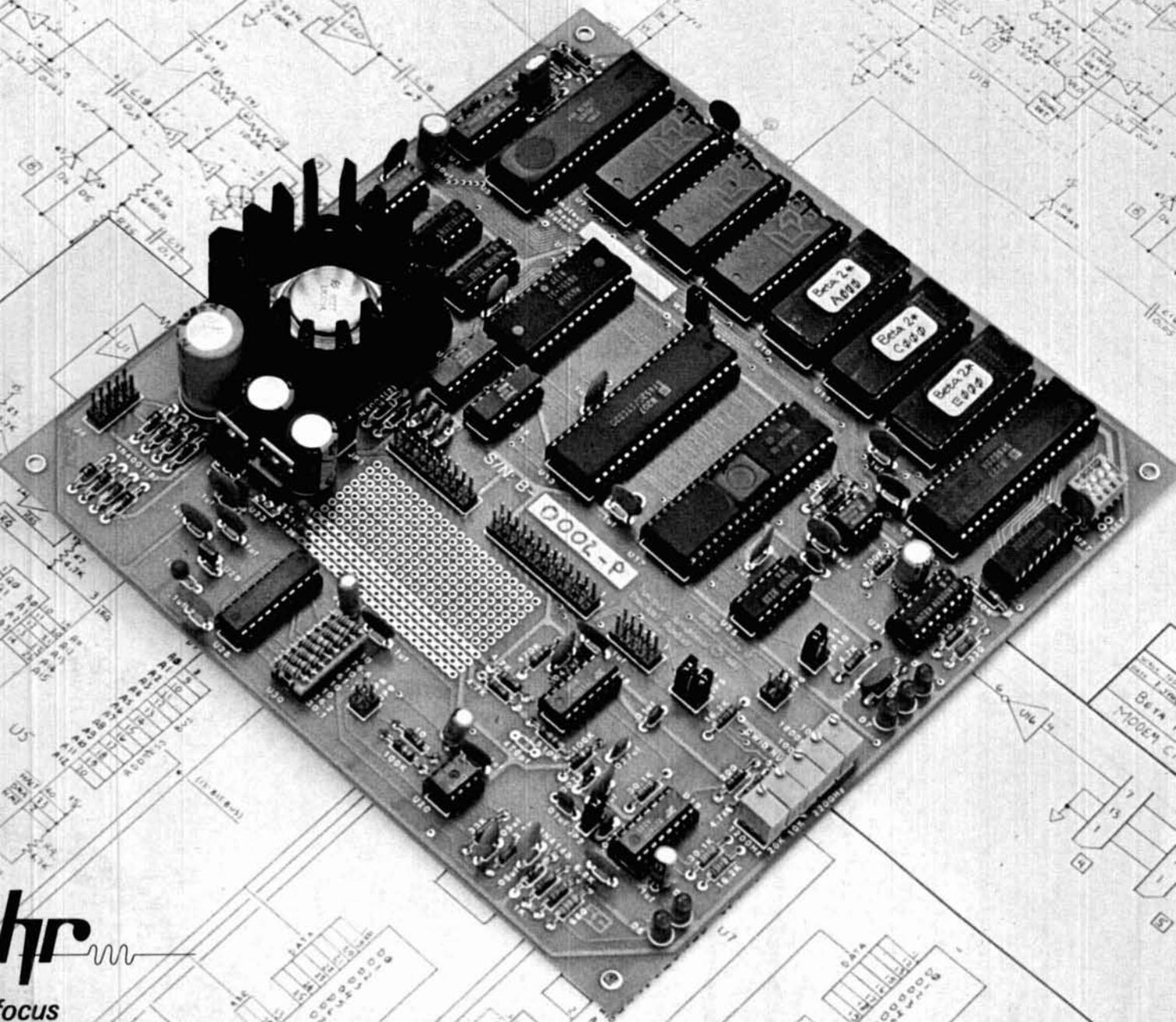


JULY 1983 / \$2.50

Tucson's Packet Radio

# ham radio

magazine



**hr**  
Focus  
on  
communications  
technology

# IC-271A

## 25 Watts of FM, SSB, CW for 2 Meters

# NEW!



OFFSET  
WRITE

PL TONES  
BUILT IN

MODE  
SCAN

NEW  
DISPLAY

32 CHANNELS  
OF MEMORY

1 MHz  
UP/DN  
BUTTONS

**ICOM presents the most advanced all mode, two meter base station available today... the IC-271A.**

**25 watts of power from 12 VDC or from 117 VAC with the optional internal power supply/32 full function memories/multimodes/subaudible tones/PLL locked to 10Hz/high visibility, multi-color fluorescent display/RIT readout/scanning/dual VFO's/new size.**

**25 watts.** Now a 2 meter base station with 25 watts of power and an optional internal power supply. The IC-271A is a complete station.

### 32 full function memories.

Each memory holds frequency, offset, offset direction, mode, and subaudible tone. Frequency, tones and offset are selected by rotating the main tuning knob.

### Subaudible tones.

Subaudible tones are selected by rotating the main tuning knob and may be stored into memory.

### PLL locked to 10Hz.

Extremely low noise and a good signal-to-noise ratio PLL allow synthesizer lock to 10Hz.

### High visibility display.

ICOM's new high visibility, multi-color display gives easy to read

at-a-glance display of frequency, mode, offset, VFO in use, memory channel, and RIT offset direction and amount.

**Scanning.** The IC-271A can scan memories, programmable sections of the band, or modes. Mode-S scan is a mode scan and can be used to scan memories with a particular mode or to lock out frequencies continuously busy so that the receiver will not stop at that memory channel each time.

**Dual VFOs.** ICOM's dual VFO system is now even more versatile with the ability to transfer from memory to VFO. This allows frequencies from the tunable

memories to transfer directly into another memory without moving a VFO to the new frequency first.

**New size.** Only 11 1/4" W x 4 3/8" H x 10 3/4" D the IC-271A is styled to look good and engineered for ease of operation.

**Other features.** To make the IC-271A functional and easy to use, ICOM has incorporated many asked for features: UP/DN buttons, dial lock, switchable preamplifier, duplex check, all mode squelch, receive audio tone control, S meter, center meter, computer interface, and 7 year lithium battery memory backup.

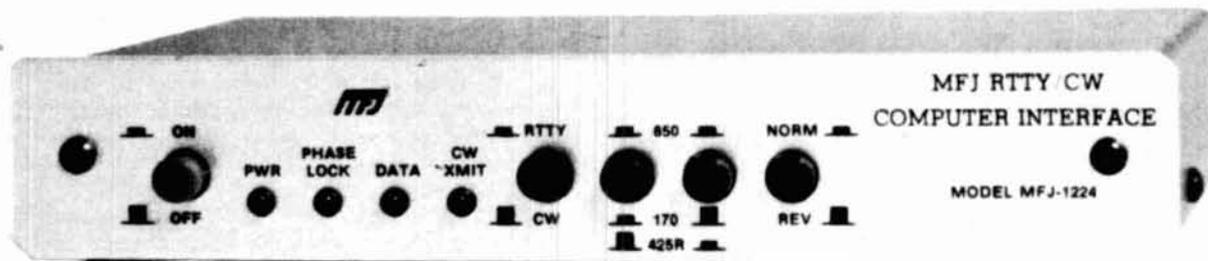


# ICOM

## The World System

# MFJ RTTY / ASCII / CW COMPUTER INTERFACE

Lets you send and receive computerized RTTY/ASCII/CW. Copies all shifts and all speeds. Copies on both mark and space. Sharp 8 Pole active filter for 170 Hz shift and CW. Plugs between your rig and VIC-20, Apple, TRS-80C, Atari, TI-99, Commodore 64 or most other personal computers. Uses Kantronics software and most other RTTY/CW software.



- Copies on both mark and space tones.
- Plugs between rig and VIC-20, Apple, TRS-80C, Atari, TI-99, Commodore 64 and most other personal computers.
- Uses Kantronics software and most other RTTY/CW software.

This new MFJ-1224 RTTY/ASCII/CW Computer Interface lets you use your personal computer as a computerized full featured RTTY/ASCII/CW station for sending and receiving.

It plugs between your rig and your VIC-20, Apple, TRS-80C, Atari, TI-99, Commodore 64, and most other personal computers.

It uses the Kantronics software which features split screen display, 1024 character type ahead buffer, 10 message ports (255 characters each), status display, CW-ID from keyboard, Centronic type printer compatibility, CW send/receive 5-99 WPM, RTTY send/receive 60, 67, 75, 100 WPM, ASCII send/receive 110, 300 baud plus more.

You can also use most other RTTY/CW software with nearly any personal computer.

A 2 LED tuning indicator system makes tuning fast, easy and positive. You can distinguish between RTTY/CW without even hearing it.

Once tuned in, the interface allows you to copy any shift (170, 425, 850 Hz and all shifts between and beyond) and any speed (5 to 100 WPM on RTTY/CW and up to 300 baud on ASCII).

Copies on both mark and space, not mark only or space only. If either the mark or space is lost the MFJ-1224 maintains copy on the remaining tone. This greatly improves copy under adverse conditions.

A sharp 8 pole active filter for 170 Hz shift and CW allows good copy under crowded, fading and weak signal conditions. Uses FET input op-amps.

An automatic noise limiter helps suppress static

crashes for better copy.

A Normal/Reverse switch eliminates retuning while stepping thru various RTTY speeds and shifts.

The demodulator will even maintain copy on a slightly drifting signal.

A +250 VDC loop output is available to drive your RTTY machine. Has convenient speaker output jack.

Phase continuous AFSK transmitter tones are generated by a clean, stable Exar 2206 function generator. Standard space tones of 2125 Hz and mark tones of 2295 and 2975 Hz are generated. A set of microphone lines is provided for AFSK out, AFSK ground, PTT out and PTT ground.

FSK keying is provided for transceivers with FSK.

High voltage grid block and direct outputs are provided for CW keying of your transmitter. A CW transmit LED provides visual indication of CW transmission. There is also an external hand key or electronic keyer input jack.

In addition to the Kantronics compatible socket, an exclusive general purpose socket allows interfacing to nearly any personal computer with most appropriate software. The following TTL compatible lines are available: RTTY demod out, CW demod out, CW-ID input, +5 VDC, ground. All signal lines are buffered and can be inverted using an internal DIP switch.

For example, you can use Galfo software with Apple computers, or RAK software with VIC-20's. Some computers with some software may require some external components.

DC voltages are IC regulated to provide stable

AFSK tones and RTTY/ASCII/CW reception.

Aluminum cabinet. Brushed aluminum front panel. 8x1 1/4x6 inches. Uses 12-15 VDC or 110 VAC with optional adapter, MFJ-1312, \$9.95.

## RTTY/ASCII/CW Receive Only SWL Computer Interface



\$ 69<sup>95</sup>  
MFJ-1225

Use your personal computer to receive commercial, military and amateur RTTY/ASCII/CW traffic.

The MFJ-1225 automatically copies all shifts (850, 425, 170 Hz shift and all others) and all speeds.

It plugs between your receiver and VIC-20, Apple, TRS-80C, Atari, TI-99, Commodore 64 and most other personal computers.

It uses Kantronics software which features CW receive 5-99 WPM, RTTY receive 60, 67, 75, 100 WPM, and ASCII receive 110, 300 baud, plus more.

An automatic noise limiter helps suppress static crashes for better copy, while a simple 2 LED tuning indicator system makes tuning fast, easy and positive.

In addition to the Kantronics compatible socket, a general purpose socket provides RTTY out, RTTY inverted out, CW out, CW inverted out, ground and +5VDC for interfacing to nearly any personal computer with most appropriate software.

Audio in, speaker out jacks. 4 1/2 x 1 1/4 x 4 1/4 in. 12-15 VDC or 110 VAC with adapter, MFJ-1312, \$9.95.

ORDER ANY PRODUCT FROM MFJ AND TRY IT-NO OBLIGATION. IF NOT DELIGHTED, RETURN WITHIN 30 DAYS FOR PROMPT REFUND (LESS SHIPPING).

- One year unconditional guarantee • Made in USA.
- Add \$4.00 each shipping/handling • Call or write for free catalog, over 100 products.

# MFJ

MFJ ENTERPRISES, INC.  
Box 494, Mississippi State, MS 39762

TO ORDER OR FOR YOUR NEAREST DEALER, CALL TOLL-FREE

800-647-1800. Call  
601-323-5869 in Mississippi and out-  
side continental U.S.A. Telex 53-4590.





## TS-830S

"Top-notch"...VBT, notch, IF shift, wide dynamic range

The TS-830S has every conceivable operating feature built-in for 160-10 meters (including the three new bands). It combines a high dynamic range with variable bandwidth tuning (VBT), IF shift, and an IF notch filter, as well as very sharp filters in the 455-kHz second IF.

### TS-830S FEATURES:

- LSB, USB, and CW on 160-10 meters, including the new 10, 18, and 24-MHz bands. Receives WWV on 10 MHz.

- Wide receiver dynamic range, Junction FETs in the balanced mixer, MOSFET RF amplifier at low level, and dual resonator for each band.
- Variable bandwidth tuning (VBT). Varies IF filter passband width.
- Notch filter high-Q active circuit in 455-kHz second IF.
- IF shift (passband tuning).
- Noise-blanker threshold level control.
- Built-in digital display, (fluorescent tube), with analog dial.
- 6L46B final with RF negative feedback. Runs 220 W PEP (SSB)/180 W DC (CW) input on all bands.
- Built-in RF speech processor.
- Narrow/wide filter selection on CW.
- SSB monitor circuit.
- RIT and XIT (transmitter incremental tuning).

### Optional accessories:

- SP-230 external speaker.
- VFO-230 external digital VFO with five memories, digital display.
- VFO-240 external analog VFO.
- AT-230 antenna tuner.
- YG-455C (500 Hz) or YG-455CN (250 Hz) CW filter for 455 kHz IF.
- YK-88C (500 Hz) or YK-88CN (270 Hz) CW filter for 8.83 MHz IF.
- KB-1 deluxe heavyweight knob.



## TS-530S

"Cents-ational"...IF shift, digital display, narrow-wide filter switch

The TS-530S SSB/CW transceiver covers 160-10 meters using the latest, most advanced circuit technology, yet at an affordable price.

### TS-530S FEATURES:

- 160-10 meters, LSB, USB, CW, all amateur frequencies, including new 10, 18, and 24 MHz bands. Receives WWV on 10 MHz.
- IF shift tunes out interfering signals.

- Built-in digital display (six digits, fluorescent tubes), with analog dial.
- Narrow/wide filter selector switch for CW and/or SSB.
- Built-in speech processor, for increased talk power.
- Wide receiver dynamic range, with greater immunity to overload.
- Two 6L46B's in final, allows 220W PEP/180 W DC input on all bands.
- Advanced single-conversion PLL, for better stability, improved spurious characteristics.
- Adjustable noise-blanker, with front panel threshold control.
- RIT/XIT front panel control allows independent fine-tuning of receive or transmit frequencies.

### Optional accessories:

- SP-230 external speaker with selectable audio filters.
- VFO-240 remote analog VFO.
- VFO-230 remote digital VFO.
- AT-230 antenna tuner/SWR/power meter.
- MC-50 desk microphone
- KB-1 deluxe VFO knob.
- YK-88C (500 Hz) or YK-88CN (270 Hz) CW filter.
- YK-88SN (1.8 kHz) narrow SSB filter.



## TS-660

The TS-660 "QUAD BANDER" covers 6, 10, 12, 15 meters.

- FM, SSB (USB), CW, and AM
- Dual digital VFO's
- Digital display
- IF shift built-in
- 5 memories with memory scan
- UP/DOWN microphone
- All-mode squelch
- Noise blanker
- CW semi break-in/sidetone
- 10 W on SSB, CW, FM; 4 W on AM.

### Optional accessories:

- PS-20 power supply
- VOX-4 speech processor/VOX
- SP-120 External speaker
- MB-100 Mobile mount
- YK-88C, YK-88CN CW filters
- YK-88A AM filter.

# KENWOOD

TRIO-KENWOOD COMMUNICATIONS

1111 West Walnut, Compton, California 90220

# SAVE \$10.50\* with home delivery

Payment enclosed

Bill me later

\$19.50

\$32.50

\$42.50

U. S. prices only

\*One year newsstand cost \$30.00

Here's my address label, enter my subscription.

1 Year . . . . . 12 issues . . . . . \$19.50

2 Years . . . . . 24 issues . . . . . \$32.50

3 Years . . . . . 36 issues . . . . . \$42.50

1 Year . . . . . 12 issues . . . . . \$19.50

2 Years . . . . . 24 issues . . . . . \$32.50

3 Years . . . . . 36 issues . . . . . \$42.50

Name \_\_\_\_\_

Zip \_\_\_\_\_

State \_\_\_\_\_

Address \_\_\_\_\_  
(attach label)

City \_\_\_\_\_

Check here if this is your renewal (attach label)

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

Please allow 4-6 weeks for delivery of first issues.

**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  
enter my  
subscription



**BUSINESS REPLY CARD**

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



# ham radio

magazine

**JULY 1983**

**volume 16, number 7**

**T. H. Tenney, Jr., W1NLB**  
publisher

**Rich Rosen, K2RR**  
editor-in-chief  
and associate publisher

**Dorothy Rosa Leeds**  
assistant editor

**editorial staff**

Alfred Wilson, W6NIF  
Joseph J. Schroeder, W9JUV  
Leonard H. Anderson  
associate editors

Susan Shorrock  
editorial production

Margaret Morrison, KV7D  
and Dan Morrison, KV7B  
Cover

**publishing staff**

J. Craig Clark, Jr., N1ACH  
assistant publisher

Rally Dennis, KA1JWF  
director of advertising sales

Dorothy Sargent, KA1ZK  
advertising production

Susan Shorrock  
circulation manager

Therese Bourgault  
circulation

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, \$19.50  
two years, \$32.50; three years, \$42.50

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 67

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 1983 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

**14 Amateur packet radio: part 1**

Margaret Morrison, KV7D,  
and Dan Morrison, KV7B

**26 vertical phased arrays: part 3**

Forrest Gehrke, K2BT

**36 RTTY and the Atari™ computer**

David W. King, K5VUV

**42 ham radio techniques**

Bill Orr, W6SAI

**53 modular two-band receiver**

Jim Forkin, WA3TFS

**74 audio filter building blocks**

Bob Witte, KB0CY

**92 advertisers index**

**12 comments**

**82 DX forecaster**

**67 flea market**

**86 ham mart**

**22 ham notes**

**88 new products**

**8 presstop**

**92 reader service**

**6 reflections**

**80 short circuits**

**85 technical forum**

# REFLECTIONS

## where were you, Idaho?

Dayton Hamvention '83 is now a thing of the past but memories of the hundreds of hams I spoke to at the show are still vivid. In looking through my logbook (and I do thank everyone who stopped by the booth, chatted with me, and signed the log\*) I notice that most states were well represented (I counted 43), as were most provinces of Canada and quite a few other countries. I enjoyed seeing all of you in person, finally being able to associate faces with voices I have spoken to many times over the years. One of the highlights occurred when I met whom I believe many of us consider the finest CW/phone operator around, a very fine gentleman, — Katashi Nose, KH6J. For almost three decades (that I can remember), his crisp fist has given us not only Hawaii, but also an operating style to admire and emulate. This is in addition to his many technical and personal contributions to the hobby.

Speaking of operators, it was good to see Gene (KR2N), Gary (W1EB), Dwight (W9UO), Ted (K1OX), Rolf (KE1Y), and many other 75-meter aficionados at Dayton and commiserate on recent band conditions, discuss the latest solid-state receiver or dream about the ultimate antenna system that opens and closes the band. By the way, David (5Z4D), thanks for making the sked at Dayton to meet one week after on 3782 — unfortunately an ionospheric storm increased attenuation on those three nights.

Besides being a great place to renew acquaintances, Dayton gave me an opportunity to discuss with you, the readers, your likes and dislikes, the type of articles you enjoy reading, specific subjects or sections that should be talked about more often or dropped. Below is just a sample of opinion expressed by the 300 or so I spoke to during the three days. Where do you fit in with your preferences? Readers told me that to-day's *ham radio* magazine is, in general...

... as good as the original *ham radio*

... not as good as the original

... still THE technical journal.

In regard to technical content, readers said *ham radio* is...

... not technical enough

... too technical

... just right

What do *ham radio* readers want to see? They want more construction articles, simple circuits, antenna articles; more about computer interfaces; and more coverage of VHF through microwave. They want more on RTTY, SSTV, Packet Radio, and OSCAR.... They love Bill Orr's "Ham Radio Techniques" and wonder, "Whatever happened to the DX Diary?" (Bear in mind that *every* opinion had considerable support — both pro and con.)

Some people even said they enjoy reading the editorials.

This impromptu sampling of opinion will be followed next month with a more precise evaluation of what *ham radio* readers say they want to see.

Finally, did anyone hear me say anything about the flea market? Here goes. It's a four letter word that starts with R and ends with N. It rained again. Too bad — Dayton Hamvention's reputation was, to a large extent, built on its flea market. Wait till next year.

## Rich Rosen, K2RR Editor-in-Chief

\*Here's a random sample of some of the people I spoke to at the show:

KA6EG	WB1ADY	W8PJ	KR2N	W8TP	VE5ZV	K6IR
WD4C	WB9NDF	W8MF	W1EB	G3ZAY	W7CFX	HL9KT
KA0APK	W4LOX	XE2UAA	W9UOQ	WA0QNZ	W6HPH	W4ETO
WA9JWL	WB3JZO	N8DR1	K1OX	KH6KD	JA2A0Q	N8CGG
KA90TX	W01N	5Z4DD	VE3APG	VE3MFO	JA2CEU	W5SUI
K4KJ	WB8MVR	K8SS	KH6IJ	WB8GJP	N9CZK	W7FFP
W5XQ	K8UCN	N3BM	WA2LQD	W3PL	K1FI	CP1PO
K2GHI	VE3GI	K80PM	K9HI	W8RL	O4HV	KA4VK
WDBKLV	N9BW	VE5XK	N2NY	DK4EI	KA7NKX	W0ZO
WB2ABD	K1CKS	KE1Y	WB6MD	W0RAN	N2CF	W5DFU
WAZAOG	AF9B	K2BO	N4DKE	KB2M	XE1LL	WB9VH

# TECHNOLOGICAL BREAKTHROUGH!



# NEW

AMERICA'S SECOND GENERATION MICROWAVE RECEIVER

# SATURN-15XHP

## JDL Leads Again

The **Saturn-15 XHP**, an engineering breakthrough from JDL laboratories, has new State-of-the-Art technology never before incorporated in amateur band general microwave receivers. This technology increases reception from distances never before achieved. By designing totally **new circuitry**, and using **new ultra-sensitive components**, coupled with a precision tuned 30 inch receiving dish, a system gain of 68 decibels makes the Saturn-15 XHP the leader in microwave receivers. In field tests, the Saturn-15 XHP received clear, crisp pictures, where other units tested were snowy. During these tests the Saturn-15 XHP's highly sensitive downconverter probe was able to receive a color picture without a dish. No other unit tested could pass this test.

## Free Movies for You

That's right! **Free** movies, sports, and special events, 24 hours a day and all commercial free. The Saturn-15 XHP super deep fringe microwave receiver can be used by homeowners outside the service area of local **over-the-air** pay TV stations (ex. HBO, Showtime). Yes, if the local pay TV station installs microwave receivers on homeowners TV mast, you too can receive those unscrambled signals free by installing the Saturn-15 XHP on your TV mast in minutes. A signal can be received up to 100 miles, depending on the height and power of the local transmitter, and the installed height of the Saturn-15 XHP. If you have waited to own a microwave receiver, or own a low power unit, call and order your Saturn-15 XHP and own the most powerful receiver available today. Free TV—yours for a call. Note: General microwave receivers cannot be used for receiving scrambled signals. Nor can they pick up from cable TV or their relay towers.

## A Total Unit

The Saturn-15 XHP comes complete with a 30 inch precision tuned receiving dish, advance design downconverter, power tuner, 60 feet

coaxial cable, necessary adapters, mounting hardware, and installation instructions. A six month parts and service warranty covers the Saturn-15 XHP.

## Information for your Area

By calling our **information number** (916) 454-2190 and talking to one of our trained technicians, we can help determine if the Saturn-15 XHP will work for you.

## A Very Special Introductory Offer!!!!

As JDL Industries has and continues to provide the very best in products and customer service, we want everyone to be able to enjoy our new system, Saturn-15 XHP. The regular price for the Saturn-15 XHP is \$285.00. Order C.O.D., pay only \$260.00 and save \$25.00. Trade in your old unit, from any manufacturer or home built, working or not, with your order, pay only \$235.00—save \$50.00. Or if you own our original Saturn-5 and wish to upgrade to the Saturn-15 XHP, return your unit and pay only \$210.00—a savings of \$75.00. We also accept Visa and Mastercharge at the regular price, \$285.00. Sorry—no personal checks. Shipping (\$9.50) and 6% sales tax for Calif. residents not included. Trade-in units become the property of JDL Industries and **cannot** be returned under any circumstances.

Call our toll free number for placing **orders only**. **Information is not available at this number.**  
1-800-824-7927  
U.P.S.—C.O.D./Volume prices on request —  
(916) 454-2190

## Microwave Systems

**JDL**   
**INDUSTRIES, INC.**

4558 Auburn Blvd., Suite 208, Sacramento, CA 95841

Saturn-15 XHP must be returned within 14 days of delivery for refund if not satisfied, and is subject to a 25% restocking charge.

PCB CONTAMINATED DUMMY LOADS MAY POSE A SERIOUS HEALTH HAZARD in many ham shacks! According to the Center for Disease Control in Atlanta, many RF dummy loads manufactured as recently as the late 70s utilized transformer cooling oil containing PCBs, which have been linked with liver cancer. PCB use is now prohibited by law, and all contact with any oil that could contain PCB should be avoided. Even fumes from a warm load could be dangerous in a poorly ventilated shack! Area EPA offices may have disposal suggestions.

EXPANSION OF THE 10-METER REPEATER SUBBAND DOWN TO 29.0 MHZ was proposed by the FCC at its May 12 meeting. Ten meter repeaters are presently restricted to 29.5 to 29.7 MHz, with 100 kHz offset the accepted standard. Under this new proposal, PR Docket 83-485, Amateur satellite downlinks at 29.3-29.5 MHz would become subject to FM repeater interference.

10-Meter Simplex Interference To Satellite Users Has Become a significant problem in the past few years. Increased use of 10-meter FM has driven FM users to below 29.5 to find clear frequencies, while more and more SSB operators have moved above 29 MHz for the same reason. The resulting interference to 29.3-29.5 MHz satellite downlink signals has become a major problem at times, and even triggered some on-the-air confrontations.

Without Suggesting Any Solutions To This Problem the FCC asked that it be one of the factors considered by Comment submitters. The comment due date was pending at press time.

The 28.3 MHz Lower Phone Limit Proposed In The FCC's further NPRM on the phone band expansion, PR Docket 82-83, is also being questioned by some 10 meter users. A world-wide system of beacons now operate between 28.2 and 28.3 MHz, but setting the lower U.S. limit at the top of the beacon band would push some foreign SSB operators into the midst of the beacons. Perhaps a 28.4 MHz lower limit would be better, leaving 28.3-28.4 MHz open for foreign phone operation. Comments close July 1, with Reply Comments open until August 1.

HAND-HELD RADIOS VS. USER HEALTH HAS BECOME a legal issue in New Jersey. A fire chief there has sued General Electric, alleging his use of one of their hand-helds over a 14-year period damaged his sight and hearing. At issue is GE's alleged negligence in not providing a warning of possible health hazards, despite a recommendation by the federal government in 1973 that such a warning be provided with portable transceivers.

Whether Close Exposure To Moderate RF Fields actually causes physical ailments has been the subject of heated debate for years. Despite many government and industry studies no clear-cut consensus has been reached. Attempts have been made on the local level, most recently in Massachusetts, to closely regulate all transmitter operators, and an on-going effort (strongly supported by ARRL's Biological Effects of RF Energy Committee) is being made for the adoption of a federal preemption law with exemptions for Amateur Radio.

The Effects Of A Decision Favoring The Fire Chief could have an even more serious effect on Amateur Radio than the current antenna ordinance problems, barring federal preemption. Local governments, acting to protect citizens, could enact legislation that would severely restrict if not bar operation of Amateur transmitters within their borders.

VOLUNTEER ADMINISTERED AMATEUR EXAMS WERE "AN ABSOLUTE, UNQUALIFIED SUCCESS" at this year's Dayton Hamvention, according to the FCC's John Johnston. With only one FCC staff member present to act as "overseer," Dayton Amateur Radio Association members were able to administer 683 exams to 484 applicants. The volunteers were obviously well prepared for their task, as the program came off extremely smoothly despite only one evening of "formal training" with the FCC. Oddly enough, the ARRL quietly made a last minute attempt to scuttle the Dayton exam session, on the grounds that it was likely to be improperly done and would thus set the entire volunteer program back!

Proposed Questions For The Volunteer Exam Program are already being sought informally from the Amateur community, even though the exam program itself is still to be acted on by the Commission. It's felt that having a pool of appropriate questions on hand would facilitate preparation when the FCC is ready to move on both the overall exam program, PR Docket 83-27, and the Novice "No-Mail-Back" proposal, PR Docket 82-727. Action on the latter could take place as early as June.

BURBANK (ILLINOIS) TOWER CASE MOVED CLOSER TO COURT after a magistrate recommended to the presiding judge that the city's motion to dismiss the Amateurs' suit be denied. In his recommendation the magistrate agreed that the Amateurs' argument that their constitutional rights of free speech and civil rights were both violated by Burbank's anti-tower ordinance raised a federal issue, so the case did belong in U.S. District Court.

A Status Call Has Been Set By The Judge for June 21, when he's expected to adopt the magistrate's recommendation. A date for the trial should be set soon after that.

ARRL Funding Of Amateur Radio Legal Cases will essentially cease, following a vote to that effect at the April 21-22 League Directors' meeting. The League will, however, continue to offer other forms of support to Amateurs with legal problems and may, under special circumstances, offer financial assistance as well.

PHASE III-B COULD BE IN SPACE BY THE TIME THIS SEES PRINT with a June 16 launch date announced at press time. An AMSAT crew was to leave momentarily for the French Guiana launch site for final checkout and fueling. If Phase III-B is up, check with ARRL or an AMSAT net for status, as it's not to be used until completion of the post-launch test.

OSCAR 8 Is Now On Mode J Only, due to ongoing battery problems with the aging bird.



## Connect your computer to the air!

The "AIRWAVES" that is, thru the Microlog AIR-1, a single board terminal unit AND operating program that needs no external power supply or dangling extras to put your VIC-20 computer on CW & RTTY. And what a program! The famous Microlog CW decoding algorithms, superior computer enhanced RTTY detection, all the features that have made Microlog terminals the standard by which others are compared. Convenient plug-in jacks make connection to your radio a snap. On screen tuning indicator and audio reference tone make it easy to use. The simple, one board design makes it inexpensive. And Microlog know-how makes it best!

There's nothing left out with the AIR-1. Your VIC-20, America's most popular computer, can team-up with Microlog, America's most successful HAM terminal, to give you an unbeatable price and performance combination for RTTY & CW. If you've been waiting for the right system at the right price, or you've been disappointed with previous operating programs, your time is now. At \$199, the complete AIR-1 is your answer. Join the silent revolution in RTTY/CW and put your VIC-20 ON-THE-AIR! See it at your local dealer or give us a call at Microlog Corporation, 18713 Mooney Drive, Gaithersburg, Maryland. TEL (301) 258 8400. TELEX 908153.

