)

**H-TRONIKS**  
2710 COLLEY AVE.  
NORFOLK, VA 23517

**(804) 622-8358**



**CHRISTMAS SPECIAL. BUY ONE AT \$179.95 AND GET THE SECOND UNIT FOR \$149.95. YOU SAVE \$30!**

**STUDY  
TAPES**

**CODE PRACTICE TAPES FROM HRPG — Practice copying Morse Code anytime, anywhere. Whether you're upgrading your present license or just trying to up your code speed, a large assortment allows you to choose exactly the kind of practice you need.**

each tape \$4.95    2/\$8.95    3/\$12.95

#### CODE PRACTICE TAPES

Here are three different straight code tapes consisting of randomly generated six character groups sent at different speeds. These tapes are excellent for building both the speed and copying accuracy needed for contesting, DXing and traffic handling.

- |                                                                                                                                             |                                                                                                                                                                          |
|---------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> <b>HR-STC1 — \$4.95</b><br>7.5 wpm code for 25 minutes<br>10 wpm code for 25 minutes<br>15 wpm code for 25 minutes | <input type="checkbox"/> <b>HR-STC3 — \$4.95</b><br>25 wpm code for 20 minutes<br>30 wpm code for 20 minutes<br>35 wpm code for 20 minutes<br>40 wpm code for 20 minutes |
| <input type="checkbox"/> <b>HR-STC2 — \$4.95</b><br>15 wpm code for 50 minutes<br>22.5 wpm code for 35 minutes                              |                                                                                                                                                                          |

#### HI/LO SERIES — Code Study Tapes

In this unique series, characters are sent at high speeds with long pauses between each character. For example, HLC4 (15/2.5 wpm) consists of characters sent at a 15 wpm rate, but with 2.5 wpm spacing between each character. These tapes are excellent for the beginner who wants to practice copying higher speed code without the frustration of constantly getting behind.

- |                                                                                                                                                                                              |                                                                                                                                                     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> <b>HR-HLC1 — \$4.95</b><br>22.5/2.5 wpm code for 80 minutes                                                                                                         | <input type="checkbox"/> <b>HR-HLC3 — \$4.95</b><br>15/5 wpm code for 28 minutes<br>15/7.5 wpm code for 28 minutes<br>15/10 wpm code for 28 minutes |
| <input type="checkbox"/> <b>HR-HLC2 — \$4.95</b><br>22.5/5 wpm code for 20 minutes<br>22.5/7.5 wpm code for 20 minutes<br>22.5/10 wpm code for 20 minutes<br>22.5/13 wpm code for 20 minutes | <input type="checkbox"/> <b>HR-HLC4 — \$4.95</b><br>15/2.5 wpm code for 80 minutes                                                                  |

Please add \$1 for shipping.

**Ham Radio's Bookstore**  
Greenville, NH 03048



## portable two meter quad

A new collapsible antenna has been introduced by Palomar Engineers. It extends the range of low power 2-meter transceivers by providing the gain and front-to-back discrimination of a two-element quad. It is ideal for boating, backpacking, mountaintopping and other portable applications, since it gives the gain of a linear amplifier but does not require additional battery power.

The entire beam assembly is housed in an 18-inch carrying case that will fit in a suitcase. For use, it unfolds to form a two-element full size quad complete with stabilized mounting stand. The portable two-meter quad sells for \$67.50. For further information write Palomar Engineers, 1520-G Industrial Avenue, Escondido, California 92025.

## communications accessories brochure

A new four-page brochure describing communication accessories that are essential to operating excellence are now available from the J.W. Miller Division of Bell Industries in Compton, California.

Antenna tuners Model AT 2500 with 2500 watts PEP power capability and Model CNA-1001 for 500-watts PEP cover a frequency range of 3-30 MHz including the WARC bands. Direct-reading meters provide forward and reflected power indications and SWR. Models CN-720-B and CN-620-B cover 1.8-150 MHz, and Model CN-630 covers 140-450 MHz. Rf clipping that ensures low distortion is

provided by the Model RF-440 speech processor. Adjacent-channel isolation of better than 50 dB at 300 MHz and 45 dB at 450 MHz is provided by the CS-201 two-position and CS-401 four-position coaxial switches.

Additional information may be obtained from Joe Johnson, J.W. Miller Division, Bell Industries, P.O. Box 5825, Compton, California 90224.

## portable power systems

Heath Company announces the Heathkit GU-1820 portable power system. This lightweight alternator can produce up to 2200 watts of 120 Vac, 60-Hz power — enough to operate a ham station, an electric chain saw, or a refrigerator-freezer during a blackout. The GU-1820 is designed for ham radio clubs, home owners, civil defense, police and fire departments. It can also provide on-location power for construction and logging crews, campers, hunters, wood cutters, and others.

Mail order price is \$479.95. Voltage is regulated to within  $\pm 5$  percent, and frequency variations are limited to  $\pm 4$  Hz, from no load to full load at 3600 RPM. Radio-frequency interference is eliminated by a resistive spark plug.

The five horsepower Briggs and Stratton gas engine can run up to 1-3/4 hours, at half load, on a tankful of regular gas, unleaded gas or gasohol. Noise is controlled by a low-tone muffler; to reduce sparking to a minimum, the optional GUA-1820-1 spark-arresting muffler (\$3.95 mail order; required in California) is available.

For more information, contact Heath Company, Dept. 350-035, Benton Harbor, Michigan 49022.

## 2-meter amplifiers

Heath Company announces two new high-power amplifiers for Amateur Radio operators using the 2-meter band. The VL-2280 75-watt VHF base amplifier is suited for base or mobile use.

Both the VL-2280 and the VL-1180

amplifiers are designed to operate in all modes (single sideband, fm or CW), across the entire 144-148 MHz 2-meter band. Ten watts in produces 75 watts out. Antenna-to-receiver insertion loss is less than 0.6 db, and intermodulation distortion is less than 24 dB. Power output is kept stable across the entire band by broadband circuitry. Extra-large heatsinks provide enough cooling to make possible a 50-percent duty cycle. Keying can either be rf-sensed or remote.

The VL-1180, priced at \$137.95 (FOB Benton Harbor, Michigan), operates on 13.6-Vdc mobile power. A special design allows the VL-1180 to be used in a car trunk or other out-of-the-way place.

For more information contact Heath Company, Dept. 350-056, Benton Harbor, Michigan 49022.

## high-isolation coaxial relay

The Dow-Key Division of Kilovac Corporation has released for sale a new high-isolation SPDT coaxial relay. The model 66-23732 was developed primarily for use with cable television head-end equipment, and features the 75-ohm "F" female connectors, which provide a minimum of -100 dB isolation dc to 500 MHz. The relay comes equipped with 26.5-Vdc actuating coil and DPDT auxiliary contacts. Power capacity is 20 watts CW.

The relay is designed for video source switching, using the auxiliary contacts for audio follow-on. It has excellent rf characteristics for i-f switching, and the auxiliary contacts may be used for remote indication of the relay position. The same relay is ideal for rf switching to 500 MHz, and for use in remotely actuated or programmable switching modules. The model 66 is also available with a 12-Vdc coil, with or without auxiliary contacts. For further information contact: Kilovac Corporation, P.O. Box 4422, Santa Barbara, California 93103.

# Bencher 1:1 BALUN

- Lets your antenna radiate—not your coax
- Helps fight TVI—no ferrite core to saturate or reradiate
- Rated 5 KW peak—accepts substantial mismatch at legal limit
- DC grounded—helps protect against lightning
- Amphenol® connector; Rubber ring to stop water leakage

**New** Rugged custom Cyclocac® case, UV resistant formulation

**New** Heavy threaded brass contact posts



**NEW Improved**

|                    |                                                         |                |
|--------------------|---------------------------------------------------------|----------------|
| <b>Model ZA-1A</b> | 3.5-30 mHz                                              | <b>\$17.95</b> |
| <b>Model ZA-2A</b> | optimized 14-30 mHz<br>includes hardware for<br>2" boom | <b>\$21.95</b> |

Available at selected dealers, add \$2.00 postage and handling in U.S.A.  
WRITE FOR LITERATURE

**BENCHER, INC.**

333 W. LAKE ST., CHICAGO, IL 60606 • (312) 263-1808

## Iron Powder and Ferrite TOROIDAL CORES

Shielding Beads, Shielded Coil Forms  
Ferrite Rods, Pot Cores, Baluns, Etc.

Small Orders Welcome  
Free 'Tech-Data' Flyer

**AMIDON**  
Associates Since 1963



12033 Otsego Street, North Hollywood, Calif. 91607

In Germany: Elektronikiaden, Wilhelm — Mellies Str. 88, 4930 Detmold 18, West Germany  
In Japan: Toyomura Electronics Company, Ltd., 7-9, 2-Chome Sota-Kanda, Chiyoda-Ku, Tokyo, Japan

## REPEATER CONTROLLER

- 4 ACCESS MODES
- AUTO PATCH
- AUTO DIAL (72 NO.)
- 16 DIGIT XTAL CONTROLLED TOUCH TONE DECODER
- REVERSE AUTOPATCH
- HI/LO FREQ. INDICATOR
- 12 VDC OR 117 VAC
- 60 CONTROL FUNCTIONS
- 30 TIMERS
- EASY TO CHANGE CODES
- 3 LINKS
- PHONE, RX, & TX AUDIO INTERFACE W/MUTING

MS-001 ON G-10 PLATED  
THUR HOLE PC BOARD  
WIRED & TESTED **\$695.00**

MS-101 RACK MOUNT  
W/117 VAC POWER  
SUPPLY **\$849.25**

MICRO SECURITY 9307 Meadows La. Greenfield, IN 46140 (317)894-1201



## heavy duty portable DMM

The new rugged HD-100 from Beckman Instruments, Inc., is made waterproof and dustproof to resist the elements. It can withstand the physical impact of accidental drops and has the kind of built-in input protections never before found in other DMMs.

Voltage inputs are protected to 1500 Vdc or 1000 volts RMS. Current ranges are protected to 2 amps/250 volts while resistance changes are protected to 500 Vdc. The O-ring sealed ABS plastic case is fire retardant with ribbed side walls that are twice as thick as in other meters. The bright NATO-yellow case is highly visible — easy to spot in a tool box or on a ledge before leaving a job.

For further information and complete specifications, contact your local electronics or meter distributor, electronics retail outlet or Beckman Instruments, Inc., Advanced Electro-Products Division, 2500 Harbor Blvd., Fullerton, California 92634.

## catalog for power grid tubes

A quick-reference catalog for power grid tubes is available free from Varian/Eimac. The catalog lists tubes manufactured at Eimac's San Carlos and Salt Lake City sites. The San Carlos plant produces large ceramic/metal power grid tubes, cavities, and accessories. Glass power tubes, smaller ceramic/metal tubes, and a wide line of planar triode and X-ray tubes are manufactured in Salt Lake City.

Included in the catalog is an applications-oriented power grid tube se-

lection guide for ease in making type selections. To receive the free, quick-reference catalog of Eimac power grid tubes, contact the nearest Varian Electron Device sales office or Varian/Eimac, 301 Industrial Way, San Carlos, California 94070.

## station clock

The heart of the Zulu 3TZ is a microprocessor chip and memory that gives it greatly expanded capabilities. Besides the one local 12-hour time zone and two alternate 24-hour world time zones, the unit has a reminder I.D. timer that gives different tones at 8, 9, or 10 minute intervals. The I.D. is resettable and accurate to plus or minus 0.1 second. Other features include large, orange 0.6 inch LED readouts for easy readability; quartz crystal timebase battery backup; ac or dc operation on 12 volts or 117 Vac with the wallplug transformer that is included.

Also useful is an appliance timer output that is synchronized with the local (12-hour) time that allows one on and one off shiftpoint per day. The manual explains how to connect the appliance-timer output to a relay or triac (not included) to control any external device. The unit can be made to display remote temperature using a silicon linear thermistor probe and a highly stable voltage-to-frequency circuit. The additional parts are available for \$9.95. Contact Bullet Electronics, P.O. Box 401244, Garland, Texas 75040.

## MBA reader-only

AEA, Inc., announces the introduction of a reader for Morse, Baudot, and ASCII operation. Designated the MBA-RO (reader only), it is a state-of-the-art device using a 32-character vacuum fluorescent alphanumeric display. The 32-character display allows for up to five words to be displayed at one time. This extended display is especially useful during high-speed copy.

The reader can copy up to 99 WPM for CW, 60-70-75 and 100 WPM for

# STEP UP TO TELREX

## Professionally Engineered Antenna Systems

### Single transmission line "TRI-BAND" ARRAY

MONARCH  
TB5EM/4KWP

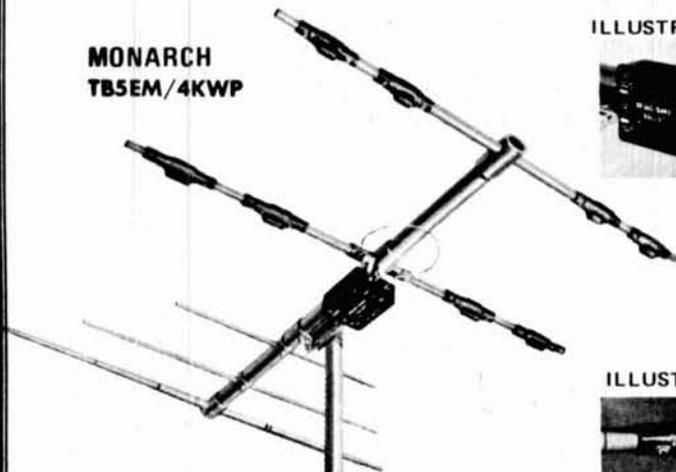


ILLUSTRATION BALUN

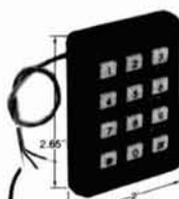


ILLUSTRATION TRAP



By the only test that means anything... on the air comparison... this array continues to outperform all competition... and has for two decades. Here's why... Telrex uses a unique trap design employing 20 HiQ 7500V ceramic condensers per antenna. Telrex uses 3 optimum-spaced, optimum-tuned reflectors to provide maximum gain and true F/B Tri-band performance.

For technical data and prices on complete Telrex line, write for Catalog PL 7



PP-1  
& PP-1K

## THE Pipo TOUCH TONE<sup>®</sup> ENCODER

An ultra high quality encoder for absolute reliability and function. Positive touch key action with non-malfunction gold contacts, totally serviceable and self-contained. Easy level control, no frequency drift, operates in temperatures from -15°f to 160°f. Supplied with instructions, schematic, template and hardware. Call or write for free catalog, dealer's list and information guide.

PP-1 \$55./PP-1K, S.P.S.T. Adj. Relay \$62.  
PP-2, \$59./PP-2K S.P.S.T. Adj. Relay \$66.  
M Series = Detached frame for irreg. install.

P-3, 12 or 16 Key, for custom installation, flush mount, 3 different circuits available-request P-3 info.

PATENTED  
\* AT&T

Mail Order To:

**PipoCommunications**®  
Emphasis is on Quality & Reliability

P.O. Box 3435  
Hollywood, California 90028  
(213) 852-1515



## Radio World

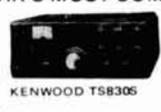


CENTRAL NEW YORK'S MOST COMPLETE HAM DEALER



ICOM IC-720

ROBOT 800



DRAKE TR7-DR7



YAESU FT707

Featuring Kenwood, Yaesu, Icom, Drake, Ten-Tec, Swan, Dentron, Alpha, Robot, MFJ, Tempo, Astron, KLM, Hy Grain, Mosley, Larsen, Cushcraft, Hustler, Mini Products, Bird, Mirage, Vibroplex, Bencher, Info-Tech, Universal Towers, Callbook, ARRL, Astatic, Shure, Collins, AEA. We service everything we sell!

Write or call for quote. You Won't Be Disappointed.

We are just a few minutes off the NYS Thruway (I-90) Exit 32



OUT OF STATE  
ORDER TOLL FREE  
800-448-9338

ONEIDA COUNTY AIRPORT TERMINAL BUILDING  
ORISKANY, NEW YORK 13424

N.Y. Res. Call (315) 736-0184

Warren - K2IXN  
Bob - WA2MSH  
Al - WA2MSI

# 10GHz GUNNPLEXER transceiver



- Complete ready to use 10 GHz fm voice/w transceiver • 10 mW power output
- Typical frequency coverage 10.235-10.295 GHz • Full duplex operation
- Internal Gunnplexer for portable operation • Gunnplexer removable for tower mounting in fixed location service — three shielded cables required for interconnection
- Powered by 13 volts dc nominal at 250 mA • 30 MHz i-f • 10-turn potentiometer controlled VCO tuning • 220 kHz ceramic i-f filter • Extra diode switched filter position for optional filter • Dual polarity afc • Rugged two-tone grey enclosure • Full one year warranty • \$389.95 with 10 mW Gunnplexer • \$269.95 without Gunnplexer

**Advanced Receiver Research**

Box 1242 • Burlington CT 06013 • 203 582-9409

Postpaid for U.S. and Canada. CT Residents add 7-1/2% sales tax. C.O.D. orders add \$2.00. Air mail to foreign countries add 10%



Baudot and ASCII at 110 and hand-typed 300 baud. The MBA incorporates automatic speed tracking, ensuring no loss of copy from rapid speed changes in signal reception. It uses a 12-Vdc external power supply, making it ideal for portable, mobile, or fixed operation. The MBA is compact and can be used with a hand key, bug, or electronic keyer.