Note: VIC-20 is a trademark of Commodore Electronics, Ltd.

## MICROLOG

INNOVATORS IN DIGITAL COMMUNICATION

**STOP PRESS**  
**AMTOR NOW OFFICIALLY**  
**APPROVED IN U.S.A.**

# AMT-1

## The Definitive AMTOR Terminal Unit



**\$499<sup>95</sup> Introductory Price**

AMTOR is the system of error correcting RTTY which has been rapidly overtaking conventional RTTY in Europe, just as its marine equivalent, SITOR, has been taking over in ship to shore communications.

It was originated by Peter Martinez, G3PLX (see June 1981 QST, p. 25). He first interpreted the international marine CCIR 476-1 specification for amateur use. Virtually all of the 400+ stations presently on AMTOR world wide are using software/hardware designs originated by Peter. The AMT-1 is a proven product which represents his latest and most highly refined design. It represents the culmination of over three years of development and on the air testing, and sets the standard against which all future AMTOR implementations will be judged.

Not only does it incorporate the latest AMTOR specification, but it gives superlative performance on normal RTTY, ASCII and CW (transmit only). As well as some fairly incredible real time microprocessor software, the AMT-1 boasts a four pole active receive filter, a discriminator type demodulator, a crystal controlled transmit tone generator, and a 16 LED frequency analyzer type tuning indicator, which is very easy to use.

Driven from a 12 volt supply, the AMT-1 connects to the speaker, microphone and PTT lines of an HF transceiver and to the RS-232 serial interface of a personal computer or ASCII terminal. All mode control is via ESCAPE and CONTROL codes from the keyboard (or computer program).

It used to be that C.W. was the ultimate mode for "getting through" when QRM and fading were at their worst. That's no longer true — AMTOR will get through with perfect error-free copy when all other conventional transmission modes become useless.



# Henry Radio

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

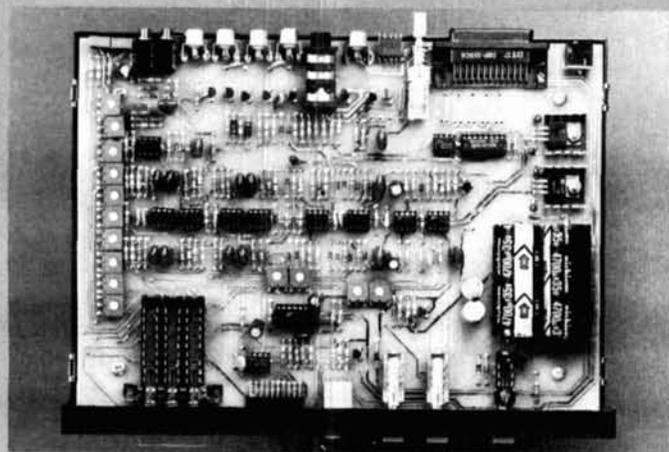
TOLL FREE ORDER NUMBER: (800) 421-6631

For all states except California

Calif. residents please call collect on our regular numbers.

## AEA Brings you the Breakthrough!

# CHAMPAGNE RTTY/CW on a Beer Budget



## CP-1 Computer Patch™ Interface

The AEA Model CP-1 Computer Patch™ interface will let you discover the fastest growing segment of Amateur Radio: computerized RTTY and CW operation.

When used with the appropriate software package (see your dealer), the CP-1 will patch most of the popular personal computers to your transceiver for a complete full-feature RTTY/CW station. No computer programming skills are necessary. The CP-1 was designed with the RTTY neophyte in mind, but its sophisticated circuitry and features will appeal to the most experienced RTTY operator.

The CP-1 offers variable shift capability in addition to fixed 170 Hz dual channel filtering. Auto threshold plus pre and post limiter filters allow for good copy under fading and weak signal conditions.

Transmitter AFSK tones are generated by a clean, stable function generator. Plus (+) and minus (-) output jacks are also provided for CW keying of your transmitter. An optional low cost RS-232 port is also available. The CP-1 is powered with 16 VAC which is supplied by a 117 VAC wall adaptor included with the CP-1.



# Henry Radio

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.

## AEA Brings you the Breakthrough!



## briefcase Bobtail

Dear HR:

Just a few comments in regards to W6BCX's article on the Bobtail curtain featured in the February and March issues of *ham radio*.

I received word just four days before departure for Haiti that I had a license waiting for me. What to do about an antenna for 20 meters? I had just reviewed the few paragraphs on the Bobtail curtain in the *ARRL Antenna Book* when W6BCX's timely article came along. This was enough for me to make preparations to build such an array.

During the last couple of days before I was to leave, I built up a parallel tuned network consisting of a 70 pF variable capacitor and 12 turns of No. 14 wire spaced 1 inch apart. Ten turns tapped one turn up from cold end and about 3/4 maximum capacity gave a perfect match into 2000 ohms. So with a roll of No. 18 copperweld wire, some insulators made from 1/2 x 2 inch pieces of 1/4 inch phenolic, my Swan dual meter SWR bridge, the parallel tuned network built into a 4-1/2 x 5 x 2-1/2 inch aluminum box and a few short lengths of RG-58 stuffed into my briefcase, I was off. Destination, 120 miles west of Port au Prince in the mountains of the panhandle of western Haiti.

It took me, with help from my son, about 20 minutes to build the antenna. Twenty feet of bamboo put the northeast leg 24 inches above the

new galvanized metal roof of his carport. The center leg also was 24 inches above the metal of the back porch roof and just six feet above my proposed operating position. The southwest leg was about three feet from the ground on a sloping hillside of about 45 degrees.

Results were outstanding. From deep in a mountain valley, with a ridge all across the north from east to west, 300 to 500 feet higher and a quarter to half a mile away, I worked all areas of the United States. I received 59+ reports from my home country of northwest Wyoming and southern Montana and 59+20 from the Denver area. The rig was HH2DR's TS520, sometimes operating on battery power. I worked a CN8 off the northeast end of the antenna just before the ARRL DX contest and had an OE6 and an HA6 call me during the contest even though I was not contesting. They gave me 55 to 57 reports. I probably had some distortion of the signal because of the large mango trees near both end elements. Compared to the 2-element quad of HH6BG located just 100 yards north, whom I had worked quite a few times from my home QTH, it was 2 to 4 S-units better. It was not the fault of the quad but instead of its location. The mountain hillside is 200-300 feet higher, begins 50 feet directly in front of the quad and at a 45 degree angle.

I brought the antenna home and will be using it on Field Day. By fall I

hope to have a 40 meter version up and aimed at Europe and the South Pacific. I'm looking forward to some good 40 meter DX next winter. A match for my 20 meter 5-element log-Yagi at 70 feet it is not, but truly a fine, easy-to-pack antenna with gain broadside and rejection off the ends.

Thanks to W6BCX for his research.

Paul M. Rich, WA7BPO  
Cody, Wyoming

## power supply

Dear HR:

In the March, 1983, article "Dual Voltage Power Supply," the LM317 could be replaced with a 723-type regulator IC realizing the following benefits: lower cost, current limiting features, and, what I view as the most important improvement over any LM317 series pass transistor design, improved voltage regulation. An additional benefit could be improved ripple rejection.

The only drawback is an increase in circuit complexity required to accommodate the feedback and the internal voltage reference. The 723 has enough output current to drive the existing pass transistor. The 723 is available at Radio Shack with required specs and circuits for about 89 cents.

Peter J. Schuch, WB2UAQ  
Little Ferry, New Jersey

## noise figure data

Dear HR:

I was rather surprised at some of the noise figure data presented by Dennis Mitchell, K8UR, in the article "GaAs FET Performance Evaluation and Preamplifier Application" in *ham radio's* March issue, and I would like to present some additional information regarding the performance of the Mitsubishi devices tested by Mr. Mitchell.

At the 1982 meeting of the Central States VHF Society, at Baton Rouge, Louisiana, there was a preamplifier noise figure competition. These tests

were conducted with the current Hewlett-Packard programmable automatic noise figure meter with matching noise head. The results, however, departed significantly from the figures quoted in the article, particularly for the MGF-1200s.

Here are some of the results:

device	noise figure (dB)	frequency
MGF-1200	0.27	144
MGF-1200	0.42	144
MGF-1402	0.42	144
MGF-1200	0.48	144
MGF-1200	0.38	220
MGF-1402	0.39	220
MGF-1402	0.45	220
MGF-1200	0.47	220
MGF-1402	0.49	220
MGF-1402	0.40	432
MGF-1402	0.58	432

The Central States VHF Society results were significantly better than those of the author for the MGF-1200 at 144 MHz. Assuming that Mr. Mitchell presented median noise figure values in his article, then the figures presented above are at least 0.1 dB better in the worst case, taking the stated  $\pm 0.23$  dB root-sum of squares uncertainty into account. In the best case for the MGF-1200 at 144 MHz the deviation from the author's noise figure is 0.3 dB!

The figures for the MGF-1402 are included to show that this device seems to reach a plateau at 432 MHz, and is not really a cost effective device at 144 MHz, with most GaAs FET users preferring the MGF-1200 or other similarly priced device at lower frequencies. Finally, the price structure that is mentioned in the article is about one year out of date, with the MGF-1200 currently selling for around \$10, rather than the \$15 indicated, and the MGF-1402 available for \$15 or less, as opposed to \$30.

From my experience, anyone using the MGF-1200 at 144 MHz should expect, and get, substantially better results than those indicated by Mr. Mitchell, in terms of noise figure attainable.

**Jack C. Parker, KC0W**  
Bismarck, North Dakota

## A DESIGN EVOLUTION



- Linear (all mode) RF power amp with automatic T/R switching (adjustable delay)
- Receive preamp option, featuring GaAs FETS (lowest noise figure, better IMD). Device NF typically .5 dB.
- Thermal shutdown protection incorporated
- Remote control available
- Rugged components and construction provide for superior product quality and performance
- Affordably priced offering the best performance per dollar
- Designed to ICAS ratings, meets FCC part 90 regulations
- 1 year transistors warranty
- Add \$5 for shipping and handling (Cont. U.S.). Calif. residents add applicable sales tax.
- Specifications/price subject to change

MODEL 1	FREQUENCY 2	OUTPUT POWER	INPUT POWER	SUGG PRICE LESS TAX
	(MHz)	(W)	(W)	\$
1410	144	160	10	225
1410G				265
1412	144	160	30	199
1412G				239
2210	220	130	10	225
2210G				265
2212	220	130	30	199
2212G				239
4410	440	100	10	225
4410G				265
4412	440	100	30	199
4412G				239

1. Models with G suffix have GaAs FET preamps. Non-G suffix units have no preamp.
2. Covers full amateur band.

★SEND FOR FURTHER INFORMATION★

**TE SYSTEMS**

**TE SYSTEMS**  
P.O. Box 25845  
Los Angeles, CA 90025  
(213) 478-0591

✓ 183

## UHF DECODER FREE IC-CHIPS

WITH PURCHASE OF FV-3 COMPONENTS  
WHICH CONSIST OF:

- FV-3 BOARD
- INSTRUCTION MANUAL
- BOX TO HOUSE IT IN
- POWER SUPPLY
- EDGE CONNECTORS
- TUNER

**FOR ONLY \$190<sup>00</sup>**

LIMITED TIME ONLY!

**CALL NOW FOR YOUR ORDER:**

**1-800-433-5169**

FOR INFORMATION CALL: 817-460-7071

**P B RADIO SERVICE**

1950 EAST PARK ROW DRIVE  
ARLINGTON, TX 76010

WE HONOR VISA AND MASTERCARD

✓ 166

# Amateur packet radio: part 1

The history and operation of packet radio are examined along with its requirements for software and hardware

*Imagine sitting down in front of your station for an evening. You get out your 2-meter fm transceiver, attach it to a cable coming from an 8 × 8 × 3-inch "black box" connected to your data terminal. After turning everything on and initiating a short dialog between the terminal and the box, you enter a friend's call letters. After a short pause you see:*

*\*\*\*CONNECTED to (call sign)*

*on your terminal. From this point on, everything you type appears on your friend's terminal, and everything he types appears on yours. Your friend could be within simplex range, or within voice repeater distance, or accessible only via a series of linking stations. In fact, you might need a satellite link to talk to your friend!*

*He asks, "Would you like a copy of my latest program for playing 'Escape The Maze'?"*

*"Sure," you reply, "only my compiler can't handle your gigantic programs. Why don't you just send me a dump of the machine language (binary) program?"*

*"No problem. Let me know when you're ready," he sends back.*

*You go over to your home computer, power it up, load your communications program, connect it to the box instead of the terminal, and type, "OK, let 'er rip."*

*Then you start your file-loading program and wait. Soon, binary data begins arriving from your friend at slightly less than 120 bytes of data per second. You sit back relaxed, knowing that even though the QSO is being held under noisy conditions, with occasional QRM breaking through, you won't receive a single bit incorrectly.*

*After the program has been stored away, you resume your conversation. It is almost boringly error-free, and with the speaker disconnected from your radio you don't even hear the QSO, which is being periodically interrupted by the automatic identification of both stations in CW. Later on you try out the new program and, sure enough, find you've received the whole thing perfectly.*

*Does this sound like magic? It shouldn't — it's happening right now with packet radio.*

**Packet radio promises to open** new worlds of communications undreamed of just a few years ago by making possible the rapid transfer of digital information over great distances — with a virtual guarantee of integrity down to the last bit. This is tremen-

**By Margaret Morrison, KV7D, and Dan Morrison, KV7B, 4301 E. Holmes, Tucson, Arizona 85711**

dously attractive. Not only can traffic be exchanged between hams equipped with data terminals, but just as easily between a ham and a computer, or between two computers.

Let's look first at what a packet is and then at the history of packet communications and the kind of hardware and software packet radio requires. We will use the two most familiar systems to serve as examples, although others are in use as well. These two are the VADCG (Vancouver Amateur Digital Communications Group) system and the TAPR (Tucson Amateur Packet Radio) system.

## what is a packet?

Packet radio is a relatively new form of digital communications. It has some characteristics in common with older forms, such as ASCII and RTTY, now both familiar to the Amateur community. In all of these modes information is coded in binary form, that is, as a series of 1s and 0s. The information is translated into an audio signal consisting of alternations between two tones, and the audio signal then used to modulate an rf signal to produce an FSK or AFSK transmission.

In an ASCII or RTTY system, the transmission typically consists of a sequence of individual characters separated by periods of unmodulated carrier transmission. In order for the receiving station to interpret the characters correctly, extra transitions are added at the beginning and end of each character (start and stop bits). Depending on reception conditions, anywhere from all the information to virtually none of it may be received correctly; what's not received correctly may be garbled or missed completely.

A packet consists of binary data (which might be ASCII, Baudot, or some other code), and the modulation techniques may be essentially the same as for conventional ASCII or RTTY, although the exact interpretation of the tones may be different. The VADCG and TAPR TNCs produce AFSK, but more sophisticated schemes are being developed. (The TNC, or terminal node controller, is the "black box" referred to in the introduction to this article. It is a complete microcomputer-based communications system with a good-sized memory, 30 kilobytes in the case of the TAPR TNC. It does all the work involved in sending and receiving packets).

In a packet, the individual characters, or bytes, are run together with no space at all between. This eliminates the need for both the start and stop bits as well as the dead time between characters. The result is much more efficient information transfer. The analog of start and stop bits are sent only for the beginning and end of the packet, and the transmitter is keyed only while information is actually being sent.

Extra information is inserted into each packet that enables the receiving station to determine automatically whether the packet was received without error. Thus every correctly received transmission is acknowledged. The sending station can keep retransmitting its information until it is assured that it has gotten through. Other features of the packet which facilitate this "handshaking" are described later.

## history of packet radio

Packet switching is a technology that was developed to tie computer users into a network which could extend over a wide area. It has been used for many years over common carrier lines, both commercially and by government. The first large-scale packet network in North America was ARPANET, set up in 1969 by Bolt Beranek and Newman, Inc., for the Defense Advanced Research Projects Agency. This network introduced packet switching, in which each message sent is broken up into small packets and each is switched to its destination over the quickest communications path available at that instant. Data interconnections are typically 50-kilobit-per-second wideband lines, and the packets are passed from node to node until they arrive at their destination. Typical end-to-end times are 250 milliseconds, and receipt of data is acknowledged.

Other networks around the world soon began operation, and today there are many government and commercial computer networks, such as TYMNET and TELENET, which allow users all over the country to access thousands of computers remotely.<sup>1</sup>

Packet radio experiments began in the 1970s. One of the largest packet radio systems, based at the University of Hawaii and known as the ALOHANET, linked together a number of computers and users, and also provided access into ARPANET and satellite links.<sup>2</sup> Other systems were developed for the purpose of providing distributed automatic digital communications for remote sensing stations.

Packet switching networks (both wire and radio based) generally use one of two methods for routing packets from the originating station, through intermediaries, to the destination. In one system used by TYMNET and others, a central controller determines the optimum path for a particular pair of stations on the basis of the stations present in the network at any time. In the other system, the network itself is intelligent and determines the routing between stations. This is the system that was pioneered by ARPANET.

North American Amateurs first entered the picture in Canada, where, beginning in 1978, the Department of Communications encouraged the use of packet radio by permitting Amateur packet transmis-

sions and by giving exclusive use of 221 to 223 MHz and 433 to 434 MHz to packet and digital transmissions. Taking advantage of this ruling, VADCG, a group in Vancouver, British Columbia, designed the first well-known Amateur packet radio TNC, and soon TNCs became widely distributed.<sup>3</sup> Their use in the U.S. followed a rule by the FCC making such ASCII transmissions legal in March of 1980. Finally, in October of 1982, the FCC revised Part 97.69, lifting many restrictions on digital communications and advanced data transmission. Today many experimenters using the VADCG TNC, the TAPR TNC, and homebrew systems are hard at work, developing this new mode of communications.

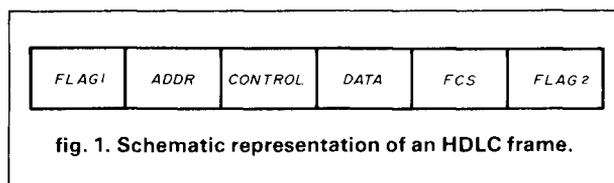
### anatomy of a packet

The basic element in packet radio is the frame — a string of bits with a specific format. The bits are presented to the transmitter on a modulator output line. In the case of the TAPR and VADCG TNCs, the modulation system uses 1200-Hz and 2200-Hz tones and coherent (phase-continuous) FSK, with a data rate of up to 1200 bits per second; it is compatible with the Bell 202 standard modem. Other modulation systems being developed for Amateur use include minimum shift keying (MSK), and various forms of phase shift keying (PSK). These schemes, which are more efficient than ordinary FSK, are useful for long-haul traffic, especially via satellite.<sup>4</sup>

The FSK signal is related to the bit stream according to specific digital encoding rules. The most commonly used system is non-return to zero inverted (NRZI) encoding. In this system, a transition from one tone to the other is interpreted as a 0, whereas no transition during the bit period is a 1. Such a method is used because, according to the rules by which the frame is constructed, a transition is guaranteed at least once in every five bit periods. This is needed to keep the receiving station in "sync" with the incoming data.

The actual structure of the frame varies from one packet radio system to another. The structure makes possible, among other things, the delivery of the message to the proper recipient and a system for ensuring data integrity. The most frequently encountered format for frames is known as HDLC, or High Level Data Link Control. Each HDLC frame consists of six fields, as shown in **fig. 1**.

In order of transmission, FLAG1 is first. It is at least eight bits long, consisting of the bit pattern 01111110. This particular combination is unique to FLAG1 and FLAG2, and appears nowhere else in the frame. Part of the transmitting station's job is to alter the message content of the frame to prevent this combination from appearing elsewhere (a process



known as bit-stuffing). This alteration is, of course, undone by the receiving station. FLAG1 (which may be repeated several times before the rest of the frame is sent) says, "Get ready! Here comes a frame!"

The ADDR (address) field varies among the various packet radio systems developed in the Amateur community. HDLC requires only that it be at least one byte long. It typically contains the source address, and may contain the destination address and perhaps routing information. The address field contains the information which permits delivery of the packet.

The CONTROL field also varies among systems. The length of this field specified by HDLC is one or two bytes. The information contained in this field typically includes acknowledgment information for previous packets successfully received; an indication that the sender would like to begin talking (connect) to the destination station; a request to terminate the conversation (disconnect); or other "supervisory" functions, such as requests to stop transmitting or to resume transmitting (referred to as flow control).

The DATA field consists of zero or more bytes of information (zero in the case of simple acknowledgments, for example). They may be in any bit pattern — ASCII characters, part of a binary program, you name it. (The FCC, however, would like you to have available enough information so they can decipher your data!) The HDLC standard requires that when five consecutive 1s appear a 0 be inserted. This is the bit-stuffing mentioned above. It prevents data from being mistaken for flags, and also ensures frequent tone transitions if NRZI encoding is used. Upon reception, these extra 0s are discarded. Typically, the maximum data length is 128 to 256 bytes.

The last item in the frame prior to the ending flag bits is the FCS, or frame check sequence, an extremely important two-byte number computed by the transmitting station based on all the bits in the frame following FLAG1. If the frame is received in garbled condition it is extremely unlikely that it would be garbled in such a way as to produce the same FCS. The FCS is separately computed by the receiving station and, if both numbers agree, there is virtual certainty that the frame was received as sent.

Finally, the frame ends with another byte of flag field, thus indicating to the receiving station that the previous two bytes were indeed the FCS.

## protocols

What we have described is not yet truly packet radio. It could be called "frame radio," the exchange of frames of information. The protocol, in addition to specifying the structure of the frame, determines the contents of the ADDRESS, CONTROL, and possibly the DATA fields. It also determines action to be taken in various situations. For example, just exactly what should be done if the first, second, and fourth frames received in a single transmission check out, but the third does not? Or, what should be done if the other station suddenly stops responding? The list of "what-ifs" increases rapidly as other users join the frequency.

The interchange of packets results in communications between the participating stations on more than one level. The ISO, International Standards Organization, has defined a model network structure consisting of seven "layers." The first three, levels 1, 2, and 3, are concerned with communications and are the ones of interest to us. Each consists of a set of related tasks which would ordinarily be handled by correspondingly related processes (electrical or software). The ISO layer structure does not define the specific protocol to be followed to accomplish the tasks of any level, and the operation of each level should be independent of how lower-level tasks are performed.<sup>5</sup>

Furthermore, each layer is "transparent" to the levels above it. This means, for example, that information used to direct actions by a level 3 process is treated as data by the level 2 process. A packet is structured like an onion. Each process peels off the applicable control information before passing the remainder to the next higher level.

The bottom layer is called the physical layer. It is concerned with such things as modulation and transmission techniques, signaling the beginning and end of packets, bit-stuffing, and maintaining synchronization with the incoming data stream. The second level, or data link layer, defines the use made of the address, control, and FCS fields of the packet. Level 2 is responsible for setting up and maintaining a connection or data link with the other station. This includes verifying data integrity, acknowledging receipt of intact frames, retransmitting unacknowledged frames, and performing various link control functions. The third level, the network layer, defines routing functions and inter-network communication. Level 3 is concerned with setting up and maintaining routing tables for communication between stations which are not in direct contact. Amateur packet radio has implemented some level 3 functions but not all.

An additional set of rules, a collision avoidance

protocol, is necessary for packet radio but not for communications over wires. Since stations cannot receive at the same time they are transmitting, "collisions" occur when two or more stations transmit simultaneously. A scheme for avoiding repeated collisions must ensure different retransmission times after an initial transmission has failed. If all stations can hear each other, as is the case when all transmissions are made on the same frequency and all stations are close together, all that is needed is to impose a short random wait time for stations retransmitting a packet. If a central controller (or a satellite) transmits on one frequency and listens for all other transmissions on another frequency, a more elaborate scheme is required.

The HDLC frame structure described above is imposed on levels 1 and 2 of all protocols implemented so far for Amateur packet radio, and both the VADCG and TAPR TNCs use LSI chips that perform many of the level 1 and 2 tasks. The two most widely used protocols, VADCG and AX.25, are thus functionally equivalent on level 1 and quite similar on level 2.<sup>6,7</sup> AX.25 is modeled on X.25, a standard developed by the Consultative Committee for International Telegraph and Telephone (CCITT) of the ITU<sup>8</sup>. AX.25 was put forward by a group of Amateurs at the AM-SAT packet conference in October of 1982. AX.25 specifies the address as containing Amateur call signs of both the sending and receiving stations, with optional routing information in the form of the call signs of stations requested to relay, or digipeat, the packet. The VADCG address field contains a numeric address of the sending station only; packets setting up the connection contain call sign information in the data field. Relay by an unspecified digipeater can be requested. The control functions implemented in AX.25 are summarized in **table 1**. Most control func-

**table 1. Level 2 control functions.**

RR	Receive ready: acknowledge receipt of information frames by specifying the sequence number of the last packet received.
RNR	Receive not ready: request to stop sending (receive buffers full).
REJ	Request retransmission of missed frames after receipt of a frame number larger than expected.
DM	Disconnected mode: response to a packet other than a connect request.
SABM	Set asynchronous balanced mode. This is a connect request.
DISC	Disconnect request.
UA	Unsequenced acknowledgment: sent in response to a connect or disconnect request.
FRMR	Reports an abnormal condition; that is, receipt of a packet with an undefined or invalid control byte.

tions can be performed by a packet which also transmits data. Fewer level 2 control functions are specified in the VADCG protocol.

## implementation

If you have a home computer, you are probably wondering where you can get a packet radio program for it. You may even be thinking about writing one yourself. The only hitch here is that you need more than a program. At a minimum, you need some hardware to enable the computer to control the radio push-to-talk line, put signals into the microphone input, and interpret signals on the speaker output. Specialized hardware, such as an HDLC controller, is very desirable. This hardware must be able to generate interrupt requests to the computer. The program itself should take care of the input and output requirements of both the radio and the terminal through interrupt processing. You can't afford to miss part of an incoming packet because you got busy parsing a line from the terminal! This means that the program probably has to be written at least partly in assembly language. Interpreted languages, such as BASIC, are commonly used on small computers, but they are neither fast enough nor versatile enough for real-time programming of this kind. These obstacles are not insurmountable, and in fact many hams have been successfully running packet radio programs on various home computers.

There are disadvantages with this approach, however. These programs are not very portable: they work on a specific computer with a specific operating system, and depend on the specific configuration of the hardware "extras." The programming has to be done over for each different type of computer. Modifying a protocol would be a major undertaking involving reprogramming many computers. Furthermore, many hams who don't own computers or who don't want to get involved in a programming project are interested in packet radio. After all, an RTTY terminal unit or a CW keyboard need not be connected to a computer. This is why most Amateurs involved in packet radio are using a terminal node controller. The TAPR and VADCG TNCs have standard terminal interface connections, and provisions for versatile radio interfaces. The ROM memory chips can be programmed with software implementing a standard packet radio protocol, and, once such software is written, it can be easily transferred to any similar TNC. Since the TNC is basically a dedicated microprocessor, the demands of radio communications do not interfere with a resident operating system.

## packet radio — communications of the future

Hams all over North America are now involved in

sending packet radio messages across town on VHF on UHF bands. Digipeater relays and ordinary voice repeaters make it possible to communicate over distances of 100 miles or more. Packet radio mailboxes and bulletin boards are on the air in several areas. Interest is growing rapidly in this newest mode of communications. With more experimentally inclined packeteers joining the ranks, exciting developments will be forthcoming. The emphasis for the future will be on long-distance communications and inter-network linking protocols. Experimental hf packet communications has been done on 10 meters. Inter-network communications through UHF and microwave linking stations using high data rate modulation techniques is envisioned. The digital special communications channel on the AMSAT Phase III-B satellite will see use by packet radio stations. Groups are working on protocol standards for this application and on L-band amplifiers to allow inexpensive access to this satellite mode. Possibly the most ambitious project in the works is a packet radio satellite with a store-and-forward mailbox as well as direct relay capability.

*Part two will continue with a detailed description of the TAPR terminal node controller; it will provide a clearly defined set of interface requirements and point out pitfalls to be avoided in making reliable radio connections.*

## references

1. L.G. Roberts, "The evolution of packet switching," *Proceedings of the IEEE*, Vol. 6, 1978, pages 1307-1319.
2. R. Binder, "ALOHA packet broadcasting — a retrospect," *Computer Networks and Communication*, AFIPS Press, 1978, pages 83-95.
3. David W. Borden and Paul L. Rinaldo, "The making of an Amateur packet-radio network," *QST*, October, 1981.
4. Phil R. Karn, "Modulation and access techniques for PACSAT," *Proceedings of the Second ARRL Amateur Radio Computer Networking Conference*, March 19, 1983, pages 29-35.
5. *Reference Model of Open Systems Architecture, International Standards Organization Document ISO/TC97/SC16/N227*, June, 1979.
6. *Tucson Amateur Packet Radio Corporation Packet Radio System Beta Test (1983)*. TAPR, P.O. Box 22888, Tucson, Arizona 85734.
7. Terry L. Fox, "AX.25 Level 2 Protocol," *Proceedings of the Second ARRL Amateur Radio Computer Networking Conference*, March 19, 1983, pages 4-14.
8. Operations Systems Network Communications Protocol Specification BX.25 issue 2, Publication #54001, *American Telephone and Telegraph Company*, 1979.

## bibliography

- Tanenbaum, Andrew S., *Computer Networks*, Prentice-Hall, 1981.
- Proceedings of the IEEE*, Vol. 6, October, 1978. This entire issue is devoted to packet communications.
- Korfhage, Robert R., editor, *Computer Networks and Communication*, AFIPS Press, 1978. This collection of papers from three computer conferences covers a wide range of topics, from ARPANET to packet radio.
- Second ARRL Amateur Radio Computer Networking Conference Proceedings*, March 19, 1983. This recent publication contains descriptions of packet radio systems, including implementation details.
- Tucson Amateur Packet Radio Corporation Packet System Beta Test (1983)*. This manual contains information on AX.25, VADCG protocol, modulation, and HDLC.

ham radio

WE SHIP WORLDWIDE

# Barry Electronics Corp.

WORLD WIDE AMATEUR RADIO SINCE 1950

Your one source for all Radio Equipment!

For The Best Buys In Town

Call: 212-925-7000

**KITTY SAYS: WE ARE NOW OPEN 7 DAYS A WEEK.  
Saturday & Sunday 10 to 5 PM**

Monday-Friday 9 to 6:30 PM

Come to Barry's for the best buys in town. For  
Orders Only Please Call: 1-800-221-2683.



"Come On Down For Our  
July 4th SELL-A-BRATION"



**ICOM**

IC-R70, IC-720A, IC-730, IC-740, IC-25A/H, IC-35A  
IC-45A, C-251A, IC-2KL, IC-451A, IC-290H



**YAESU**

FT-ONE, FT-980, FT-102, FT-77, FT-707, FT-230R  
FT-726 FT-480R, FT-720RU, FT-290R, FRG-7700, FT-625RD



**ROCKWELL/COLLINS  
KWM-380**

VoCom/Mirage  
Tokyo Hy-Power  
Amplifiers &  
5/8λ HT Gain  
Antennas IN STOCK

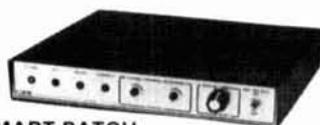


YAESU  
FT-208R  
FT-708R

ICOM  
IC2AT  
IC3AT  
IC4AT

Land-Mobile H/T  
Wilson Mini-Com II  
Yaesu FTC-2203, FT-4703  
Icom IC-M12 (Marine)  
IC-H12

DRAKE TR-5, TR-7A, R-7A, L-7, L-15, Earth  
Satellite Receiver ESR-24, THETA 9000E & 500,  
EARTH SATELLITE STATION ESS-2250



**SMART PATCH**

CES-Simplex Autopatch 510-SA Will Patch FM  
Transceiver To Your Telephone. Great For  
Telephone Calls From Mobile To Base. Simple  
To Use - \$319.95



**SANTEC  
ST-220/UP  
ST-144/UP  
ST-440/UP**

**NEW IMPROVED**

**MURCH Model  
UT2000B**

**MFJ Models  
900, 940B, 941C & 982.**



**SPECTRUM  
COMMUNICATIONS REPEATERS  
SCR-1000, 4000 & 77  
Commercial & Amateur In Stock**

**DENTRON AMPLIFIERS  
GLA-1000C**

**KANTRONICS  
Field Day 2, Mini-Reader,  
Interface, Software &  
Code Tapes**

AEA CP-1 Computer Patch

**Complete Butternut Antenna  
Inventory In Stock!**

**Communications Specialists  
Encoders In Stock!**

Smallest Wireless  
Telephone Available  
600 ft. range w/encoder \$135.00

**BENCHER PADDLES &  
Vibroplex Keys In Stock!!**

**New TEN-TEC  
Corsair In Stock**

**DIGITAL  
FREQUENCY  
COUNTER**

Trionyx-  
Model TR-1000  
0-600 MHz  
Digimax Model  
D-510 50 Hz-1GHz



Tri-Ex Towers  
Hy-Gain Towers  
& Antennas,  
and Rotors  
will be shipped direct  
to you FREE of shipping cost.

AEA 144 MHz  
AEA 440 MHz  
ANTENNAS



EIMAC  
3-500Z  
572B, 6JS6C  
12BY7A &  
4-400A

BIRD  
Wattmeters &  
Elements  
In Stock



MAIL ALL ORDERS TO BARRY ELECTRONICS CORP., 512 BROADWAY, NEW YORK CITY, NY 10012.

**New York City's**

**LARGEST STOCKING HAM DEALER  
COMPLETE REPAIR LAB ON PREMISES**

**"Aqui Se Habla Espanol!"**

BARRY INTERNATIONAL TELEX 12-7670  
TOP TRADES GIVEN ON YOUR USED EQUIPMENT  
STORE HOURS: Monday-Friday 9 to 6:30 PM  
(\$1.50 parking across the street)  
Saturday & Sunday 10 to 4 PM (Free Parking)

AUTHORIZED DIST. MCKAY DYMEK FOR  
SHORTWAVE ANTENNAS & RECEIVERS.

IRT/LEX-"Spring St. Station"

Subways: BMT-"Prince St. Station"

IND-"F" Train-Bwy. Station"

Bus: Broadway #6 to Spring St.

We Stock: AEA, ARRL, Alpha, Ameco, Antenna Specialists, Astatic, Astron, B & K, B & W, Bash, Bencher, Bird, Butternut, CDE, CES, Collins, Communications Spec. Connectors, Covercraft, Cubic (Swan), Cushcraft, Daiwa, Dentron, Digimax, Drake, ETO (Alpha), Eimac, Encomm, Henry, Hustler (Newtronics), Hy-Gain, Icom, KLM, Kantronics, Larsen, MCM (Daiwa), MFJ, J.W. Miller, Mini-Products, Mirage, Newtronics, Nye Viking, Palomar, RF Products, Radio Amateur Callbook, Robot, Rockwell Collins, Saxton, Shure, Swan, Telex, Tempo, Ten-Tec, Tokyo Hi Power, Trionyx TUBES, W2AU, Waber, Wilson, Yaesu Ham and Commercial Radios, Vocom, Vibroplex, Curtis, Tri-Ex, Wacom Duplexers, Repeaters, Phelps Dodge, Fanon Intercoms, Scanners, Crystals.

**WE NOW STOCK COMMERCIAL COMMUNICATIONS SYSTEMS  
DEALER INQUIRIES INVITED. PHONE IN YOUR ORDER & BE REIMBURSED.**

**COMMERCIAL RADIOS stocked & serviced on premises.**

**Amateur Radio & Computer Courses Given On Our Premises, Call**

**Export Orders Shipped Immediately. TELEX 12-7670**

# RECEIVE WEATHER CHARTS IN YOUR HOME!



## You can DX and receive weather charts from around the world.

Tune in on free, worldwide government weather services. Some transmitting sites even send weather satellite cloud cover pictures!

## You've heard those curious facsimile sounds while tuning through the bands—now capture these signals on paper!

Assemble ALDEN's new radiofacsimile Weather Chart Recorder Kit, hook it up to a stable HF general-coverage receiver, and you're on your way to enjoying a new hobby activity with many practical applications. Amateurs, pilots, and educators can now receive the same graphic printouts of high-quality, detailed weather charts and oceanographic data used by commercial and government personnel.

## Easy to assemble—Backed by the ALDEN name.

For over 40 years, ALDEN has led the way in the design and manufacture of the finest weather facsimile recording systems delivered to customers worldwide. This recorder kit includes pre-assembled and tested circuit boards and mechanical assemblies. All fit together in a durable, attractive case that adds the finishing professional touch.

## Buy in kit form and save \$1,000!

You do the final assembly. You save \$1,000. Complete, easy-to-follow illustrated instructions for assembly, checkout, and operation. And ALDEN backs these kits with a one-year limited warranty on all parts.

## Easy to order.

Only \$995 for the complete ALDEN Weather Chart Recorder Kit. To order, fill out and mail the coupon below. For cash orders enclose a check or money order for \$995. Add \$5 for shipping and handling in the U.S. and Canada (for Massachusetts delivery, add \$49.75 sales tax). To use your MasterCard or Visa by phone, call (617)366-8851.

## ALDENELECTRONICS

Washington Street, Westborough, MA 01581

NAME: _____											
CALLSIGN: _____											
ADDRESS: _____											
CITY: _____	STATE: _____ ZIP: _____										
<input type="checkbox"/> I've enclosed a check or money order for \$995.00 and \$5.00 for shipping and handling, plus applicable sales tax.											
<input type="checkbox"/> Charge to:	<input type="checkbox"/> MasterCard 										
	<input type="checkbox"/> Visa 										
ACCOUNT # (ALL DIGITS)											
<table border="1" style="width: 100%; height: 20px;"> <tr> <td style="width: 12.5%;"></td> </tr> </table>											
EXPIRATION DATE											
<table border="1" style="width: 100%; height: 20px;"> <tr> <td style="width: 25%;"></td> <td style="width: 25%;"></td> <td style="width: 25%;"></td> <td style="width: 25%;"></td> </tr> </table>											
SIGNATURE REQUIRED IF USING CREDIT CARD _____											

WHEN ONLY THE BEST IS GOOD ENOUGH



# TERMINALL

for ATARI<sup>®</sup>

TERMINALL T4 is a hardware and software system that converts your Atari 400, 800 or 1200 personal computer into a state of the art communications terminal. TERMINALL features simple connections to your computer and radio plus sophisticated and reliable software.

#### New on Atari Version

■ **Cursor Editing** - use the cursor keys to compose, overwrite, delete or insert any text to be transmitted, any preprogrammed message, or any received text.

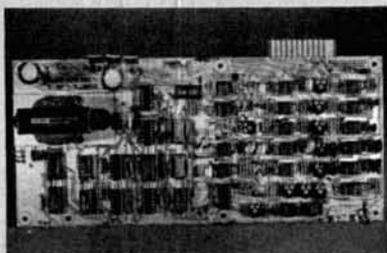
■ **Color Displays** - on a color TV or color monitor.

■ **Disk Save and Retrieve** received text or any preprogrammed message. Files are compatible with most word processors including Text Wizard\*.

■ **Backup copy** saves all user selectable options as defaults - such as call sign, modes, messages, etc.

#### Simplicity

TERMINALL was designed from the outset to be easy to connect to your radio and easy to use. Plug into your receiver headphone jack and copy Morse Code or radioteletype (RTTY). Plug into your CW key jack and send Morse Code. Attach a microphone connector and send Baudot



#### NO COMPROMISE HARDWARE

or ASCII RTTY using audio tones (AFSK). That's all there is to hooking it up.

The software is loaded into your computer from disk or cassette. Enter your call sign and the time and you will start receiving immediately. No settings or adjustments are necessary to receive Morse Code, it's fully automatic - and it works! You may type your message while receiving or transmitting.

You will be on the air, receiving and transmitting in any mode, in minutes. As we said, TERMINALL is simple.

#### More for your money.

■ TERMINALL has the RTTY terminal

unit - demod and AFSK - built in. This results in a lower total cost.

■ **Fantastic Morse reception.** Six stage active filter demodulator copies the weak ones. Auto adaptive Morse algorithm copies the sloppy ones. Received code speed displayed on status line.

■ **Outstanding documentation.** Professionally written, 90 page user manual contains step-by-step instructions.

■ **Built, in separate, multi-stage, active filter RTTY and CW demodulators.** No phase lock loops. RTTY demodulator has 170 and either 425 or 850 Hz shift-keyboard selectable - and



#### MORE FOR YOUR MONEY

uses either the panel meter or scope outputs for easy tuning. Copy the weak ones. Copy the noisy ones. Copy the fading ones.

■ **Built in crystal controlled AFSK.** Rock stable for even the most demanding VHF or HF applications. A must on many VHF RTTY repeaters.

■ **Built in 110 or 220 volt AC power supply.**

■ **Built in parallel printer driver software** through controller ports or Atari 850 Module. Write for details.

■ **Multi level displays** - allows examining and editing of historical text.

■ **Word wrapping,** word mode editing, diddle, ignore carriage returns, user programmable end of line sequence, adjustable carriage width, multiple user-defined WRU, transmit delay, break mode and more!

■ **The all-in-one TERMINALL design** makes it great for use on HF or VHF, Ham, Commercial, SWL or MARS! SWL's: TERMINALL may be jumpered for either 425 or 850 Hz reception to copy news and weather services.

Other versions available for TRS-80\* Models I and III and Apple II, Apple II Plus or Apple IIe

\*Atari is a registered trademark of Atari Inc., TRS-80 is a registered trademark of Tandy Corp, Apple is a registered trademark of Apple Computer Inc. and Text Wizard is a registered trademark of DataSoft Inc.

1 yr. parts and labor limited warranty. Call or write for more details.



15 day money back trial period on factory direct orders.

#### SYSTEM REQUIREMENTS

Atari 400, 800 or 1200 computer with minimum of 32K RAM and one disk drive or a cassette recorder. Includes software on disk and cassette, assembled and tested hardware and an extensive instruction manual. \$499.

Add \$4.00 shipping UPS reg. delivery, CA residents add 6% sales tax.



CALL OR WRITE FOR DETAILS

(209) 667-2888

**MACROTRONICS, inc.**®

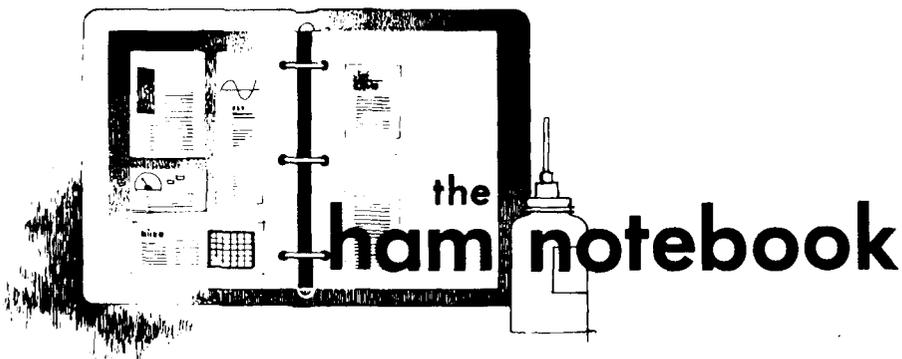
1125 N. Golden State Blvd.  
Turlock, California 95380

We periodically experience telephone difficulties. Please keep trying.



C.O.D.

**The communications terminal that does it all!**



## heatsink cooling fan

Most modern transceivers in the 200 watt class mount the amplifier on the back of the cabinet. The heatsink is exposed, and should be cooled by a breeze. A muffin fan is just right to make that breeze.

Surplus houses sell them for around \$12, but you can pick them up new at ham flea markets for around \$4. These fans run from 120 Vac, but are fast and noisy, masking the speaker signal. To slow the fan down, put a 600 ohm 20/30 watt resistor in series with the 120 volt line. I put mine in front of the breeze to

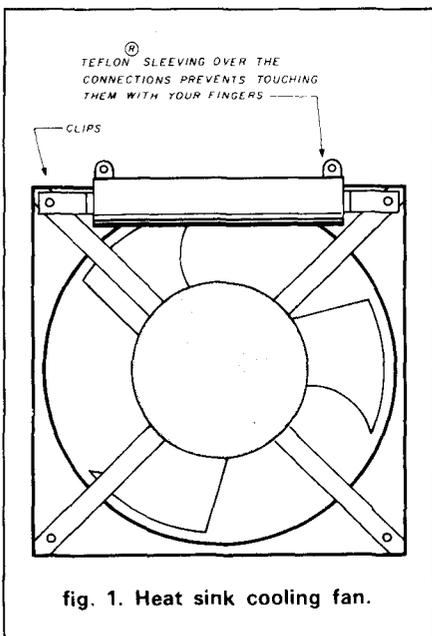


fig. 1. Heat sink cooling fan.

keep it cool. A four-inch resistor will mount on clips attached to the holes in the fan used for mounting (see fig. 1).

Ed Marriner, W6XM

## HF antenna

Some time ago I tried a 160-meter antenna described in *Editors & Engineers Radio Handbook* by Bill Orr, W6SAI, (21st Ed., Section 27-17, fig. 22). The results were quite gratifying, probably because of the high ground conductivity under the antenna. The ground for the antenna was at the base of a 40-foot TV tower.

I now have a small home at the seashore on a small lot, too small to put up a 120-foot dipole for 75 meters. In the past I had tried a single-wire 1/4-wave antenna, but with only limited success. Then this year I put up the one shown in fig. 2. I first put up the 75-meter portion, made with 300-ohm TV ribbon to the specs given in the *Handbook*. My results on 75 were much better than with the 1/4-wave dipole, but this antenna, of course, worked on only one band.

Next I tried using two lengths of 300-ohm ribbon, cut for 40 meters and 20 meters, and slung under the 75-meter section. Because of the close coupling to the 75-meter section, these did not work. But it was interesting to note that the performance of the 75-meter antenna was not

affected by the addition of these two sections. I replaced the 40-meter and 20-meter sections with wire, to form a 1/4-wave antenna on these bands. Now all three antennas tuned up well. VSWR at 3.825 MHz was 1.4, at 7180 it was 1.2, at 14275 it was 1.4, and at 21.300 it was 1.4. Normally it would not be necessary to use an antenna tuner, but with the TS-120S solid-state transceiver, maximum output occurs at only 50 ohms. Also, by using the tuner I work over the full portion of these phone bands.

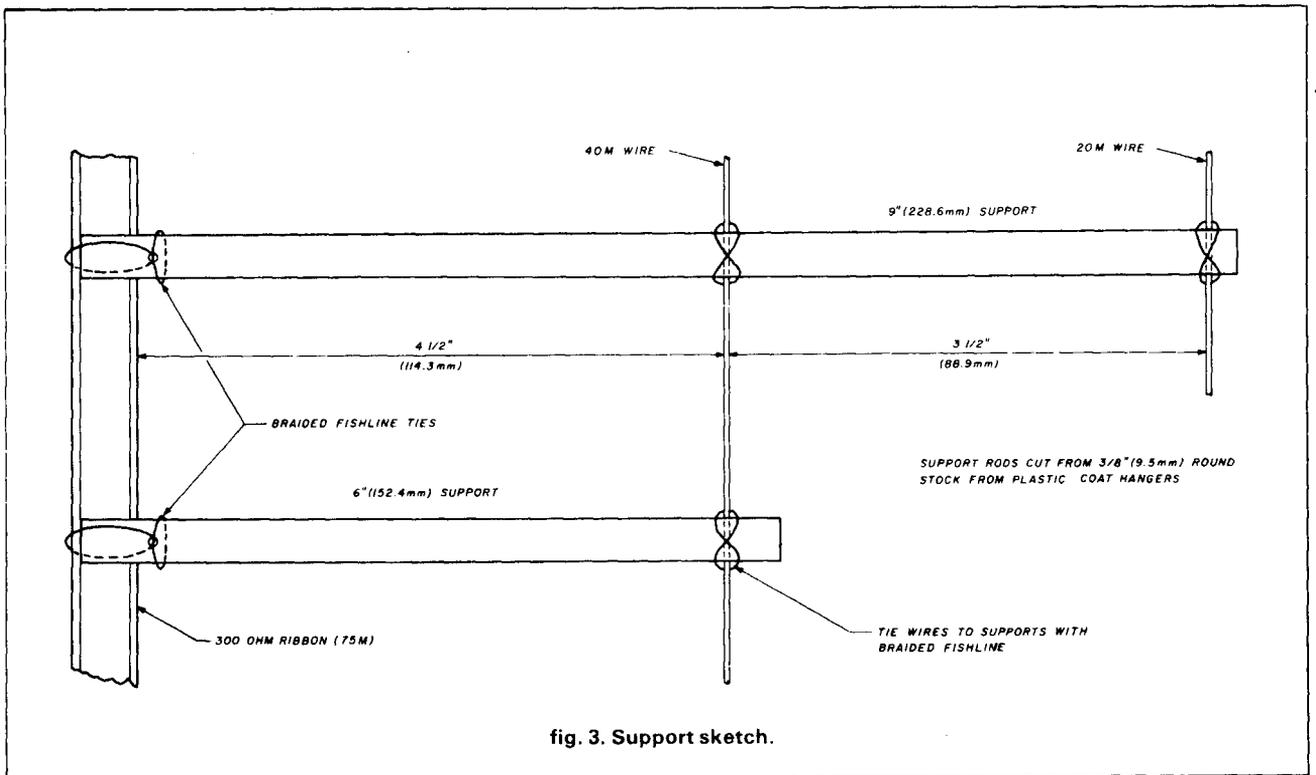
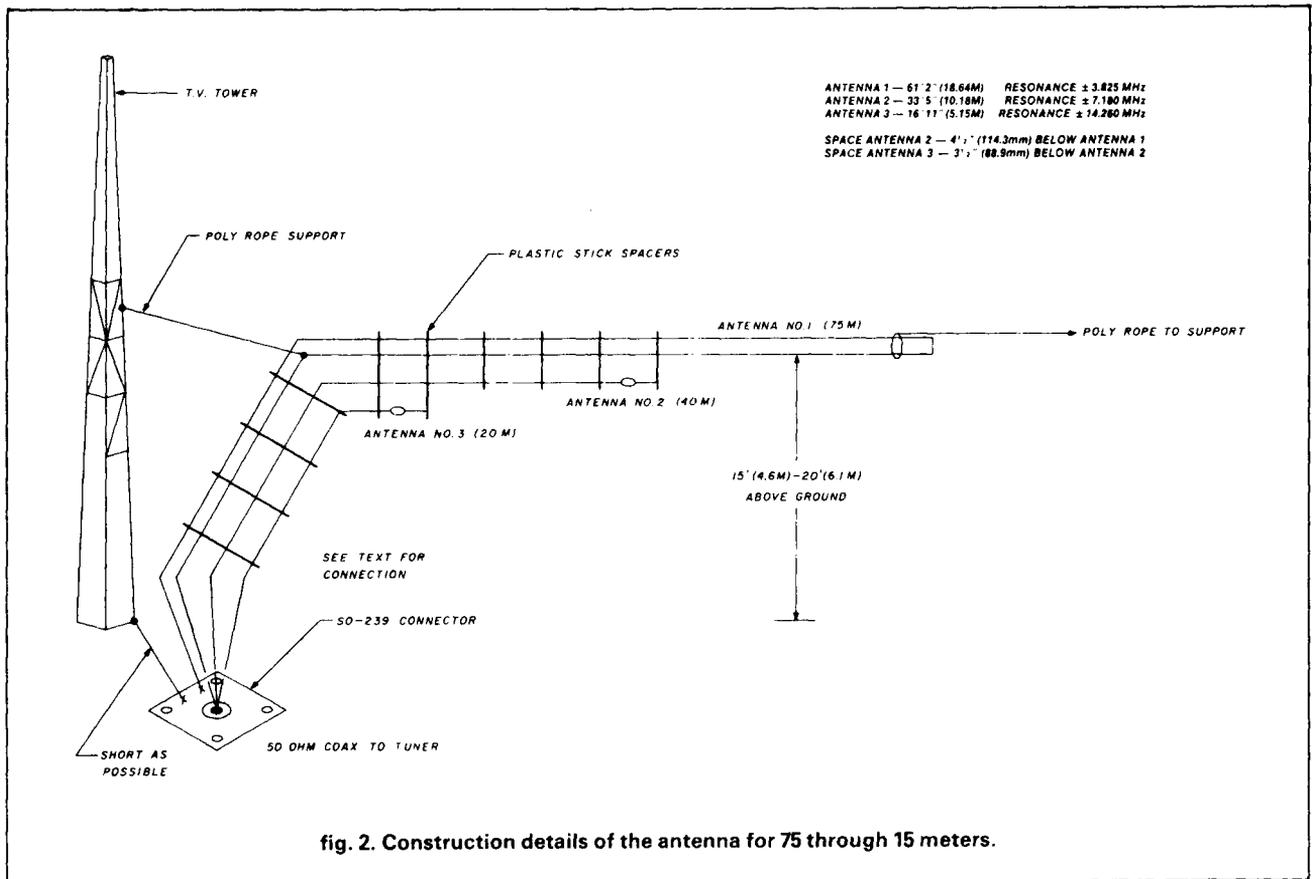
## construction

The spacers were made from three plastic clothes hangers purchased at the local discount store for 97 cents. Each hanger was cut up to get the straight sections. Six were cut to 9-inch lengths and these were used for the 40-meter and 20-meter sections. Four were cut to 6-inch lengths for the outer supports of the 40-meter section. Holes were drilled for passing the wires through them, and then the wire was tied to the supports with a piece of fishline. See fig. 3 for details.

Here I might remind you to make sure the grounded portion of the SO-239 cable connector is secured to the tower base with a strap or heavy wire (#14 or larger). The one grounded side of the 300-ohm ribbon is soldered to the SO-239 casing and the other three wires are soldered to the center pin. After soldering, the SO-239 was coated with Dow-Corning DC-9 for weather protection. Connection to the equipment is by means of thirty-five feet of RG8/U.

For use on a small lot, this system seems to work quite well, and it has a high angle of radiation, which I prefer for contacts up to 800 miles on 75. Don't expect this type of antenna to compete with a high half-wave antenna on any of these bands, but it does perform well for reasonable distances — even with its short length.

J.F. Sterner, W2GQK

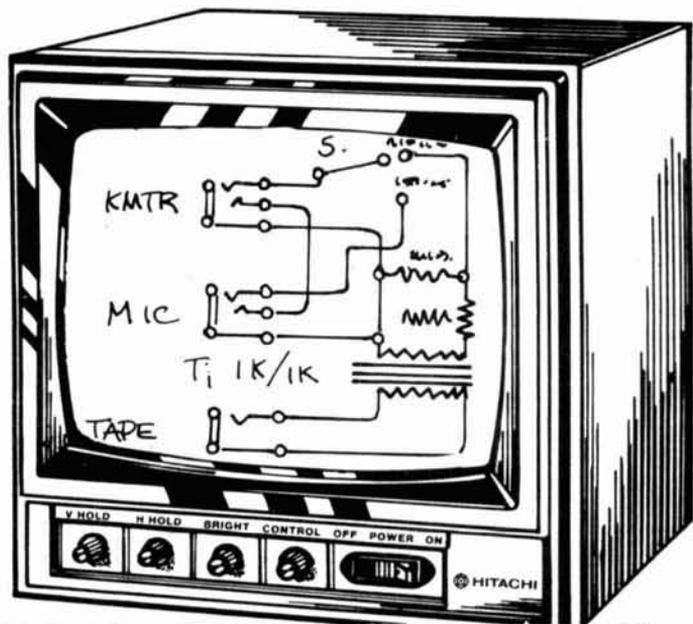


# Experience tomorrow with a home computer!

## SAVE \$36!

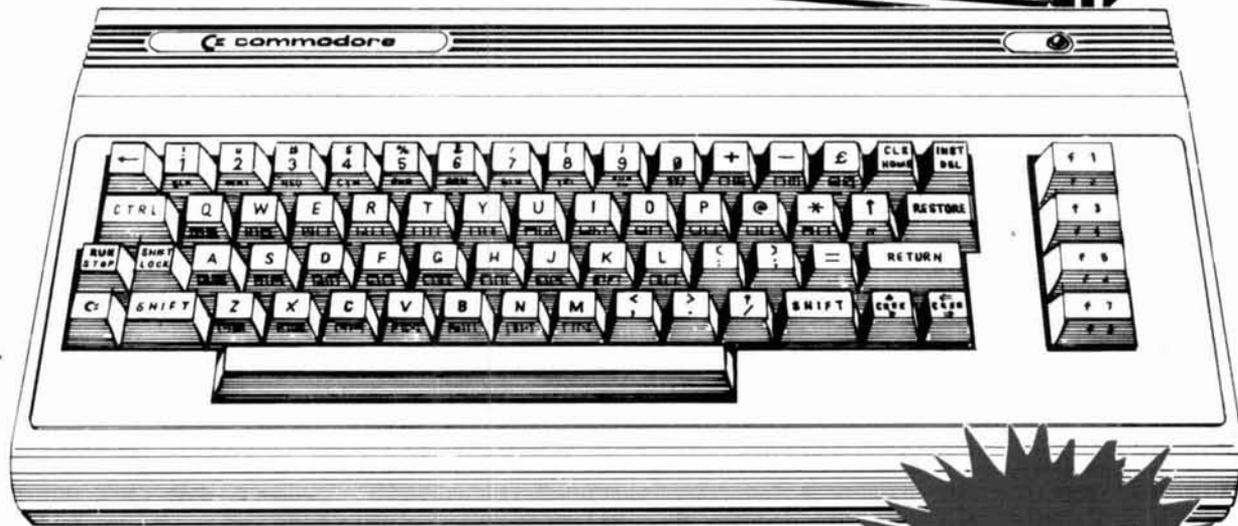
### HITACHI VM-900 9" black and white video monitor

Offers 500 lines of horizontal resolution for sharp video displays and features special circuitry for rock-steady pictures. All solid state design for greatest reliability. Inputs selectable for high impedance or 75 ohms with loop-through output for additional monitors. User adjustable brightness, contrast, vertical and horizontal controls. Built-in AC power supply. Lightweight and compact-weighs just 13.5 pounds and measures 9.6"x 9.2"x 9.3".



## \$119

List Price 155.00 Item No. HITVM900  
Add 4.32 shipping & handling



### COMMODORE VIC-20 personal computer

Now drastically reduced in price! Features typewriter size keyboard, built-in BASIC language and 5K of memory, expandable to 32K. Operation is so easy, you'll be writing your first program in just 15 minutes! A wide range of add-on accessories is available for amateur application as well as financial planning, self-education and entertainment. Connects in seconds to any black and white or color TV. Complete with RF modulator connecting cables and manual with sample programs. An extraordinary value!

## \$99

List Price 299.00 Item No. COMVIC20  
Add 2.57 shipping & handling

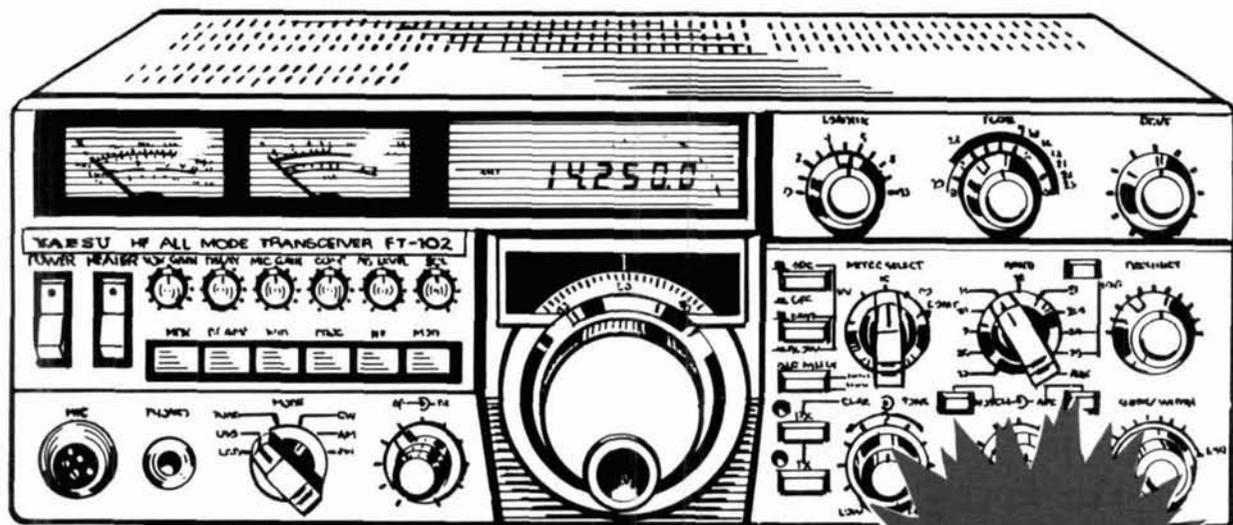
**SAVE  
\$200!**

# Long's Electronics



MAIL ORDERS: P.O. BOX 11347 BIRMINGHAM, AL 35202 • STREET ADDRESS: 3131 4TH AVENUE SOUTH BIRMINGHAM, AL 35233

# YAESU FT-102 high performance transceiver



Deluxe HF transceiver at tremendous savings! The FT-102 covers 160-10 meters, including the WARC bands and delivers 240W DC on SSB and CW. Its commercial grade transmitter uses three 6164B final tubes for greater signal purity. Plus, the audio may be tailored prior to being sent to the built-in RF speech processor. A highly sensitive front end provides exceptional dynamic range and there's an IF shift/width system for superb selectivity. Adjustable noise blanker, AGC, plus ALC width hold switch and built-in AC power supply.



**\$889**

List Price 1149.00 Item No. YEAFT102  
Add 9.00 shipping & handling



## MFJ 1224 computer interface

Join the action on RTTY, ASCII and high speed CW with your personal computer, amateur transceiver and this impressive new unit from MFJ! Operates at all popular RTTY/ASCII speeds and shifts, plus offers CW send/receive at 5-99 WPM. Uses Kantronics or similar software. Requires 12V DC for operation.

**89.95** List Price 99.95 Item No. MFJ1224  
Add 2.18 shipping & handling



## KANTRONICS Hamtext 20 software package

A new and expanded software package for use with the VIC-20 computer. Features split-screen display, status display, 1024 character type-ahead buffer and CW ID during RTTY/ASCII operations. Ten message ports with 256 characters each which may be "dumped" for cassette storage. For the ultimate in RTTY, ASCII and CW!