For further information, contact Advanced Electronic Applications, Inc., P.O. Box 2160, Bldg. O & P — 2006-196th SW, Lynnwood, Washington 98036.

## short circuits wideband sweep generator

The following correction should be made to fig. 2 in the article "Stable Wideband Sweep Generator," which appeared in the June, 1981, issue: The 100k resistor between R3 and pin 2 of the 741 IC should be connected between pins 2 and 6. The side of R3 that is shown connected to the 100k resistor should be connected to pin 6.

## antenna bridge calculations

The following errors appeared in the program listed in K6GK's article in the March, 1981, issue (page 85).

Line 160 is missing an end bracket. Line 640 should have no bracket. Line 350 should read + 1 + 2, not = 1 + 1. Line 400 should read (A2\*B1) not (A2 + B1). Line 610 should read - I4, not I4.

Line 390 is an overlooked "garbage" term and can be scratched. The program "just growed" and can be shortened a bit, but it was submitted as is in the hope that it would stimulate interest in this approach.

## G3LDO wire beam

Please note that in fig. 7 of Bill Orr's article, "Ham Radio Techniques," in the January, 1981, issue, the dimension D should have been indicated on the drawing as the distance from the top of the vertical mast to the point at which the support rods cross.

# ALL BAND TRAP ANTENNAS!



PRETUNED - COMPLETELY ASSEMBLED - ONLY ONE NEAT SMALL ANTENNA FOR UP TO 7 BANDS! EXCELLENT FOR CONGESTED HOUSING AREAS - APARTMENTS LIGHT - STRONG - ALMOST INVISIBLE!

FOR ALL MAKES & MODELS OF AMATEUR TRANSCEIVERS - TRANSMITTERS - GUARANTEED FOR 2000 WATTS SSB 1000 WATTS CW. INPUT FOR NOVICE AND ALL CLASS AMATEURS!

COMPLETE AS SHOWN with 90 ft. RG58U-52 ohm feedline, and PL259 connector, insulators, 30 ft. 300 lb. test dacron end supports, center connector with built in lightning arrester and static discharge - molded, sealed, weatherproof, resonant traps "X6" - you just switch to band desired for excellent worldwide operation - transmitting and receiving! Low SWR over all bands - Tuners usually NOT NEEDED! Can be used as inverted V's - slopers - in attics, on building tops or narrow lots. THE ONLY ANTENNA YOU WILL EVER NEED FOR ALL DESIRED BANDS - WITH ANY TRANSCEIVER - NEW - EXCLUSIVE! NO BALUNS NEEDED!

80-40-20-15-10-6 meter - 2 trap --- 104 ft. with 90 ft. RG58U - connector - Model 998BUA ... \$79.95  
40-20-15-10 meter --- 2 trap --- 54 ft. with 90 ft. RG58U - connector - Model 1001BUA ... \$78.95  
20-15-10 meter --- 2 trap --- 26 ft. with 90 ft. RG58U - connector - Model 1007BUA ... \$77.95

SEND FULL PRICE FOR POSTPAID INSURED. DEL. IN USA. (Canada is \$5.00 extra for postage - clerical - customs etc.) or order using VISA - MASTER CHARGE - CARD - AMER. EXPRESS. Give number and ex. date. Ph 1-308-236-5333 9AM - 6PM week days. We ship in 2-3 days. ALL PRICES WILL INCREASE... SAVE - ORDER NOW! All antennas guaranteed for 1 year. 10 day money back trial if returned in new condition Made in USA. FREE INFO. AVAILABLE ONLY FROM WESTERN ELECTRONICS Dept. AR- 11 Kearney, Nebraska, 68847

## ★ ★ ★ ★ ★ A STAR IS BORN ★ ★ ★ ★ ★

- ★ Ideal for Novices, SWL's and seasoned amateurs
- ★ Built-in code practice oscillator & speaker
- ★ 12 VDC Operation or 120 VAC with adapter provided
- ★ Optional serial/parallel ASCII output port



- ★ Copies Morse, Baudot & ASCII codes
- ★ Two optimized Morse ranges
- ★ Digital & Analog filtering with 16 db AGC
- ★ Automatic speed tracking 3 - 70 WPM

Call or write for brochure or order direct.

CODE★STAR™ Kit ..... CS-K \$169.95  
CODE★STAR Wired ..... CSF \$249.95  
Optional ASCII Output Port Kit ..... CS-1K \$69.95

Send check or money order. Use your VISA or MasterCard. Add \$5.00 shipping and handling for continental U.S. Wisconsin residents add 4% State Sales Tax.

*Microcraft*

Corporation Telephone: (414) 241-8144  
P. O. Box 513HR, Thiensville, Wisconsin 53092



# UNIVERSAL COMMUNICATIONS

A Division of  
Innovative Labs, Inc.

For information call  
(817) 265-0391  
TOLL FREE — ORDERS ONLY  
(800) 433-5172

MC, VISA, Phone or Mail Orders Accepted.  
Hours, 8:30-4:30 CDST; Mon.-Fri.

## THIS MONTH'S SPECIAL

**DL 2000 Satellite Receiver . . . . . \$699.95**

Fully Assembled

**120 Low Noise Amplifier . . . . . \$650.00**

(other accessories available)

**SUPERVERTER I . . . . . \$99.95**

The ultimate in converter technology! Dual stage selective preamp, mixer, i.f. amplifier and no-drift crystal controlled oscillator. We recommend this kit for the experienced kit builder.

**12 V. Stationary Power Supply . . . . . \$24.95**

**SELECTIVE PREAMP . . . . . \$44.50**

This new unit is not like other wide band preamps. Experienced kit builders can easily add this unit to our existing boards or to other manufactured boards to

**COMING NEXT MONTH.** Our own 2300 MHz Transmitter. 1691 MHz Crystal Controlled Weather Satellite Downconverter (with preamp).

**Our product may be copied, but the performance is never equaled.**

**UNIVERSAL COMMUNICATIONS** P.O. Box 339  
Arlington, TX 76004-0339

improve overall performance.

**2300 MHz Downconverter . . . . . \$35.00**

PC Board, all components and instructions for a working unit.

**VARIABLE POWER SUPPLY . . . . . \$24.95**

Complete kit includes all components for working unit including deluxe box and overlays.

**DISH YAGI ANTENNA . . . . . \$25.00**

Complete kit with PVC and mounting brackets. Stronger than loop yagi, equal in gain.

**4 ft. Dish Antenna . . . . . \$49.95**

Overall 25 dB gain. Partial assembly required. Shipped UPS ground only.

## SMITHE

# ALUMINUM

SENT VIA UPS!!

High-quality 6061-T6 seamless drawn tubing  
6' lengths — .058" wall

| Dia. | Price | Dia.  | Price | Dia.  | Price |
|------|-------|-------|-------|-------|-------|
| 1/4  | 2.30  | 7/8   | 5.75  | 1-1/2 | 9.75  |
| 3/8  | 3.10  | 1     | 6.40  | 1-5/8 | 10.90 |
| 1/2  | 3.75  | 1-1/8 | 7.45  | 1-3/4 | 11.50 |
| 5/8  | 4.65  | 1-1/4 | 8.00  | 1-7/8 | 11.85 |
| 3/4  | 5.00  | 1-3/8 | 9.00  | 2     | 12.55 |

SHIPPING/HANDLING \* — \$3.50 PER ORDER

Also in stock: 18-8 stainless steel  
U-bolts, gusset plate, clamps, etc.

\* CATALOG — 40 CENTS; DATA SHEETS, SASE \*

Smithe Aluminum P.O. Box 273  
Bonifay, Florida 32425 (904) 547-4411

## R-4C+SHERWOOD CRYSTAL FILTERS STILL THE FINEST COMBINATION

**600 HZ LOW-LOSS 1st-IF CW FILTER.** Improve early-stage selectivity. Eliminate high-pitched leakage around 2nd-IF filters. Improve ultimate rejection to 140 dB. Eliminate strong signals overloading 2nd mixer, causing intermod and desensitization. CF-600/6: \$80.00. New PC board relay switch kit: \$45.00.

**16-POLE R-4C SSB!** Optimum-bandwidth plug-in filter. Unexcelled skirt selectivity. Low loss. 1800 Hz at -6 dB, 2400 Hz at -60 dB. CF-2K/16: \$135.00.

**250 AND 500 HZ 8-POLE 2nd-IF PLUG-IN FILTERS.** CF-250/8, CF-500/8: \$80.00.

1st-IF SSB FILTERS still available. CF-2K/8: \$150.00 pair. SPECIAL AM FILTERS and switching kits available.

Filters also available for R-7, TR-7, TR-4, Signal/One, Atlas.

Add \$3 shipping per order; \$6 overseas air.

Europeans: Please contact Ingoimpex, Postfach 24 49, D-8070, Ingolstadt, West Germany.

### Sherwood Engineering Inc.

1268 South Ogden St.  
Denver, Colo. 80210  
(303) 722-2257



# ELENCO PRECISION

## Reach Out with ELENCO

### 2 METER 5/8 λ

### HT ANTENNA

with BNC Connector

**November Special \$14<sup>95</sup>**

\$1.75 shipping and handling

### 2 METER 25 WATT LINEAR AMPLIFIER

200 mW or 2 watt drive  
1 watt delivers 15-20 watts out  
10 MHz bandwidth  
Meets FCC specifications

**2 WL \$84.95**  
**Kit \$74.95**  
**200 ML \$99.95**  
**Kit \$89.95**

Add \$3.00 shipping and handling



Orders Only — 24 hrs. 7 days  
(800) 621-0660 outside Illinois  
(800) 572-0444 in Illinois



(312) 564-0919  
1936 Raymond Drive  
Northbrook, IL 60062

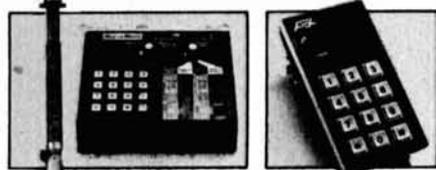
QRZ W1's, W2's and W3's...

## LOOKING FOR AEA PRODUCTS IN THE NORTHEAST?

# LOOK TO RADIOS UNLIMITED... NEW JERSEY'S FASTEST GROWING HAM STORE!

Get your hands on AEA's great keyers and isopole antennas at Radios Unlimited. You can reach us easily via the Jersey Turnpike, and when you get here you can TRY BEFORE YOU BUY at our in-store operating position. Yes! Pick out any AEA keyer, (or any other equipment from our

huge stock of ham gear), and try before you buy! We don't mean a little off-the-air diddling with the keyer...we let you PUT IT ON THE AIR AND HAVE A QSO...really check it out under YOUR kind of operating conditions... then decide. We know AEA, and we know you'll select one of these:



**CK-1** Contest Keyer with 500 character memory, soft message partitioning, automatic serial number, and much, much more. *call for super-low price!*

**MK-1** Morse Keyer with selectable dot & dash memory, full weighting, calibrated speed, bug mode and more. *call for super-low price!*

**KT-1** Keyer Trainer with all the features of the MK-1 above and the MT-1 below. *call for super-low price!*

**MT-1** Morse Trainer for pulling up that code speed the easy way with automatic speed increase, five letter or random word length and more, more, more. *call for super-low price!*

**MM-1** MorseMatic™ memory keyer with two microcomputers and 37 fantastic features including up to 2000 characters of memory plus virtually every capability of all the other keyers & trainers listed below. *call for super-low price!*

## PLUS THE EXCITING ISOPOLES THAT ARE BOOMING OUT THOSE INCREDIBLE VHF SIGNALS WITH MAXIMUM GAIN

### ATTAINABLE, ZERO DEGREE RADIATION ANGLE AND 1.4:1 SWR ACROSS THE ENTIRE BAND!

|                    |       |           |
|--------------------|-------|-----------|
| Isopole 144        | ..... | call for  |
| Isopole 220        | ..... | super-low |
| Isopole 144 junior | ..... | price!    |
| Isopole 220 junior | ..... |           |

Find them all at Radios Unlimited, plus a huge collection of new gear from all major manufacturers...a big selection of used equipment bargains, all you'll ever need in books, accessories, operating aids, coax, connectors and parts plus a modern service department dedicated to keeping you on the air. It's like a perpetual flea market! For directions, call (201) 469-4599.

**FIND AEA AT**

# RADIOS UNLIMITED

1760 EASTON AVENUE, SOMERSET, NJ 08873 • (201) 469-4599

# GLB HIGH PERFORMANCE PRESELECTORS

MODEL P50 to P500



- 50 - 500 MHz
- Ultimate rejection over 80 dB
- Five large helical resonators
- Low noise
- High overload resistance
- Typical rejection figures:
  - ± 600 kHz at 144 MHz: -30 dB
  - ± 1.6 MHz at 220 MHz: -40 dB
  - ± 5 MHz at 450 MHz: -45 dB
- The solution to interference, intermod and desens problems on repeaters
- 12V DC operation
- Dimensions only 1.6 x 2.6 x 4.75 excluding connectors
- Custom tuned to your frequency
- Low cost — only \$69.95
- Allow \$2.00 for shipping and handling

We have a complete line of transmitter and receiver strips and synthesizers for Amateur and commercial use. Write or call for our free catalog.

We welcome MasterCard or VISA

## GLB ELECTRONICS

1952 Clinton St., Buffalo, N. Y. 14206  
1-(716) 824-7936, 9 to 4

## 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

Allow 4-6 weeks for correction.

Greenville, NH 03048

Thanks for helping us to serve you better.

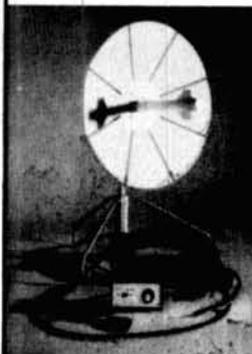
Here's my new address:

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

**AFFIX LABEL HERE**

## \* Quality Microwave Systems

2100 to 2600 MHz Antennas  
34 db Gain or Greater



|                                                          |          |
|----------------------------------------------------------|----------|
| Complete System (As Pictured) Ready to Install           | \$174.95 |
| Down Converter (Probe Mntd.) Assembled and Tested        | 64.95    |
| Down Converter PCB (Chassis Mntd.) Assembled and Tested  | 64.95    |
| Power Supply Assembled and Tested                        | 59.95    |
| Down Converter PCB (Chassis Mntd.) Kit w/ Parts and Data | 49.95    |
| Printed Circuit Board (Chassis Mntd.)                    | 29.95    |
| Data Information (Plans for Kit Building)                | 9.95     |

SEND CHECK, CASH, MONEY ORDER TO:

**Phillips-Tech Electronics**  
P. O. Box 33205  
Phoenix, Arizona 85067

For Special Quantity Pricing, C.O.D.'s, MasterCard or Visa Call:

**(602) 274-2885**

*\*Intended For Amateur Ham Use!*

# flea market

**RATES** Noncommercial 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 editing) on a space available basis only. 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 corrected ad in next available issue.

**DEADLINE** 15th of second preceding month.

**SEND MATERIAL TO:** Flea Market, Ham Radio, Greenville, N. H. 03048.

## QSL CARDS

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

**QSL's & RUBBER STAMPS** — Top Quality! Card Samples and Stamp Info — 50¢ — Ebbert Graphics SR, Box 70, Westerville, Ohio 43081.

**QSL CARDS:** 500/\$12.50, ppd. Free catalogue. Bowman Printing, 743 Harvard, St. Louis, MO 63130.

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

**DISTINCTIVE QSL's** — Largest selection, lowest prices, top quality photo and completely customized cards. Make your QSL's truly unique at the same cost as a standard card, and get a better return rate! Free samples, catalogue. Stamps appreciated. Stu K2RFP Print, P.O. Box 412, Rocky Point, NY 11778 (516) 744-6260.

## Foreign Subscription Agents for Ham Radio Magazine

Ham Radio Austria  
F. Basi  
Hauptplatz 5  
A-2700 Wiener Neustadt  
Austria

Ham Radio Belgium  
Sterehouse  
Brusselsesteenweg 416  
B-9218 Gent  
Belgium

Ham Radio Canada  
Box 400, Goderich  
Ontario, Canada N7A 4C7

Ham Radio Europe  
Box 444  
S-194 04 Upplands Vasby  
Sweden

Ham Radio France  
SM Electronic  
20 bis, Ave des Clairons  
F-69000 Auxerre  
France

Ham Radio Germany  
Karin Ueber  
Postfach 2454  
D-7850 Loerrach  
West Germany

Ham Radio Holland  
MRL Electronica  
Postbus 98  
NL-2204 Delft  
Holland

Ham Radio Italy  
G. Yurpelli  
P.O. Box 37  
I-22063 Cantù  
Italy

Ham Radio Switzerland  
Karin Ueber  
Postfach 2454  
D-7850 Loerrach  
West Germany

Ham Radio UK  
P.O. Box 63, Harrow  
Middlesex HA3 6HS  
England

Holland Radio  
143 Greenway  
Greenside, Johannesburg  
Republic of South Africa

**CADILLAC OF QSL CARDS.** 3 to 4 colorings, send \$1 for samples (Refundable). Mac's Shack, P.O. Box 43175, Seven Points, TX 75143.

**AMPLIFIER:** Parts — Info — Sources. Find it in THE AMP-LETTER, an upcoming newsletter devoted to Ham amplifiers. Write for details! Andy Thornburg, KB9WL, RR2, Box 39A, Thompsonville, IL 62890.