**89.95** List 99.95 Item No. KANC20  
Add 1.40 shipping & handling

Call Toll Free **1-800-633-3410**

IN ALABAMA CALL 1-800-292-8668 9 AM TIL 5:30 PM CST, MONDAY THRU FRIDAY

# vertical phased arrays: part 3

## Array impedances, measurements, and calculations

This is the third in a series of articles on phased vertical arrays by K2BT.

In Part 1 (May), the author examined essential design parameters, and more importantly, the *assumptions* underlying design. (In the past, incorrect assumptions have misled designers into constructing less than optimally performing arrays.)

Part 2 (June) continued with relative power plots of two- to four-element arrays indicating the correlation between physical and electrical (phase) spacing and performance.

This month, K2BT's discussion includes the determination of self- and mutual impedances, the importance of an extensive ground system, and a tabulation of mutual and driving point impedance values for some popular vertical phased arrays. — Editor.

In Part 2<sup>1</sup> various types of arrays were examined and relative power (in dB) plots were shown. We saw how specific physical arrangements of elements, current amplitude ratios, and phase displacements formed beams. By varying current amplitude ratios and phases, the forward beam width or the rejection characteristics of a given physical array were modified. The question now is how can these drive conditions be created in a real array? To do this we need information about element impedances in order to design the feed network.

Knowledge of self-impedance and mutual impedances, as well as factors that influence them, is essential because everything will be either directly or indirectly affected by these parameters.

### self-impedance

The self-impedance of an antenna at any frequency is a function of the element length, its radius, ground plane loss, and coupling with other nearby antennas. Strictly speaking, the last two items are not components of self-impedance. However, when measuring self-impedance, both may be present in the reading of *apparent* self-impedance.

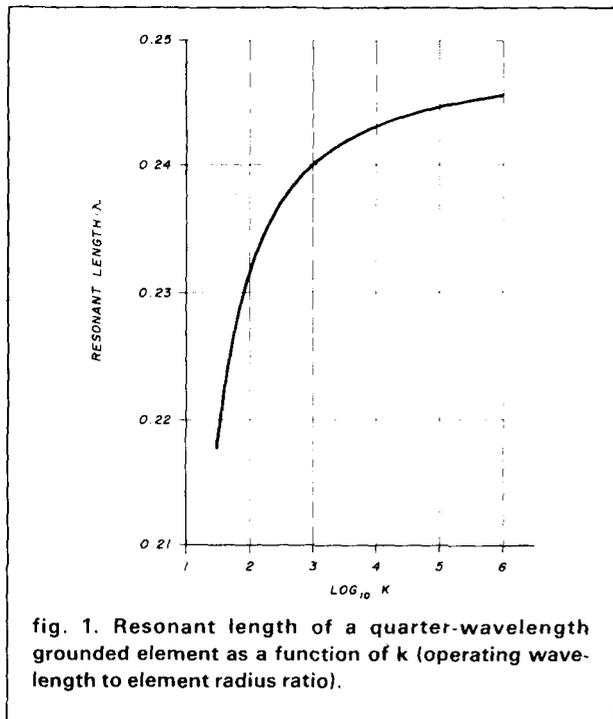
Although resonant elements are not required for an array, their use simplifies calculations and provides the following advantages:

1. An *open-circuited* 1/4-wavelength element presents virtually no coupling. This simplifies measurement procedure and ensures best conditions for accuracy of self- and mutual impedance readings.
2. The resistive component of self-impedance is normally higher than ground loss resistance which results in reasonable efficiency.
3. Ground plane evaluations and comparisons are easier to make because more information is available about the 1/4-wavelength resonant antenna than about other types of vertical antennas.

### element length and radius

An article on Yagi design by James Lawson, W2PV<sup>2</sup>, provides data on the relationship between an element's resonant length and its radius. (When using this source, be sure to refer to error corrections<sup>3</sup>) It's important to use a full wavelength when calculating length-to-radius ratio,  $K$ , for W2PV's equations. For determining parameters of a resonant grounded 1/4-wavelength element, I have revised W2PV's chart as shown in fig. 1. In the Yagi antenna

By Forrest Gehrke, K2BT, 75 Crestview Road,  
Mountain Lakes, New Jersey 07046



design, emphasis was placed on the reactance component of self-impedance, ignoring the effect that radius has upon the resistive component. In an all-elements-driven array as compared to a parasitic array, it is more important to know this effect. A review of the Amateur literature yields a range of values for a 1/4-wavelength vertical resistive component of impedance; these values are probably all correct. Any disparity is probably due to the different antenna element diameters that are used. The theoretical self-impedance of a physical 1/4-wavelength high vertical is  $36.5 + j21^4$  which assumes the use of an infinitely conducting ground plane and an infinitely thin element. Obviously neither of these conditions is physically realizable. However, even if an infinitely thin element could be used, it still would have to be shortened to achieve resonance — and in so doing the resistive component would decrease. A real element, having real thickness, would reduce resistance some more since it requires a further reduction in length in order to achieve resonance. Kraus<sup>5</sup> shows that  $l/r$  ratios in the range of 60 to 1000 are equal to a resistance variation from 34 to 36 ohms, with 35 ohms as an average value. He uses an element's actual length when calculating  $l/r$ . The comparable data for reactance change compiled by W2PV would show a variation for  $K$  from 240 to 4000. When resistance is plotted against the logarithm of  $K$ , we see a virtually straight line, showing a slow reduction in resistance as the element diameter is varied from 1.5 to 24 inches.

## ground planes

Considerable controversy surrounds the subject of required ground plane size and its influence on antenna performance. The ground plane essentially establishes an image antenna to represent the other half of a dipole. The better that image, the lower the ground loss and the lower the radiation angle. How large the ground plane should be is answered by examining the near field (within the first 1/2 wavelength), and far field (to at least 6 wavelengths) components. The near field requirements for proper pattern formation is satisfied by a ground system composed of wire radials; a sufficient quantity allows us to get quite close to the theoretical resistance. At the lower frequencies the far field usually must be left to nature, since it would be prohibitively expensive to provide so large a radial wire or mesh ground system. Even the large a-m broadcast antennas are located in salt marshes whenever available to take advantage of the high conductivity of earth for many wavelengths beyond the reach of the radials.

My experience correlates closely with the work reported by Jerry Sevick, W2FMI.<sup>6,7</sup> His graph of resistance versus number of radials used on 40 meters is applicable for 80 meters as well. I used radials averaging 0.3 wavelength in length, composed of PVC No. 24 hookup wire, and laid them on the ground. The only difference noted is that resistance did not decrease as rapidly as his graph shows. For instance, I never found resistance below 40 ohms with 40 radials, but at 60 radials and greater the data correlated more closely. This discrepancy is probably attributable to the differences in soil conductivity; the land under my array is part of a moraine, and consequently represents very low conductivity earth. All indications are that with 120 1/4-wavelength radials, resistance of a resonant 1/4-wavelength vertical is within a half ohm of the theoretical value regardless of the underlying soil conductivity. Another effect I noticed which W2FMI did not comment upon was that as radials were added, the element length had to be slightly but continually adjusted upward to maintain resonance.

## coupling with other antennas

The attempt to approach the theoretical self-impedance value can be frustrated by inadvertent coupling of the antenna under test to another antenna. As will be seen when discussing mutual impedance, the effects are subtle and can be easily mistaken for ground plane differences. These effects can go in both directions — you may think you are achieving theoretical self-impedance with a 30-radial ground plane, or conversely that a 120-radial ground plane has several ohms loss. If you encounter either of

# Introducing the **hy-gain**® **EXPLORER 14**

## Remarkably Compact, High Performance Broadband Tribander with Quad-Band Option

### New Para-Sleeve Design

The Explorer 14 is a new antenna design we call PARA-SLEEVE which uses an "open-sleeve" dipole optimized for maximum bandwidth and directivity. Here is the concept. A central dipole, driven directly by the transmission line, has a 1/2 wave resonance on the lowest operating frequency. Two shorter sleeve elements, tightly coupled to the central dipole, modify its impedance to create a 1/2 wave resonance to the highest operating frequency. This para-sleeve system is expanded by the addition of 15 meter traps and 20 meter element tips. A revolutionary new concept for HF tribanders. So unique, we've applied for a patent.

### Broadband Performance

The Explorer 14 will load solid state transceivers to maximum output with VSWR below 2:1, eliminating the need for an antenna tuner. You'll have edge to edge broadband

performance on 20, 15 and 10 meters with gain and front-to-back ratio competitive to giant tribanders that cost twice as much or more. You'll be able to work stations you cannot even hear with a dipole antenna. And, the Explorer 14 handles maximum continuous legal power with a respectable safety margin.

### Short Boom Save Space and Money

If your space or budget was too limited for a long boom tribander, chances are the Explorer 14 will fit both. The boom is only 14' (4.3 m) long and the turning radius requires only 17'3" (5.3 m). The compactness of the Explorer 14 reduces its overall weight and windload surface so you can mount it on a roof tripod, a mast or a tower. For example, the Hy-Gain CD-45II rotator and HG52 tower are a perfect match for the Explorer 14. This saves you the cost of an extra heavy duty rotator and tower.

### Superior Construction

The Explorer 14 includes passivated stainless steel hardware and heavy gauge, pre-formed element and mast brackets. High grade 6063-T832 thick wall swaged aluminum tubing is used throughout. A BN86 balun is included and a new Beta Multi-Match provides DC ground to reduce lightning hazard and precipitation static. It's a rugged, easily assembled antenna that survives winds to 100 mph (160 km/h).

### Quad Band Option

You can add a fourth band, either 30 meters or 40 meters to the Explorer 14 with the QK-710 kit. A kit that attaches to the central dipole and is easily adjusted for either 30 meters (WARC) or 40 meters at minimal extra cost.

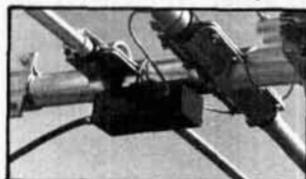
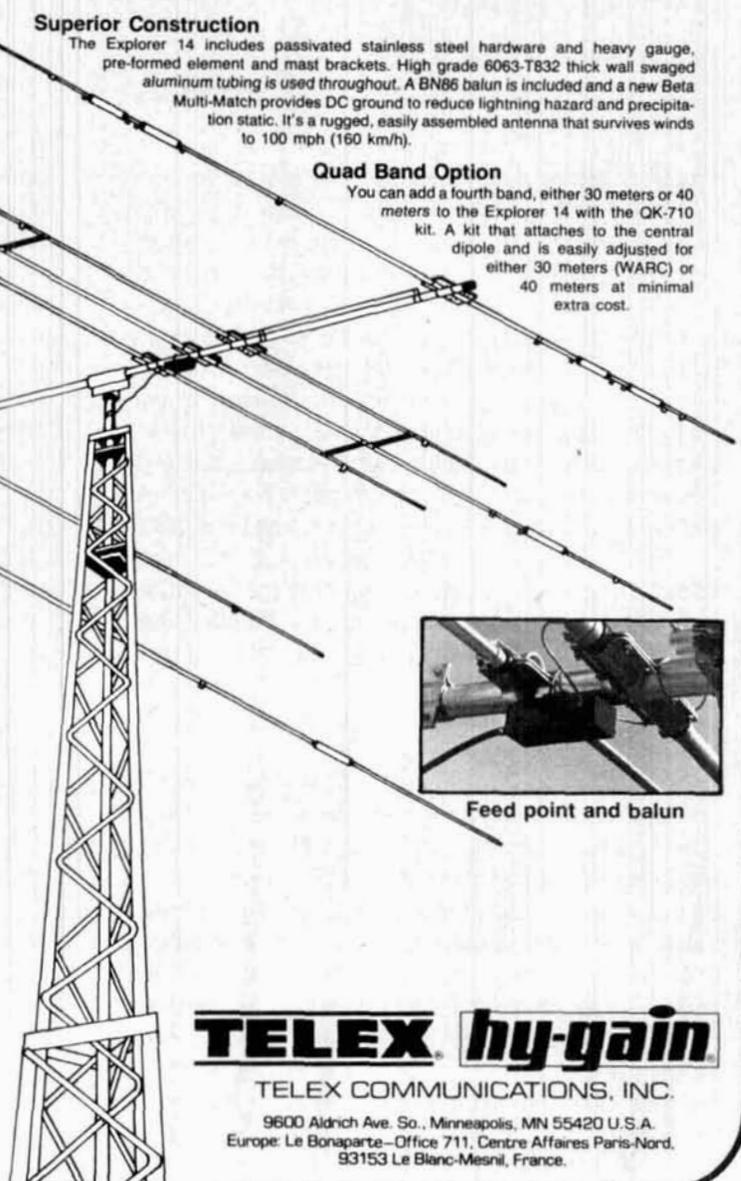


Lew McCoy, W1ICP, is among the most authoritative writers in amateur radio. For over 30 years he served on the ARRL technical staff with his last position as assistant senior technical editor. Presently he is the technical writer for CQ magazine. Here is what he had to say about the Explorer 14:

"In my opinion, with Explorer 14, Hy-Gain produced a truly high gain, high performance antenna in a small package. The "para-sleeve" design provides the amateur a whole new ball game, particularly in the area of broadbanding. I was really surprised when I actually verified the gain, front-to-back and bandwidth during my recent visit to the Hy-Gain labs and antenna range in Lincoln, Nebraska. The Explorer 14 is a winner."

### Specifications:

Frequencies of operation:	Electrical		
	20M	15M	10M
Under 2:1 VSWR (MHz).....	14.0-14.35	21.0-21.45	28.0-29.7
Maximum F/B Ratio (dB).....	27	27	21
Maximum Gain (dB).....	7.5	8.0	8.0
Maximum Power.....	Maximum Legal DC Ground		
Mechanical			
Boom Length.....	14'1 1/2" (4.3 m)		
Turning Radius.....	17'3" (5.3 m)		
Net Weight.....	43 lbs. (19.5 kg)		
Wind Surface Area.....	7.5 sq. ft. (.69m <sup>2</sup> )		



Feed point and balun

## TELEX hy-gain

TELEX COMMUNICATIONS, INC.

9600 Aldrich Ave. So., Minneapolis, MN 55420 U.S.A.  
 Europe: Le Bonaparte—Office 711, Centre Affaires Paris-Nord,  
 93153 Le Blanc-Mesnil, France.

these indications, suspect coupling with another antenna (or something acting like one even if you don't "see" it). Another indication of this problem is a significant departure (at 80 meters — several inches) in element length for resonance. I had a tower guy wire (adequately broken up with insulators, I thought) whose lowest section ran to an anchor at the base of a tree. This section was approximately 1/4 wavelength and it found sufficient ground conductivity in the tree roots to present lossy coupling to one of my array elements. Though I knew that element wasn't right, I could not see anything that would act as a resonant antenna around it. That guy wire didn't look as if it had a ground plane! The solution was to insulate it at the anchor, thus decoupling the section of guy wire.

I am sure many Amateurs will identify with this frustrating experience: the first element of a multi-element array is erected and adjusted for resonance. The length is carefully recorded and the second erected. Then, letting the first element remain connected to its feed cable, the second element is checked for resonance, found too long, and is readjusted downward. Reconnecting the second element to its feeder, the first element is now found too long. And so it continues; the result is that the elements end up considerably shortened below their uncoupled resonant length. This is mutual coupling at work and the error was in failing to open-circuit other elements when making self-impedance measurements. Other elements, at or near resonance and within about 0.35 wavelength of the antenna being measured, will manifest inductive coupling. Unless you're aware of what is happening, you may diagnose this inductive reactance to be due to the element's being too long. Shortening it will bring it to "resonance" and this may be accompanied by a satisfactory reduction in resistance (perhaps even below theoretical), but all this changes when the second element is open-circuited. It is well to remember that this situation can also occur inadvertently with a conductor not recognized as acting as an antenna. However, as we shall soon see, this same effect — mutual coupling — is the very same process used to advantage to create field enhancement and cancellation in arrays.

### mutual impedance

Coupling between elements is a function of element lengths, distance between elements, relative attitudes of elements (e.g., parallel, co-linear, echelon), and ground plane losses. Ground losses are not actually a component of theoretical mutual impedance but in a practical situation they become a part of the *apparent* mutual impedance. (Mutual impedance is a term that relates to the interaction of two

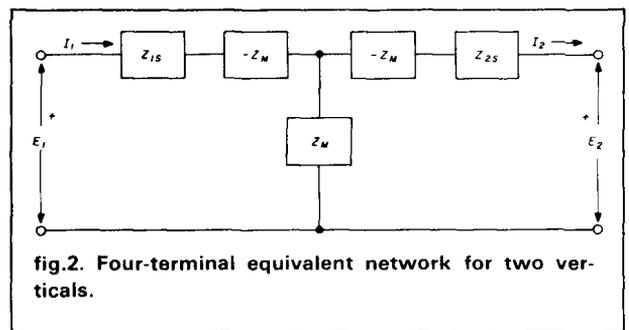


fig.2. Four-terminal equivalent network for two verticals.

or more antennas which are close enough to each other to cause their driving impedances to be different from their self-impedances.) The unit of measurement — ohms — may be, like any impedance, resistive or reactive, or both. Such antennas are coupled by an impedance which appears to be in common with all elements. (Driving point impedance calculations only require the mutual impedance between pairs — that is, two elements at a time be measured.) Mutual impedance between antennas is similar to mutual inductance between coupled coils; the impedance relationship can be both depicted and its value measured in the same way. In fig. 2 the driving point impedance  $Z_1$  or  $Z_2$  of each vertical as measured at either set of terminals reacts to the presence of the other vertical as though its self-impedance  $Z_{11}$  or  $Z_{22}$  had a common impedance  $Z_{12}$  in series with it.  $Z_{12}$  is, by definition:

$$Z_{12} = -E_2/I_1$$

Although useful mathematically, it doesn't provide a practical basis for measurement. The voltage and current relationships existing in a system of antenna elements, each mutually coupled to one another, have the same form as the voltage and current in a general network. Writing their mesh equations produces:

$$E_1 = I_1Z_{11} + I_1Z_{12} + \dots + I_nZ_{1n}$$

$$E_2 = I_1Z_{21} + I_2Z_{22} + \dots + I_nZ_{2n}$$

⋮

$$E_n = I_1Z_{n1} + I_2Z_{n2} + \dots + I_nZ_{nn}$$

where  $E_1, E_2, \dots, E_n$  are voltages applied to elements 1, 2, ..., N

$I_1, I_2, \dots, I_n$  are element drive currents

$Z_{11}, Z_{22}, \dots, Z_{nn}$  are element self-impedances

$Z_{12}, Z_{21}, \dots, Z_{1n}, Z_{2n}$  are mutual impedances and are denoted by dual subscripts which are always different. As in general networks, mutual impedances with the same subscripts but with reversed positions, (e.g.,  $Z_{12}$  and  $Z_{21}$ ), describe the identical impedance (from the Reciprocity Theorem).

If the equation for each drive voltage is divided by that element's drive current, the following driving point impedance terms are obtained:

$$Z_1 = E_1/I_1 = Z_{11} + I_2 Z_{12}/I_1 + \dots + I_n Z_{1n}/I_1 \quad (1)$$

$$Z_n = E_n/I_n = I_1 Z_{n1}/I_n + I_2 Z_{n2}/I_n + \dots + Z_{nn}$$

Notice that each element's driving point impedance consists of its self-impedance and includes terms for the mutual impedances between it and each of the other elements. The *influence* of the mutual impedances upon the driving point impedance is a function of the drive currents (amplitude and phase) to other elements. Although at first glance these equations appear quite formidable and look like there are too many unknowns for solution, this is not the case. Having selected an array configuration and the driving current ratios and displacements for the field plot, we already know what the currents need to be.<sup>1</sup> If we could find a way to reduce the complexity and consequently the number of unknowns, a means for deriving mutual impedances might be devised. Fortunately there is one. Since each mutual impedance we need to know exists between only two elements, we can write a simpler set of equations:

$$E_1 = I_1 Z_{11} + I_2 Z_{12}$$

$$E_2 = I_1 Z_{12} + I_2 Z_{22}$$

If the terminal of element 2 is connected to its ground plane, the drive voltage  $E_2$  becomes zero and:

$$\begin{aligned} E_1 &= I_1 Z_{11} + I_2 Z_{12} \\ 0 &= I_1 Z_{12} + I_2 Z_{22} \end{aligned} \quad (2)$$

Solving for the driving point impedance yields:

$$Z_1 = E_1/I_1 = Z_{11} - (Z_{12})^2/Z_{22}$$

and solving for the mutual impedance  $Z_{12}$  gives

$$Z_{12} = \pm \sqrt{Z_{22}(Z_{11} - Z_1)} \quad (3)$$

Note that all references to voltages and currents have been eliminated. We are now in a position to find all the remaining unknowns.

### mutual impedance measurement

Provided the elements are 1/4 wavelength or less, the procedure is: open-circuit all elements; measure

the self-impedance of element 1; connect element 2 terminal to its ground plane; measure the driving point impedance of element 1; and open-circuit element 2.

If there are additional elements, connect element 3 terminal to its ground plane; measure the driving point impedance of element 1; and open-circuit element 3.

Following the same sequence, all remaining elements are measured from element 1. When completed, a similar set of measurements are taken from element 2, starting with self-impedance and then measuring the various pairs of driving point impedances, and so on with each remaining element. This procedure allows each element to be individually treated as the reference element of each pair of elements for mutual impedance measurements. When completed, the same mutual impedance will have been read from each side of every pair. This provides a check on previously determined calculations. I am continually amazed (even though I know it is supposed to happen) by the close coincidence of the resulting value for mutual impedance as determined from either element of a pair! This occurs, as it should, even when the two self-impedances are quite *different*.

### using 1/2-wavelength elements

What if the elements are significantly longer than 1/4 wavelength, specifically a 1/2 wavelength? Open-circuiting these elements from the ground plane will not decouple them (in all likelihood, coupling will be found to increase if the length is exactly a 1/2-wavelength). Means for temporarily sectioning other elements into two electrically separate halves must be provided so that self-impedances are measured with the temporary sectioning reconnected and *that element* connected to its ground plane. I have no experience with this situation but I believe the array can be driven properly, provided the high impedance at the bases of the elements can be handled.

In antenna texts, mutuals are always referred to current loops (maximum current points). Mutuals derived from measurements as above are referred to the base of the elements. These are quite different values, just as self-impedances differ according to whether they are measured at a voltage or current loop.

### mutual impedance calculations

Data is taken from a 40-meter 4-square array with elements spaced 0.272 wavelength at 7.0 MHz. The elements are not alike, not resonant, and the ground plane is quite lossy. Data are shown for two elements and mutual coupling was measured from each.

**table 1. List of mutual resistance and reactance between two physical 1/4-wavelength verticals separated by 0 through 1.5 wavelength spacings.**

spacing	R	X	spacing	R	X
0	+36.57	+21.27	.80	-9.25	+6.13
.05	+35.83	+12.14	.85	-6.66	+8.15
.10	+33.67	+3.77	.90	-3.75	+9.28
.15	+30.22	-3.55	.95	-.78	+9.50
.20	+25.70	-9.59	1.00	+2.00	+8.87
.25	+20.40	-14.18	1.05	+4.38	+7.52
.30	+14.63	-17.22	1.10	+6.16	+5.61
.35	+8.75	-18.71	1.15	+7.26	+3.36
.40	+3.11	-18.72	1.20	+7.63	+0.97
.45	-1.99	-17.39	1.25	+7.28	-1.33
.50	-6.27	-14.97	1.30	+6.30	-3.35
.55	-9.53	-11.71	1.35	+4.81	-4.92
.60	-11.66	-7.94	1.40	+2.99	-5.94
.65	-12.61	-3.97	1.45	+1.00	-6.35
.70	-12.43	-0.13	1.50	-.94	-6.15
.75	-11.25	+3.32			

**Equation 3** is used to calculate the mutual impedance.

**Measurements from Element A (referenced as Element #1)**

Element A	$Z_{11} = 45.73 + j 8.19$	Self-impedance of A
Element B	$Z_{22} = 42.53 + j 5.72$	Self-impedance of B
Element A	$Z_1 = 46.98 + j15.66$	Driving point impedance of A with B grounded
	$Z_{12} = 12.53 - j12.95$	Calculated mutual impedance

**Measurements from Element B (referenced as Element #1)**

Element B	$Z_{11} = 42.53 + j 5.72$	Self-impedance of B
Element A	$Z_{22} = 45.73 + j 8.19$	Self-impedance of A
Element B	$Z_1 = 44.20 + j12.79$	Driving point impedance of B with A grounded
	$Z_{12} = 12.63 - j13.34$	Calculated mutual impedance

Note the following:

1. There is a nomenclature interchange for the self-impedances of the elements, denoting the change in reference element for the measurement of mutual coupling.
2. There is only a small increase in resistive component when measuring the effect of coupling, requiring a highly accurate impedance bridge.<sup>8</sup>
3. At this spacing, the effect of coupling is decidedly inductive on the measured element.
4. There is reasonably good correspondence in the mutual impedance calculation from either side of the pair of elements, despite the differences in the individual elements.
5. The measured mutual impedance is quite different from theoretical values. (See table 2.)

As a further verification of measurements and calculations, this test is useful and instructive: With element 2 connected to its ground plane, drive element 1 from a 50 to 100 watt source while measuring current at the terminals of each element. The ratio of the current flowing in element 2 to element 1 is equal to the ratio of the mutual impedance to element 2 self-impedance:

$$I_2/I_1 = -Z_{12}/Z_{22}$$

(This identity is a rearrangement of eq. 2.)

Since ratios are involved, the only restraint on the current measuring device is that it be linear. Although phase angles are difficult to measure when the reference points are located at some distance, current amplitudes can be measured and this identity is useful as a verification of impedance measurements and calculations, even if only the magnitude of the mutual impedance vector can be obtained. When performing this test, if there are more elements, open circuit them. If driving with more than 50 watts be careful of those open-circuited elements; don't provide a ground return through your body. You may be surprised to find how much energy is being coupled.

The calculations for mutual impedances require a square root extraction. Which sign to use? As general guidance, the polar vector angle of the root is *always* lagging except at spacings less than about 0.15 wavelengths. For a specific calculation the pattern of sign changes seen in published sources is an aid. Mutual resistance and reactance vary with element separation in the nature of a damped sine wave, starting with both signs positive at zero separation and proceeding through cyclic sign variations

thereafter. For example, suppose at 1/4-wavelength separation with 1/4-wavelength elements your calculator or computer produces the square root extraction  $-13.7 + j15.1$  (polar notation  $20.4 \angle +132.2^\circ$ ). The polar angle shows lead and it should be lagging. Looking at published sources we see confirmation for this. Subtracting  $180^\circ$  from the polar vector angle will produce the correct signs for resistance and reactance. To aid in determining signs I have converted the table of mutual resistances and reactances shown by W2PV, to grounded physical 1/4 wavelength values in **table 1**.

The question arises: "Why bother measuring mutual impedances? Why not use published values from antenna texts?" The best answer is another question: "Why not also use textbook values for self-impedance?" Most Amateurs measure self-impedance because they want to be sure the element length is resonant at the frequency of interest or because they know from experience that the actual self-impedance can differ considerably from the theoretical value. Theoretical mutual impedance derivations are quite complex and solutions often use different simplifying assumptions. The result is that few textbook sources — except those which obtained data from a common origin — agree exactly. Regardless of source, the following assumptions apply: infinitely conducting ground plane; infinitely thin element; and element lengths measured in physical wavelengths. Element radius has a relatively small effect on mutuals. The element length assumption can be determined from the values for zero separation between elements (see first line in **table 1**). This is the self-impedance of a single element and may be recognized as identical with theoretical self-impedance. (Applies to equal length element data only.) For example, the value  $36.5 + j21$  means that physical 1/4-wavelength elements had been assumed. The length difference (over resonant length) will not seriously affect driving point impedance calculations, but the assumption of lossless self-impedances will. **Table 2** lists mutual impedance between 1/4 wavelength high elements from several sources compared

to an average of 16 measurements I have made.

The resistive component differs most. Despite these differences, if no means of measurement is available, there is something to be said for using theoretical values; at least there is recognition they exist rather than ignoring them entirely. However, as I have previously emphasized, the significance of deviation from optimum drive conditions increases with the complexity of the array. When I first became aware of the need to take mutual impedances into account for the feed network, I used theoretical values. There was improvement in F/B, but it was still far from what is achievable.

You may have wondered if an element driving-point impedance could have a negative resistive component, and if so, what that means. This is entirely possible with arrays of more than two elements, particularly with close spaced arrays or arrays employing non-unity current ratios. Elements exhibiting this condition are being driven by energy coupled from other elements; instead of *receiving* any drive from its feeder, this element is *sending* drive back into the feed network. This is still a coupled passive system, in equilibrium, merely observing the law of conservation of energy.

### calculations of driving-point impedances

Using **equation 1**, I have calculated and listed in **table 3** the driving-point impedances of several arrays discussed in **Part 2** using measured mutuals. (For smaller spacings, values were estimated based on extrapolations of my data). For a comparison, the 4-square array driven impedances are also calculated using mutual impedances from **table 1**.

Data common to all calculations:

Element effective radius = 0.7 inch  
 Element height = 62.7 feet  
 Self-impedance =  $36.4 + j0$  ohms  
 Frequency = 3.8 MHz

### notes and comments

1. The 3 element in-line and the 1/8-wavelength 4-square have elements which exhibit substantial negative resistance components in their driving point impedances.
2. Nearly all driving point impedances show substantial reactance, requiring some care in establishing correct phasing.
3. All arrays except one exhibit unlike driving impedances, *ruling out equal power* distribution networks where *equal current* amplitude is intended.
4. Note the difference in driving point impedances in

**table 2. Values of mutual impedance between two quarter-wavelength high verticals. Data from five different sources. (Gehrke's entry represents measured data for a real vertical over a real ground.)**

source	mutual impedance	
	(0.272 spacing)	(0.385 spacing)
Brown	17.49 - j17.01	2.96 - j18.47
Jasik	17.47 - j16.01	6.00 - j17.50
Jordan	17.55 - j16.37	1.66 - j18.99
Mushiake	17.51 - j15.70	4.80 - j18.75
Gehrke	13.20 - j16.24	0.20 - j16.61

**table 3. Mutual and driving point impedance values for some popular vertical phased arrays.**

array	current ratio	mutual impedances	driving point impedances
2-element, $\lambda/4$ spacing*	1/1; $0^\circ, -90^\circ$	$Z_{12} = 15 - j15$	$Z_1 = 21.4 - j15$ $Z_2 = 51.4 + j15$
3-element in-line, $\lambda/4$ spacing	1/2/1; $0^\circ, -90^\circ, -180^\circ$	$Z_{12} = Z_{23} = 15 - j15$ $Z_{13} = -9 - j13$	$Z_1 = -6.6 - j21$ $Z_2 = 51.4 + j0$ $Z_3 = 79.4 - j39$
2-element, $\lambda/2$ spacing	1/1; $0^\circ, -180^\circ$	$Z_{12} = -9 - j13$	$Z_1 = 45.4 + j13$ $Z_2 = 45.4 + j13$
triangular array, $0.289\lambda$ spacing	1/0.5/0.5; $0^\circ, -90^\circ, -90^\circ$	$Z_{12} = Z_{23} = Z_{13}$ $= 10 - j16$	$Z_1 = 28.4 - j10$ $Z_2 = 78.4 + j4$ $Z_3 = 78.4 + j4$
4-square array, $\lambda/4$ spacing	1/1/1/1; $0^\circ, -90^\circ, -90^\circ, -180^\circ$	$Z_{12} = Z_{13} = Z_{24} = Z_{34}$ $= 15 - j15;$ $Z_{14} = Z_{23} = 3 - j17.5$	$Z_1 = 3.4 - j12.5$ $Z_2 = 39.4 - j17.5$ $Z_3 = 39.4 - j17.5$ $Z_4 = 63.4 + j47.5$
4-square array, $\lambda/4$ spacing (using table 1 mutual impedance data)	1/1/1/1; $0^\circ, -90^\circ, -90^\circ, -180^\circ$	$Z_{12} = Z_{13} = Z_{24} = Z_{34}$ $= 20.4 - j14.18;$ $Z_{14} = Z_{23} = 8.41 - j18.72$	$Z_1 = -0.37 - j22.08$ $Z_2 = 44.81 - j18.72$ $Z_3 = 44.81 - j18.72$ $Z_4 = 56.35 + j59.52$
2 x 2 array of arrays, $\lambda/4$ spacing	1/1/1/1; $0^\circ, 0^\circ, -90^\circ, -90^\circ$	$Z_{12} = Z_{13} = Z_{24} = Z_{34}$ $= 15 - j15,$ $Z_{14} = Z_{23} = 3 - j17.5$	$Z_1 = 18.9 - j33$ $Z_2 = 18.9 - j33$ $Z_3 = 83.9 + j3$ $Z_4 = 83.9 + j3$
4-square array, $\lambda/8$ spacing	1/1/1/1; $0^\circ, -135^\circ, -135^\circ, -270^\circ$	$Z_{12} = Z_{13} = Z_{24} = Z_{34} =$ $= 30 - j3,$ $Z_{14} = Z_{23} = 25 - j9$	$Z_1 = -1.27 - j13.18$ $Z_2 = 18.97 - j4.76$ $Z_3 = 18.97 - j4.76$ $Z_4 = -10.78 + j21.67$

\*This 2-element, 1/4-wavelength spaced array is probably the most common phased array configuration used by Amateurs today. Please note that the driving point impedances are different.  
Editor.

the 1/4 wavelength spaced 4-square using actual mutual impedances as compared to the use of theoretical values. Current and phases in the latter case will not occur as intended in a real array.