**APARTMENT DX** — Get out like a bandit from apartment or condo — *Handbook of Apartment Operation* by Dan Fox, W2IQD. Only \$8.95 + 1.00 postage and handling. Money back guarantee. Send check, VISA, or MasterCard to Wessex Publishing Co., Dept. A9, P.O. Box 175, N. Chelmsford, MA 01863.

**MOBILE OPERATORS:** Anteck's Mobile Antennas cover 3.2 to 30 MHz inclusive, with no coil changing. 50 Ohms input. Two models, the MT-1 MANUAL, MT-1RT REMOTE-TUNED from the operators position. Uses two Hyd. Pumps and Motors. MT-1 \$129.95, MT-1RT \$240.00 plus UPS postage. Check your local dealer or write for Dealer List and Brochure. ANTECK, INC., Route One, Box 415, Hansen, ID 83334. 208-423-4100.

**RTTY JOURNAL-EXCLUSIVELY AMATEUR RADIOTELETYPE.** one year subscription \$7.00. Beginners RTTY Handbook \$5.00, RTTY Index \$1.50. P.O. Box RY, Cardiff, CA 92007.

**BUSINESS WANTED:** Entrepreneur/hams interested in buying an active electronics manufacturing business, preferably ham-related. Reply to J. Smallwood, Box 242, Blacksburg, VA 24060. 703-951-9030.

**CUSTOM EMBROIDERED EMBLEMS** — Your design, low minimum. Informational booklet. Emblems, Dept 65, Littleton, New Hampshire 03561.

**PHOTO ENLARGING:** 8 x 10 color enlargement of your ham shack, or any other favorite negative, only \$3.50. H. E. Rowe, W4WQD. 4412 Charlestown Rd., Jeffersonville, IN 47130.

**MANUALS** for most ham gear made 1937/1970. Send \$1.00 for 18 page "Manual List", postpaid. HI-MANUALS, Box H802, Council Bluffs, Iowa 51502.

**FOR SALE:** Regency HR-6 6m fm Xcvr. 12 channels 2 channels installed 52.525 52/53.55 Rpt. with manual \$100.00. Eric Marang, 942 Amherst, Massillon, OH 44646.

**ATLAS DD6-C and 350XL Digital Dial/Frequency Counters.** \$175.00 plus \$3.00 UPS. AFC! Stop VFO drift. See June 79 HR. \$65.00 plus \$3.00 UPS. Mical Devices, P. O. Box 343, Vista, CA 92083.

**SATELLITE TELEVISION:** Information on building or buying your earth station. Six pages of what's needed, where to get it, costs, etc. \$4.00 to Satellite Television, RD #3, Oxford, NY 13830. Build your own parabolic antenna. Book also available. Send SASE for details.

**WANTED:** Help in completing the largest collection of Hallicrafter equipment in the world. Urgently needed are receivers with aluminum colored panels, back lighted plastic dials with "airplane" hands, early transmitters, unusual accessories, etc. Chuck Dachis, WD5EOG, "The Hallicrafter Collector," 4500 Russell Drive, Austin, Texas 78745.

**WANT JOHNSON COIL 1000HCS40** for push-pull amplifier. Paul, K6PY, 9845 Oakdale, Chatsworth, CA 91311. (213) 993-8459.

**RECIPROCATING DETECTOR Construction Handbook.** \$10 ppd. Peters Publications, P.O. Box 62, Lincoln, MA 01773.

**LOCKSMITHING:** Free book. Locksmithing Institute, Dept. 319-111, Little Falls, NJ 07424.

**ELECTRONIC BARGAINS, CLOSEOUTS, SURPLUS!** Parts, equipment, stereo, industrial, educational. Amazing values! Fascinating items unavailable in stores or catalogs anywhere. Unusual FREE catalog. ETCO-012, Box 762, Plattsburgh, NY 12901. SURPLUS WANTED.

**UHF circuit board material.** .026 inch polyolefin dielectric (2.320 er), .096 aluminum base, 1 oz. copper, 8-7/8 by 11-7/8, 1.2 lbs., with computerized data sheets, send SASE for info, \$10/pair plus \$2.50 shipping. Barry Bue-low, WA0RJT, 4110 Emerson Ave. N.E., Cedar Rapids, IA 52402.

**RECONDITIONED TEST EQUIPMENT.** Tektronix, H-P, etc. Catalog 50¢. Aldonics, Box 2980, Stn. D, Ottawa, Canada K1P 5W4.

**SELL:** Icom IC-720 Transceiver, IC-HM7 Preamp Microphone, Power Cord, Manual, Schematics, Less than 1 year old, \$895.00. Box 513, Saipan, CM 96950-0513.

**KEYER PADDLES,** iambic, more features, better action. Kits available. \$15.00 up. Write Earl Snyder, 213 W. Davis, Sapulpa, OK 74066.

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

**DIGITRAN MINI KEYBOARD**  
PHONE FORMAT 2-3/4" X 2"  
1/4" THICK SW-0234 \$7.95

SEND FOR FREE CATALOG



12 VDC COAX RELAY SPDT  
450 MHZ+ 100 WATTS  
2 MALE RCA PLUG TO SO-239  
RL-0042 \$6.95



BLACK TOUCH-TONE HOUSING. TT-0191 \$3.95

TWO METER ANTENNAS

BNC ADJ. ELBOW AN-0067 \$7.95

BNC STRAIGHT AN-0065 \$7.95

BNC DUCKIE AN-0269 \$8.95

|                           |                           |                           |                           |
|---------------------------|---------------------------|---------------------------|---------------------------|
| UHF-M/CABLE PL-259 \$3.75 | UHF-F/PANEL SO-239 \$3.65 | UHF-F/UHF-F PL-258 \$1.50 | UHF-M/UHF-M DM-1 \$2.50   |
| BNC-M/CABLE UG-88 \$1.35  | BNC-F/PANEL UG1094 \$1.00 | BNC-F/BNC-F UG-914 \$2.25 | BNC-M/BNC-M UG-491 \$4.25 |
| UHF 90° F/M M-359 \$2.50  | UHF 1° 2F/M M-358 \$2.95  | BNC 90° F/M UG-306 \$3.75 | BNC 1° 2F/M UG-274 \$4.50 |
| BNC-M/UHF-F UG-255 \$3.75 | BNC-F/UHF-M UG-273 \$3.00 | N°-F/UHF-M UG-83 \$5.95   | N°-M/UHF-F UG-146 \$5.95  |
| N°-M/CABLE UG-21 \$3.25   | N°-F/PANEL UG-58 \$2.25   | N°-F/N°-F UG-29 \$3.00    | N°-M/N°-M UG-57 \$5.95    |
| N° 90° F/M UG-27 \$4.50   | N° 1° 2M/F UG-107 \$9.50  | N°-M/BNC-F UG-201 \$3.65  | N°-F/BNC-M UG-349 \$5.95  |

**Marlin P. Jones & Assoc.**  
P.O. Box 12685  
Lake Park, FL 33403  
(305) 848-8236  
MC, VISA, COD-ADD. \$1.1F UNDER \$10.  
FL. RES. 4% ADD. SUFFICIENT POSTAGE

## ISOTRON ANTENNAS

THE BEST THINGS come in little packages...

ISOTRON80 54 IN. HIGH    ISOTRON 40 31 IN. HIGH    ISOTRON 20 17 IN. HIGH

**BIG ON PERFORMANCE**

**SMALL ON SPACE**

**BILAL COMPANY**

(303) 687-3219

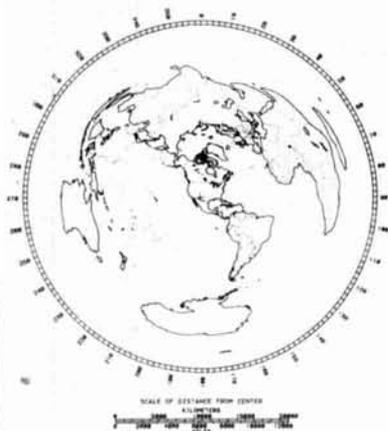
STAR ROUTE    FLORISSANT CO 80816

More Details? CHECK — OFF Page 102

November 1981 **ham** 87

# COMPUTERIZED GREAT CIRCLE MAPS

NEAR AZIMUTHAL EQUIDISTANT MAP CENTERED ON  
N5KR



- Great Circle Map Projection •
- Centered on your exact QTH •
- Calculated and drawn by computer •
- 11 x 14 inches • Personalized with your callsign • \$12.95 ppd. • (Air Mail add \$2.00) • Beam Heading Printout with bearings to 660 locations, \$9.95 • Great gift idea, too!

**Bill Johnston, N5KR**

Dept. H.  
1808 Pomona Drive  
Las Cruces, New Mexico 88001

**BE HEARD!**

Model 225 \$79.95 Kit  
Model 335 \$64.95 Kit  
Model 875 \$109.95 Kit

**WITH THESE LOW-COST 2-METER AMPLIFIERS.**

Anyone who can operate a 2-meter rig can assemble these low cost amplifiers. Detailed step-by-step instructions. No SWR bridge, wattmeter, or other equipment required.

**Model 225** 25 watts out with 350mW drive.  
**Model 335** 35 watts on FM with 3 watt input, 2 watts yields 30 watts. 1 watt yields 15 watts.  
**Model 875** Full 75 watts on FM or SSB with 10 watt input.  
**Model KEB 430 MHz 100 Watt Linear Amplifier** This high power kit is designed for ATV, SSB or FM operation in the 420 to 450 MHz band.

**Communication Concepts Inc.**  
2648 North Aragon Avenue • Dayton, Ohio 45420 • (513) 296-1411

**TRANSMITTER TECHNICIANS** — Voice of America has career opportunities available for qualified transmitter technicians at the VOA stations near Delano, California, Greenville, North Carolina, and Bethany, Ohio. Duties include operations/maintenance of high power VOA transmitters and related facilities on shift basis. Applicants must have 3-5 years recent "hands-on" experience in technical operation of broadcast, TV, or military fixed-station transmitters. U.S. citizenship required. Starting salary \$20,467. Full federal fringe benefits apply. Qualified candidates should send standard Federal applications form SF-171 (available at U.S. Post Offices) to International Communications Agency, MGT/PDE, Washington, D.C. 20547. AN EQUAL OPPORTUNITY EMPLOYER

**AZDEN** only \$295 INCLUDES TT KIT

For \$25 we will assemble your kit and install it in the back of your mike. Send your kit, mike and \$25.

Order 24 hours a day (215) 884-6010  
FREE UPS - N.P.S. Inc. WA31FQ  
1138 BOXWOOD RD., JENKINTOWN, PA 19046

**AMATEUR RADIO REPAIR** — Professional service, reasonable rates, ALL BRANDS. Official KDK after warranty repair center. Amateur Radio Repair Center of IEC, Inc., 1020 Brookstown Avenue, Winston-Salem, NC 27101. (919) 725-7500.

**MOBILE IGNITION SHIELDING** provides more range with no noise. Available most engines. Many other suppression accessories. Literature, Estes Engineering, 930 Marine Dr., Port Angeles, WA 98362.

**WANTED:** Government Surplus radar equipment, microwave equipment and "old" General Radio test equipment. P. J. Plishner, 2 Lake Avenue Extension, Danbury, CT 06810 WA1LDU.

**TUBES, TUBES** wanted for cash or trade: 340TL, 4CX1000, SCX1500. Any high power or special purpose tubes of Eimac/Varian, DCO, 10 Schuyler Avenue, No. Arlington, NJ 07032. (800) 526-1270.

**FT-101E**, fan, three filters SSB, 600, 250 installed. Includes spare tubes (originals ok), free UPS shipping. \$675 firm. John Skubick, 791 - 106 Ave., Naples, FL 33940.

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

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

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

**HAM RADIO REPAIR**, experienced, reasonable, commercial licensed. Robert Hall Electronics, P.O. Box 8363, San Francisco, CA 94128. W6BSH, (408) 292-6000.

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

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

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

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

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

**NEED HELP** for your Novice or General ticket? Recorded audio-visual theory instruction. No electronic background required. Free information. Amateur License, P.O. Box 8015, Norfolk, VA 23508.

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

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

**FREE SAMPLE** Ham Radio Insider Newsletter! Send large S.A.S.E.. W5Y1, Box #10101-H, Dallas, Texas 75207.

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



Organize your shack with a  
**CLUTTERFREE MODULAR  
CONSOLE \$203.35**

- Large, 42" H x 57" W x 29"D
- Strong groove-construction
- Mar-resistant wood grain finish
- Options, drawers & face plate
- For ham or home computer
- Visa and Master Charge

**CLUTTERFREE  
MODULAR  
CONSOLES**

P.O. Box 5103 Tacoma, WA 98405  
(206) 759-1611

**S-LINE OWNERS**  
ENHANCE YOUR INVESTMENT

with  
**TUBESTERS™**

Plug-in, solid state tube replacements

- S-line performance—solid state!
- Heat dissipation reduced 60%
- Goodbye hard-to-find tubes
- Unlimited equipment life

TUBESTERS cost less than two tubes, and are guaranteed for so long as you own your S-line.

**SKYTEC**

Box 535  
Talmage, CA 95481

Write or phone for  
specs and prices.  
(707) 462-6882

**PC BOARD BARGAINS**

GIO FR 1/16" 1 OZ. COPPER

|                         |                  |
|-------------------------|------------------|
| 1 SIDE 12" x 12"        | PKG OF 5 \$31.25 |
| 1 SIDE 5 3/4" x 11 1/2" | PKG OF 5 \$18.75 |
| 2 SIDE 12" x 12"        | PKG OF 5 \$35.25 |
| 2 SIDE 5 3/4" x 11 1/2" | PKG OF 5 \$21.25 |

**MARCO**

P.O. BOX 2310, WEIRTON, WV 26062

**SAY YOU SAW IT  
IN  
HAM RADIO**

Tell 'em you saw it in HAM RADIO!

## MINIATURE AUTOMATIC C.W. STATION IDENTIFIER



### MODEL 97813, ONLY \$74.95 •

COMPLIES WITH NEW FCC RULES, PARTS 89, 91, 93, 95

• **MULTI-MODE OPERATION:** MANUAL, SEMI-AUTO AND AUTO.

**MANUAL MODE** — A pushbutton switch triggers the identifier which keys the transmitter for the duration of the ID cycle.

**SEMI-AUTO MODE** — The PTT line activates the ID'er if the repeat interval time has elapsed and keeps the transmitter keyed throughout the duration of the ID cycle.

**AUTO MODE** — The identifier will key the transmitter and ID every time the repeat interval time has elapsed.

• **CONNECTS DIRECTLY TO MICROPHONE AND PTT INPUTS OF MOST TRANSMITTERS.** MINIATURE SIZE MAKES IT FEASIBLE TO MOUNT INSIDE THE TRANSMITTER.

• **PROGRAMMABLE CODE SPEED, TONE, AND REPEAT TIME.**

• **ADJUSTABLE CODE AUDIO LEVEL.**

• **PREPROGRAMMED MEMORY ELEMENTS** — 254 OR (510 BIT) (OPTIONAL)

• **SIZE — 1 X 4 INCHES**

• **INCLUDES SWITCHES, WIRING AND INSTRUCTION MANUAL.**

• **ONE YEAR WARRANTY • MADE IN U.S.A.**

• Include \$3 shpg/hdlg., \$5 foreign.  
CA. res. add sales tax. allow four weeks delivery.

# Securatron

P.O. Box 32145 • San Jose, Ca. 95132  
Phone (408) 294-8383

# Christmas Shopping Complete?

Uncle Joe?  
Aunt Enna ✓  
~~The Boss~~

Grampa Ronnie??  
Uncle Hohmer?

If not . . . see page 92.

## Coming Events ACTIVITIES "Places to go..."

**INDIANA:** The Allen County Amateur Radio Technical Society's 9th annual Hamfest, November 15, 8 AM to 4 PM, Allen County Memorial Coliseum, Ft. Wayne. Admission: \$2.50 advance, \$3.00 door. Children 11 years and under free. Large flea market, forums, door prizes. Talk-in on 146.28/88. Tables \$6.00 each. Premium tables \$20.00. For information or pre-registration: Allen County ARTS, P.O. Box 10342, Ft. Wayne, IN 46851. Att: Hamfest Committee.

**MICHIGAN:** The 16th annual Hazel Park Amateur Radio Club's Swap & Shop, Sunday, December 6, Hazel Park High School, Hughes Street, 9 1/2 Mile Road, 1 mile east of I-75, Hazel Park. Tickets \$2.00. Tables 75¢ per foot. Doors open 8 AM. Main prize drawing 2 PM plus hourly prizes. Grand prizes included with admission ticket. Talk-in on 146.52. For information: SASE to Jack Field, WABUPU, 1444 E. Evelyn, Hazel Park, MI 48030.

**MICHIGAN:** The Oak Park High School Electronics Club's 12th annual Swap & Shop, Thanksgiving Sunday, November 29, Oak Park High School, Oak Park. Admission: \$1.50 advance, \$2.00 door. 8 ft. tables \$5.00 advance, \$6.00 door. Door prizes and refreshments. For tickets and reservations: SASE to Herman Gardner, Oak Park High School, 13701 Oak Park Blvd., Oak Park, MI 48237. Or call (313) 968-2675.