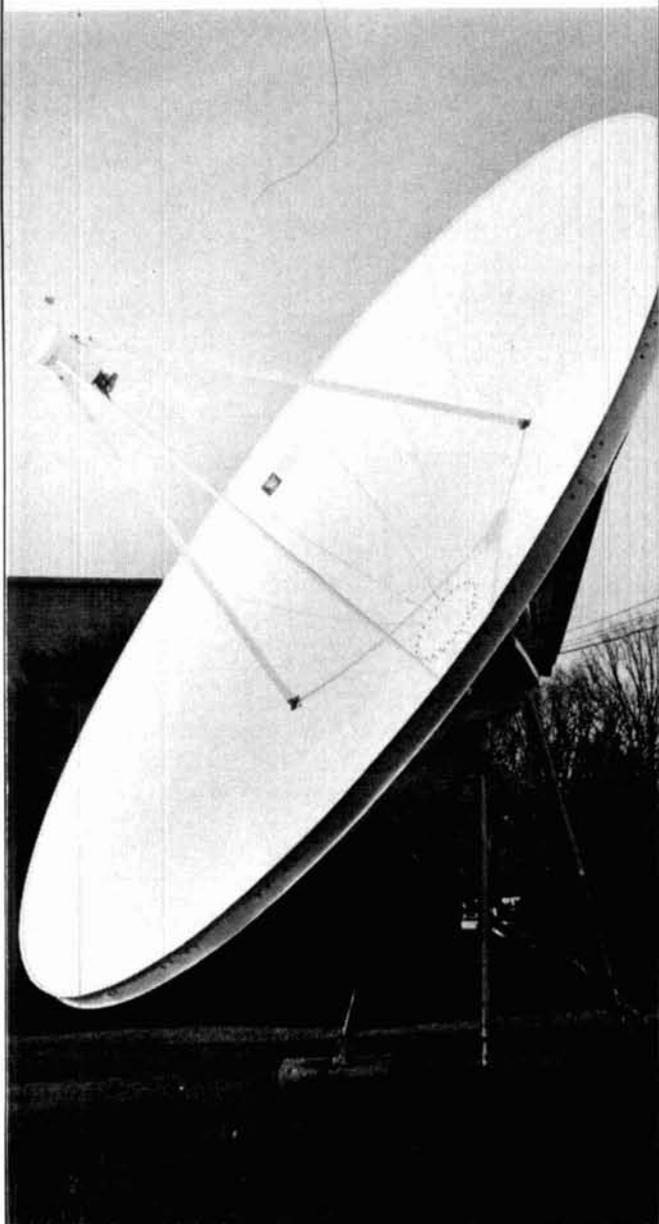
5. Note the 2 element 1/2 wavelength spaced array (not shown in Part 2). Because of the equal driving impedances, here is one of the few instances of an array which operates as intended regardless of feeder length, as long as they are equal and a 1/2 wavelength delay line is inserted in series with one of them. Except for VSWR,  $Z_0$  of coax is not important. The antenna pattern in this case is *not* a function of the coaxial cables  $Z_0$  (characteristic impedance) though the VSWR still is.

We tend to become accustomed to thinking of an antenna, just as any discrete component, as having a fixed impedance at any frequency. The concept that elements within an array present impedances that are determined by other element drive currents (amplitude and phase) is, at first, difficult to appreciate. That these impedances may have negative compo-

nents of resistance also can be a bit unsettling. Yet when an array is looked at mathematically as a general network which includes the impedance branches represented by mutual impedances, these seemingly unusual effects can be seen to be physical realities. Consequently, the rest of this coupled system, the feed network, must be designed for these driving impedances as the terminations.

If we expect to switch directions with this array, then we need to be sure that each physical element presents the same driving point impedance appropriate to the electrical position in the array it is assuming. I have found that equalizing self-impedances is the best means for doing this. Each element is adjusted for length to present the identical reactance (if resonance is the objective, then this is zero reactance). Assuming all elements have the same radius, radials are added to those elements showing higher resistive components. At the 100 radial level, it is not unusual for a spread of +20 radials to occur among the ground planes of the elements in this effort at equalization.

# ANYWAY YOU LOOK AT IT.... ADM HAS YOUR ANTENNA



**ADM 11, ADM 13, ADM 16, ADM 20**  
**Sturdy Aluminum & Steel**  
**Construction**  
**Easy Assembly & Installation**

**ANTENNA DEVELOPMENT &  
MANUFACTURING, INC.**

**P.O. Box 1178, Hwy. 67 South**  
**Poplar Bluff, MO 63901**  
**(314) 785-5988 686-1484**

✓ 108

## summary

We have worked our way through the design of vertical phased array antennas. A number of typical arrays were examined, as well as the current requirements of each element and the driving point impedances that must exist to cause the array to operate as designed. What remains is to design the feed network which will create conditions as they must appear, not at the element terminals, but at the end of the feed lines coming from those terminals. By now you are aware, if you weren't already, that feed lines are an integral part of the feed network.

There is no unique network which achieves the necessary current amplitude ratios and phase displacements. We can get to that objective in a number of different ways. In the next article the design task will be of use A,B,C,D parameters in single matrices as a tool. If this technique is new to you, I believe you will find this approach most interesting. You will see that this is a powerful and versatile means of network design, useful not just for antenna arrays, but for other network applications as well.

## references

1. Forrest Gehrke, K2BT, "Phased Arrays, Part 2," *ham radio*, June, 1983, page 24.
2. James L. Lawson, W2PV, "Yagi Antenna Design, Performance Calculations," *ham radio*, January, 1980, page 22.
3. Short Circuits (errata corrections), "Yagi Antenna Design," *ham radio*, September, 1980, page 66.
4. Prof. John D. Kraus, W8JK, *Antennas*, McGraw-Hill Book Publishing Co., page 262.
5. Prof. John D. Kraus, W8JK, *Antennas*, McGraw-Hill Publishing Co., page 245.
6. Jerry Sevick, W2FMI, "The W2FMI Ground-Mounted Short Vertical," *QST*, March 1973, page 13.
7. Jerry Sevick, W2FMI, "Short Ground-Radial Systems for Short Verticals," *QST*, April, 1978, page 30.
8. Forrest Gehrke, K2BT, "A Precision Noise Bridge," *ham radio*, March, 1983, page 50.

In commenting on vertical phased arrays, several writers have cautioned against placing arrays near trees. The apparent assumption is that trees represent resonant loss elements or somehow disturb the field so that the radiated pattern will be changed. I remain unconvinced. At wavelengths 40 meters and longer, I have measured self- and mutual impedances of elements, among trees, at all seasons of the year without seeing any significant changes that are not also seen on a pair of 40-meter elements completely away from trees. Small variations (0.3 to 0.5 ohms) are seen in self-impedances, depending upon soil moisture conditions, which are reflected in mutual impedance measurements. Since all elements are affected in the same way, these small changes cannot significantly affect radiation patterns. Examination of published mutual impedance data indicates that the presence of conductive elements, *resonant or not*, within about 0.1 wavelength of an element will significantly affect mutual impedance in unanticipated ways. Prudence would therefore dictate that nothing conductive, or even partially so, which could act as an antenna be allowed within that distance. If despite this precaution array patterns are indeed disturbed, my advice is to look for something that may be acting as a real conductive antenna in the immediate area of the array, or to re-evaluate the feed network. —K2BT

ham radio

When it comes to

# QSL's...



it's the **ONLY BOOK!**

US or Foreign Listings

## 1983 callbooks

Here they are! The latest editions of the world-famous Radio Amateur Callbook are available now. The U.S. edition features over 400,000 listings, with over 75,000 changes from last year. The Foreign edition has over 370,000 listings, over 50,000 changes. Each book lists calls and the address information you need to send QSL's. Special features include call changes, census of amateur licenses, world-wide QSL bureaus, prefixes of the world, international postal rates, and much more. Place your order for the new 1983 Radio Amateur Callbooks, available now.

	Each	Shipping	Total
<input type="checkbox"/> US Callbook	\$19.95	\$3.05	\$23.00
<input type="checkbox"/> Foreign Callbook	\$18.95	\$3.05	\$22.00

Order both books at the same time for \$41.95 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 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.

ORDER TODAY!

RADIO AMATEUR **callbook** INC.  
 Dept. F  
 .....  
 925 Sherwood Drive  
 Lake Bluff, IL 60044, USA

✓ 173

More Details? CHECK—OFF Page 92

# Proven Success

Our best salesmen don't even work for Kantronics

Dear Sirs:

I am writing first of all to say how much I enjoy the Kantronics Interface and the software that I bought for my VIC-20 micro-computer. For a very reasonable price I have had a whole new world of amateur radio—not to mention some commercial transmissions I have been able to copy—opened to me.

P.S. Am "tickled pink" with this setup and having a bell. Thanks for a nice product!

Dear Phil:

I recently purchased a VIC 20 computer and your companies "Interface" and software for RTTY and CW and I must say it does a magnificent job. I have worked over twenty countries on RTTY on 15 and 20 meters in one month. The copy on CW is unbelievably excellent.. adding a new dimension to amateur radio for me. "You done good," as we say here in Tennessee.

I must tell you, I have the equipment in operation and it works super good! I think it is an outstanding piece of electronics.

Gentlemen

It's nice to find someone like you that responds to user suggestions - keep up the good work.

The Interface is available with software for six popular computers. Hamsoft is our original program for the Apple II, II+, or IIE; Atari 400 or 800; Radio Shack Color Computer, VIC-20, or Texas Instruments TI-99/4A. Hamtext, our advanced program, works with the Apple II, II+, or IIE; VIC-20, or Commodore 64.

The Interface and Hamsoft or Hamtext combination has put computerized communications at a reasonable price. Contact your local Kantronics dealer or write us for more information.

## Kantronics

(913) 842-7745  
1202 E. 23rd Street  
Lawrence, Kansas 66044

✓ 153

OVER 70 BRANDS IN STOCK    BIRD    LAND-MOBILE RADIO    FULL SERVICE SHOP • Spectrum Analysis • Antennas  
 DRAKE    HYGAIN • ARRL    New and Used Equipment • CW-SSB-FM, Etc. • Towers  
 ICOM    FCC Study Guides • Code Tapes • Books • Accessories

**AMATEUR RADIO**  
**SHORTWAVE**  
**SCANNERS**

**SPECTRONICS**

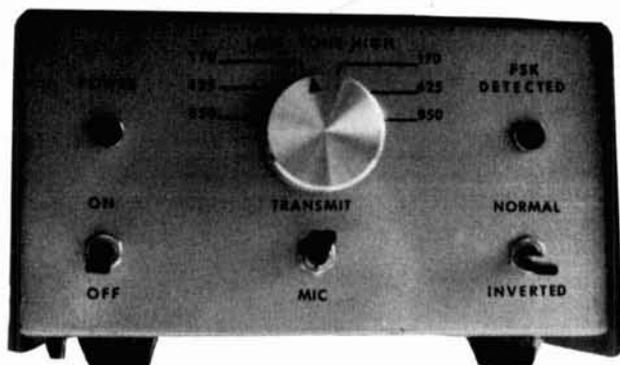
Specialists in Amateur Radio,  
 Short-Wave Listening  
 And Contemporary  
 Electronic Gear.

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

BEARCAT • MORGAIN • MANY MORE...

**SPECTRONICS, INC.** (312) 848-6777  
 1009 GARFIELD ST. OAK PARK, IL. 60304



## RTTY and the Atari™ computer

Turn your Atari home computer into an RTTY terminal for either Baudot or ASCII

If there's one area in Amateur Radio that is becoming dominated by microprocessors, it's certainly RTTY. It's now common to find an RTTY operator using either a home computer or a piece of commercial gear fully dedicated to RTTY. RTTY is basically a digital form of communications, and as such it lends itself well to the use of computers. Applying a computer to RTTY requires that some basic problems first be solved. This article describes those problems and shows how they are solved in the process of making an Atari computer into an RTTY terminal (fig. 1).

### basic problems: receiving and transmitting

When you tune your receiver to a ham RTTY station, you hear an alternation of two tones, called a low tone pair, which consist of a 1275-Hz "mark" and a 1445-Hz "space." The duration of these tones determines the character speed, measured in words per minute. A device called a terminal unit receives the two tones and generates a voltage-on state when mark is present and a voltage-off state when space is present (see fig. 2).

It's here that the serial interface to the computer comes into play. The serial interface detects the start of the pulse string, all on/off voltage transitions, and the end of the pulse string coming from the terminal unit. A pulse string represents a single character, and is stored as a binary number in a holding register in the interface. The computer reads this binary number and processes it before the next character appears in the serial interface. Processing usually means printing the character on a CRT, TV screen, or LED display.

The terminal unit designed for this application is shown in fig. 3. It is a receive-only device whose operation is controlled by the XR2211 chip. The resis-

By David W. King, K5VUV, 743 Rodney Drive, Baton Rouge, Louisiana 70808

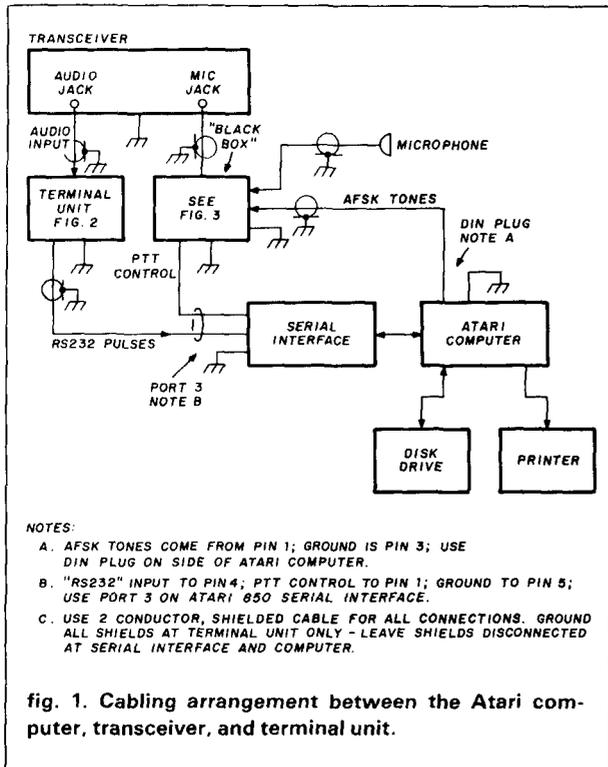


fig. 1. Cabling arrangement between the Atari computer, transceiver, and terminal unit.

tors and capacitors connected to this chip are used to change its frequency response characteristics. This circuit provides digital pulse strings when either low tone pairs or high tone pairs with a frequency difference of 170, 425, or 850 Hz are received.

All parts except the XR2211 chip come from Radio Shack; the XR2211 is available from Jameco.\* Application note AN-01 from Exar Integrated Systems† explains chip operation. The serial interface used in this application is the Atari™ 850. With this interface, it is possible, under program control, to receive Baudot or ASCII at rates from 60 to 960 WPM. Although this interface is billed as an RS232-level device, it works fine with the 0 to 12 volt signal generated by the terminal unit described.

To transmit RTTY, there must be some way of choosing the character or number you wish to send. This is normally done via a keyboard. Pressing a keyboard button closes a switch which is detected by the computer program and decoded into a unique binary number. This number is normally converted into a pulse string, which is subsequently converted to either mark or space tones, depending on the voltage level of the pulses. These audio frequency tones must be held for the appropriate time (approximately

22 milliseconds for 60 WPM) and fed to the microphone input circuit of the transmitter.

## detailed solutions

The audio tones sent to the microphone jack need to be fairly precise in frequency and duration. In this application, advantage may be taken of a feature in the Atari computer itself. The Atari has a set of internally programmable sound generators (they are used to simulate explosions, battle tanks, and so forth in game programs). These sound chips happen to generate the audio frequencies for mark and space at all frequencies and shifts needed. Although these tones are neither precisely those specified for RTTY (plus/minus 10 Hz) nor perfectly sinusoidal, they work flawlessly.

This feature makes it unnecessary to build an external tone generator — thus the receive-only terminal unit. To control the time duration of the tones a small assembly-language program was used. The BASIC language that composes most of the program is not fast enough to turn the tones on and off at the required speed.

The same assembly language program is used for all of the different tone duration times. The main BASIC program modifies the timing constants in this assembly-language program whenever you change from one WPM rate to another.

FCC regulations require that Amateur Radio operators provide CW identification at the end of their RTTY transmissions. This is accomplished using the same method as the tone pair generation. The program transmits the CW ID at approximately 20 WPM at a single pure tone that is between the mark and

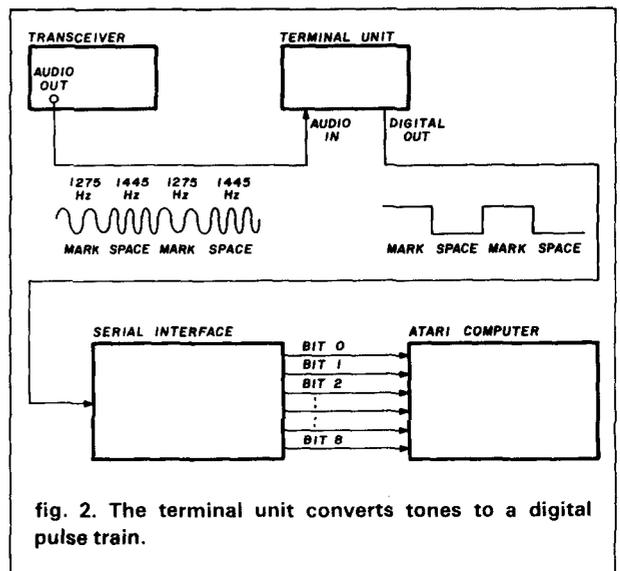


fig. 2. The terminal unit converts tones to a digital pulse train.

\*Jameco Electronics, 1355 Shoreway Road, Belmont, California 94002.  
 †Exar Integrated Systems, Inc., 750 Palomar Avenue, P.O. Box 62229, Sunnyvale, California 94088.

space frequencies. This enables the receiving station to hear your CW ID without retuning the receiver.

### Baudot computer program options

The program allows you to select any of several options, which include receiving RTTY; transmitting at 60 WPM using the low tone frequency pair, 170-Hz shift; transmitting at 60 WPM using the high tones frequency pair, 170-Hz shift (for VHF); transmitting at 100 WPM-low tones, 170-Hz shift; transmitting at 100 WPM-high tones, 170-Hz shift; printing using a hardcopy device; and "go to ASCII program."

Other options included in the program are:

**A.** Automatic transmitter turn-on/turn-off using the PTT feature, accomplished by using a spare pin on the Atari 850 serial interface. One of the signals available at the output of this interface is called Data Terminal Ready. This pin supplies either +12 or -12 volts and is switchable under program control. It is therefore ideal for driving a transistor switch to activate PTT when transmitting and deactivate the PTT when receiving (see fig. 4).

**B.** Brag tapes (pre-recorded messages) are nice to have, so there is a feature in the program that allows you to call up and transmit any one or all of seven Brag tapes stored on the disk. When you are transmitting, a Control A will read Brag tape 1 from the disk and send it. Control B sets Brag tape 2, and so on up to Control G. Control H is reserved for the CW ID To Follow announcement and automatically sends your CW ID. A separate program is used to build the Brag tapes.

**C.** Hard copy on a printer is possible. The program stores all received characters in memory and after the QSO allows you to list it to the printer. This application is programmed to store 4000 characters. It can be increased or decreased depending on memory availability.

**D.** Some systems permit transmission of date and time. Control T will do this if you enter the correct time and date into the program when it first runs. (This piece of coding is not smart enough to change the month if you transmit past midnight on the last day of the month — a good thing for you to modify!)

**E.** Sometimes a reception error occurs and you go into the Numbers printing mode erroneously. Pressing Start forces you back to Letters mode immediately.

**F.** Pressing Select clears the screen and printer storage buffer, and reprograms the serial interface to change the expected reception baud rate (WPM). You can cycle the WPM reception rate from 60 to 66 to 75 to 100 back to 60 with four pressings of the Select key. This is handy for copying commercial RTTY broadcasts.

**G.** The Option key aborts the receive portion of the program and allows you to begin transmission, begin printing, select a different WPM transmit rate, or go back to receiving.

**H.** Control I aborts the transmit section of the program and goes to the Option section without sending a CW ID.

**I.** Control H sends CW ID To Follow-DE (Your Call), in RTTY, then sends your call in CW and immediately

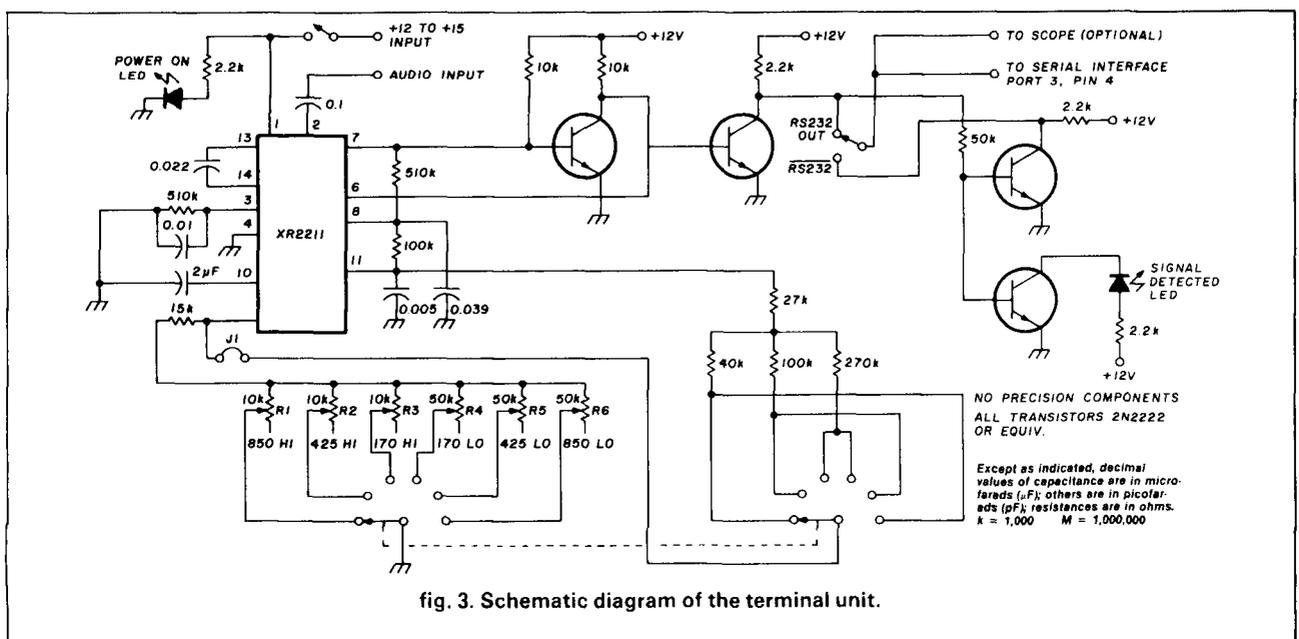
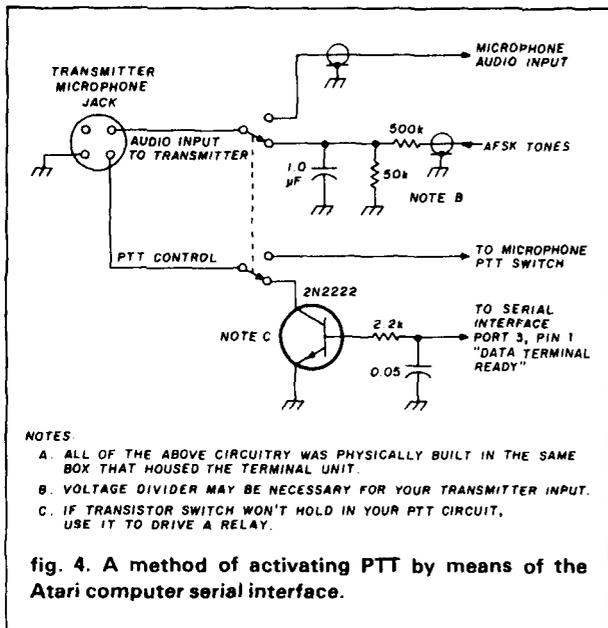


fig. 3. Schematic diagram of the terminal unit.



switches to receive at the same baud rate you were using in transmission.

## differences in the ASCII program

The ASCII program is similar to the Baudot program just described. Its option section permits: receiving ASCII; transmitting at 110 Baud, 170-Hz shift, low tones; transmitting at 300 Baud, 425-Hz shift, high tones (for VHF); transmitting at 600 Baud, 425-Hz shift, high tones; transmitting at 1200 Baud, 850-Hz shift, high tones; printing to a hardcopy device; "Go to Baudot" program. (Receiving and transmitting at Baud rates above 300 have not been tested extensively to date.)

All of the options described above except Control T and the Letters-mode-forcing exist in the ASCII program. All of the equipment remains the same as for the Baudot program.

## future possibilities

Some additional attractions you may want to add to the program could be: split-screen viewing of both typing and reception simultaneously; buffering your input so it's not sent immediately upon entry, but in fast strings to impress your contact with how smoothly and fast you type; automatic logging to the disk of time, date, call, and other QSO information; and CW reception — hint: This could be done through the joystick input port using the terminal unit described and an assembly language program.

## getting started

Copies of the three BASIC program listings and the assembly language program listing described above are available from *ham radio*.\*

For those of you who don't want to type all of these program listings into your computers, I'll be happy to send them to you on a 5¼ inch floppy diskette. I'll customize your diskette with your name and call. (Sorry, I can't send cassettes — just disks.)†

## terminal unit construction adjustments

The circuit was built on perfboard and wire wrapped. No printed circuit board is available. Layout is not critical. I would advise using a metal box enclosure and shielded cable. Open Jumper J1 as shown in fig. 2.

Use an ohmmeter to measure the resistance from pin 12 of the XR2211 chip to ground. As you change the six-position switch's location, adjust R1 to R6 to give the following ohm readings:

ohm reading	adjust	switch position
17825	R1	850-Hz-shift high tones
19445	R2	425-Hz-shift high tones
20568	R3	170-Hz-shift high tones
26738	R4	170-Hz-shift low tones
30558	R5	425-Hz-shift low tones
33422	R6	850-Hz-shift low tones

Replace J1. The application notes from Exar give a more elaborate tune-up method, but mine worked fine with the above procedure. My settings were  $\pm 2$  percent of the above values. These resistances are theoretically calculated from Exar's design information.

## conclusion

The programs and equipment described in this article have been in use since November of 1982. They have resulted in numerous RTTY QSOs on both the hf and VHF bands. If you have an Atari computer, try it on RTTY! Please feel free to write if you have questions or run into problems with the programs. Include an SASE; I'll do what I can to help.

## acknowledgments

My thanks to N5IB, Jim Giammanco, who put me onto the XR2211 chip and to my daughters, Wendy and Melanie, who let me onto their computer long enough to develop these programs.

\*For copies of the program listings, send a stamped (37c), self-addressed #10 envelope to PROGRAM LISTINGS, *ham radio* magazine, Greenville, N. H. 03048.

†To order a program diskette, send \$10.88 directly to the author, David W. King, K5VUV, 743 Rodney Drive, Baton Rouge, LA 70808. The price includes diskette, postage, and service fee.

# NEW LOW-NOISE PREAMPS RECEIVING CONVERTERS TRANSMIT CONVERTERS

New low-noise microwave transistors make preamps in the 0.9 to 1.0 dB noise figure range possible without the fragility and power supply problems of gas-fet's. Units furnished wired and tuned to ham band. Can be easily retuned to nearby freq.



Models LNA( ), P30, and P432 shown

Model	Tunable Freq Range	Noise Figure	Gain	Price
LNA 28	20-40	0.9 dB	20 dB	\$39.95
LNA 50	40-70	0.9 dB	20 dB	\$39.95
LNA 144	120-180	1.0 dB	18 dB	\$39.95
LNA 220	180-250	1.0 dB	17 dB	\$39.95
LNA 432	380-470	1.0 dB	18 dB	\$44.95



Models to cover every practical rf & if range to listen to SSB, FM, ATV, etc. NF = 2 dB or less.

	Antenna Input Range	Receiver Output
<b>VHF MODELS</b>	28-32	144-148
	50-52	28-30
Kit \$44.95	50-54	144-148
Less Case \$39.95	144-146	28-30
Wired \$59.95	145-147	28-30
	144-144.4	27-27.4
	146-148	28-30
	144-148	50-54
	220-222	28-30
	220-224	144-148
	222-226	144-148
	220-224	50-54
	222-224	28-30

	Antenna Input Range	Receiver Output
<b>UHF MODELS</b>	432-434	28-30
Kit \$54.95	435-437	28-30
Less Case \$49.95	432-436	144-148
Wired \$74.95	432-436	50-54
	439.25	61.25

**SCANNER CONVERTERS** Copy 72-76, 135-144, 240-270, 400-420, or 806-894 MHz bands on any scanner. Wired/tested Only \$79.95.

**SPECIAL FREQUENCY CONVERTERS** made to custom order \$119.95. Call for details.

For SSB, CW, ATV, FM, etc. Why pay big bucks for a multi mode rig for each band? Can be linked with receive converters for transceiver. 2 watts output.

	Exciter Input Range	Antenna Output
For VHF, Model XV2 Kit \$79.95 Wired \$119.95 (Specify band)	28-30	144-146
	28-29	145-146
	28-30	50-52
	27-27.4	144-144.4
	28-30	220-222
For UHF, Model XV4 Kit \$99.95 Wired \$149.95	50-54	220-224
	144-146	50-52
	50-54	144-148
	144-146	28-30

	Exciter Input Range	Antenna Output
For UHF, Model XV4 Kit \$99.95 Wired \$149.95	28-30	432-434
	28-30	435-437
	50-54	432-436
	61.25	439.25
	144-148	432-436*

\*Add \$35 for 2M input

**FREE OFFER**

For limited time, buy a transmit converter above with 40-45W PA (\$129.95) and get \$39.95 cabinet FREE.



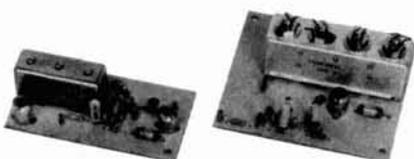
## ECONOMY PREAMPS

Our traditional preamps, proven in years of service. Over 20,000 in use throughout the world. Tuneable over narrow range. Specify exact freq. band needed. Gain 16-20 dB. NF = 2 dB or less. VHF units available 27 to 300 MHz. UHF units available 300 to 650 MHz.

- P30K, VHF Kit less case \$14.95
- P30C, VHF Kit with case \$20.95
- P30W, VHF Wired/Tested \$29.95
- P432K, UHF Kit less case \$18.95
- P432C, UHF Kit with case \$24.95
- P432W, UHF Wired/Tested \$33.95

P432 also available in broadband version to cover 20-650 MHz without tuning. Same price as P432; add "B" to model #.

## HELICAL RESONATOR PREAMPS



Our lab has developed a new line of low-noise receiver preamps with helical resonator filters built in. The combination of a low noise amplifier similar to the LNA series and the sharp selectivity of a 3 or 4 section helical resonator provides increased sensitivity while reducing intermod and cross-band interference in critical applications. See selectivity curves at right. Noise figure = 1 to 1.2 dB. Gain = 12 to 15 dB.

Model	Tuning Range	Price
HRA-144	143-150 MHz	\$49.95
HRA-220	213-233 MHz	\$49.95
HRA-432	420-450 MHz	\$59.95

## SAVE A BUNDLE ON VHF FM TRANSCEIVERS!

FM-5 PC Board Kit - **ONLY \$159.95** complete with controls, heatsink, etc. 10 Watts, 5 Channels, for 6M, 2M, or 220

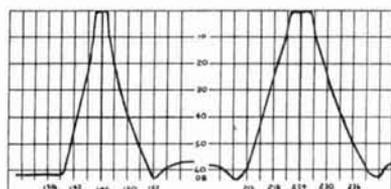


Cabinet Kit, complete with speaker, knobs, connectors, hardware. Only \$59.95

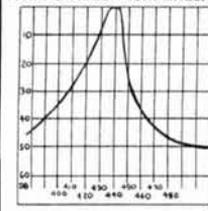
**REPEAT OF A SELLOUT!**

While supply lasts, get \$59.95 cabinet kit free when you buy an FM-5 Transceiver kit. Where else can you get a complete transceiver for only \$159.95?

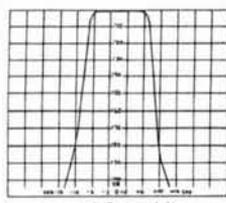
## LOOK AT THESE ATTRACTIVE CURVES!



R144 & R220 Front Ends, HRA 144/220, & HRF-144/220

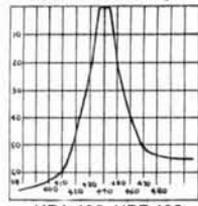


R451 Receiver Front End



Rcvr I-F Selectivity

Typical Selectivity Curves of Receivers and Helical Resonators.



HRA-432, HRF-432

- Call or Write for **FREE CATALOG** (Send \$1.00 or 4 IRC's for overseas mailing)
- Order by phone or mail • Add \$2 S & H per order (Electronic answering service evenings & weekends) Use VISA, MASTERCARD, Check, or UPS COD.

# hamtronics, inc.

65-Y MOUL RD. • HILTON NY 14468

Phone: 716-392-9430

Hamtronics is a registered trademark

**AT LAST —  
A REPEATER  
YOU CAN AFFORD!**

For years, Hamtronics® Modules have been used by individual hams and manufacturers to make repeaters. Now, in the Hamtronics tradition of top quality and superb value, we are proud to offer a complete repeater package.



**JUST LOOK AT THESE PRICES!**

Band	Kit	Wired/Tested
6M, 2M, 220	\$595	\$745
440	\$645	\$795

Both kit and wired units are complete with all parts, modules, hardware, and crystals.

**CALL OR WRITE FOR COMPLETE DETAILS.**

Also available for remote site linking/crossband & 10M.

**FEATURES:**

- SENSITIVITY SECOND TO NONE; TYPICALLY 0.15 uV ON VHF, 0.3 uV ON UHF.
- SELECTIVITY THAT CAN'T BE BEAT! BOTH 8 POLE CRYSTAL FILTER & CERAMIC FILTER FOR GREATER THAN 100 dB AT ± 12KHZ. HELICAL RESONATOR FRONT ENDS. SEE R144, R220, AND R451 SPECS IN RECEIVER AD BELOW.
- OTHER GREAT RECEIVER FEATURES: FLUTTER-PROOF SQUELCH, AFC TO COMPENSATE FOR OFF-FREQ TRANSMITTERS, SEPARATE LOCAL SPEAKER AMPLIFIER & CONTROL.
- CLEAN, EASY-TUNE TRANSMITTER; UP TO 20 WATTS OUT.

**HIGH QUALITY MODULES FOR  
REPEATERS, LINKS, TELEMETRY, ETC.**

**INTRODUCING —  
NEW 1983 RECEIVERS**



R144 Shown

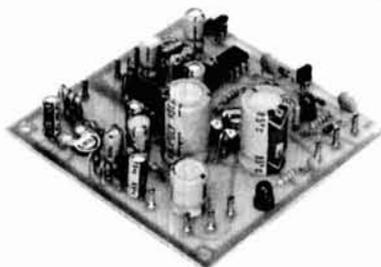
- **R144/R220 FM RCVRs** for 2M or 220 MHz. 0.15 uV sens.; 8 pole xtal filter & ceramic filter in i-f, helical resonator front end for exceptional selectivity (curves at left). AFC incl., xtal oven avail. Kit only \$119.95
- **R451 FM RCVR** Same but for uhf. Tuned line front end, 0.3 uV sens. Kit only \$119.95.
- **R76 FM RCVR** for 10M, 6M, 2M, 220, or commercial bands. As above, but w/o AFC or hel. res. Kits only \$109.95. Also avail w/4 pole filter, only \$94.95/ kit.
- **R110 VHF AM RECEIVER** kit for VHF aircraft band or ham bands. Only \$84.95
- **R110 UHF AM RECEIVER** for UHF uses, including special 259 MHz model to hear SPACE SHUTTLE. Kit \$94.95



- **HELICAL RESONATOR FILTERS** available separately on pcb w/connectors.

HRF-144 for 143-150 MHz \$34.95  
HRF-220 for 213-233 MHz \$34.95  
HRF-432 for 420-450 MHz \$44.95

(See selectivity curves at left.)



- **COR KITS** With audio mixer and speaker amplifier. Only \$29.95.
- **CWID KITS** 158 bits, field programmable, clean audio. Only \$59.95.
- **DTMF DECODER/CONTROLLER KITS.** Control 2 separate on/off functions with touchtones®, e.g., repeater and autopatch. Use with main or aux. receiver or with Auto-patch. Only \$89.95.
- **AUTOPATCH KITS.** Provide repeater autopatch, reverse patch, phone line remote control of repeater, secondary control via repeater receiver. Many other features. Only \$89.95. Requires DTMF Module.
- **A16 RF TIGHT BOX** Deep drawn alum. case with tight cover and no seams. 7 x 8 x 2 inches. Only \$18.00.

**TRANSMITTERS AND  
ACCESSORIES**



- **T51 VHF FM EXCITER** for 10M, 6M, 2M, 220 MHz or adjacent bands. 2 Watts continuous. Kits only \$59.95



- **T451 UHF FM EXCITER** 2 to 3 Watts on 450 ham band or adjacent. Kits only \$69.95.
- **VHF & UHF LINEAR AMPLIFIERS.** Use on either FM or SSB. Power levels from 10 to 45 Watts to go with exciters & xmtg converters. Kits from \$69.95.

**hamtronics®**

# ham radio TECHNIQUES

Bill O'Neil  
W6SAI

Now that we have temporary operating privileges for the 10 MHz band, we can look forward to the opening of the 18 and 24 MHz Amateur bands, another outcome of the 1979 World Administrative Radio Conference; the bands encompass 18.068 to 18.169 MHz and 24.890 to 24.990 MHz. As this column is being written (late February), it looks as if these bands are far away indeed for U.S. Amateurs, unless somebody pulls a rabbit out of the hat.

Operation on the new bands is authorized in many European and South American countries, although to date activity has been sparse except on weekends. Most stations congregate around 18.07 MHz and 24.9 MHz. In California, European signals came through very well on both bands in the morning hours during the winter.

The Federal Communications Commission has adopted Docket 80-739 NPRM of December 30, 1982, and the planned action (for "action" you may read "inaction") includes use of these frequencies by the fixed services until July 1, 1989. There is no indication of any plan for implementation of the WARC Resolution 640, and no indication that any interim action is contemplated.

So here we sit, as the sunspot count slowly sinks toward the next

minimum, due to arrive in a few years. If the FCC follows its present policy of inaction, by the time the bands are opened for Amateur Radio *they will be useless* for long-distance communications. The next sunspot minimum is predicted to cover the period 1985 through 1990, so if we do achieve operating privileges in these bands in 1989, they will be of little use to us until about 1992. That's nine years from now! If the FCC really wishes to aid Amateur Radio, they should amend Part 97 of the Rules to permit operation on these bands on a noninterfering basis now.

As far as Amateur interference to existing fixed stations is concerned, both bands are a wilderness. Despite the FCC count of stations authorized to operate on these frequencies, few do. Six months of listening has logged very few fixed-service stations, far fewer in fact than the number noted on the 10-MHz band before it was authorized for Amateur operation.

I hope this frustrating hang-up can be solved, if possible before the end of this year.

## the Kenwood R-600 communications receiver

This is not a product review but rather two ideas for improving this interesting receiver.

My general-coverage Collins 51J-4

receiver seems to grow more massive as the years roll by. It is an invaluable adjunct to my station, as it provides a-m/CW and SSB reception over the range of about 480 kHz to 30 MHz. With multiple mechanical filters, it serves in a pinch as a good Amateur receiver, backing up my regular ham-band-only receiver. I'd had my eye on the Kenwood R-600 receiver (which weighs less than 10 pounds!) for some time, and I finally bought one as a tentative substitute for the 51J-4, which, in its steel cabinet, is a real boat anchor.

I was really pleased with the Kenwood: excellent sensitivity, readout to 1 kHz, and excellent audio quality for listening to shortwave broadcast, regular broadcast, or long-wave reception of local aircraft weather reports. The little receiver exhibited two characteristics, however, that I found improvements for.

First, when I used a random-length wire antenna, cross-talk and birdie problems were evident in the broadcast and the long-wave bands. I found that a 70-pF variable compression mica capacitor placed at the antenna terminal, in series with the wire antenna, proved to be the cure. The capacitor is simply adjusted for minimum cross-talk; it does not hinder shortwave reception at all.

Second, I noticed a peculiar buzz-

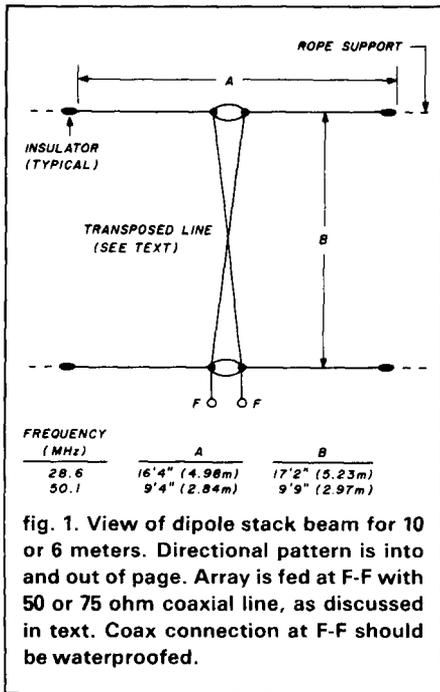


fig. 1. View of dipole stack beam for 10 or 6 meters. Directional pattern is into and out of page. Array is fed at F-F with 50 or 75 ohm coaxial line, as discussed in text. Coax connection at F-F should be waterproofed.

ing on the high-frequency bands, particularly around 20 MHz. The high-pitched buzzing noise grew loudest when I brought my hand near either the receiver's tuning dial or the digital frequency readout immediately above it.

It only took a moment to ascertain that the receiver was listening to the counting pulses that drove the digital frequency display. Moving the antenna about in the room alleviated the problem somewhat; and the use of an elevated dipole fed with coax a distance from the receiver completely eliminated the noise. But the dipole is useless for general coverage reception. What to do?

Using a short test lead as a probe connected to the antenna input terminal of the R-600, I found that the counter noise was coming from the glass dial of the frequency readout. Removing the top and bottom covers of the receiver enabled me to see that the readout was well shielded from the rear; but the shield was open to the front to make the readout visible.

My cure was quick, inexpensive, and simple. I removed the knobs and front panel (the panel is held in place by top and bottom bolts, plus two bolts under the tuning dial). At the hardware store I bought an envelope

of "screen door patches," which are little squares of aluminum screening. I cut one of these squares down so that it was about 2 inches long and 1 inch high, just big enough to place behind the glass window. When the glass was replaced, it pressed the screen against the metal chassis, making a good ground connection. Before reassembly I sprayed both sides of the screen with flat black enamel to remove any reflection, leaving the edges of the screen clear of paint to make a good ground.

That did the trick! It bottled up the counter noise so well that it cannot be heard on any band.

Most modern ham equipment has some kind of frequency display. Does yours generate noise that can get into the front-end of the receiver? Perhaps some of those funny noises you've noticed from time to time are caused by this problem. You can make a quick check by disconnecting your regular station antenna and using a short pickup wire as a substitute antenna. Place the free end near the digital display and check it on all ham bands. If you hear any high pitched birdies, reconnect your station antenna and see if you can still hear them. If not, you probably have nothing to worry about. But if you do notice any counter noise, try a small piece of screening to bottle it up — provided the manufacturer shielded the readout assembly on the *inside* of your receiver.

## wire antennas for 10 and 6

It's fun to build antennas! And you don't need an advanced degree in computer engineering to do it. There are plenty of simple wire antennas that you can build in a few hours, antennas that will outperform the popular ground plane or dipole. This is especially true on 6 and 10 meters, where high-gain antennas become a manageable size.

Shown in this section are two wire beam antennas for these bands. The first is a stack of dipoles and the second is a simple V-beam. Both designs were popular years ago but have been obscured by the rotary Yagi and quad.

Even if you don't have room or money for a rotary, you can build one of these simple beams for just a few dollars. They have a bi-directional (figure 8) pattern, like the dipole, and they provide worthwhile gain on both transmit and receive.

The dipole stack beam is shown in **fig. 1**. The array consists of two dipoles, one above the other, the lower dipole fed from a coaxial transmission line. The dipoles are cross-connected by an open wire line, as shown in the illustration. Power gain is about 4 dB or more over a dipole when the bottom of the antenna is at least one-half wavelength above ground. Dimensions for the two bands are given in the illustration. The two-wire interconnecting line is made of No. 16

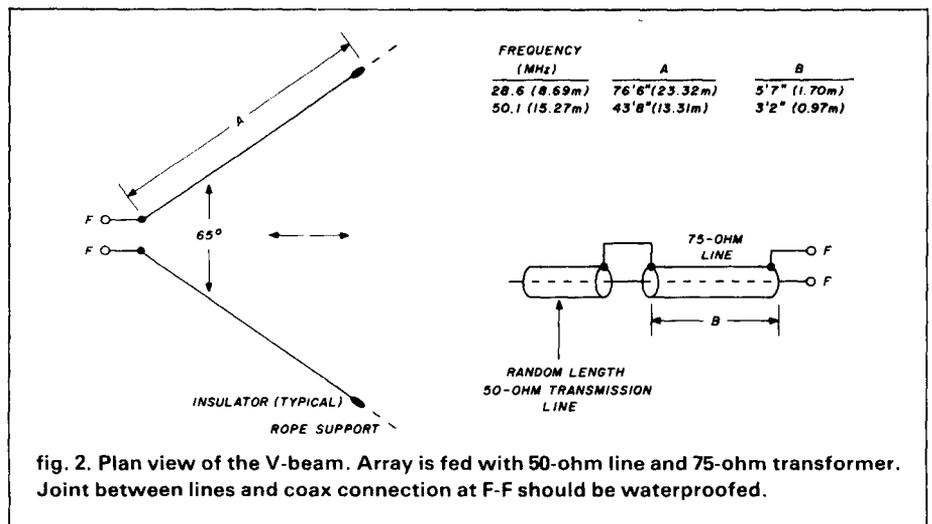


fig. 2. Plan view of the V-beam. Array is fed with 50-ohm line and 75-ohm transformer. Joint between lines and coax connection at F-F should be waterproofed.

# Nampa Satellite SYSTEMS

(IDAHO'S LARGEST DEALER)

"HAMS SERVING HAMS"  
Lowest Prices in TVRO

INTRODUCING  
The NSS 75F

.3 F D -1 piece fiberglass,  
weighs only 80#. True polar-  
mount, buttonhook feed.

SYSTEM PRICES

SAT-TEC R5000	\$1550
KLM Sky Eye IV	1550
Universal Comm. DL2000	1550
AUTO-TECH GLR 500	1650
DEXCEL DXPI100-stereo	1750
DRAKE ESR 24	1850
Luxor-Stereo-	1850
Infra-Red Remote	

All packages include: 7.5' dish,  
Polar mount, Polarotor II  
Polarizer, 100° K LNA,  
modulator and cables.

**PRODELIN 10' Dish** - .3 F D 8  
panels, fiberglass. The ultimate  
in 4 GHZ dishes.

SYSTEM PRICES

KLM Sky Eye IV	\$1765
SAT-TEC	1765
Universal Comm. DL2000	1765
AUTO-TECH GLR 500	1994
DRAKE ESR 24	2094
AUTO-TECH GLR 520	2165
DEXCEL DXR 1100	
with LNC - stereo	2350
AUTO-TECH GLR 560	2360
LUXOR STEREO, Infra-Red	
remote control	2395
General Instruments	
Infra-Red Remote	2395

All packages include 100° K LNA  
or LNC, Cables, Modulator,  
Dish, Polar mount, Polatron II  
Polarizer.

DEALERSHIPS AVAILABLE

NATIONAL FINANCING  
AVAILABLE WITH AS LITTLE AS

10% DOWN (O.A.C.)  
CALL TOLL FREE

1-800-654-0795

for info or ordering

312 12th Avenue South

Nampa, Idaho 83651

WB6TOC (208) 466-6727 K17D

✓ 163

BUY! SELL! TRADE!

COMPUTER & HAM EQUIPMENT

COMPUTER  
TRADER

ANNUAL  
SUBSCRIPTION  
\$15.00

Low Ad Rates — Mailed Monthly  
Foreign Subscriptions - \$30.00 Year  
FREE 50 Word Classified Ad with Subscription Order

COMPUTER TRADER®

Chet Lambert, W4WDR

1704 Sam Drive • Birmingham, AL 35235

(205) 854-0271

Sample Copy — \$1.00

✓ 124

## TIDBITS

### MORSE CODE, BREAKING THE BARRIER

by Phil Anderson, WØXI

Learning the Morse Code does not have to  
be the painful experience many folks make it  
out to be. This little booklet is chockfull of  
helpful and highly recommended hints and  
tips on how to learn the Morse Code. Uses  
the high/low method to eliminate the dread-  
ed 10 wpm plateau. ©1982, 1st edition.

PA-MC Softbound \$1.50 each

Please add \$1.00 for shipping and handling.

HAM RADIO'S BOOKSTORE

Greenville, NH 03048

### FREE! CABLE LOSS CHART IN SPRING CATALOG NEMAL ELECTRONICS COAXIAL CABLE SALE

POLYETHYLENE DIELECTRIC

RG213 noncontaminating 96% shield mil spec	36¢/ft.
RG214/U double silver shield 50 ohm	\$1.48/ft.
RG174/U min. 50 U mil spec	10¢/ft.
RG11U 96% shield 75 ohm mil spec	25¢/ft.
★ RG-8/U 96% shield Mil Spec	(\$27.95/100) or 31¢/ft.
RG62A/U 96% shield mil spec 93 ohm	12¢/ft.
RG-55B/U double shield (RG-58 size) 50 ohm	50¢/ft.
★ RG58U mil spec 96% shield	(\$9.95/100) or 11¢/ft.

LOW LOSS FOAM DIELECTRIC

RG-8X (Mini 8) 95% shield	(\$14.95/100) or 17¢/ft.
★ RG8U 80% shield	(\$15.95/100) or 19¢/ft.
RG-8/U 97% shield 11 gauge (equiv. Belden 8214)	31¢/ft.
RG58U 80% shield	07¢/ft.
RG58U 95% shield	10¢/ft.
RG59/U 100% foil shield TV type	(\$7.00/100) or 10¢/ft.
HEAVY DUTY rotor cable 2-16 ga 6-18 ga	36¢/ft.
Rotor cable 2-18 ga 6-22 ga	19¢/ft.

CONNECTORS MADE IN USA

Amphenol PL 259	79¢
PL-259 push-on adapter shell	10/\$3.89
PL-259 and/or SO-239	10/\$5.89
Double Male Connector	\$1.79
PL-258 Double Female Connector	98¢
PL-259 Silver-Teflon Kings	\$1.59 ea
Reducer UG-175 or 176	10/\$1.99
UG-255 (PL-259 to BNC)	\$3.50
Elbow (M359) UHF Elbow	\$1.79
F59A (TV type)	10/\$1.99
UG 21 D/U Type N Male for RG8, Amphenol	\$3.00
UG-88C/U BNC Male for RG-58, Amphenol	\$1.25
UG 273 BNC-PL259 Amphenol	\$3.00
3/16 inch Mike Plug for Collins etc. (cutoff)	\$1.25

Call or write for Free Catalog  
shipping

Cable — \$3.00 1st 100 ft., \$2.50 each add'l 100 ft.

Connectors — add 10%, \$3.00 minimum.

Orders under \$20 add \$2 additional plus shipping.

COD add \$2.00. Florida Residents add 5%.

NEMAL ELECTRONICS

Dept. H, 1327 N.E. 119 St., N. Miami, FL 33161

Telephone: (305) 893-3924

✓ 164



enamel wires, spaced 3 inches apart.  
The spacers are made of Lucite® or  
plastic rods about 4 inches long. They  
are drilled to pass the wires, which  
are tied to the insulators with short  
sections of scrap wire. A half-twist is  
given to the line to reverse the con-  
nections at the opposite ends.

The stack beam is fed at points F-F  
with either a 50 or 75 ohm coaxial  
line. Feedpoint impedance at reso-  
nance is about 60 ohms so the SWR  
at antenna resonance should be well  
below 1.5-to-1 using either cable. The  
antenna is hung in the vertical plane,  
broadside to the direction of radia-  
tion. The coaxial line is wrapped into  
a four-turn coil directly below the  
feedpoint, to decouple the outside of  
the line from antenna currents. Keep  
the decoupling coil at right angles to  
the antenna wires.

The bottom of the antenna should  
be at least as high above ground as  
dimension B — the higher the better.

The V-beam is shown in fig. 2. The  
wires are parallel to the ground and  
their length (2-1/4 wavelengths) plus  
the selection of the included angle  
between the wires provides a bidirec-  
tional array which shows a power  
gain over a dipole of about 4.5 dB.  
Feedpoint resistance of the antenna  
is matched by the use of a 50-ohm  
transmission line and a 75-ohm quar-  
ter-wave impedance-transforming  
section, as shown in the illustration.

The beam is constructed of No. 16  
enamel wire. Either hard-drawn wire  
or prestretched softdrawn wire is rec-  
ommended. The coaxial transformer  
section of the line is wrapped into a  
four-turn coil directly at the feedpoint  
to decouple the outside of the line  
from antenna currents. At the design  
frequency, the measured SWR on  
the line should be below 1.5-to-1. For  
best results the V-beam should be  
mounted at least one-half wavelength  
above ground.

One nice fact about both of these  
beam antennas is that they are virtu-  
ally invisible once they are up in the  
air. That's a plus if you live in a neigh-  
borhood that has an anti-ham bias!

ham radio

# RADIO WAREHOUSE

NO FRILLS — JUST LOW PRICES

Example — 2AT  
2m Handheld

\$219<sup>00</sup>



CALL FOR SPECIAL PRICES ON —

Kenwood TS-830S HF Radio  
TS-430 S — new Kenwood  
mobile HF w/gen.  
coverage receiver



CALL TOLL FREE  
**1-800-433-3203**

IN TEXAS CALL 817-496-9000  
P.O. BOX 50155  
FT. WORTH, TEXAS 76105

## Homebrew Headquarters

### PROJECT PACKS\*

DIRECT from ENGLAND

- 2 Meter Converter R & EW 10/81  
Low noise 144-146 to 28-30 MHz  
MOSFET Converter **\$37.50**
- 2 Meter Pre-Amp. R & EW 4/82  
Gain 22 db, BW 6 MHz, NF < 1.5 db,  
Z<sub>i</sub>/Z<sub>o</sub> 50 Ω **\$6.50**
- 2 Meter GaAs Pre-Amp. (Mast Head  
Mount w R/T relay) R & EW 10/82  
Gain 17 db, BW 6 MHz, NF < 1.0 db,  
Z<sub>i</sub>/Z<sub>o</sub> 50 Ω **\$123.50**
- UHF (70 CM) Converter. R & EW 11/81  
Low noise 432-434 to 28-30 MHz  
MOSFET Converter **\$38.50**
- UHF (70 CM) Pre-Amp. R & EW 3/82  
Gain 13 db, BW 20 MHz, NF < 2 db,  
Z<sub>i</sub>/Z<sub>o</sub> 50 Ω **\$9.50**
- 23 CM Converter R & EW 3/82  
Low Noise 1240-1325 MHz to 2 or 10  
Meter Converter **\$43.50**
- Air Band Receiver R & EW 9-10/82  
108-136 MHz, 720 Channel Synthesized  
VHF AM Receiver **\$162.50**
- FET Dip Oscillator Rad Com 11/81  
1.6 - 215 MHz (includes tone dip  
feature) **\$52.50**

\*US Distributor for RADIO & ELECTRONIC WORLD

Catalog 50 cents

**RADIOKIT**  
Box 411H, Greenville, NH 03048  
(603) 878-1033 ✓ 174

1982-1983

AMATEUR  
RADIO

CALL  
**DIRECTORY**

THE BARGAIN AT **\$14.95**  
Plus Shipping



A no frills directory of over  
411,000 U.S. Radio Amateurs.  
8½x11, easy to read format.  
Completely updated.

Also available for the  
first time ever—  
(Alphabetically arranged—Sold separately)  
**Geographical Index**  
by State, City and Street No. and Call  
**Name Index**  
by Name and Call

Ordering Information:  
• Directory—\$14.95  
• Geographical Index—\$25.00  
• Name Index—\$25.00  
Add \$3.00 Shipping to all orders.

Dealers/Clubs inquiries welcome  
Send your order—enclosing check or  
money order in U.S. dollars to:

**Buckmaster Publishing**  
70-B Florida Hill Road  
Ridgefield, CT 06877 U.S.A. ✓ 116

# PERFECT ANTENNA?

FOR  
10-15-20 METERS

VERTICAL  
OMNI-GAIN

HALFWAVE  
END FED

NO RADIALS

NO REFLECTED  
POWER

BROADBAND

FIXED OR  
PORTABLE

REMOTE TUNING

2 KW PEP

UPS SHIPPABLE

# R3

R3 may be the perfect  
antenna for condominiums,  
apartments, small lots or any  
limited space situation. It is a  
great antenna for hams who  
are concerned about neat  
appearance and maximum  
performance.

R3's self supporting radiator  
is only 21ft-6.4m high x 1ft  
.304m wide at the base.  
Assembly is quick and easy  
for portable, marine, field day,  
DX-peditions, or fixed  
installations. It is complete  
with remote tuner.

AVAILABLE THROUGH  
DEALERS WORLDWIDE



**cushcraft**  
CORPORATION

THE ANTENNA COMPANY  
P.O. Box 4680  
Manchester, NH 03108 USA  
TELEX 953050

✓ 127

July 1983 **TV** 45

# LSI comes to AMATEUR RADIO

## Digital Microsystems™ Chips Now Available

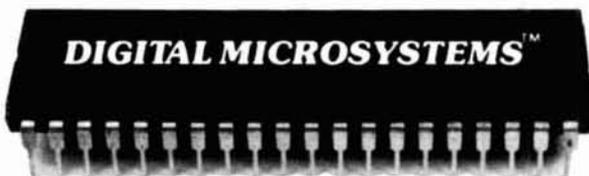
### REPEATER CONTROL

- Complete repeater control incorporating ID, tail and timeout timers, audio generator, local control and PL enable • Perfect as main controller or as backup for your present system • Master enable input for non-override local control • Switchable PL input for access security • ID on start-up can be selected • Non volatile ID memory • Selectable timeout length • Automatically powers up and runs; ideal for remote applications • Selectable ID transmission rate • Adjustable tail timer length • Force ID input for manual trigger of ID sequence • Latched COR for ID holdoff and timing control • Two separate Morse outputs for interfacing to audio and/or logic. One is direct audio, the other can be used as a keying line • Crystal controlled timers • Any number of selectable messages can be transmitted using MCMG chip • Test input for automatic transmission of CW test message following ID

Digital Microsystems™ SCRC Chip

\$89.95

LOOK AT WHAT ONE CHIP CAN DO!



### ASCII to MORSE CODE CONVERTER

- Turns any ASCII terminal or computer into a Morse code keyboard • When used with a computer, reduces system overhead and allows system time for disk access • When used with Morse to ASCII chip, any ASCII terminal or computer is transformed into a Morse code system • 1 to 90 words per minute transmission rate keyboard selectable. 1-30 wpm in 1 wpm increments, 32-90 wpm in 2 wpm increments • Master enable output for compatibility with Morse to ASCII converter-chip • Two separate Morse outputs for easy interface to your transmitter; one high one low • Logically perfect Morse code generation • 110 and 300 baud • Automatic line feed insertion selectable by user • Selectable automatic echo back of ASCII characters • Internal 32 byte type-ahead buffer • Supports Modem control type handshaking with UARTS • Compatible with personal computer RTTY software packages • **PARALLEL ASCII TO MORSE CODE CONVERTER** • Similar to SATOM chip but for parallel strobed ASCII keyboards • 16 letter buffer for ID • Automatic test and CQ message generation

Digital Microsystems™ SATOM Chip

\$34.95

Digital Microsystems™ PATOM Chip

\$24.95

### GENERAL SPECIFICATIONS

- All circuitry contained on a single chip • Crystal controlled for accuracy • Requires 5 volts DC • TTL/CMOS compatible I/O pins • Chips designed with the experimenter/homebrew specialist in mind • Manual for each chip available for \$5 postpaid • Deductible with order

### ORDERING INFORMATION

- All prices include shipping. Massachusetts residents please add 5% sales tax. Check or Money Order for payment. Prices and specifications subject to change without notice or obligation.