## OPERATING EVENTS "Things to do..."

**DECEMBER 4, 5, 6.** The Pike County Amateur Radio Club of Vincennes will operate a special events station from Santa Claus, Indiana. Call sign W9CZH. Time 0000 Z on December 4 through 2300 Z December 6. Frequencies: 21.410, 14.305, 7.270, 3.925. All SSB, 14.090-14.100 RTTY and 146.52 FM. A special QSL/XMAS card postmarked from Santa Claus post office sent upon receipt of SASE to Santa Claus, P.O. Box 111, Ireland, IN 47545.

**DECEMBER 5, 6, 7.** The 17th annual Telephone Pioneers QSO party, 1900 UTC, December 5 through 0500 UTC, December 7. CW call CQTP. Phone call CQ Telephone Pioneers. Phone frequencies: 3.955-3.975; 7.265-7.285; 14.285-14.305; 21.355-21.375; 28.665-28.885; 50.10-50.25; 144.275-145.500 and 146.52. CW frequencies: 3.555-3.575; 7.055-7.075, 14.055-14.075; 21.055-21.075; 28.055-28.075; Novice/tech: 3.725, 7.125, 21.125, 28.125. Send logs by January 15, 1982 to: Ted Phelps, W8TP, John D. Burlie Chapter No. 89, Telephone Pioneers of America, c/o Western Electric, Dept. 45150, 6200 East Broad Street, Columbus, OH 43213.



Master code or upgrade in a matter of days! Code Quick is a unique breakthrough to revolutionize the learning of Morse Code. Instead of an endless maze of dits and dahs, each letter will magically begin to call out its own name! Stop torturing yourself with old-fashioned methods. Your amazing kit contains 5 power-packed cassettes, visual breakthrough cards, and original manual. All this for only \$39.95! Send check or money order today to WHEELER APPLIED RESEARCH LAB, P.O. Box 3261, City of Industry, CA 91744. Ask for Code Quick #107. California residents add 6% sales tax.

You can't lose! Follow each simple step. You must succeed or return the kit for total immediate refund!

## SHACK SUPPLIES

### R. L. DRAKE SALE!

TR-7/DR-7 160-10M Transceiver . . . List \$1599 . . . SALE \$1399  
PS-75 Heavy Duty AC Supply . . . List \$299 . . . SALE \$ 269  
PS-75 Standard AC Supply . . . List \$199 . . . SALE \$ 179  
R-7 Digital 0-30 Mhz Receiver . . . List \$1549 . . . SALE \$1349  
L-7 160-15M 1KW PEP Linear . . . List \$1090 . . . SALE \$ 969  
L-75 160-15M 1.2KW Linear . . . List \$699 . . . SALE \$ 619  
RV-7 Remote VFO for TR-7 . . . List \$195 . . . SALE \$ 175  
MS-7 Speaker for TR-7/R-7 . . . List \$49 . . . SALE \$ 45  
MN-75 200W PEP 160-10M Tuner . . . List \$259 . . . SALE \$ 229  
MN-2700 2KW PEP 160-10M Tuner . . . List \$349 . . . SALE \$ 319  
CS-7 Remote Antenna Switch . . . List \$169 . . . SALE \$ 149  
WH-7 20/200/2000 Wattmeter . . . List \$129 . . . SALE \$ 116  
DL-300 300W Dry Dummy Load . . . List \$27 . . . SALE \$ 25  
DL-1000 1KW Dry Dummy Load . . . List \$53 . . . SALE \$ 49  
AK-75 Multiband Antenna . . . List \$40 . . . SALE \$ 37  
7000E Communications Terminal . . . List \$1095 . . . SALE \$ 979  
TR-930 9" Video Monitor . . . List \$185 . . . SALE \$ 169  
COMPLETE STOCK OF DRAKE FILTERS, FANS, TECHNICAL MANUALS, SERVE KITS, MICS AND OTHER ACCESSORIES — CALL US!!

### BIG TEN-TEC SALE!

OMNI-C 160-10M Transceiver . . . List \$1289 . . . SALE \$1049  
DELTA 160-10M Transceiver . . . List \$869 . . . SALE \$ 749  
ARGOSY 80-10M Transceiver . . . List \$549 . . . SALE \$ 469  
HERCULES Solid State Linear . . . List \$1575 . . . SALE \$1329  
225 AC Supply for Argosy . . . List \$129 . . . SALE \$ 115  
255 Deluxe AC Supply for Omni . . . List \$199 . . . SALE \$ 169  
280 AC Supply for Delta . . . List \$169 . . . SALE \$ 149  
209 300W PEP Dry Dummy Load . . . List \$26 . . . SALE \$ 24  
214 Electret Mic for 234 . . . List \$39 . . . SALE \$ 36  
215PC Ceramic Mic . . . List \$35 . . . SALE \$ 29  
227 200W PEP Antenna Tuner . . . List \$79 . . . SALE \$ 75  
228 200W Tuner w/SWR Meter . . . List \$95 . . . SALE \$ 89  
229 2KW PEP Tuner w/SWR Meter . . . List \$269 . . . SALE \$ 229  
243 Remote VFO for Omni-C . . . List \$189 . . . SALE \$ 169  
234 RF Speech Processor . . . List \$139 . . . SALE \$ 119  
283 Remote VFO for Delta . . . List \$189 . . . SALE \$ 169  
COMPLETE STOCK OF ALL TEN-TEC FILTERS, BREAKERS AND OTHER ACCESSORIES IN STOCK FOR IMMEDIATE SHIPMENT — CALL!!

### ETO/ALPHA

76A 2 KW Pep Linear Amp w/2 8874S . . . \$1495  
76PA 2 KW Pep Linear Amp w/3 8874S . . . \$1795  
374A No Tune Up Version of 76A . . . \$1995  
78 No Tune Up QSK-3 8874S . . . \$2595  
77DX Linear Amp w/8877 Final . . . \$3995

### RF POWER LABS AMPLIFIERS

A1000 150 mtr. 15 mtr. KW Linear . . . \$1199  
V76 6 mtr. 8-15W in - 120W out amp w/PS . . . \$349  
V360 6 mtr. 5-10W in - 450W out w/PS . . . \$949  
V70 2 mtr. 10-15W in - 90W out amp w/PS . . . \$299  
V71 2 mtr. 1-3W in - 90W out amp w/PS . . . \$349  
V180 2 mtr. 5-15W in - 200W out amp w/PS . . . \$499  
V350 2 mtr. 10-20W in - 400W out amp w/PS . . . \$949  
V1308 220 MHz 10W in - 85W out amp w/PS . . . \$299  
V1358 220 MHz 25W in - 160W out amp w/PS . . . \$429  
FAN KITS AND RACK ADAPTERS ALSO AVAILABLE CALL!

### DAIWA/J.W. MILLER

AT2500 2KW PEP Automatic Antenna Tuner . . . \$699  
CNA-1001 500W PEP Automatic Antenna Tuner . . . \$299  
CN-2608 1.8-150 Mhz SWR/Power Meter . . . \$112  
CN-630 140-150 Mhz SWR/Power Meter . . . \$129  
CN-720B 1.8-150 Mhz SWR/Power Meter . . . \$149  
CS-201 2-Pos Cavity type Coax Switch . . . \$ 21  
CS-401 4-Pos Cavity type Coax Switch . . . \$ 64  
RF-440 RF Speech Processor w/AC Supply . . . \$129

## TEXAS TOWERS

A DIVISION OF TEXAS COMMUNICATIONS PRODUCTS  
1108 Summit Ave., Suite 4  
Plano, Texas 75074  
Mon.-Fri. 9 a.m. - 6 p.m. Sat 9 a.m. - 1 p.m.  
TELEPHONE: (214) 423-2376  
PRICES SUBJECT TO CHANGE WITHOUT NOTICE

# Sized and priced to suit all pockets

## AR-22 DIGITALLY SYNTHESIZED VHF FM RECEIVER

### STANDARD FREQUENCIES

- 141.000-149.995 MHz (AR-22 Type-A)
- \* 146.000-154.995 MHz (AR-22 Type-B)
- 151.000-159.995 MHz (AR-22 Type-C)
- \* 156.000-164.995 MHz (AR-22 Type-D)
- 161.000-169.995 MHz (AR-22 Type-E)

Marked with (\*) are subject to available supply

### TECHNICAL DATA

- FREQUENCY COVERAGE: 131.000MHz to 179.995MHz
- MAXIMUM FREQUENCY COVERAGE: 8.995MHz without any degrading
- RECEIVING MODE: Frequency Modulation, 16F3
- RECEIVER SYSTEM: PLL Frequency synthesized dual conversion superheterodyne
- USABLE SENSITIVITY: 0.2uV across 50-ohm at 12db SINAD
- AUDIO SQUELCH SENSITIVITY: 0.2uV at threshold squelch, adjustable
- SELECTIVITY: Adjacent channel rejection (12.5kHz) greater than 60dB
- SPURIOUS AND IMAGE ATTENUATION: Less than 50dB
- FREQUENCY STABILITY: Within ± 10PPM over the operating temp. range
- IF FREQUENCIES: 1st 10.7MHz, 2nd 455kHz
- AUDIO OUTPUT POWER: 100mW into 8-ohm load at 10% THD
- POWER CONSUMPTION: 25mA at receiver squelched; 100mA at 100mW audio output power
- OPERATING TEMPERATURE RANGE: -10° C to +60° C
- BATTERY: Rechargeable NiCd battery pack, 4.9 volts and 225mAh
- PHYSICAL SIZE: 5 1/2" (H) X 2 1/2" (W) X 1.0" (D) without knobs
- WEIGHT: 7.1 oz. (200 grams) with battery pack
- FREQUENCY SELECTION: 3 digits of digital push switches and slide switch
- PCB: Double sided glass-epoxy printed circuit board

Order today your AR 22, if you are not completely satisfied, return it within 15 days for your refund. (less shipping charge) add \$2.50 for shipping charge. California residents add 6% sales tax.

SEND: Cashier's check, Money order, Master charge or Visa. UPS C.O.D.

DEALER INQUIRY IS INVITED

ALL TYPES

\$150.00 with accessories



**ACE communications, inc.**

2832-D WALNUT AVENUE, TUSTIN, CALIFORNIA 92680 (714) 544-8281  
TELEX: 655-306

# 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 **Webster** DISTRIBUTOR

**Webster**  
associates

115 BELLARMINE  
ROCHESTER, MI 48063

CALL TOLL FREE

**800-521-2333**

IN MICHIGAN 313 - 375-0420

OVER 70 BRANDS IN STOCK

LAND-MOBILE RADIO

Full Service Shop • Spectrum Analysis • Antennas  
New and Used Equipment • CW-SSB-FM, Etc. • Towers  
FCC Study Guides • Code Tapes • Books • Accessories

**SPECTRONICS**

Specialists in Amateur Radio,  
Short-Wave Listening  
And Contemporary  
Electronic Gear.

HOURS  
MON, TUES, WED.: 9:30-6:00 PM  
THURS, FRI.: 9:30-8:00 PM  
SAT.: 9:30-3:00 PM

CLOSED SUNDAYS, HOLIDAYS

**SPECTRONICS, INC.**  
1009 GARFIELD ST. OAK PARK, IL. 60304

(312) 848-6777

## Homebrew Headquarters

**Building A Transmatch?  
Fixing An Antenna?  
Making Test Gear?  
Constructing A Kit?**

**KITS**

**— IN STOCK —**

B & W coils, switches, antennas  
Jackson dials and drives  
J. W. Miller parts  
Millen components  
Multronics roller inductors  
Toroids, cores, beads, baluns  
Variable capacitors:  
Cardwell — E F Johnson  
Hammarlund — Millen

**NEW**

Improved UHF Oscillator (hr 8/81)  
L-Meter (QST 1/81)  
General Coverage with Drake R-4 A, B, & C (QST 5/81)  
T-R Solidstate Switch (hr 6/80)  
Antenna Switch (QST 6/81)  
Modulator for 2-Meter Synthesizer (hr 4/81)

R-X Noise Bridge (hr 2/77)  
Split-band Speech Processor (hr 9/79)  
40 Meter QRP Transceiver (hr 4/80)  
Microprocessor Contest Keyer (hr 1/81)  
Many Others

**RADIOKIT**  
Box 411H, Greenville, NH 03048  
(603) 878-1033

Catalog — 25 cents

# TOWERS by ALUMA

HIGHEST QUALITY ALUMINUM & STEEL

60 Ft. Alum. Crank-Up Model T-60-H

40' Steel Crank-Up Model SHD-40

- ★ TELESCOPING (CRANK UP)
- ★ GUYED (STACK-UP)
- ★ TILT-OVER MODELS

Easy to install. Low Prices. Crank-ups to 100 ft.

EXCELLENT FOR AMATEUR COMMUNICATIONS

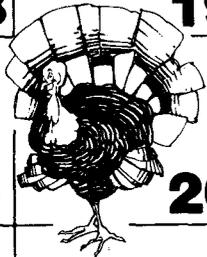
SPECIAL Four Section 50 Ft. Van Mounted Crank-Up Aluma Tower

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

**ALUMA TOWER COMPANY**  
BOX 2806HR  
VERO BEACH, FLA. 32960  
(305) 567-3423 TELEX 80-3405

# HAM CALENDAR

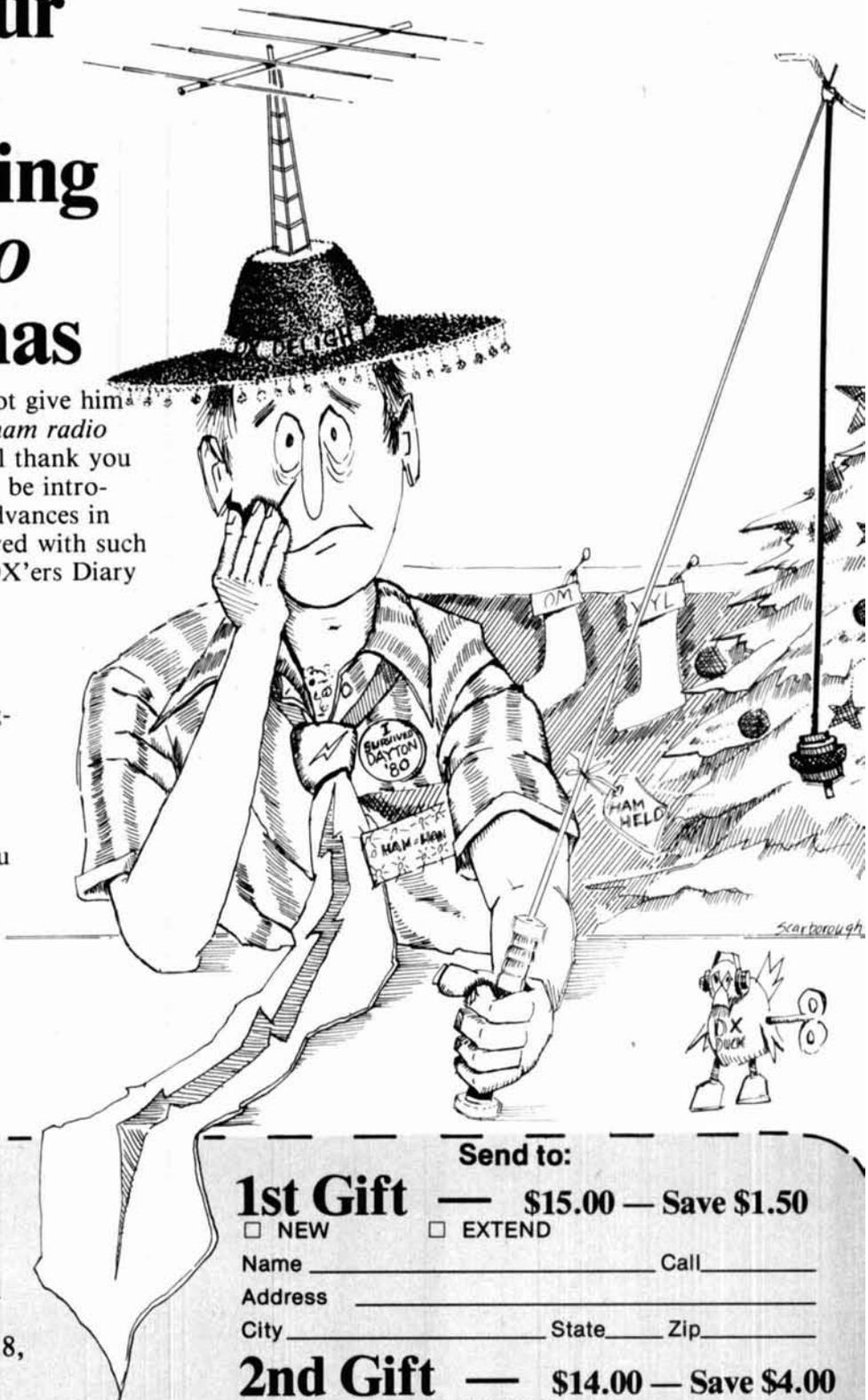
# November

| SUNDAY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | MONDAY                                                                           | TUESDAY                                                                                                                                                                                                                                                                                | WEDNESDAY                                        | THURSDAY                                                                             | FRIDAY    | SATURDAY                                                                                                                                                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|--------------------------------------------------------------------------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>5TH ANNUAL U.S. MARINE CORPS MARATHON</b> — beginning 0900 EST. Frequencies used will be: All 2-meter repeaters in the D.C. area; 10-meter FM &amp; single-sideband in vicinity of 29.6 and 28.5 MHz; 15-meters in vicinity of 21.360 MHz; 40 meters in vicinity of 14.3 MHz; 40 meters in vicinity of 7.225 MHz. Operators who complete their QSO's with N3ES via W3NKF send their QSL cards to W3NKF, Code 9015, Naval Research Lab, Washington, D.C. 20375. 1</p> <p><b>DEFIANCE COUNTY HAMFEST &amp; FLEA MARKET</b> — Defiance County Fairgrounds, Hicksville, OH. Contact Ed Ballard, Jr., WD8JVV. 1</p> | <p><b>WEST COAST BULLETIN</b> — 8PM PST (0400UTC), 3540 KCS, A-1, Z2 WPM. 2</p>  | <p><b>AMSAT East Coast Net 3850</b><br/>kHz 9:00 PM EDST (0100Z)<br/>Wednesday Morning)</p> <p><b>AMSAT Mid-Continent Net 3850</b><br/>kHz 9:00 PM CDST (0200Z)<br/>Wednesday Morning)</p> <p><b>AMSAT West Coast Net 3850</b><br/>kHz 8:00 PM PDST (0300Z)<br/>Wednesday Morning)</p> | <p><b>YLRL ANNIVERSARY PHONE CONTEST</b> 4-5</p> |                                                                                      |           | <p><b>ARRL SWEEPSTAKES (CW)</b> 7-8*</p>                                                                                                                           |
| <b>1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>2</b>                                                                         | <b>3</b>                                                                                                                                                                                                                                                                               | <b>4</b>                                         | <b>5</b>                                                                             | <b>6</b>  | <b>7</b>                                                                                                                                                           |
| <p><b>R.F. HILL ARC 5TH ANNUAL HAMFEST</b> — Sellersville National Guard Armory, Sellersville, PA. Contact K3TV for more information. 8</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                  | <p><b>AMSAT East Coast Net 3850</b><br/>kHz 9:00 PM EDST (0100Z)<br/>Wednesday Morning)</p> <p><b>AMSAT Mid-Continent Net 3850</b><br/>kHz 9:00 PM CDST (0200Z)<br/>Wednesday Morning)</p> <p><b>AMSAT West Coast Net 3850</b><br/>kHz 8:00 PM PDST (0300Z)<br/>Wednesday Morning)</p> | <p><b>WI1AW QUALIFYING RUN</b> 11</p>            |                                                                                      |           | <p><b>ESPERANTO (ILERA)</b> Details from G4MR, QTHR 14-15</p> <p><b>NORTH CAROLINA QSO PARTY</b> 14-15</p> <p><b>EUROPEAN DX CONTEST</b> — see July QST. 14-15</p> |
| <b>8</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>9</b>                                                                         | <b>10</b>                                                                                                                                                                                                                                                                              | <b>11</b>                                        | <b>12</b>                                                                            | <b>13</b> | <b>14</b>                                                                                                                                                          |
| <p><b>ALLEN COUNTY AMATEUR RADIO TECHNICAL SOCIETY 5TH ANNUAL HAMFEST</b> — Allen County Memorial Coliseum, Ft. Wayne, IN. Contact Allen County ARTS, P.O. Box 10342, Ft. Wayne, IN 46851. 15</p>                                                                                                                                                                                                                                                                                                                                                                                                                    | <p><b>WEST COAST BULLETIN</b> — 8PM PST (0400UTC), 3540 KCS, A-1, Z2 WPM. 16</p> | <p><b>AMSAT East Coast Net 3850</b><br/>kHz 9:00 PM EDST (0100Z)<br/>Wednesday Morning)</p> <p><b>AMSAT Mid-Continent Net 3850</b><br/>kHz 9:00 PM CDST (0200Z)<br/>Wednesday Morning)</p> <p><b>AMSAT West Coast Net 3850</b><br/>kHz 8:00 PM PDST (0300Z)<br/>Wednesday Morning)</p> |                                                  |                                                                                      |           | <p><b>WI1AW QUALIFYING RUN</b> 21</p> <p><b>ARRL SWEEPSTAKES (phone)</b> 21-22*</p>                                                                                |
| <b>15</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>16</b>                                                                        | <b>17</b>                                                                                                                                                                                                                                                                              | <b>18</b>                                        | <b>19</b>                                                                            | <b>20</b> | <b>21</b>                                                                                                                                                          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                  | <p><b>AMSAT East Coast Net 3850</b><br/>kHz 9:00 PM EDST (0100Z)<br/>Wednesday Morning)</p> <p><b>AMSAT Mid-Continent Net 3850</b><br/>kHz 9:00 PM CDST (0200Z)<br/>Wednesday Morning)</p> <p><b>AMSAT West Coast Net 3850</b><br/>kHz 8:00 PM PDST (0300Z)<br/>Wednesday Morning)</p> |                                                  |  |           |                                                                                                                                                                    |
| <b>22</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>23</b>                                                                        | <b>24</b>                                                                                                                                                                                                                                                                              | <b>25</b>                                        |                                                                                      | <b>26</b> | <b>27</b>                                                                                                                                                          |
| <p><b>OAK PARK HIGH SCHOOL ELECTRONICS CLUB 11TH ANNUAL SWAP &amp; SHOP</b> — Oak Park High School, Oak Park, MI. For more information send SASE to Herman Gardner, Oak Park H.S., 13701 Oak Park Blvd., Oak Park, MI 48237. 29</p>                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                  | <p><b>AMSAT East Coast Net 3850</b><br/>kHz 9:00 PM EDST (0100Z)<br/>Wednesday Morning)</p> <p><b>AMSAT Mid-Continent Net 3850</b><br/>kHz 9:00 PM CDST (0200Z)<br/>Wednesday Morning)</p> <p><b>AMSAT West Coast Net 3850</b><br/>kHz 8:00 PM PDST (0300Z)<br/>Wednesday Morning)</p> |                                                  |                                                                                      |           | <p><b>CQ WORLDWIDE DX CONTEST (CW)</b> 28-29</p>                                                                                                                   |
| <b>29</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>30</b>                                                                        | <b>31</b>                                                                                                                                                                                                                                                                              |                                                  |                                                                                      |           |                                                                                                                                                                    |

\*See October QST.

# Maybe your friends were expecting *ham radio* last Christmas

Now that he has everything, why not give him something he'll really enjoy! Give *ham radio* this Christmas and your friends will thank you all year 'round. Each month they'll be introduced to the very latest technical advances in Amateur Radio, and become involved with such very special features as W9KNI's DX'ers Diary or Ham Radio Techniques by Bill Orr. Of course there will also be W6BNB's upgrade series and the many other exciting features that make *ham radio* such a special magazine for today's Amateur. So do your friends a favor and subscribe now at our very special gift price below. While you're at it, put your own name and address down — you deserve a money-saving gift too.



## YES!

Please send my *ham radio* gift subscriptions as indicated. Also send a handsome gift acknowledgement card. (A gift card will be sent to each gift recipient if order is received by December 18, 1981.)

### From:

Name \_\_\_\_\_ Call \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

- Check or Money Order Enclosed  
 VISA  Master Charge

Acct. # \_\_\_\_\_

Expires \_\_\_\_\_ MC Bank # \_\_\_\_\_

### Foreign gift subscription prices:

Europe, Japan, Africa: Air Delivery \$28.00 per year. Canada and other countries: \$21.50 per year.

### Send to:

## 1st Gift — \$15.00 — Save \$1.50

- NEW  EXTEND

Name \_\_\_\_\_ Call \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

## 2nd Gift — \$14.00 — Save \$4.00

- NEW  EXTEND

Name \_\_\_\_\_ Call \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

## 3rd Gift — \$14.00 — Save \$6.50

- NEW  EXTEND

Name \_\_\_\_\_ Call \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Bill me after January 1, 1982.

# MBA READER™ A NAME YOU SHOULD KNOW



**What does MBA mean?** It stands for Morse-Baudot and ASCII. **What does the MBA Reader do?** The RO model (reader only) uses a 32 character alphanumeric vacuum fluorescent display and takes cw or tty audio from a receiver or tape recorder and visually presents it on the display.

The copy moves from right to left across the screen, much like the Times Square reader board. **Is the AEA model MBA Reader different from other readers?** It certainly is! It is the first to give the user 32 characters of copy (without a CRT), up to five words at one time. It can copy cw up to 99 wpm and Baudot at 60-67-75 and 100 wpm. Speeds in the ASCII mode are 110 and hand typed 300

baud. The expanded display allows easy copy even during high speed reception.

The AEA model MBA has an exclusive automatic speed tracking feature. If you are copying a signal at 3-5 wpm and tune to a new signal at 90 wpm, the MBA catches the increased speed without loss of copy.

The MBA Reader allows a visual display of your fist and improves your code proficiency. It is compact in size, and has an easily read vacuum fluorescent display.

The Reader operates from an external 12 VDC source. This allows for portable/mobile or fixed operation.

Check the AEA model MBA Reader at your favorite dealer and see all the features in this new equipment. If your dealer cannot supply you, contact **Advanced Electronic Applications, Inc.**

P.O. Box 2160, Lynnwood, WA 98036 Call 206/775-7373

Prices and specifications subject to change without notice or obligation

**AEA** Brings you the  
**Breakthrough!**

## RADIO WAREHOUSE

Get THEIR lowest price . . .

**THEN CALL US!  
GREAT RECEIVERS  
AT  
GREAT PRICES**

**KENWOOD R-1000**



**\$384<sup>95</sup>**

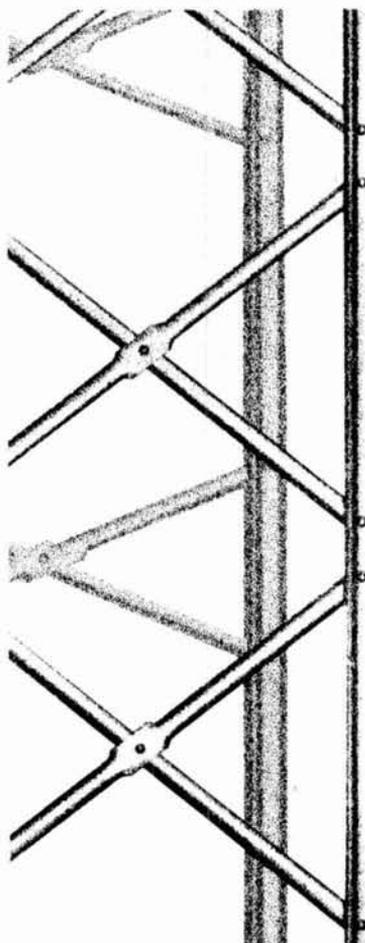
**YAESU FRG-7700**

**\$464<sup>95</sup>**



Prices shown, m.o. or certified check only  
Shipping not included.

**P.O. BOX 2728  
DALLAS, TX 75221  
Telephone: (817) 496-9000**



## Rohn 'BX' TOWERS

- For Home TV, Ham Radio and CB.
- Up to 18 sq. ft. antenna capacity.
- Available to 64' in 8' sections.
- All riveted construction — no welds.
- Beaded channel leg for added strength.
- All steel — galvanized for added life.
- Can be used with Concrete Base Stubs, Cylinder Base or Hinged Concrete Base.

**UNR-Rohn**

Division of UNR Industries, Inc.  
6718 West Plank Road, P.O. Box 2000  
Peoria, Illinois 61656  
U.S.A.



*Ham Radio's guide to help you find your loca*

## Arizona

**POWER COMMUNICATIONS CORPORATION**  
1640 W. CAMELBACK ROAD  
PHOENIX, AZ 85015  
602-242-6030 or 242-8990  
Arizona's #1 "Ham" Store. Kenwood, Yaesu, Icom and more.

## California

**C & A ELECTRONIC ENTERPRISES**  
2210 S. WILMINGTON AVE.  
SUITE 105  
CARSON, CA 90745  
213-834-5868  
Not The Biggest, But The Best —  
Since 1962.

**JUN'S ELECTRONICS**  
3919 SEPULVEDA BLVD.  
CULVER CITY, CA 90230  
213-390-8003 Trades  
714-463-1886 San Diego  
The Home of the One Year Warranty  
— Parts at Cost — Full Service.

**QUEMENT ELECTRONICS**  
1000 SO. BASCOM AVENUE  
SAN JOSE, CA 95128  
408-998-5900  
Serving the world's Radio Amateurs  
since 1933.

**SHAVER RADIO, INC.**  
1378 S. BASCOM AVENUE  
SAN JOSE, CA 95128  
408-998-1103  
Azden, Icom, Kenwood, Tempo,  
Ten-Tec, Yaesu and many more.

## Connecticut

**HATRY ELECTRONICS**  
500 LEDYARD ST. (SOUTH)  
HARTFORD, CT 06114  
203-527-1881  
Call today. Friendly one-stop shop-  
ping at prices you can afford.

## Delaware

**DELAWARE AMATEUR SUPPLY**  
71 MEADOW ROAD  
NEW CASTLE, DE 19720  
302-328-7728  
Icom, Ten-Tec, Swan, DenTron,  
Tempo, Yaesu, Azden, and more.  
One mile off I-95, no sales tax.

## Florida

**AMATEUR ELECTRONIC SUPPLY**  
1898 DREW STREET  
CLEARWATER, FL 33515  
813-461-HAMS  
Clearwater Branch  
West Coast's only full service  
Amateur Radio Store.

**AMATEUR ELECTRONIC SUPPLY**  
621 COMMONWEALTH AVE.  
ORLANDO, FL 32803  
305-894-3238  
Fla. Wats: 1 (800) 432-9424  
Outside Fla: 1 (800) 327-1917

**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  
Atlas, B&W, Bird, Cushcraft,  
DenTron, Drake, Hustler, Hy-Gain,  
Icom, K.D.K., Kenwood, MFJ, Rohn,  
Swan, Ten-Tec, Wilson.

## 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 — 312-631-5181  
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

**THE HAM SHACK**  
808 NORTH MAIN STREET  
EVANSVILLE, IN 47710  
812-422-0231  
Discount prices on Ten-Tec, Cubic,  
Hy-Gain, MFJ, Azden, Kantronics,  
Santec and others.

## Kansas

**ASSOCIATED RADIO**  
8012 CONSER, P. O. BOX 4327  
OVERLAND PARK, KS 66204  
913-381-5900  
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 & Apple  
Computers.

## Massachusetts

**TEL-COM, INC.**  
675 GREAT ROAD, RTE. 119  
LITTLETON, MA 01460  
617-486-3040  
617-486-3400 (this is new)  
The Ham Store of New England  
You Can Rely On.

**Dealers:** *YOU SHOULD BE HERE TOO!*  
*Contact Ham Radio now for complete details.*

# Amateur Radio Dealer

## Minnesota

**MIDWEST AMATEUR RADIO SUPPLY**  
3452 FREMONT AVE. NO.  
MINNEAPOLIS, MN 55412  
612-521-4662  
It's service after the sale that counts.

## Nevada

**AMATEUR ELECTRONIC SUPPLY**  
1072 N. RANCHO DRIVE  
LAS VEGAS, NV 89106  
702-647-3114  
Pete, WA8PZA & Squeak, AD7K  
Outside Nev: 1 (800) 634-6227

## New Hampshire

**TUFTS ELECTRONICS**  
61 LOWELL ROAD  
HUDSON, NH 03051  
603-883-5005  
New England's friendliest ham store.

## New Jersey

**RADIOS UNLIMITED**  
P. O. BOX 347  
1760 EASTON AVENUE  
SOMERSET, NJ 08873  
201-469-4599  
New Jersey's only factory authorized  
Yaesu and Icom distributor. New and  
used equipment. Full service shop.

**ROUTE ELECTRONICS 46**  
225 ROUTE 46 WEST  
TOTOWA, NJ 07512  
201-256-8555

**ROUTE ELECTRONICS 17**  
777 ROUTE 17 SOUTH  
PARAMUS, NJ 07625  
201-444-8717  
Drake, Cubic, DenTron, Hy-Gain,  
Cushcraft, Hustler, Larsen, MFJ,  
Butternut, Fluke & Beckman  
Instruments, etc.

## New Mexico

**PECOS VALLEY  
AMATEUR RADIO SUPPLY**  
112 W. FIRST STREET  
ROSWELL, NM 88201  
505-623-7388  
Now stocking Ten-Tec, Lunar, Icom,  
Morsematic, Bencher, Tempo,  
Hy-Gain, Avanti and more at low,  
low prices. Call for quote.

## New York

**BARRY ELECTRONICS**  
512 BROADWAY  
NEW YORK, NY 10012  
212-925-7000  
New York City's Largest Full Service  
Ham and Commercial Radio Store.

**GRAND CENTRAL RADIO**  
124 EAST 44 STREET  
NEW YORK, NY 10017  
212-599-2630  
Drake, Kenwood, Yaesu, Atlas,  
Ten-Tec, Midland, DenTron, Hy-Gain,  
Mosley in stock.

**HARRISON RADIO CORP.**  
20 SMITH STREET  
FARMINGDALE, NY 11735  
516-293-7990  
"Ham Headquarters USA" since  
1925. Call toll free 800-645-9187.

**RADIO WORLD**  
ONEIDA COUNTY AIRPORT  
TERMINAL BLDG.  
ORISKANY, NY 13424  
TOLL FREE 1 (800) 448-9338  
NY Res. 1 (315) 337-0203  
Authorized Dealer — ALL major  
Amateur Brands.  
We service *everything* we sell!  
Warren K2IXN or Bob WA2MSH.