✓ 131

### DTMF DIGITAL CONTROL

- Provides digital input and output capability under the control of a DTMF decoder • Perfect for repeater, remote base, and other homebrew control applications • 21 separate i/o pins which can be set high or low by a four digit custom sequence. Each bit may be checked by entering a digit code. The chip will respond with a Morse code 1 or 0 depending upon the logic state • Direct interface with the Mostek 5102 DTMF decoder chip • Anti-jamming mode automatically activates to prevent tampering • Five second timer for proper control sequencing and grouping • May be purchased in two different versions — version 'A' for 12 digit decoding, 'B' for 16 digit decoding • Each chip is different — The codes for each chip are randomly selected by computer, but custom codes are available at extra cost

Digital Microsystems™ DCC Chip

\$34.95

### MORSE CODE to ASCII CONVERTER

- Advanced adaptive algorithm converts most hand sent and machine sent Morse code to ASCII • 110 and 300 baud • Automatic line feed insertion selectable by user • Automatic carriage return insertion selectable by user • Selectable number of characters per line before insertion of carriage return or line feed (if selected) • Master enable input for compatibility with ASCII to Morse converter chip (SATOM) • Two separate ASCII outputs for easy interface to RS232 or RS422 drivers • Designed to work with any ASCII compatible terminal or computer • Internal inverter may be selected to invert incoming Morse waveform before decoding

Digital Microsystems™ MTOA Chip

\$39.95

### MORSE CODE MESSAGE GENERATOR

- Up to 6 separate user definable messages • Completely non-volatile memory • Will not forget your messages when power is shut off • Supports manual, continuous automatic, and timed automatic modes • User selectable transmission rate • Individual messages, or groups of messages may be transmitted • Can be wired as a beacon controller, automatically repeating any selected messages • Can be wired as a repeater/remote base ID controller: a. Automatic repeat of any selected message(s) at selectable intervals; b. Latched COR input for trigger of ID mode; c. ID holdoff mode selectable for repeater ID mode • Two separate Morse outputs available — direct audio or digital logic • Two message in-progress signals available — one high, the other low • Crystal controlled 1, 5, 6, 7, 8, 9, and 10 minute timers, useful for repeater ID mode • Perfect companion to your RTTY, ATV, or SSTV station

Digital Microsystems™ MCMG Chip

\$49.95

### ACCESSORIES CRYSTALS

one required per chip \$5.00 ea.

**DIGITAL MICROSYSTEMS, Inc.**  
**607 SUDBURY STREET**  
**MARLBORO, MA 01752**

# Find the Right Crystal Source

by ordering

## 1983-84 QUARTZ CRYSTAL INDUSTRY GUIDE & DIRECTORY

Published each May, this Directory lists quartz crystal manufacturers worldwide and details each company's products, services and frequency ranges.

**Order Yours Today!**

A Good Investment at

**\$35.00**

Plus \$1.95 postage & handling

**GSM, inc.**

p.o. box 10277 • ft. lauderdale, fl 33334

**(305) 563-1338**

✓ 137

ANNOUNCING

## HAM-PAK™

The Multi-Purpose Program for Computer-Equipped Ham Shacks

Throw away your dog-eared beam heading chart (if you can find it.) Stop tearing through your old logbooks to see if you verified that VU7. And what was that coil-winding formula again? HAM-PAK puts the answers at your fingertips with:

- Instant, accurate beam headings from your QTH to 300 countries
- Instant retrieval of past DX confirmations
- Instant prefix identification
- Math formulas for radio use

Minimum System: TRS-80 III, 32K, 1 disk

ONLY **\$29<sup>95</sup>** and we pay the postage! (Check or money order, please. No C.O.D.'s) HAM-PAK is a trademark of Sunderland Software. Inquire about HAM-PAK for Apple, Atari, & VIC!



**SUNDERLAND SOFTWARE**

39255 Sunderland Drive  
Mt. Clemens, MI 48044

✓ 181

## BASE

## RINGO RANGER II

7dB GAIN  
HIGHEST GAIN  
2 METER OMNI  
OUTPERFORMS  
CONE AND  
DOUBLE ZEPP  
WORK MORE STATIONS  
ELIMINATE NOISE  
LIGHTNING PROTECTED  
ACCESS MORE REPEATERS  
ASSEMBLE EASILY  
INSTALL QUICKLY  
A COMPLETE ANTENNA  
ALL PARTS INCLUDED  
600,000 HAPPY USERS  
BECOME ONE TODAY  
ARX-2B 134-164MHz  
ARX-220B 220-225MHz  
ARX-450B 435-450MHz

## TERRIFIC 2 METER RANGERS

## MOBILE RANGERS

MORE RANGE  
3 dB GAIN  
5/8 STAINLESS WHIP  
GRIP TIGHT 90LB  
MAGNET  
CHROME PLATED BASE  
NEAT APPEARANCE  
THUMB LOCK ADJUSTMENT  
NO WHIP CUTTING  
LOW PRICE  
MAGNETIC MOUNTS  
AMS-147 146-148 MHz  
AMS-220 220-225 MHz  
TRUNK LIP MOUNTS  
ATS-147 146-148 MHz  
ATS-220 220-225 MHz

**MOBILE**

**BUY FROM YOUR DEALER**



**THE ANTENNA COMPANY**

48 Perimeter Road, P.O. Box 4680  
Manchester, NH 03108  
Telex - 953050

✓ 128

**BRAND NEW ENGLISH EDITION**

## THE UHF COMPENDIUM

by K. Weiner, DJ9HO

First published in German in 1980 — this book was an instant European best seller. Now available in English — only from Ham Radio Magazine. This hefty, 413 page book is an absolute must for every VHF and UHF enthusiast. The UHF Compendium has been divided into 7 sections to fully cover theory and practical building instructions. Special emphasis has been placed on state-of-the-art techniques such as GaAs Fet preamplifiers and converters. Author Weiner also fully describes all of the test equipment, alignment tools, power measuring equipment and other handy gadgets that will be of use to the UHF/VHF Amateur. All of the projects and designs have been tested and proven and are not engineer's pipe dreams. Antennas are also fully covered with a number of easy-to-build designs as well as large mega-element arrays. Noted VHF enthusiast, Joe Reisert, W1JR, tells us that every ham interested in UHF/VHF should have a copy of this book. Get yours today — only from Ham Radio Magazine.

KW-UHF

Reg. ~~\$26.95~~

**Special \$19.95**

(expires July 31, 1983)

Please add \$2.50 shipping and handling

**Ham Radio's Bookstore**

**GREENVILLE, NH 03048**

**BIG SIGNAL.....LITTLE EFFORT.....**

## INTRODUCING.....THE HJ-SERIES COAXIAL DIPOLES AND PHASING KIT.....

Specifications: 5.0 DBD 10-22DB F/B

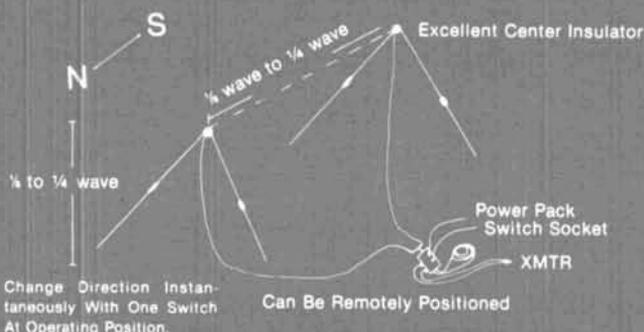
Example

Antenna Tested ON 7.2mc, 1/4 wave spacing at 18' at APEX.

ENDS AVERAGE HGT. 6'

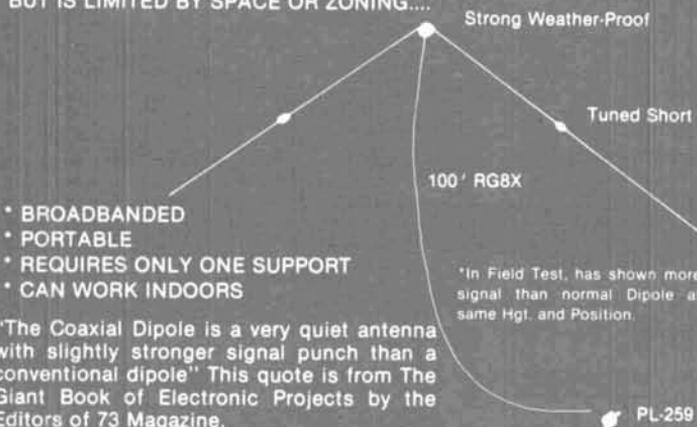
SWR-FLAT or BELOW 1.5 to 1 over Phone Band

- \* When Testing just one of 2 Antennas - SWR was Flat or Below 1.5 to 1 over Entire Band... 7.0 to 7.3 MHZ



FOR THE HAM WHO WANTS A BETTER SIGNAL ON THE BAND, BUT IS LIMITED BY SPACE OR ZONING.....

### HJ-DIPOLE\*



- \* BROADBAND
- \* PORTABLE
- \* REQUIRES ONLY ONE SUPPORT
- \* CAN WORK INDOORS

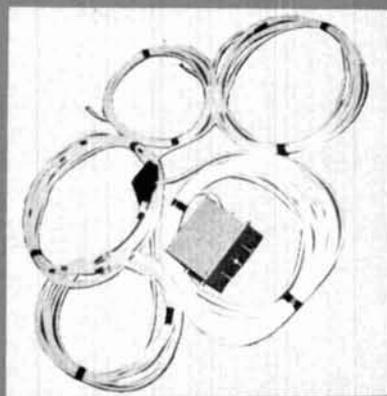
"The Coaxial Dipole is a very quiet antenna with slightly stronger signal punch than a conventional dipole" This quote is from The Giant Book of Electronic Projects by the Editors of 73 Magazine.

- \* THE SINGLE HJ-DIPOLE CAN BE UPGRADED TO A PHASED ANTENNA SYSTEM AT A LATER DATE...NO TUNER REQUIRED, HOWEVER, WITH A TUNER ANTENNA CAN BE LOADED UP ON A HIGHER FREQUENCY...

\*In Field Test, has shown more signal than normal Dipole at same Hgt. and Position.

THE HJ-PHASING KIT...CONTAINS EVERYTHING YOU NEED, BUT A PLACE TO HANG THEM.....\*

- Contents:
- 9-PL-259
  - 2-Coax Tees
  - 1-Barrel Connector
  - 5-Female Connectors
  - 2-Male Phono Plugs
  - 2-Female Phono Sockets
  - 1-Cabinet
  - 1-Power Pack
  - 4-Short Covers
  - 2-Center Insulators
  - 5-Stainless Steel 1/2" Screws
  - 5-Stainless Steel 1/2" Nuts
  - 1-Relay
  - 3-Sets of 1/4 wave coax lines
  - 2-100' lengths of coax feedline
  - 2-Antennas Cut and Tuned



- \* ALL ANTENNAS ARE ASSEMBLED-PHASING LINES CUT AND HAVE PL-259S INSTALLED...LEAD-IN CABLES PL-259 ARE INCLUDED BUT NOT ATTACHED FOR USER CONVENIENCE...PHASING BOX IS ALSO ASSEMBLED AND READY TO USE...

PRO-SEARCH™ has designed quality into simplest of antennas...Center insulator is made up of high quality material that is virtually unaffected by heat, cold or impact...will withstand rugged use and extreme environments...RG-8X has 93% shield...Antennas are very flexible and very portable...good for vacation or field day...apartment dwelling...Tuned shorts are weather-proofed with gripping covers which also add strength to this area of the antenna...Stainless steel hardware, of course...Antennas can be made for any frequency...The most important part, we stand behind our products...That's a Promise...

FREQUENCY	SINGLE ANTENNA	TUNED PAIR OF ANTENNAS	PHASING KIT	TOTAL
1.8	\$139.95	\$251.91	\$110.95	\$362.36
3.5	96.95	174.51	110.95	285.46
7.0	73.95	133.11	110.95	244.06
10.0	68.95	124.11	110.95	235.06
14.0	64.95	116.91	110.95	227.86
18.0	61.95	111.51	110.95	222.46
21.0	59.95	107.91	110.95	218.86
24.0	57.95	105.91	110.95	216.85
28.0	56.95	102.51	110.95	213.46

U.S. and Foreign Patents Pending

Prices and specifications subject to change without notice or obligation.

For more information on this and other products Write or Call Pro-Search Electronics Co. Suite 305 10411 Clayton Rd. St. Louis, Mo. 63131 1-314-994-7872 (Missouri) 1-800-325-4016

# MORE FROM PRO-SEARCH™ ELECTRONICS

## NOW THREE MODELS OF OUR DIGITAL ANTENNA CONTROL

Your Choice Of Center, North Or South



**GOOD**  
PSE-1A, 3A

The "CONTESTER" provides the least expensive DIGITAL CONTROL UNIT WITH COMPLETE COMPUTERIZED CONTROL, BUT WITH LESS FEATURES, than the "DX'ER" and "DELUX".

This unit gives you the current position of your antenna digitally in 5° steps. It has 2 memories and the command mode, plus single button operation. The PSE-1A, "CONTESTER" comes with a 7.0 amp continuous duty motor supply. PSE-3A has a 12 amp power pack.

It is not capable of being modified to talk or accept the computer interface or remote interface.

It is completely shielded and made of the same quality components as the other models.

The warranty on our unit is one year on materials and labor, and ninety days on parts.

This unit is a very inexpensive way to have the best of both worlds. A real time saver during contests. Hands off operation will save many hours of hanging on the rotor. Just a few dollars more than the manual control box, but worlds apart in state-of-the-art and operation. Price \$229.95\*



**BETTER**  
PSE-1, PSE-3

The "DX'ER" is the top of the line of the non-voice synthesized units, and is for the ham who is in need of more features on their controller. It has "2" digital readouts, one to show the antenna's current position, plus a storage readout which holds a heading or digitally displays your last position. This is valuable for switching between long path or short path, or checking front to back, or working between two different stations...a real time saver and just a nice convenience.

The "DX'ER" also has "5" scan functions: 0-90, 90-180, 180-270, 270-360, and 0-360. This is a real aid in looking for that dogleg opening or peaking a weak signal.

It can be expanded to talk, and does have the hardware necessary to use with the computer interface.

It can be remotely keyed, where verbal confirmation isn't required. Price \$362.95\*



**BEST**  
PSE-2, PSE-4

This is the ultimate in rotor controls. Nothing tops this one.

It has all the features of the other models, plus it talks...Yes, it talks.

The "DELUX" has a voice synthesizer which confirms your entries, plus tells you your heading as you enter it and when your antenna arrives.

All commands are spoken, plus as your antenna turns you hear a 400HZ tone going in one direction and a 80HZ tone in the other. This gives you positive verification of movement.

This unit, as the others, will combine with the HAM IV, T2X, and HDR-300, giving you the best antenna rotor combination you could ever want at any Price \$469.00\*

## INTRODUCING THE ULTIMATE PACKAGE...FROM PRO-SEARCH™ NINE COMBINATIONS OF OUR CONTROL UNIT AND THE TELEX/HYGAIN\* ROTOR MOTORS... FOR JUST A FEW DOLLARS MORE YOU CAN HAVE THE CONTROLLER OF THE FUTURE TODAY!

#1 The "Contester" Package...try one of these TELEX/HY-GAIN rotors with our PSE-1A/3A. A system which is low in cost, high in performance.



HAM IV\*

T2X\*

HDR-300\*

PSE-1A will save you lots of time in your favorite contests. No more hanging on the rotor control...Gives you positive control with DIGITAL readout plus 10 memories, command positioning, and single button manual movement.

The "DX'ER" Package...Couple this unit with a rotor and you have the best non talking control we make. Expandable, plus has 5 scan functions, 2 DIGITAL displays and REC/LAST to check long path or short path. Has all internal hardware to plug into our computer interface. Can be remotely controlled from accessory jack.

Try this with any of the TELEX/HY-GAIN\* Rotors! This will give you the broadest of functions with a mid-range price.

The "Delux" is the most sophisticated antenna control unit ever made. With the "Delux" you have all the functions of our other units, plus it talks...Yes it talks. Not only do you have your headings digitally displayed, but is also said as your antenna stops...All commands are spoken, plus as your antenna turns you hear a 400Hz tone in one direction and an 80Hz in the other, giving you positive verification of movement. This unit, when combined with the HAM IV, T2X or HDR-300 gives you the best buy anywhere at any price...

### Package Special

PSE-1 + HAM IV	\$508.95
PSE-1 + T2X	548.95
PSE-3 + HDR-300	677.95

### Package Special

PSE-2 + HAM IV	\$608.95
PSE-2 + T2X	655.00
PSE-4 + HDR-300	784.00

PSE-1A + HAM IV \$369.95

PSE-1A + T2X 415.95

PSE-3A + HDR-300 544.95

\* Printed with permission of TELEX/HYGAIN Telex Communications, Inc.



© Copyright 1983

Controllers also available for other rotors.

Prices and specifications subject to change without notice or obligation.

U.S. and Foreign Patents

\* For PSE, 3A, 3, 4 add \$24.50 for 12 amp power pack



## SATELLITE TELEVISION SYSTEMS

**WE WILL NOT BE UNDERSOLD!!**

Complete Systems, Antennas,  
Receivers, LNA's & Accessories

**CALL US TODAY!**

**812-238-1456**

**hoosier  
electronics**

"Nation's Largest Total Communications Distributor"  
P.O. BOX 3300 • TERRE HAUTE, INDIANA 47803

✓ 146

## ORR BOOKS

### BEAM ANTENNA HANDBOOK

by Bill Orr, W6SAI

Recommended reading. Commonly asked questions like: What is the best element spacing? Can different yagi antennas be stacked without losing performance? Do monoband beams outperform tribanders? Lots of construction projects, diagrams, and photos. 198 pages. ©1977. 1st edition.

RP-BA Softbound \$5.95

### SIMPLE LOW-COST WIRE ANTENNAS

by Bill Orr, W6SAI

Learn how to build simple, economical wire antennas. Apartment dwellers take note! Fool your landlord and your neighbors with some of the "invisible" antennas found here. Well diagramed. 192 pages. ©1972.

RP-WA Softbound \$6.95

### THE RADIO AMATEUR ANTENNA HANDBOOK

by William I. Orr, W6SAI and Stuart Cowan, W2LX

Contains lots of well illustrated construction projects for vertical, long wire, and HF/VHF beam antennas. 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 baluns and how to use them, and new information on the popular Sloper 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

### ALL ABOUT CUBICAL QUAD ANTENNAS

by Bill Orr, W6SAI

The cubical quad antenna is considered by many to be the best DX antenna because of its simple, lightweight design and high performance. You'll find quad designs for everything from the single element to the multi-element monster quad, plus a new, higher gain expanded quad (X-Q) design. There's a wealth of supplementary data on construction, feeding, tuning, and mounting quad antennas. 112 pages. ©1977.

RP-CQ Softbound \$5.95

Please add \$1.00 to cover shipping and handling.

## HAM RADIO'S BOOKSTORE

GREENVILLE, NH 03048

✓ 141

## DUAL DRIVE TRIBANDERS

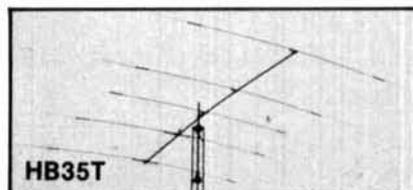
- 20, 15 and 10 meters • Wideband. Low SWR. No tuner needed
- Exclusive phased dual drive gives higher gain • Exclusive coaxial capacitors have lower losses, higher Q • Transmitter power is radiated not lost in the traps • Full power low loss balun. Gives improved beam pattern

TET Antenna Systems presents three full size trap multiband beams to meet every amateur need. 5 element, 4 element, and 3 element models all with the exclusive TET dual phased drive. This famous drive system originated with HB9CV and was perfected by JA3MP. When you buy TET dual drive you know you have the best. It has more gain - just like adding another parasitic element. And wide bandwidth so you can use your solid-state transceiver on both phone and CW without a tuner.

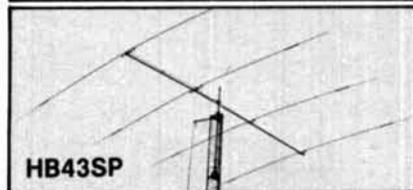
Only the highest quality materials are used throughout. All aluminum tubing is 6061-T6 alloy. Stainless steel fasteners are provided for all electrical connections. Tubing is cut and predrilled to precision tolerances for easy one afternoon assembly. Light weight and low wind area designs permit use of simpler support structures.

All models feature full 3 Kw PEP power handling, VSWR typical 1.5 or less across all of 20, 15 and, on 10 meters, from 28.0 to 29.2 MHz. Drive impedance is 50 ohms and maximum element length 27'. They accommodate masts from 1 1/2 to 2" diameter, withstand winds to 100 mph and are furnished complete with a low loss balun that easily withstands full rated power. For gain and front-to-back ratio specifications write or call the factory.

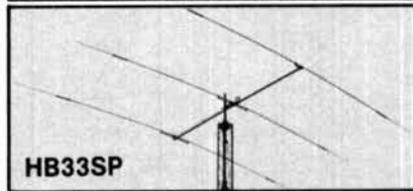
	HB35T	HB43SP	HB33SP
Boom Length:	24' 7"	19' 8"	13' 2"
Turn Radius:	18' 10"	16' 9"	15'
Wind Area Ft <sup>2</sup> :	7.9	6.6	4.7
Wind load lbs. @ 80 mph:	160	132	102
Boom Dia.:	2"	2"	1-5/8"
Weight, lbs.:	50	38	27
Price:	\$349.95	\$239.95	\$199.95
	+ shipping	+ shipping	+ shipping



HB35T



HB43SP



HB33SP

Send for free catalog describing these dual drive beams, our VHF Swiss quads, roof-mount towers, elevation rotators and more.

BY MAIL:



2775 Kurtz St., Suite 11  
San Diego, CA 92110-3171

BY PHONE: 619-299-9740

**TET ANTENNA SYSTEMS**

New!

AZDEN® PCS-4000

Small—yet so Sophisticated...  
so Advanced—there is  
No Comparison!

SHOWN ACTUAL SIZE

FEATURES SO  
UNIQUE AND  
OF SUCH  
SUPERIOR  
COMMERCIAL-  
GRADE  
QUALITY,  
THAT...



IT CARRIES A **1** YEAR LIMITED WARRANTY!

- **8 MHZ COVERAGE, CAP/MARS BUILT IN:** 142,000-149,995 MHz in selectable steps of 5 or 10 kHz. **COMPARE!**
- **TINY SIZE:** Only 2" H x 5.5" W x 6.8" D! **COMPARE!**
- **MICROCOMPUTER CONTROL:** At the forefront of technology!
- **UP TO 8 NON-STANDARD SPLITS:** Ultimate versatility for CAP/MARS. **COMPARE!**
- **16-CHANNEL MEMORY IN TWO 8-CHANNEL BANKS:** Retains frequency and standard offset.
- **DUAL MEMORY SCAN:** Scan memory banks either separately or together. **COMPARE!**
- **TWO RANGES OF PROGRAMMABLE BAND SCANNING:** Limits are quickly reset. Scan the two segments either separately or together. **COMPARE!**
- **FREE AND VACANT SCAN MODES:** Free scanning stops 5 seconds on a busy channel. Vacant scanning stops on unoccupied frequencies.
- **DISCRIMINATOR SCAN CENTERING (AZDEN EXCLUSIVE PATENT):** Always stops on frequency.
- **TWO PRIORITY MEMORIES:** Either may be instantly recalled at any time. **COMPARE!**
- **NICAD MEMORY BACKUP:** Never lose the programmed channels!
- **FREQUENCY REVERSE:** The touch of a single button inverts the transmit and receive frequencies, no matter what the offset.
- **ILLUMINATED KEYBOARD WITH ACQUISITION TONE:** Unparalleled ease of operation.
- **BRIGHT GREEN LED FREQUENCY DISPLAY:** Easily visible, even in direct sunlight.
- **DIGITAL S/R/F METER:** Shows incoming signal strength and relative output.
- **BUSY-CHANNEL AND TRANSMIT INDICATORS:** Bright LEDs show when a channel is busy and when you are transmitting.
- **FULL 16-KEY TOUCHTONE® PAD:** Keyboard functions as autopatch when transmitting.
- **PL TONE:** Optional PL tone unit allows access to PL repeaters. Deviation and tone frequency are fully adjustable.
- **TRUE FM:** Not phase modulation. Unsurpassed intelligibility and fidelity.
- **25 WATTS OUTPUT:** Also 5 watts low power for short-range communication and battery conservation. (Transmitter power is fully adjustable)
- **SUPERIOR RECEIVER:** Sensitivity is 0.2 uV for 20-dB quieting. Audio circuits are designed to rigorous specifications for exceptional performance, second to none. **COMPARE!**
- **REMOTE-CONTROL MICROPHONE:** Memory A-1 call, up/down manual scan, and memory address functions may be performed without touching the front panel! **COMPARE!**
- **OTHER FEATURES:** Dynamic microphone, built-in speaker, mobile mounting bracket, remote speaker jack, and all cords, plugs, fuses and hardware are included.
- **ACCESSORIES:** CS-6R 6-amp ac power supply, CS-AS remote speaker, and Communications Specialists SS-32 PL tone module.
- **ONE-YEAR LIMITED WARRANTY!**

EXCLUSIVE DISTRIBUTOR:

AMATEUR-WHOLESALE ELECTRONICS

8817 S.W. 129th Terrace, Miami, Florida 33176 Telephone (305) 233-3631 Telex: 80-3356

TOLL FREE...800-327-3102

MANUFACTURER:

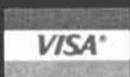
 AZDEN

JAPAN PIEZO CO., LTD.

1-12-17 Kamirenjaku, Mitaka, Tokyo, 181 Japan.

105

Telex: 781-2822452



## KENWOOD TS-430S



- All Bands
- General Coverage
- 200 Watts
- Dual VFO's
- 8 Memories

## ICOM IC-740



- 1.8 to 30 MHz
- Super Receiver
- 200 Watts
- Selectable IF/PBT Tuning

## YAESU -NEW FT-77



- Extremely Compact
- 200 Watts
- 3.5 to 30 MHz
- Inexpensive

## ANTENNA SALE

CUSHCRAFT	HYGAIN TOWERS	BUTTERNUT	HYGAIN
A-3 \$175	HG37SS \$ 649	HF6V \$109	TH5MK2S \$318
A-4 \$226	HG52SS \$ 919	KT34A \$299	TH7DXS \$378
R-3 \$226	HG54HD \$1429	KT34XA \$449	TH3MK3S \$218
AV-5 \$ 90	HG70HD \$2339	144-148LBA \$ 69	TH3JRS \$158
214-FB \$ 69	HG50MTS \$ 749	CALL AEA	TH2MKS \$138
32-19 \$ 82	LARSEN CALL	CALL	18AVT/WS \$ 94
40-2CD \$260			18HTS \$335
			V2S \$ 37

CALL "TOLL FREE" FOR ALL ANTENNAS & ACCESSORIES

CALL FOR HYGAIN TOWER PACKAGES.

2900 N.W. VIVION RD. / KANSAS CITY, MISSOURI 64150 / 816-741-8118

161

### APPLIED INVENTION SOURCE

THE SOURCE FOR SOLID STATE / STATE-OF-THE-ART

#### GaAs FETS by MITSUBISHI

2M - Ku Band. Very low noise and medium power.

- MGF 1100 Dual Gate GaAs FET 2.5dBm @ 4GHz \$ 7.35
- MGF 1202 (1402 chip in a 1200 package) \$ 9.70
- MGF1404 GUARANTEED 0.65dBm @ 4GHz \$66.60
- MGF1402 - 0.4 dBm @ 432, 1.1 dBm @ 4GHz \$14.00
- MGF1412 GUARANTEED 0.8, 0.9 or 1.0 dBm @ 4GHz \$21. - \$34.75

Also: MGF1200, MGF1400, MGF1403 and medium power MGF1801

#### MICROWAVE MODULES

MITSUBISHI X BAND Hybrid Integrated Circuits with Dielectric Resonator (0.12MHz/°C) GaAs FET Oscillators

- FO-1010X - 10.4 GHz, 15mw out, UER100 Flange \$39.37
- FO-1210Y - 11.5 or 12.0 GHz, UER120 Flange \$39.37
- FO-UP1KF - Complete Heterodyne Rx, 10.468 GHz LD \$36.22

Use with 2 GHz IF for 12 GHz Satellite TVRO

- FO-DP13KF Doppler Module 10.525 GHz UER100 Flange \$43.05
- X-Band 15 dBm die cast horn antenna (UER100) \$17.85
- GaAs FET Preamp 1.7-2.1 GHz, 2.0-2.35 GHz, 2dBm \$49.00

#### COMPONENTS

ALL THE SOURCE FOR RETICON Universal Active Filters

- RS620 digitally programmed switched capacitor filter \$ 7.85
- RS621 dual resistor programmed SCF \$ 6.51
- RS622 quad resistor programmed SCF \$11.07

Application notes \$ 2.00

#### OPTOELECTRONICS from MITSUBISHI and SIEMENS

CW LASER DIODES, HIGH OUTPUT INLEDS, PIN PHOTO DIODES, FIBER OPTICS, MORE!

- MRF 901 Substitute 2SC2876, Ft=7GHz, 2.2dBm @ 1GHz \$ 1.50
- NEC 64535 direct replacement: Siemens BFQ 74 \$ 9.66

LEADLESS DISK CAPS 100, 220, 470, 680, 1000 pF 10¢ / \$ 2.50

#### MICROWAVE CHIP CAPS

Very low loss VITRAMON P7600 series

- G02(0.7:1.4 GHz) G04(1.3:2.6 GHz) G01(2.6:4.2GHz) \$ 1.25
- VITRAMON VHF/UHF NPO chips: 10, 100, 1000 pF 5¢ / \$ 2.50
- A-B type FWSN 1000pF Feedthru \$ 0.75

STRAPLINE SHUTTLE TRIMMERS (VOLTRONICS) 0.1-2.5, 0.5-9.0pF \$ 3.34

H-Q SEALED CERAMIC PISTON TRIMMERS (VOLTRONICS) 0.6-9.0pF \$ 3.58

Thermo Electric Heat Pumps & Sub-Minature Cryogenic Refrigerators CALL

3M GX250 glass/ite board, Et=2.55 @ 10GHz 0.031 \$0.31/sq. in.  
0.062 \$0.52/sq. in.

JOHNSON SMA's: Sq flange female \$3.50, Male cable \$ 2.88

PROMPT SERVICE. SEND FOR CATALOG. MINIMUM ORDER \$5.00  
VISA/MASTERCARD Accepted. CASH prepay take 5% discount.  
S&H \* ITEMS (UPS) \$3.75. ALL OTHER ITEMS \$2.50 (1st CLASS)  
NY STATE RESIDENTS ADD 8% SALES TAX

R.D.2 ROUTE 21 HILLSDALE, NY 12529  
518-325-3911

### SYNTHESIZED SIGNAL GENERATOR

MADE IN USA

MODEL SG1000 \$349.95 plus shipping

- Covers 100 to 185 MHz in 1 kHz steps with thumb-wheel dial • Accuracy 1 part per 10 million at all frequencies • Internal FM adjustable from 0 to 100 kHz at a 1 kHz rate • Spurs and noise at least 60 dB below carrier • RF output adjustable from 5-500 mV at 50 ohms • Operates on 12 Vdc @ 1/2 Amp • Available for immediate delivery • \$349.95 plus shipping
- Add-on Accessories available to extend frequency range, add infinite resolution, voice and sub-audible tones, AM, precision 120 dB calibrated attenuator
- Call for details • Dealers wanted worldwide.