## Ohio

**AMATEUR ELECTRONIC SUPPLY**  
28940 EUCLID AVE.  
WICKLIFFE, OH (CLEVELAND AREA)  
44092  
216-585-7388  
Ohio Wats: 1 (800) 362-0290  
Outside Ohio: 1 (800) 321-3594

**UNIVERSAL AMATEUR RADIO, INC.**  
1280 AIDA DRIVE  
REYNOLDSBURG (COLUMBUS), OH  
43068  
614-866-4267  
KENWOOD: The biggest and best  
Ham Store in the midwest featuring  
quality Kenwood products with work-  
ing displays. We sell only the best.  
Authorized Kenwood Service.

## Oklahoma

**DERRICK ELECTRONICS, INC.**  
714 W. KENOSHA — P.O. BOX A  
BROKEN ARROW, OK 74012  
Your *Discount* Ham equipment dealer  
in Broken Arrow, Oklahoma  
1-800-331-3688 or  
1-918-251-9923

## Pennsylvania

**HAMTRONICS,  
DIV. OF TREVOSE ELECTRONICS**  
4033 BROWNSVILLE ROAD  
TREVOSE, PA 19047  
215-357-1400  
Same Location for 30 Years.

**LaRUE ELECTRONICS**  
1112 GRANDVIEW STREET  
SCRANTON, PENNSYLVANIA 18509  
717-343-2124  
Icom, Bird, Cushcraft, Beckman,  
Fluke, Larsen, Hustler, Astron,  
Antenna Specialists, W2AU/W2VS,  
AEA, B&W, CDE, Sony, Vibroplex.

**SPECIALTY COMMUNICATIONS**  
2523 PEACH STREET  
ERIE, PA 16502  
814-455-7674  
Service, Parts, & Experience For Your  
Atlas Radio.

## Virginia

**ELECTRONIC EQUIPMENT BANK**  
516 MILL STREET, N.E.  
VIENNA, VA 22180  
703-938-3350  
Metropolitan D.C.'s One Stop  
Amateur Store. Largest Warehousing  
of Surplus Electronics.

## Washington

**THE RADIO STORE**  
1505 FRUITDALE BLVD.  
YAKIMA, WA 98902  
509-248-4777  
Your complete Ham store for sales/  
service. All major brands. TRADE-  
SELL-BUY!

## Wisconsin

**AMATEUR ELECTRONIC SUPPLY**  
4828 W. FOND DU LAC AVE.  
MILWAUKEE, WI 53216  
414-442-4200  
Wisc. Wats: 1 (800) 242-5195  
Outside Wisc: 1 (800) 558-0411



# HAM RADIO'S HOLIDAY SHOPPER

**DON'T WAIT  
ORDER TODAY**

## 1982 U.S. RADIO AMATEUR CALLBOOK

Radio Amateur Callbooks will be ready for shipping week of December 1, 1981. No Amateur station is complete without the very latest Callbook! The new 1982 U.S. Callbook features over 390,000 up-to-date names and addresses right where you want them — at your finger tips. Also contains many helpful operating and station aids. ©1981. Softbound.

CB-US \$18.95 + \$3.05 shipping (U.S.A.) = **\$22.00**

## 1982 FOREIGN CALLBOOK

If DX is your "thing" then you need a copy of the 1982 Foreign Callbook. Getting a QSL card can be quite a chore without proper names and addresses. Make sure you don't miss out. ©1981. Softbound.

CB-F \$17.95 + \$3.05 shipping (U.S.A.) = **\$21.00**

Get 'em both and be really prepared. You save money too!

CB-USF **Only \$39.95**

## BRAND NEW 22ND EDITION OF THE FAMOUS RADIO HANDBOOK by Bill Orr, W6SAI

The Radio Handbook has been an electronic best seller for over 45 years! This brand new edition reflects all of the latest state-of-the-art advances in a comprehensive, single source reference book. An invaluable aid for Hams, technicians, and engineers alike. Also chock-full of projects and other ideas that are of interest to all levels of electronics expertise. 1136 pages. ©1981.

21874 **Hardbound \$26.95**

## BRAND NEW 1982 ARRL RADIO AMATEUR'S HANDBOOK

Order today for delivery by late November. Be one of the first to get your copy. Internationally recognized, universally consulted. It's the all purpose volume for radio. Jam packed with information, drawings, and illustrations that are useful to the Amateur and professional alike. ©1981.

AR-HB82 **Softbound \$10.00**  
 AR-BB82 **Hardbound \$15.75**

(Available mid December)

## FROM:

Name \_\_\_\_\_ Call \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Check or Money Order Enclosed

VISA  MasterCard

Acct. # \_\_\_\_\_

Expires \_\_\_\_\_ MC Bank # \_\_\_\_\_

## TUNE IN THE WORLD WITH HAM RADIO

by ARRL staff

This package contains THE goodies needed by the beginner to get started in Amateur Radio. Assuming that you have no prior knowledge of radio, the reader is taught how to pass the Novice exam, both code and theory, and how to set up a station. Unique code study method makes learning the Morse code easy as 1-2-3. And it's full of illustrations to help clarify difficult technical points. 160 pages. ©1981. 3rd edition.

AR-HR

**Softbound \$8.50**

HR-LB

## 2ND OP

by Jim Rafferty, N6RJ  
Shipping Postpaid

Completely revised and updated with all of the latest information, the latest 2nd Op is an indispensable operating aid for all Radio Amateurs. The 2nd Op gives you at the twist of a dial: prefixes in use, continent, zone, country, beam heading, time differential, postal rates, QSO and QSL record and the official ITU prefix list. Every ham needs a 2nd Op. Order yours today. ©1981. N6RJ's 1st Edition.

HR-OP

**\$6.95**

## MODERN ELECTRONIC CIRCUIT MANUAL

by John Markus

8½ lbs. of valuable information

3600 circuits, from amplifiers to zero voltage reference switches! Exhaustively researched and arranged for ease of use, this comprehensive volume is an invaluable aid to anyone interested in electronics. Many circuits are taken from popular Amateur magazines and authors. For the ham there are filters, amplifiers, counters, clippers and more. Electronics hobbyists will also find this book full of valuable and interesting circuits that can be used in a variety of different ways. The list is almost endless! Circuits are fully referenced as to where they came from, so that further research is easy. It's big, it's heavy and it's expensive. But it's a must if you want your library to be complete. ©1980. 1238 pages, 8½ pounds.

MH-40446

**Hardbound \$47.00**

(\$44.50 + \$2.50 shipping, U.S.A.)

## FROM BEVERAGES THRU OSCAR — A BIBLIOGRAPHY

by Rich Rosen, K2RR

Your complete guide to 65 years of Amateur Radio Publishing.

From Beverages Thru Oscar — A Bibliography is a complete list of every article that would be of interest to a Radio Amateur or professional that has been published over the last 65 years. References are from CQ, Ham Radio, 73, QST, Proceedings of both the IRE and IEEE and Wireless Engineer, to name just a few. In fact, over 292 Magazines have been listed in this book with 92 different subject areas referenced. If you can't find it in this wonderfully complete bibliography, chances are, it was never published. Never before has a book like this been put together. Makes your radio magazine collection infinitely more useful. It costs just \$29.95 but is worth much, much more. ©1979.

PR-BO

**Softbound \$29.95**

## HAM RADIO LOG BOOK

Ham Radio's Log Book has room for 2100 QSO's — that's over twice as many entries as other popular log books. Room for all pertinent information, plus extra space for the name and address of each station you contact all on a convenient horizontal format. For contesters, there is a consistent 30 entries per page for easy counts. In addition, a handy frequency spectrum chart showing every band for Novice to Extra, plus a listing of all worldwide Amateur prefixes currently in use. Spiralbound to lay flat on your operating table. Unquestionably the best log book value anywhere! 8-1/2 x 11. 80 pages. ©1978.

**Spiralbound \$1.75  
3 Logs Just \$3.95**

## COMPLETE HANDBOOK OF RADIO TRANSMITTERS

by Joseph J. Carr, K4IPV

350 pages of easy-to-understand fundamentals and practical descriptions of circuits which include: fundamentals of vacuum tubes, transistors, amplifier circuits, oscillator circuits, frequency multipliers, dividers and synthesizers, RF power amplifiers, and speech amplifiers. Covers SSB, FM and PM design, theory and operation. Other subjects include: transmitter trouble-shooting, safety, interference prevention, rf neutralization, tuning, feedline devices and antennas. ©1980. 350 pages.

T-1224

**Softbound \$8.95**

## COMPLETE HANDBOOK OF RADIO RECEIVERS

by Joseph J. Carr, K4IPV

All-in-one manual. Contains complete data on almost all receivers in use today. Written in an easy-to-read manner, this handbook includes basic receiver types; specifications for the latest ideas in parameter measurements such as sensitivity, noise figures, dynamic range, and selectivity measurements. Also covered are all types of modern receiver circuits, and a wide range of troubleshooting ideas for both solid-state and vacuum tube receiver circuits. ©1980. 300 pages.

T-1182

**Softbound \$8.95**



| Catalog # | Title | QTY. | Price | Total |
|-----------|-------|------|-------|-------|
|           |       |      |       |       |
|           |       |      |       |       |
|           |       |      |       |       |

Allow 2-4 weeks for delivery Prices subject to change without notice.

SHIPPING **\$2.50**  
TOTAL

**SEND TO: HAM RADIO'S BOOKSTORE  
GREENVILLE, NH 03048**

# Advertisers check-off

... for literature, in a hurry — we'll rush your name to the companies whose names you print below. It's simple to do. Simply select the advertiser's number and name from the Advertisers' Checkoff list found on the same page as the Advertisers' Index. Just print the number and the company's name and drop in the mail.

| NUMBER | NAME OF COMPANY | NUMBER | NAME OF COMPANY |
|--------|-----------------|--------|-----------------|
| _____  | _____           | _____  | _____           |
| _____  | _____           | _____  | _____           |
| _____  | _____           | _____  | _____           |
| _____  | _____           | _____  | _____           |
| _____  | _____           | _____  | _____           |
| _____  | _____           | _____  | _____           |
| _____  | _____           | _____  | _____           |

Please  month \_\_\_\_\_ Sept. \_\_\_\_\_ Oct. \_\_\_\_\_ Nov. 81

Limit 14 inquiries please.

NAME \_\_\_\_\_ CALL \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

AFFIX POSTAGE  
OR  
POST OFFICE  
WILL NOT  
DELIVER

**ham**  
**radio**  
*magazine*

READER SERVICE CENTER  
P.O. BOX 358  
ARLINGTON, MA 02174

ATTN: Reader Service Dept.

# APPLIED INVENTION

THE SOURCE FOR SOLID STATE / STATE-OF-THE-ART

## GaAs FETS by MITSUBISHI NOW!! EVEN LOWER PRICES

VHF through 18 GHz  
 MGF 1200 - \$13.00 MGF 1400 - \$19.00 MGF 1402 - \$33.75  
 MGF 1412 (0.8db NF at 4GHz) - \$61.00  
 MGF 1403 (1.8db NF at 12 GHz) - \$108.  
 All devices in stock. Complete data.  
 Quantity discounts available.

## Microwave Modules

### NEW from MITSUBISHI

X BAND very high stability  
 GaAs FET / Dielectric Resonator oscillators  
 FO-1010X 15mw transmitter  
 10 GHz, 0.12MHz/C° \$37.50  
 FO-UP11KF heterodyne receiver,  
 10 GHz \$34.50

### NEW from PLESSEY

K BAND Gunn Diode oscillators and detectors  
 GDO-33 24.125GHz 10mw transmitter  
 SDM-31 24GHz detector (GaAs Shotkey diode)  
 Horn antennas also available.  
 Send for price and data.

## Components

MICROWAVE CHIP CAPACITORS VITRAMON  
 Vee Jem 7800 series for bypass/coupling  
 7800P7G08 1.1-1.7GHz 7800P7G04 1.3-2.6GHz  
 7800P7G01 2.6-4.2GHz  
 5 for \$5.00 no mixing. Data provided

SOLDER-IN DISK CAPACITORS for VHF-UHF bypassing  
 RMC JF series 100, 220, 470, 680pf 10 for \$2.50

### OPTOELECTRONICS from Siemens:

LD271 High efficiency infrared LED \$0.75  
 BPW34 Fast, large area PIN photo-diode \$3.00

### THERMOELECTRIC COOLERS:

MELCOR FRIGICHIP Send for Data and Price

### MINIMUM ORDER:

\$5.00, ADD \$2.00 POSTAGE & HANDLING  
 N.Y. STATE RESIDENTS ADD 6% SALES TAX  
 SEND S.A.S.E. FOR CATALOG

R.D.2 ROUTE 21 HILLSDALE, NY 12529  
 518-325-3911

## NOVEMBER SPECIALS

BONUS 2% discount for prepaid orders  
 (cashier's check or money order)  
 CALL FOR QUOTES

# ege, inc.

TOLL FREE 1-800-336-4799  
 ORDERS ONLY  
 HOURS: M-F 11-8; SAT 9-3 EDT  
 CLOSED TUESDAYS

### MFJ PRODUCTS COMPLETE LINE IN STOCK

|                                      |             |
|--------------------------------------|-------------|
| 989 New 3KW Tuner                    | 287.75      |
| 962 1.5KW Tuner mtr/switch           | 199.95      |
| 961 1.5KW Tuner                      | 139.95      |
| 949B 300 watt deluxe tuner           | 122.00      |
| 941C 300 watt tuner switch/mtr.      | 78.42       |
| 940 300 watt tuner switch/mtr.       | 69.70       |
| 484 Grandmaster memory keyer 12 msg. | 121.72      |
| 482 4 msg Memory keyer               | 87.96       |
| 422 Pacesetter Keyer w/Bencher BY1   | 87.15       |
| 410 Professor Morse keyer            | 113.95      |
| 408 Deluxe Keyer with speed mtr.     | 69.69       |
| 496 Keyboard II                      | 296.95      |
| 752B Dual turnable filter            | 78.42       |
| 102 24-hour clock                    | 30.95       |
| 260/262 Dry Dummy Loads              | 23.50/56.75 |
| 250 2KW PEP Dummy Load               | 31.10       |

### BENCHER PADDLES Black/Chrome 35.25/42.95

|                                       |        |
|---------------------------------------|--------|
| ASTRON POWER SUPPLIES (13.8 VDC)      |        |
| RS7A 5 amps continuous, 7 amp ICS     | 48.60  |
| RS12A 9 amps continuous, 12 amps ICS  | 66.35  |
| RS20A 16 amps continuous, 20 amps ICS | 87.20  |
| RS20M same as RS20A + meters          | 105.50 |
| RS35A 25 amps continuous, 35 amp ICS  | 131.95 |
| RS35M same as RS35A + meters          | 151.95 |

### TELEX HEADSETS-HEADPHONES

|                                         |             |
|-----------------------------------------|-------------|
| C1210/C1320 Headphones                  | 22.95/32.95 |
| PROCOM 200 Headset/dual Imp. MIC        | 77.50       |
| PROCOM 300 lt/wt Headset/dual Imp. mic. | 69.35       |

### VoCom Antennas/2m Amps

|                                 |        |
|---------------------------------|--------|
| 5/8 wave 2m hand held Ant       | 19.95  |
| 2 watts in, 25 watts out 2m Amp | 69.95  |
| 200 mw in, 25 watts out 2m Amp  | 82.95  |
| 2 watts in, 50 watts out 2m Amp | 108.95 |

### MIRAGE AMPS & WATT METERS

|                                         |      |
|-----------------------------------------|------|
| MPI HF/MP2 VHF SWR/Watt Meter           | CALL |
| B23 2 in. 30 out. All Mode              | CALL |
| B108 10 in. 80 out. All Mode, Pre-Amp   | CALL |
| B1016 10 in. 160 out. All Mode, Pre-Amp | CALL |

### TRANCEIVERS — BIG DISCOUNTS

KENWOOD, ICOM, YAesu, TENTE, SANTEC, AZDEN, KDK  
 — Call for Quotes —

2410 Drexel Street  
 Woodbridge, VA 22192  
 Information (703) 643-1063 Orders: 1-800-336-4799  
 Store Location: 14415 Jeff Davis Hwy., Woodbridge, VA

### AEA Keyers, Code Readers, ISOPOLE Antennas CALL

|                         |        |
|-------------------------|--------|
| HY-GAIN ANTENNAS        |        |
| TH6DX Triband Beam      | 238.95 |
| TH3MK3 3-Element Beam   | 179.95 |
| TH3JR 3-Element Triband | 138.95 |
| 18AVT/WB 10-80 Vertical | 82.95  |
| 14AVQ/WB 10-40 Vertical | 50.77  |

### CUSHCRAFT ANTENNAS

|                                |        |
|--------------------------------|--------|
| A4 New Triband Beam 10-15-20m  | 206.95 |
| A3 New Triband Beam 10-15-20m  | 169.95 |
| AV3 New 10-15-20m Vertical     | 41.50  |
| ARX 2B New Ringo Ranger 2m     | 34.00  |
| A32-19 2m 'Boomer' DX Beam     | 75.95  |
| 220B 220 MHz 'Boomer'          | 68.95  |
| 2148 Jr. Boomer 144-146 MHz    | 62.10  |
| 2148B Jr. Boomer 144.5-148 MHz | 62.10  |
| A147-11 11-Element 2m          | 34.50  |

### MINIQUAD HQ-1 132.95

|                                     |        |
|-------------------------------------|--------|
| ALLIANCE HD73 Rotor                 | 93.95  |
| CDE HAM IV ROTOR                    | 169.95 |
| CABLE R8/U Foam 95% Shield          | 26c/ft |
| 8 wire Rotor 2 #18, 6 #22           | 18c/ft |
| BUTTERNUT HF-5V-III 10-80m Vertical | 86.95  |

### KLM ANTENNAS (other antennas in stock)

|                                          |        |
|------------------------------------------|--------|
| KT34A 4-Element Triband Beam             | 320.75 |
| KT34XA 6-Element Triband Beam            | 469.50 |
| 144-148 13LB 2m 13-Element with balun    | 77.95  |
| 144-148 16C 2m 16-Element for oscar      | 93.55  |
| 420-450 14 420-450 MHz 14-element Beam   | 37.54  |
| 420-450 18C 420-450 MHz 18-Element oscar | 58.70  |
| 432 16LB 16 elem. 430-434 MHz beam/balun | 60.70  |
| HUSTLER 5BTV 10-80m Vertical             | 92.50  |
| 48TV 10-40m Vertical                     | 73.95  |
| 3TBA New 10-15-20m Beam                  | 161.95 |

### HF Mobile Resonators Standard Super

|                 |       |       |
|-----------------|-------|-------|
| 10 and 15 meter | 7.95  | 12.50 |
| 20 meters       | 10.95 | 14.95 |
| 40 meters       | 12.50 | 17.30 |
| 75 meters       | 13.50 | 27.95 |

### Avanti AP 151.3G 2m on glass ant. 27.95

— CALL FOR QUOTES —

Send stamp for a flyer. Terms: Prices do not include shipping. VISA and Master Charge accepted. 2% discount for prepaid orders (cashier's check or money order). COD fee \$2.00 per order. Prices subject to change without notice or obligation.

# The Gunnplexer Cookbook

by Robert M. Richardson, W4UCH/2

Ever wanted to take a good look at 10 GHz operation? Well here's your chance. Starting with the basic theory of the Microwave Associate's Gunnplexer transceiver, author Richardson describes in 16 building-block chapters, how to put a functioning Gunnplexer system into operation.

The Gunnplexer Cookbook has been written for the Radio Amateur or electronic student who has at least modest experience assembling vhf converter or receiver kits. Only very basic test equipment is required.

You've waited a long time for this book. Don't wait any longer. Order your copy today! ©1981 Softbound HR-GP \$9.95 plus \$1.00 for shipping.

Ham Radio Publishing Group  
 Greenville, New Hampshire 03048

# 2300 MHz MICROWAVE DOWNCONVERTERS

## DOWNCONVERTER

|           |         |
|-----------|---------|
| Kit       | \$28.50 |
| Assembled | \$48.50 |

## 2300 MHz PREAMP

|     |         |
|-----|---------|
| Kit | \$25.00 |
|-----|---------|

## POWER SUPPLY

|           |         |
|-----------|---------|
| Assembled | \$35.00 |
|-----------|---------|

## SATELLITE TV EARTH STATION

- 24 Channel Receiver
- 10' Antenna
- Dexcel 120° LNA

Call for details and price

Also Available: Commercial System with Bogner Antenna ..... \$169.00

## 2300 MHz ANTENNA



WITH BOX FOR DOWN-CONVERTER \$27.50

# PB RADIO SERVICE

1950 E. PARK ROW • ARLINGTON, TX 76010

CALL ORDER DEPT. TOLL FREE  
 (800) 433-5169



FOR INFORMATION CALL  
 (817) 460-7071

## FILTER CASCADING WORKS!

You can get significantly better performance from your Receiver by improving its IF filtering. The most cost-effective way to do this is to place a superior 8-pole SSB filter essentially in series (or Cascade) with the original unit. The resulting increase in the number of poles of filtering to as many as 16 causes a dramatic increase in selectivity and reduction of adjacent channel QRM. The authors of the following major articles all stress the effectiveness of FOX-TANGO filters in this application and comment on its simplicity: easy soldering; no drilling, no switching, and no panel changes. As a bonus, CW performance is improved as well as SSB, at no extra cost or effort!

### Recent Magazine Articles on Filter Cascading

YAESU FT-901/902. See "73", Sept. 1981  
HEATH SB104A See "Ham Radio", April 1981  
KENWOOD TS820 See "CQ", March 1981

Read the original article or send \$1 to FoxTango for complete details of the one that interests you. To make the modification, order the appropriate cascading kit from below. Each contains the parts specified in the article, the recommended Fox-Tango filter, and complete instructions.

### FOX-TANGO Cascading Kits in Stock

YAESU FT-901/902 Series ..... \$60  
HEATH SB104A Series ..... \$60  
KENWOOD TS820 Series ..... \$65 w/mini amp.  
\*KENWOOD TS520 Series ..... \$65 w/mini amp.  
\*YAESU FT-101 Series (not ZD) \$65 w/casc bd

\*Proven mods based on articles in preparation

Shipping via Airmail: \$2 US/Canada, \$5 Elsewhere  
Florida Residents: Add 4% sales tax

FOX-TANGO stocks the widest variety of custom-made time-tested crystal filters available from any source for Yaesu, Kenwood, Heath, Drake, and Collins rigs. Cascading is only one application for these filters. Others include replacing outdated or inferior original units, filling spots provided for optional filters, or adding extra filters using diode switching boards if the "spots" are filled. However, since the degree of improvement depends upon the quality of the filter used, cheap substitutes are no bargain! FOX-TANGO has never spared expense or effort to make its filters the very BEST and guarantees satisfaction - plus fast, friendly, knowledgeable, personalized service. For information about our complete line, including SSB, CW and AM filters, phone or write for our free brochure. Specify the set you want to improve.

We welcome mail or phone orders and accept payment by VISA, MASTERCHARGE, M.O., Check, Cash, or C.O.D. (at your expense).

## FOX TANGO CORPORATION

Since 1971, By and For Radio Amateurs  
Box 15944H, W. Palm Beach, FL 33406  
Phone: 1-305-683-9587

## ... If You Want The Finest

## ETD ALPHA 77DX



- Alpha 77DX: The ultimate amplifier for those who demand the finest.
- Tube: Eimac 8877 - 1500 watts of plate dissipation
- Transformer: 4.4 KVA Hypersil<sup>®</sup>, removable, plug-in
- Filter Capacitor: oil filled, 25 MFD
- Bandswitch: 20 AMP 6 KV
- Teflon - Insulated Toroid Inductors
- QSK CW: Full break-in, (2) vacuum relays
- Tuning Capacitor: Vacuum
- Cooling: Ducted air, large, quiet blower, computer grade
- Price: \$4945, limited warranty 24 months, tube by Eimac
- Other Alphas: 78-\$3185, 76CA-\$2395, 76PA-\$2195, 76A-\$1895, 374A-\$2395, 77SX-\$5935 (EXPORT ONLY)

## ETD ALPHA 78



- ALPHA 78: Has everything an amplifier needs.
- TUBES: 3 Eimac 8874, 1200 watts dissipation
- TRANSFORMER: 2.4 kVA Hypersil<sup>®</sup>, removable plug-in.
- TUNE UP: Bandpass (no tune-up) or manual
- QSK CW: Full break-in, (2) vacuum relays
- WARRANTY: 24 mos. limited warranty tubes by Eimac.
- BLOWER: Noise and vibration isolated — QUIET.
- PLATE INPUT: 2.5 kW PEP-SSB, 1.5 kW CW  
NO TIME LIMIT
- PRICE: \$3185, call for Special Sale Prices.

Phone Don Payne, K4ID, for a brochure, special prices, and his experience with Alpha Amplifiers

## ... If You Want The Finest

Personal Phone — (615) 384-2224  
P.O. Box 100  
Springfield, Tenn. 37172

# PAYNE RADIO

Free! SEND FOR OUR NEW 40 PAGE CATALOG Free!

### RFI LINE FILTER

for line to line & line to ground noise suppression

CORCOM # 10K6

Rated: 10 amp  
115/250 v  
50-450 hz

\$3.75 ea.

10 for \$35.00

ALL ELECTRONICS CORP.

905 S. Vermont Ave.

P.O. BOX 20406

Los Angeles, Calif. 90006

(213) 380-8000

Mon. - Fri. Saturday

9 AM - 5 PM 10 AM - 3 PM

### MRF 901

MICROWAVE TRANSISTOR

\$3.00 EACH

TYPE N CONNECTOR

KINGS UG 526 B-U

FITS RG55, RG58, RG141,

RG142, RG223

SOLDER TYPE

\$1.75 each 10 for \$16.00

### TERMS

• Quantities Limited

• Min. Order \$10.00

• Add \$2.50

Shipping USA

• Calif. Res. Add 6%

• Prompt Shipping

# Give Us Your Tired arms, Your Poor coverage, Your Huddled 2-meter band

... with range-extending products from VoCom, you won't need the old Statue of Liberty pose to squeeze more distance from your 2-meter hand-held radio.

- VoCom's 5/8 HT gain antenna boosts reception while giving your hand-held full quieting out of spots you're nearly dead in with a rubber duck.
- VoCom's tiny 12V power amp gives your 2-watt hand-held the talk-out range of a 25W mobile rig.
- 50 and 100 watt power amplifiers also available for use with low power hand-held radios.

See your favorite amateur radio dealer or order direct.

## VoCom PRODUCTS CORPORATION

65 East Palatine Road  
Prospect Heights, IL 60070



(312) 459-3680



## Preamplifiers



The famous Palomar Engineers preamplifier has been updated and packaged in an attractive new cabinet.

For the SWL there is the P-305 (9-v DC powered) and the P-308 (115-v AC powered) featuring full shortwave coverage, selection of two antennas, 20 db attenuator, 15 db gain control and on-off-bypass switch.



For transceivers, the P-310X (115-v AC powered) and the P-312X (12-v DC powered) feature automatic bypass on transmit, adjustable delay for return to receive, and 350 watt transmit capability.

All models have these features:

- Up to 20 db gain.
- Covers 1.8 to 54 MHz in four bands.
- Low noise figure.
- Reduces image and spurious response.
- 8" x 5" x 3". Brushed aluminum control panel. Black vinyl cover.
- SO-239 connectors.
- LED pilot.

Order direct or from your favorite dealer. Model P-305 Receiver Pre-amplifier for 9-v DC \$99.95. Model P-308 for 115-v AC \$109.95. Transceiver Pre-amplifier Model P-310X \$129.95. Model P-312X \$129.95. Add \$3 shipping/handling. Calif. residents add sales tax.



Don't wait any longer to pull out weak, rare DX.

## Palomar Engineers

1924-F.W. Mission Rd., Escondido, CA 92025  
Phone: (714) 747-3343

### FACSIMILE

COPY SATELLITE PHOTOS,  
WEATHER MAPS, PRESS!  
The Faxes Are Clear — on our full size (18-1/2" wide) recorders. Free Fax Guide.

### TELETYPE

RTTY MACHINES, PARTS, SUPPLIES  
ATLANTIC SURPLUS SALES (212) 372-0349  
3730 NAUTILUS AVE BROOKLYN, N.Y. 11224

### RED HOT SPECIALS

|                                     |              |
|-------------------------------------|--------------|
| AZDEN PCS 3000 2 m .....            | 288.00       |
| SANTEC HT1200 2m Handheld .....     | 288.00       |
| NEW! KDK 2025 MkII .....            | 288.00       |
| JANEL QSA5 2m Preamp .....          | 36.50        |
| BEARCAT 220 Scanner .....           | 269.00       |
| KANTRONICS FDII Code Reader .....   | 360.00       |
| All MFJ Items .....                 | 12% off list |
| TEN-TEC Argosy Xcvr. ....           | 474.00       |
| TEN-TEC Delta Xcvr. ....            | 738.00       |
| TEN-TEC Omni C Xcvr. ....           | 1040.00      |
| BENCHER Black Paddle .....          | 36.00        |
| SANTEC ST-7T 440 MHz Handheld ..... | 283.00       |
| ICOM 2KL Linear Amp (2 only) .....  | 1399.00      |

Prices subject to change without notice.

SASE for our Large Specials  
and Used Equipment Lists

### BEN FRANKLIN ELECTRONICS

115 1/2 N. Main Hillsboro, KS 67063  
316-947-2269

### COMM AUDIO PROCESSOR

SELECT: 13 POLE VOICE-FILTER OR 9 POLE 100 Hz BW FILTER  
WITH SELECTABLE FLAT SKIRTS • ADJUSTABLE TONE-TAG AND  
ANTI-PHASIC WHITE NOISE - ALL IN SYNTHESIZED BINAURAL

See HR Jan, '80 • COMPLETE SYSTEM, KITS, BOARDS - BROCHURES

### Hildreth Engineering

P.O. Box 60003 Sunnyvale, CA 94088

# Advertisers 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  234

- |                                      |                                  |
|--------------------------------------|----------------------------------|
| Ace _____ 850                        | Kilovac _____ 956                |
| AEA _____ 677                        | L-Tronics *                      |
| Advanced Electro-Products _____ 955  | MFJ _____ 082                    |
| Advanced Receiver Research _____ 919 | Madison _____ 431                |
| Alaska Microwave _____ 826           | Marco _____ 929                  |
| All Elec. _____ 926                  | Microcraft _____ 774             |
| Aluma _____ 589                      | Micro Security _____ 939         |
| ARRL _____ 780                       | Microwave Filter _____ 637       |
| Amidon _____ 005                     | Mid-Com _____ 479                |
| Applied Inv. _____ 862               | J. W. Miller _____ 745           |
| Atlantic Surplus *                   | N. P. S. _____ 866               |
| Barker & Williamson _____ 015        | NRI *                            |
| Barry *                              | P. B. Radio _____ 921            |
| Bencher _____ 629                    | P. C. _____ 766                  |
| Ben Franklin _____ 864               | Palomar Eng. *                   |
| Bilal _____ 817                      | Panasonic _____ 683              |
| Britt's 2-Way Radio _____ 953        | Payne _____ 867                  |
| Butternut *                          | Phillips-Tech _____ 936          |
| Clutterfree _____ 952                | Pipo _____ 481                   |
| Comm. Concepts _____ 797             | RF Power Components _____ 954    |
| Comm. Elec. _____ 489                | Callbook _____ 100               |
| Comm. Spec _____ 330                 | Radiokit _____ 801               |
| Drake *                              | Radios Unlimited _____ 941       |
| EGE _____ 901                        | Radio Warehouse *                |
| Elenco _____ 947                     | Radio World _____ 592            |
| Encomm _____ 888                     | Securitron _____ 461             |
| Erickson Comm. *                     | Semiconductors Surplus _____ 512 |
| ETCO _____ 856                       | Sherwood *                       |
| Fair Radio _____ 048                 | Skytec _____ 704                 |
| Fox-Tango _____ 657                  | Smithe _____ 930                 |
| GLB _____ 552                        | Spectronics *                    |
| H-Troniks _____ 927                  | Spectrum Int. _____ 108          |
| Hal Comm. _____ 057                  | Stewart Quads _____ 890          |
| Hal-Tronix _____ 254                 | Telrex *                         |
| H. R. B. _____ 150                   | Ten-Tec *                        |
| H. R. Magazine *                     | Texas Towers _____ 681           |
| Ham Shack _____ 879                  | The Comm Center _____ 634        |
| Hatry _____ 889                      | Universal Comm. _____ 885        |
| Heath _____ 060                      | UNR-Rohn _____ 410               |
| Henry _____ 062                      | Valor _____ 946                  |
| Hildreth _____ 283                   | Vanguard Labs _____ 716          |
| Icom *                               | Varian _____ 043                 |
| I. C. A. *                           | VoCom _____ 857                  |
| Int. Crystal _____ 066               | Webster Assoc. _____ 423         |
| Jameco _____ 333                     | Western Elec. _____ 909          |
| Jan _____ 067                        | Wheeler App. Res. Lab _____ 931  |
| Johnston, Bill _____ 948             | World-Wide _____ 957             |
| Jones _____ 626                      | Yaesu _____ 127                  |
| Kenwood *                            |                                  |

\*Please contact this advertiser directly.

Limit 15 inquiries per request.

**November, 1981**

Please use before December 31, 1981

Tear off and mail to

HAM RADIO MAGAZINE — "check off"  
Greenville, N. H. 03048-0498

NAME.....

CALL.....

STREET.....

CITY.....

STATE..... ZIP.....

# hey look here

call toll free:nights  
**(800) 231-3057**

6-10 PM CDST, M.W.F.  
days: 713-658-0268

- |               |                      |        |
|---------------|----------------------|--------|
| <b>ICOM</b>   | IC 720A/AC ....      | \$1298 |
|               | IC 730 .....         | 729    |
|               | IC 2AT .....         | 249    |
|               | IC 22U .....         | 269    |
|               | IC 25A .....         | 309    |
| <b>Santec</b> | HT 1200 .....        | 299    |
|               | ST7 440 FM .....     | 299    |
| <b>ETO</b>    | Alpha 78 .....       | 2595   |
|               | 76A .....            | 1495   |
|               | 76PA .....           | 1795   |
| <b>Telrex</b> | TB 5EM .....         | 425    |
| <b>Drake</b>  | TR7/DR7 .....        | 1349   |
|               | R7/DR7 .....         | 1299   |
| <b>AEA</b>    | Morse CK1 .....      | 115.00 |
| <b>YEASU</b>  | FT707 .....          | 699    |
|               | FRG7700 .....        | 449    |
|               | FT101ZD .....        |        |
|               | Mark 3 Limited ..... | 749    |

Order **KWM 380** Now  
**OLD PRICE**

## Rockwell Accessories in Stock

- |                                     |        |
|-------------------------------------|--------|
| <b>Janel 8SA5</b> .....             | 41.95  |
| <b>Bash Books</b> .....             | 9.95   |
| <b>Amphenol Silver Plate PL-259</b> | 1.00   |
| <b>Antique/Rare Tubes</b> .....     | Call   |
| GE 572 B .....                      | 38     |
| <b>Times 24 hour Wallclock</b> ..   | 24.95  |
| <b>Robot 800A</b> .....             | 749    |
| <b>Cubic 103</b> .....              | 1195   |
| <b>Bird 43 SLUGS</b>                |        |
| Portable VJ Amplifier               |        |
| 2 watts in 33 watts out ....        | 89.95  |
| <b>Belden 9405 Heavy Duty</b>       |        |
| Rotor Cable 2#16, 6#18 ..           | 45¢/ft |
| <b>Belden 8214 RG-8 Foam</b> ..     | 36¢/ft |
| <b>Belden 9258 RG-8X</b>            |        |
| Mini-coax .....                     | 19¢/ft |
| <b>Alliance HD73 Rotor</b> .....    | 109.95 |
| Call for <b>TS830S, TS130S,</b>     |        |
| <b>TS-530S</b> plus accessories     |        |

MASTERCARD VISA

All prices fob Houston except where indicated. Prices subject to change without notice, all items guaranteed. Some items subject prior sale. Texas residents add 6% tax. Please add sufficient postage, balance collect.

# MADISON Electronics Supply

1508 McKinney  
Houston, Texas 77010

# Advertisers iNdex

|                                                     |                    |
|-----------------------------------------------------|--------------------|
| Ace Communications, Inc.                            | 90                 |
| AEA, Advanced Electronic Applications               | 39, 93             |
| Advanced Receiver Research                          | 84                 |
| Alaska Microwave Labs                               | 78                 |
| All Electronics Corp.                               | 100                |
| Aluma Tower Company                                 | 90                 |
| American Radio Relay League                         | 40                 |
| Amidon Associates                                   | 82                 |
| Applied Invention                                   | 99                 |
| Atlantic Surplus Sales                              | 100                |
| Barker & Williamson, Inc.                           | 75                 |
| Barry Electronics                                   | 33                 |
| Bencher, Inc.                                       | 74, 82             |
| Ben Franklin Electronics                            | 100                |
| Bilal Company                                       | 87                 |
| Britt's 2-Way Radio                                 | 64                 |
| Butternut Electronics                               | 70                 |
| Clutterfree Modular Consoles                        | 88                 |
| Communications Concepts                             | 88                 |
| Communications Electronics                          | 25                 |
| Communications Specialists                          | 104                |
| Drake, R.L., Co.                                    | 101                |
| EGE, Inc.                                           | 99                 |
| Elenco Precision                                    | 85                 |
| Encomm, Inc.                                        | 56                 |
| Erickson Communications                             | 70                 |
| ETCO                                                | 71                 |
| Fair Radio Sales                                    | 70                 |
| Fox-Tango Corp.                                     | 100                |
| GLB Electronics                                     | 86                 |
| H-Troniks, Inc.                                     | 80                 |
| Hal Communications Corp.                            | 48, 49             |
| Hal-Tronix                                          | 75                 |
| Ham Radio's Bookstore                               | 64, 78, 80, 96, 99 |
| Ham Radio Magazine                                  | 86, 88, 89, 92     |
| The Ham Shack                                       | 74                 |
| Hatry Electronics                                   | 29                 |
| Heath Company                                       | 1                  |
| Henry Radio Stores                                  | Cover II           |
| Hildreth Engineers                                  | 100                |
| Icom America, Inc.                                  | 5, Cover IV        |
| International Communications Agency                 | 88                 |
| International Crystal                               | 79                 |
| Jameco Electronics                                  | 63                 |
| Jan Crystals                                        | 74                 |
| Johnston, Bill: N5KR Computerized Great Circle Maps | 88                 |
| Jones, Marlin P. & Associates                       | 87                 |
| Trio-Kenwood Communications                         | 2, 52, 53          |
| L-Tronics                                           | 74                 |
| MFJ Enterprises                                     | 9                  |
| Madison Electronics Supply                          | 102                |
| Marco                                               | 88                 |
| Microcraft Corporation                              | 84                 |
| Micro Security                                      | 82                 |
| Microwave Filter, Inc.                              | 65                 |
| Mid-Com Electronics                                 | 80                 |
| N. P. S., Inc.                                      | 88                 |
| NRI Schools                                         | 71                 |
| P. B. Radio                                         | 99                 |
| P. C. Electronics                                   | 75                 |
| Palomar Engineers                                   | 101                |
| Panasonic                                           | 11                 |
| Payne Radio                                         | 100                |
| Phillips-Tech Electronics                           | 86                 |
| Pipo Communications                                 | 83                 |
| RF Power Components                                 | 65                 |
| Radio Amateur Callbook                              | 78                 |
| Radiokit                                            | 90                 |
| Radios Unlimited                                    | 86                 |
| Radio Warehouse                                     | 93                 |
| Radio World                                         | 83                 |
| Securitron                                          | 89                 |
| Semiconductors Surplus                              | 72, 73             |
| Sherwood Engineering                                | 85                 |
| Skytec                                              | 88                 |
| Smithe Aluminum                                     | 85                 |
| Spectronics                                         | 35, 90             |
| Spectrum International, Inc.                        | 64                 |
| Stewart Quads                                       | 70                 |
| Telrex Laboratories                                 | 83                 |
| Ten-Tec, Inc.                                       | 27                 |
| Texas Towers                                        | 89                 |
| The Comm Center                                     | 79                 |
| Universal Communications                            | 85                 |
| UNR-Rohn                                            | 93                 |
| Valor Enterprises, Inc.                             | 65                 |
| Vanguard Labs                                       | 70                 |
| VoCom Products Corporation                          | 101                |
| Webster Associates                                  | 84                 |
| Western Electronics                                 | 90                 |
| Wheeler Applied Research Lab                        | 89                 |
| World-Wide Amateur Radio Center, Inc.               | 39                 |
| Yaesu Electronics Corp.                             | Cover III          |

## **DRAKE** 7-Line Family



A pacesetter since 1943, Drake led in 1963 with 9 MHz i-f transceiving, and now with 48 MHz i-f "Up Conversion"... Drake brings you tomorrow's state of the art today.



# R7

## Synthesized General Coverage Receiver

Model 1240

Full general coverage reception, 0-30 MHz, with no gaps or range crystals required.

Continuous tuning all the way from vlf thru hf. Superb state-of-the-art performance on a-m, ssb, RTTY, and cw—and it transceives with Drake TR7.

- **100% solid state broadband design**, fully synthesized with a permeability tuned oscillator (PTO) for smooth, continuous tuning.
- **Covers the complete range 0 to 30 MHz** with no gaps in frequency coverage. Both digital and analog frequency readout.
- **Special front-end circuitry** employing the high level double balanced mixer and 48 MHz "up-converted" 1st i-f for superior general coverage, image rejection and strong signal handling performance.
- **Complete front-end bandpass filters** are included that operate from hf thru vlf. External vlf preselectors are not required.
- **10 dB pushbutton-controlled broadband preamp** can be activated on all ranges above 1.5 MHz. Low noise design.
- **Various optional selectivity filters** for cw, RTTY and a-m are switch-selected from the front panel. Ssb filter standard.
- **Special new low distortion "synchro-phase" a-m detector** provides superior international shortwave broadcast reception. This new technique permits 3 kHz a-m sideband response with the use of a 4 kHz filter for better interference rejection.
- **Tunable i-f notch filter** effectively reduces heterodyne interference from nearby stations.
- **The famous Drake full electronic passband tuning system** is employed, permitting the passband position to be adjusted for any selectivity filter. This is a great aid in interference rejection.
- **Three agc time constants** plus "Off" are switch-selected from the front panel.
- **Complete transceive/separate functions** when used with the Drake TR7 transceiver are included, along with separate R7 R.I.T. control.
- **Special multi-function antenna selector/50 ohm splitter** is switch-selected from the front panel, and provides simultaneous dual receive with the TR7. This makes possible the reception of two different frequencies at the same time. Main and alternate antennas and vhf/uhf converters may also be selected with this switching network.
- **The digital readout** of the R7 may be used as a 150 MHz counter, and is switched from the front panel. Access thru rear panel connector.
- **The built-in power supply** operates from 100, 120, 200, 240 V-ac, 50/60 Hz, or nominal 13.8 V-dc.
- **The R7 includes a built-in speaker**, or an external Drake MS7 speaker may be used.
- **Built-in 25 kHz calibrator** for calibration of analog dial.
- **Low level audio output** for tape recorder.
- **Up to eight crystal controlled fixed channels** can be selected. (With Drake Aux7 installed.)
- **Optional Drake NB7A Noise Blanker** available. Provides true impulse type noise blanking performance.

*Specifications, availability and prices subject to change without notice or obligation.*

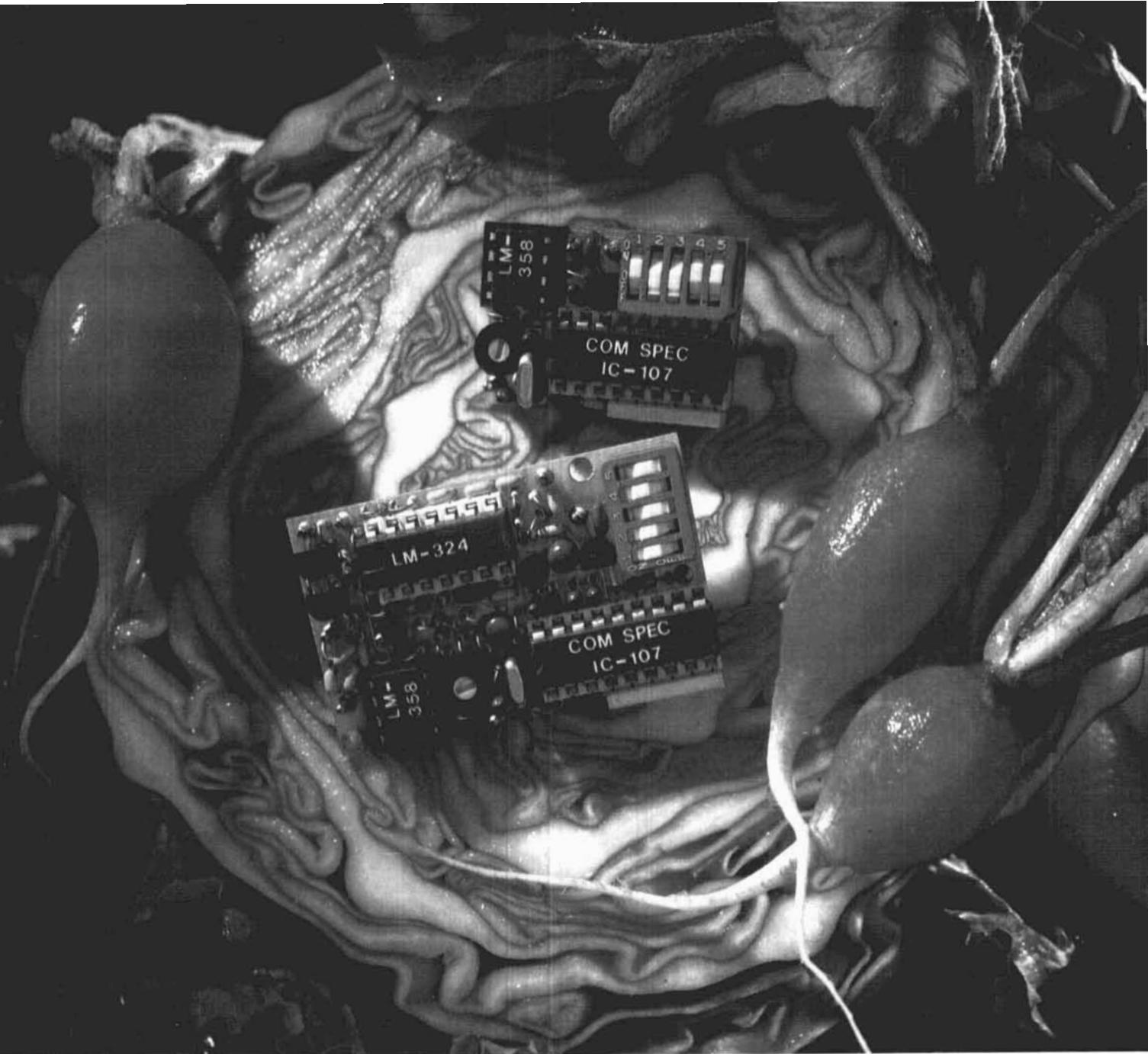
**R. L. DRAKE COMPANY**



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

More Details? CHECK — OFF Page 102

November 1981  103



# 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 astonishing  $\pm 1$  Hz over all temperature extremes. Multiple tone frequency operation is a snap since the dip switch may be removed. Our TS-32 encoder/decoder may be programmed for any of the 32 CTCSS tones. The SS-32 encode only model may be programmed for all 32 CTCSS tones plus 19 burst tones, 8 touch-tones, and 5 test tones. And, of course, there's no need to mention our one day delivery and one year warranty.

 **COMMUNICATIONS SPECIALISTS**

426 West Taft Avenue, Orange, California 92667  
(800) 854-0547 / California: (714) 998-3021



SS-32 \$29.95, TS-32 \$59.95

# Full Duplex Oscar Transverter



## YAESU FTV-901R

**Tired of compromise in your VHF/UHF operating? Does your "compact" multimode rig leave something to be desired in the selectivity department? With the Yaesu FTV-901R VHF/UHF Transverter, the superb capabilities of your FT-901/902DM or FT-101ZD can be extended to the 50, 144 or 430 MHz bands!**

#### Multiband Design Philosophy

The FTV-901R comes equipped for operation on the 144 MHz band, with 50 MHz and 430-440 MHz modules available as options. Power input is 20 watts on all three bands.

#### Duplex Satellite Operation

For satellite operators, three satellite bands are provided, allowing full duplex operation through the transverter for downlink monitoring. You can transmit on 2 meters while receiving on 10 meters or 70 cm, or transmit on 70 cm while listening on 2 meters. An external receiver is required (in addition to your FT-901/902DM or FT-101ZD) for duplex operation.

#### Rugged, Dependable Construction

The FTV-901R is a futuristic blend of FET, bipolar, and stripline techniques, providing high reliability, consistent power output, good noise figure, and outstanding rejection of spurious responses. And there's attention to the details, like the Type N connector for 430 MHz operation.

#### Worldwide Power Capability

Equipped for operation from supply voltages of 100/110/117/200/220/234 VAC, the FTV-901R won't become obsolete if you move to another country. The transmit drive requirement of 3V RMS at 28-30 MHz makes the FTV-901R compatible with many older Yaesu transmitters.

#### Repeater Split Capability

The FTV-901R comes equipped for repeater operation on the 6 and 2 meter bands. For 6 meters, 1 MHz split is provided, while 600 kHz split is provided on 2 meters. Take full advantage of the FM capability on your FT-901/902DM or FM-equipped FT-101ZD Mk III.

#### FT-901/902 Line of Accessories

Other high-performance accessories for your FT-901/902DM station include: the FV-901DM Synthesized Scanning VFO; YO-901P Multiscope with Panadapter; and the FC-902 160-10 Meter Antenna Tuner. See your dealer also for details of the YR-901 Code Reader and SP-901P Speaker/Patch.



For top performance on 1.8 through 450 MHz, Yaesu has the most complete line of transceivers, receivers, and accessories in the Amateur industry. Yaesu products are backed by a nationwide dealer network and two factory service centers for your long-term service needs. So when it's time to upgrade your station equipment, join the thousands of hams that are tired of compromise — join them by investing in Yaesu!

# YAESU

**The radio.**



981

**YAESU ELECTRONICS CORP.** 6851 Walthall Way, Paramount, CA 90723 • (213) 633-4007  
Eastern Service Ctr., 9812 Princeton-Glendale Rd., Cincinnati, OH 45246 • (513) 874-3100

# ICOM IC-730

ICOM's Go-Anywhere HF Rig for Everyone's Pocketbook



## Compact.

Only 3.7 in (H) x 9.5 in (W) x 10.8 in (D) will fit into most mobile operations (compact car, airplane, boat, or suitcase)

## Affordable.

Priced right to meet your budget as your main HF rig or as a second rig for mobile/portable operation.

## Convenient.

- Unique tuning speed selection for quick and precise QSY, choice of 1 KHz, 100 Hz or 10 Hz tuning.
- Electronic dial lock, deactivates tuning knob for lock on, stay on frequency operation.
- One memory per band, for storage of your favorite frequency on each band.
- Dual VFO system built in standard at no extra cost.

## Full Featured.

- 200W PEP input—powerful punch on SSB/CW (40 W on AM)
- Receiver preamp built-in • VOX built-in
- Noise blanker (selectable time constant) standard
- Large RIT knob for easy mobile operation
- Amateur band coverage 10-80M including the new WARC bands
- Speech processor—built-in, standard (no extra cost)
- IF shift slide tuning standard (pass band tuning optional)
- Fully solid state for lower current drain
- Automatic protection circuit for finals under high SWR conditions
- Digital readout • Receives WWV • Selectable AGC
- Up/down tuning from optional microphone
- Handheld microphone standard (no extra cost)
- Optional mobile mount available



2112 116th Avenue N.E., Bellevue, WA 98004  
3331 Towerwood Dr., Suite 307, Dallas TX 75234