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

Custom Mailing Lists on Labels!

### Amateur Radio Operator NAMES

Custom lists compiled to your specifications  
-Geographic by ZIP and/or State; by Age or Birthdate; by Licence Issue or Expiration Date-on labels of your choice.

Total List: 411,000 Price: \$25/Thousand  
Call 203: 438-3433 for more information

**Buckmaster Publishing** 198  
70 Florida Hill Rd., Ridgefield, CT 06877



July 30 thru August 12, 1983

Our 24th year

Learn why the answers are what they are. Upgrade with electronics professionals.

**OAK HILL ACADEMY RADIO SESSION**  
in the  
Blue Ridge Mountains of Virginia

Theory and code together:

- Novice to General
- General or Technician to Advanced
- Advanced to Amateur Extra

Expert Instructors — Friendly Surroundings — Excellent Accommodations.

Ham Lab set up for all to use.

"A Vacation with a Purpose"

C. L. PETERS, K4DNJ, Director  
Oak Hill Academy Amateur Radio Session  
Box 43  
Mouth of Wilson, VA 24363

Name \_\_\_\_\_ Call \_\_\_\_\_  
Address \_\_\_\_\_  
City/State/Zip \_\_\_\_\_



Three different versions of the receiver, two of which have been expanded into transceivers. The one on the left is the original which was built in modules. It uses a cabinet available from Radio Shack, and a homemade front panel. On the top right is the basic receiver described in this article. It uses an inverted chassis with cover plate. Wooden rails have been added to both sides and an aluminum trim strip adds a finishing touch to the front panel. A bar graph display has been used here instead of an S-meter. It is mounted just above the digital readout. On the bottom right is a unit built by Bob Kirby, WA3DYF. His version includes an antenna tuner, so that a random length wire can be used as an antenna.

## modular two-band receiver

State-of-the-art circuitry  
with digital frequency readout

I have often been impressed by the many excellent articles which have been published about my favorite subject — communications receivers. A problem I have found with most of the articles, however, is that duplicating some of the circuits is often difficult. Some receivers use surplus or discontinued parts, or parts not readily available. In some cases extremely expensive, custom-made components are used.

There is no reason why a top-quality, high-performance receiver should cost a small fortune to build — or require a bench full of sophisticated test equipment to adjust. You *can* build a receiver for less money than you would have to spend to purchase one of similar performance.

This article describes my answer to these problems. Here is a reliable, high-performance Amateur communications receiver that will perform as well as some of the best receivers available to Amateurs today. The basic two-band design can be expanded to cover the other bands, and, with the addition of two boards, can operate as a transceiver on CW and SSB.

### the evolution of the design

The typical receiver should be able to handle strong signals (both on and off frequency), such as

By Jim Forkin, WA3TFS, 3210 Shadyway Drive, Pittsburgh, Pennsylvania 15227



## bandpass filters

Each band has its own double-tuned bandpass filter (fig. 2). This filter design has good rejection of unwanted signals both above and below the band of interest.<sup>2</sup> The two coils for each band are wound on ferrite cores and tuned with ceramic or mica trimmer capacitors.<sup>3</sup> (See table 2.) Once initially adjusted at the center of each band, the filters require no other tuning or adjustments.

One drawback of this type of front-end filter is the fact that the antenna must present a 50-ohm load.

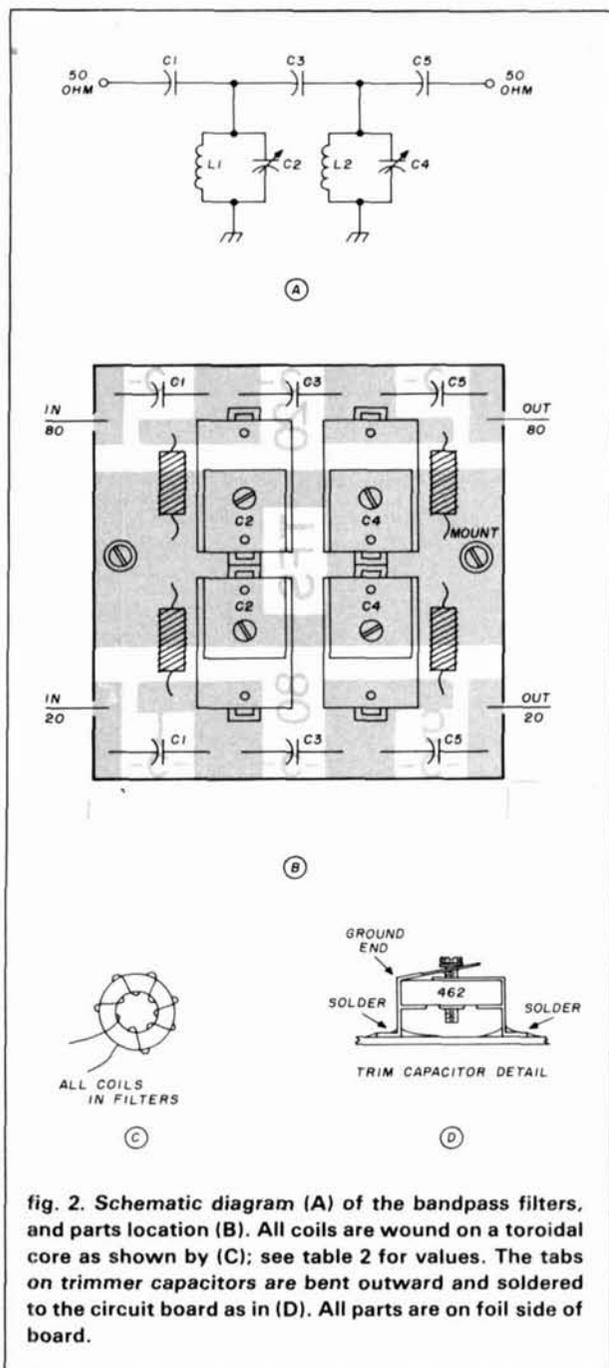


fig. 2. Schematic diagram (A) of the bandpass filters, and parts location (B). All coils are wound on a toroidal core as shown by (C); see table 2 for values. The tabs on trimmer capacitors are bent outward and soldered to the circuit board as in (D). All parts are on foil side of board.



Two more versions of the receiver, both of which have been expanded in function. The one on top has been designed for mobile use. It is built in a compact package measuring only 4 × 7 × 11 inches. The cabinet is formed by using two chassis fastened together with a top and bottom cover. A separate front panel hides the seam where the two chassis join together. The bottom unit is the dual-diversity unit mentioned in the article. Note the two dot displays to the left of the digital readout. These give a direct comparison of signal strength on each channel.

Severe mismatch at the antenna will detune the filter and cause a loss in sensitivity. It is not possible to just hang a wire on the antenna input and obtain good results. With a matched antenna, the filters are excellent.

table 2. Component values for the bandpass filters. C1, C3, and C5 are silver-mica capacitors. Coils are wound with No. 28 enamel wire.

	C1-C5	C3	C2-C4	L1-L2
80 meters	100 pF	12 pF	ARCO 464	35 turns on T37-2 core (red)
20 meters	15 pF	2 pF	ARCO 462	27 turns on T37-6 core (yellow)

## the mixer

Initial experiments with the mixer stage involved double-balanced diode mixers, but these were rejected in favor of a dual-gate mosfet stage, as shown in the receiver-board schematic (fig. 3).

In theory, the diode double-balanced mixer is, perhaps, the ultimate design. However, in practice, the maximum capabilities of this device are rarely achieved in a home-built receiver.

The diode mixer, in order to work properly, must be terminated at all frequencies present — not just the i-f. This requires a circuit called a diplexer. This circuit can be very difficult to get working properly

with simple test equipment. This type of mixer exhibits a loss and also requires a high-level local-oscillator signal. This not only consumes extra power, but makes interstage coupling of the local oscillator signal a problem.

A dual-gate mosfet mixer, on the other hand, is not in the least bit temperamental, and good performance can be obtained without any adjustments. The drain is terminated in the eight-pole crystal filter. Impedance matching is handled by a 510-ohm resistor in the drain circuit of the mixer, which approximates the 500-ohm input impedance of the KVG filter.

### the intermediate frequency amplifier

The local-oscillator signal and the desired incoming signal are mixed (heterodyned) to produce an

output signal at the i-f center frequency of 9.0 MHz. This signal is then passed through the eight-pole crystal filter with a -6 dB bandwidth of 2.4 kHz. The outstanding skirt selectivity of this filter (1.8 shape factor) rejects off-frequency signals very well. It is this selectivity which allows you to separate the closely spaced signals which are common on the Amateur bands.

The signals at the output of the crystal filter must be amplified, of course, and this is handled by an integrated circuit which provides about 50 dB of gain and a bit more than 60 dB AGC control.

Although this eight-pin chip appears quite simple, the MC 1350 is really quite sophisticated.<sup>1</sup> It is also inexpensive. The gain of this stage is controlled by applying a voltage of 5 volts or greater to pin 5. An increase in voltage on this pin causes a decrease in gain in the chip.

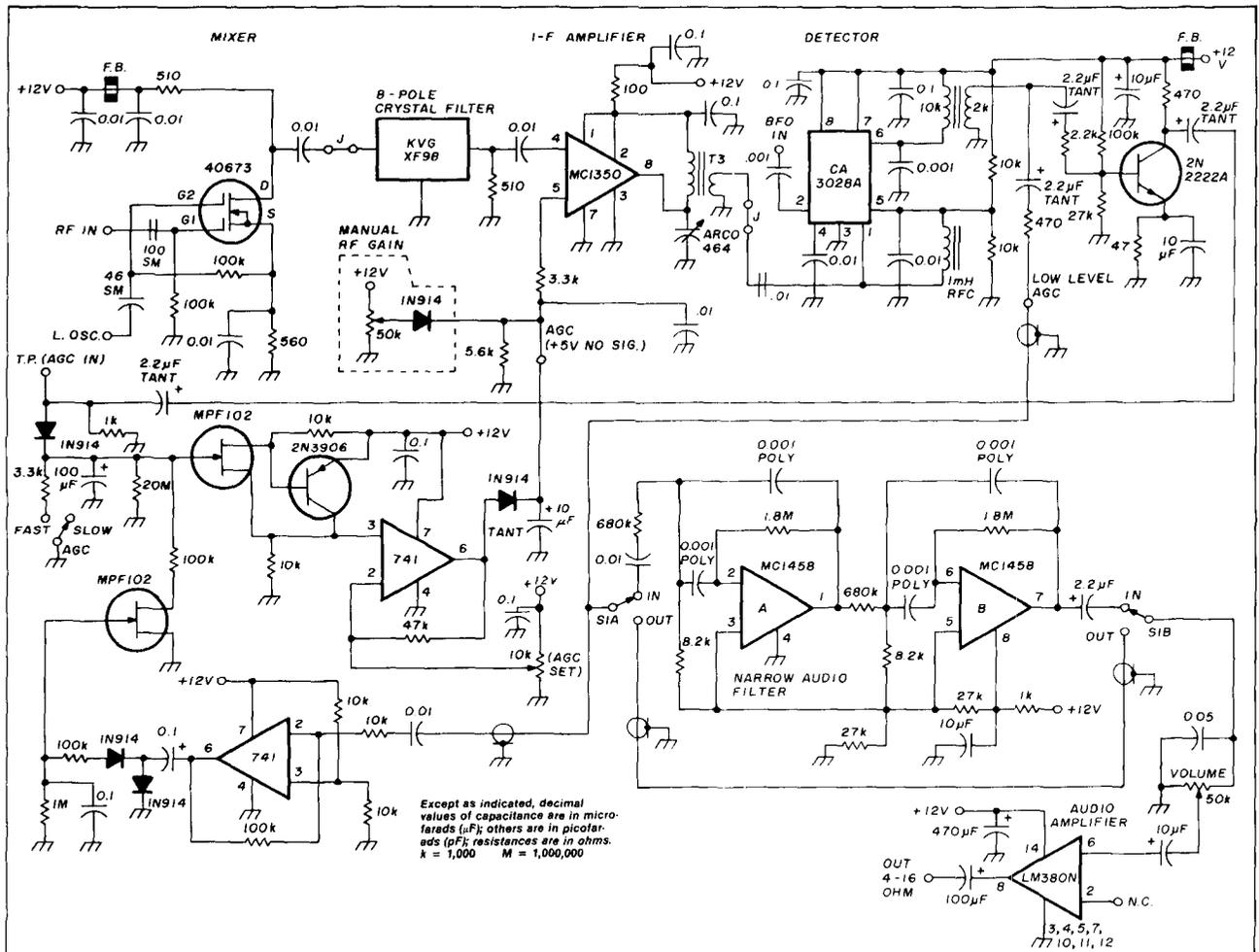


fig. 3. Schematic diagram of the receiver board of the modular receiver. S1 A and B is a miniature dpdt toggle switch. Capacitors in audio filter must be polystyrene or mica. Capacitors marked + can be either tantalum or other electrolytic. T3 primary is twenty-five turns No. 28 enameled wire on T37-6 core; secondary is five turns No. 28 wound over primary.

# CQ CQ HAMS

- SPECIAL OFFER TO LICENSED HAMS -

Do you think *Ham Radio* is the number 1 Amateur Publication?

Are you interested in Satellite Television?

Then why not read *Satellite TV Magazine*?

Believe me - this is the number 1  
Satellite TV Publication!

Now ... as a special offer to licensed amateurs only - we will send you a sample copy of *Satellite TV Magazine* for only \$1.00\* (Reg. \$2.95) and offer you an annual subscription for only \$24.95\* (Reg. \$29.95).



If you're still not convinced - QSY the Satellite TV Net each Sunday at 2:00 pm Eastern Time on 14.310 MHz and hear what the other HAMS are saying about *Satellite TV Magazine*.

Chris J. Schultheiss VE-2FRJ  
Editor & Publisher

Just give us your name and QTH

Name \_\_\_\_\_ Call \_\_\_\_\_

Address \_\_\_\_\_

State \_\_\_\_\_ Zip \_\_\_\_\_

Please Enclose Check or Money Order or if you prefer we accept Visa® & Mastercard®.

Card Number \_\_\_\_\_ Exp. Date \_\_\_\_\_

\*All Prices in US Funds.



Satellite TV Magazine  
P.O. Box 2384  
Shelby, North Carolina



Call Toll Free  
1-800-438-2020

✓ 177

## new HYBRID PHONE PATCH



**NEW DESIGN** **Model P101**

- VU meter for line level and null readings
- Separate receiver, transmitter, & null controls
- Either PTT or Vox operation
- Pi-filters to eliminate RF feedback
- Simple phone line hook up
- Attractive blue panel, woodgrain cabinet
- Dimensions 8" wide x 5¾" deep x 2¼" high

**PRICE \$95.00** Plus \$2.50 Shipping and Handling

ALL OUR PRODUCTS MADE IN USA

**B&W BARKER & WILLIAMSON**  
Quality Communication Products Since 1932

At your Distributors, write or call  
10 Canal Street, Bristol, Pa. 19007

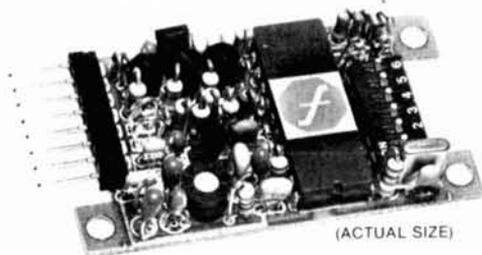
(215) 788-5581



More Details? CHECK - OFF Page 92

✓ 112

## PROGRAMMABLE CTCSS ENCODER/DECODER



(ACTUAL SIZE)

- All 37 EIA Tones
  - Quartz Accurate
  - Universal
- \$54.95**

**IMMEDIATE DELIVERY AVAILABLE**  
FROM NEW YORK AND CALIFORNIA  
DISTRIBUTION CENTERS

For more information call TOLL-FREE

(800) 828-6884

NY: (800) 462-7242

CANADA: (416) 884-3180



**FERRITRONICS**  
MOBILE DATA SYSTEMS

1319 PINE AVE.  
NIAGARA FALLS NY 14301

✓ 134



# JULY BOOK SPECIAL

## RADIO HANDBOOK 22nd Edition by Bill Orr, W6SAI

A best seller for over 45 years! The 22nd edition reflects state-of-the-art techniques in a comprehensive, single source reference book. Invaluable for Hams, technicians, and engineers alike. Chock-full of projects and other ideas that are of interest to all levels of electronics expertise. 1136 pages, ©1981, 22nd edition.

21874      Reg. \$39.95  
**SAVE \$7    NOW \$32.95**

## FROM BEVERAGES THRU OSCAR — A BIBLIOGRAPHY by Rich Rosen, K2RR

The most unique Amateur Radio index ever published. Imagine a complete index to virtually every article of interest to Amateurs published up to 1978. Listings from 292 different magazines including both Amateur and commercial titles. Most of us have a collection of older radio magazines. Here is a book which will easily multiply the value of these magazines many times over. A bargain at twice the price. ©1979, 1st edition.

PR-B0      **Softbound \$29.95**  
**ADDENDUM 1979-1981** — HR, QST, CQ, 73 and Radio Communications from 1979-1981. ©1982.  
 PR-B02      **Softbound \$9.95**  
 PR-BOB      **Both volumes only \$39.95**

## RADIO COMMUNICATIONS RECEIVERS

by Cornell Drentea

Complete and detailed history of receivers covering the coherer, the decoherer, Galena crystals, audion and regenerative designs and the tuned frequency receiver. It also includes single, multiple and direct conversions of the superheterodyne design. You get helpful hints and tips on how to solve image problems, selectivity, crystal filters, mechanical and ceramic filters and much, much more. System design, J-fets and synthesizers — it's all here in one complete volume.

©1982, 1st edition.  
 T-1393      **Softbound \$13.95**

## GUIDE TO RTTY FREQUENCIES

by Oliver P. Ferrell

Fully revised to reflect latest information available. Contains most shortwave military, commercial, press, aeronautical, embassy and weather broadcasting RTTY stations. You also get shift speed, power, schedules, formats, special ID's plus much more. Author Ferrell gives you the benefit of his years of experience in helpful hints and tips that will simplify your listening. He also tells you the secrets behind current trends in encoding signals and what it means to you the listener. ©1982, 160 pages, 2nd edition.

GL-FR      **Softbound \$9.95**

## HAM RADIO LOGBOOK

A real Ham Radio bestseller. Lies flat just like the other one... But uses both sides of each page to give you twice as many entries per book! Plenty of e-x-t-r-a features make this the Logbook for you. 8 1/2" x 11". ©1982.

HR-LB      **Spiralbound \$2.50 ea.**  
**SPECIAL 3 Logs for \$4.95**

## ARRL ANTENNA BOOK 14th Edition

The Amateur Antenna bible. Includes just about every bit of information you'd ever want to know about antenna design, construction and theory. Starts with wave propagation, antenna fundamentals and transmission line theory, progresses through coupling the transmitter and antenna to the feedline to 9 big, inclusive chapters on how to build different antennas. New large magazine style. ©1982, 14th edition, 200 pages.

AR-AM      **Softbound \$8.00**

## HOW TO BUILD HIDDEN, LIMITED SPACE ANTENNAS THAT WORK

by R. J. Traister

Space problems limiting your signal? It doesn't have to be that way. How-to book complete with plenty of projects on antennas for that big signal. Projects include a suspended multi-band vertical, window antenna, attic dipole, 20m indoor antenna, two meter coaxial and much more. Softbound, 308 pages. ©1981.

T-1254      **\$9.95**

TO ORDER — SEND YOUR CHECK, MONEY ORDER OR CHARGE CARD PLUS \$2.50 SHIPPING AND HANDLING TO:

**HAM RADIO'S BOOKSTORE**  
GREENVILLE, NH 03048  
(603) 878-1441

**Tri-Ex TOWER CORPORATION**  
**TRI-EX TOWER — THE TOWER OF YOUR FUTURE**

Tri-Ex is the tower of your future. If you want quality and experience Tri-Ex is the name you want. People from all over the world recognize Tri-Ex, and that is why Tri-Ex is located on every continent of the globe. Tri-Ex towers are manufactured in the United States and licensed for manufacture in Europe.

Tri-Ex puts the same quality in each and every tower. Ask those who own them. Features include high strength low wind resistant W bracing formed guides, galvanizing inside and out, high strength aircraft cabling, hand and motor driven winch systems, bearing rollers, and electronic welding in precision jigs.

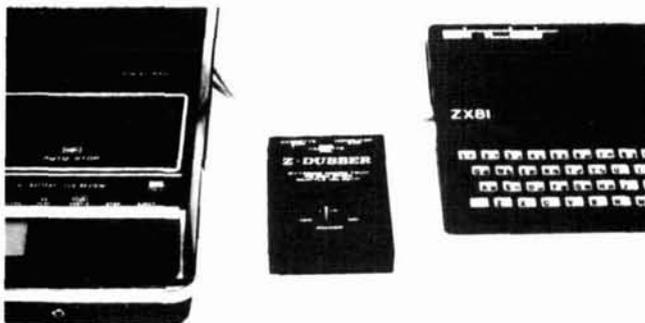
Tri-Ex manufactures a complete line of towers, crank-up towers from 25 feet to 150 feet, and stacked towers from 10 feet up.

For additional information write to:  
**TRI-EX TOWER CORPORATION**  
P.O. Box 5009  
Visalia, CA 93278  
(209) 651-2171

Ask for a copy of our dealer list.

## NO MORE BAD CASSETTE LOADS with THE Z-DUBBER

The frustration of trying to load a cassette program into your Sinclair ZX80/81 or Timex 1000, is this what you really bought your computer for? **Why put up with it? Now you don't have to.** The Z-Dubber is a small device which connects between your computer and cassette player, improving your loading ease 100%.



The Z-Dubber also allows you to connect two tape recorders together, to create perfect duplicates of your favorite cassette programs. The Z-Dubber can be yours for \$31.95 postage paid within the U.S., Canada & Mexico. Add \$2.50 additional for other postal areas. Visa & Mastercard welcome.

### FOR CHARGE AND C.O.D. ORDERS



1-(800) 227-3800 TOLL FREE  
1-(800) 792-0990 IN CALIFORNIA  
ASK FOR OPERATOR 225



For additional information or service, call or write:  
**BYTESIZE MICRO TECHNOLOGY**  
PO BOX 21123 - DEPT. AQ - SEATTLE, WA 98111  
(206) 236-BYTE

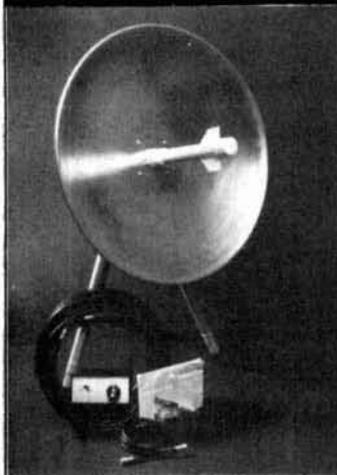
Dealer Inquiries Wanted.

## MICROWAVE TV ANTENNA SYSTEMS

Freq. 2.1 to 2.6 GHz • 34 db Gain +



**TWO YEAR WARRANTY  
PARTS & LABOR**



### COMPLETE SYSTEMS

(as Pictured)  
Commercial 40"  
Rod Style \$ 89.95  
Parabolic 20"  
Dish Style \$ 79.95

### COMPONENTS

Down Converters  
(both types) \$ 34.95  
Power Supplies  
(12V to 16V) \$ 24.95  
Data Info (Plans) \$ 9.95

CALL OR WRITE FOR  
KITS, PARTS, INDIVIDUAL  
COMPONENTS

We Repair All Types Down  
Converters & Power Supplies

## Phillips-Tech Electronics

P.O. Box 34772  
Phoenix, AZ 85067  
(602) 265-8255

Special Quantity Pricing  
Dealers Wanted



✓ 152

## CATCH 10 METER FEVER with a MONGOOSE 2000



**\$279.95\*\***

When Calling  
ask for  
KA4VAS (KEVIN)

### 200 CHANNEL 10 METER ALL MODE TRANSCEIVER

The Mongoose incorporates the latest technology for today's high-tech standards. The Mongoose also features a manual off-set for working repeater stations.

#### Specifications

**General**  
Frequency composition: PLL synthesizer  
Frequency range: 28,000 MHz to 30,000 MHz  
Channels: 200  
Frequency space: 10 kHz  
Emission: AM/FM/USB/LSB/CW  
Power source: 13.8 V DC

**Receiver**  
Sensitivity: AM — 1 micro-V @ 10 dB S/N  
FM — 1 micro V @ 20 dB S/N  
SSB/CW — 0.5 micro-V @ 20 dB S/N  
Selectivity: 60 dB  
Audio Output: 2 W @ 8 Ohm  
Fine Tune range: ± 800 Hz  
Course Tune range: ± 5 kHz  
Squelch range: 0.5 to 300 micro-V  
Intermediate freq: AM/FM — 10.695 MHz/455 kHz  
SSB/CW — 10.695 MHz

**Transmitter**  
RF power output: High Mid Low  
SSB/CW 12 W 8 W 2 W  
AM 7.5 W 4 W 1 W  
FM 10 W 7 W 2 W

SSB generation: Double-balanced modulator with crystal lattice filter  
Coarse Tune range: + 5 kHz

Make Check or Money Order payable to:  
**COIN INT'L, INC.**

2305 N. W. 107th Avenue, Miami Free Trade Zone  
Miami, FL 33172 • (305) 593-9300  
Don't delay — order today!

\*\*10% off with purchase of 2 or more units  
Prices and specifications subject to change without notice.  
Dealer inquiries invited.  
Florida Residents please add 5% sales tax.  
Allow 6-8 weeks for delivery. ✓ 122

## PREVENT HI-TECH HEADACHES

Our Isolators  
eliminate  
equipment

interaction,  
clean up interference,  
curb damaging power line spikes and  
lightning bursts.



### ISO-1 Isolator

3 isolated sockets; quality spike  
suppression; basic protection. . . \$76.95

### ISO-3 Super-Isolator

3 dual isolated sockets; suppressor;  
commercial protection. . . . . 115.95

### ISO-17 Magnum Isolator

4 quad isolated sockets; suppressor;  
laboratory grade protection. . . 200.95

ESP Electronic Specialists, Inc.

171 S. Main St., Box 389, Natick, MA 01760

Toll Free Order Desk 1-800-225-4876  
MasterCard, VISA, American Express

✓ 132



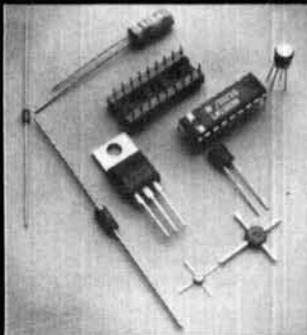
# KCS

## ELECTRONICS CORPORATION

### SEMICONDUCTOR PARTS & PRODUCTS

#### FACTORY PRIME DEVICES INCLUDE:

- Capacitors  
all types & styles
- Chokes & Coils
- Connectors
- Digital & Linear IC's
- Hardware & Accessories
- IC Sockets
- Memory
- Microwave Semiconductors
- Resistors  
fixed & variable
- Transformers
- Transistors & MORE!



**MANUFACTURERS SUCH AS:** Motorola, National, NEC,  
J.W. Miller, Texas Instruments and more!

**WE STOCK & SUPPLY DEVICES FOR:** OEM's,  
Distributors, Hobbyists, Magazine Projects, Engineers,  
Schools, Technicians & You!

Call or Write for Quantity Pricing  
and FREE Catalog.

P.O. Box 33205  
Phoenix, AZ 85067

**(602) 274-2885**

✓ 169

## RF Porta-Tenna

VHF/UHF Telescopic 1/4 & 5/8  
Wavelength Antennas for  
Hand-Held Transceivers &  
Test Equipment

### 1/4 WAVELENGTH

Model No.	Freq. MHz	Description	Price
196-200	144-148	5/16-32 stud w/spring	\$5.95
196-204	"	BNC connector w/spring	7.95
196-214	"	BNC connector	6.95
196-224	144-UP	BNC conn. adj. angle	7.95
196-814	220-225	BNC connector	6.95

### 5/8 WAVELENGTH

191-200	144-148	5/16-32 for HT-220	\$22.95
191-201	"	1/4-32 stud	22.95
191-210	"	5/16-32 for old TEMPO	22.95
191-214	"	BNC connector	19.95
191-219	"	PL-259 w/M-359 adpt.	22.95
191-810	220-225	5/16-32 for old TEMPO	22.95
191-814	"	BNC connector	19.95
191-940	440-450	5/16-32 for HT-220	22.95
191-941	"	1/4-32 stud	22.95
191-944	"	BNC connector	19.95

Largest Selection of Telescopic  
Antennas. Write for info. Price are  
postpaid via UPS to 48 States. For air  
delivery via UPS Blue add \$1.50.  
Florida add 5% sales tax. Payment by  
M.O. or Cashiers Check only. ✓ 172

## RF PRODUCTS

P.O. Box 33, Rockledge, FL 32955, U.S.A.  
(305) 631-0775

The printed circuit board (fig. 4) is designed so that the entire i-f amplifier stage, along with the crystal filter, can be diode or relay switched whenever this receiver is modified for use as a transceiver.

Although it was not included in the original design, a two-pole crystal filter was added at the output of the i-f amplifier. This was not necessary to realize excellent performance in the receiver, but it does produce a quieter receiver by eliminating most of the noise generated in the i-f amplifier. The use of the filter is especially noticed and appreciated when copying extremely weak signals near the noise floor of the receiver.

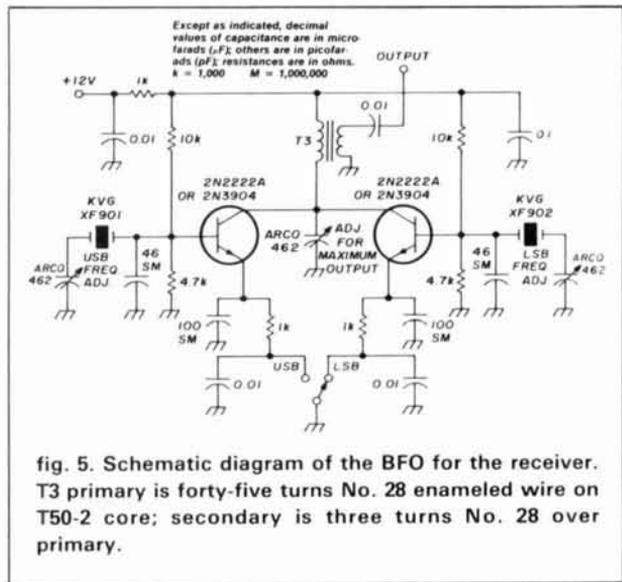


fig. 5. Schematic diagram of the BFO for the receiver. T3 primary is forty-five turns No. 28 enameled wire on T50-2 core; secondary is three turns No. 28 over primary.

The low cost involved by adding the two-pole filter is justified by the increased performance. The filter can be added without modification to the printed circuit board.

### the product detector

I have experimented extensively over the past several years with direct conversion receivers (synchrodyne) and have found that the RCA CA3028-A integrated circuit works very well as a product detector. I have, therefore, used this device in this receiver. It exhibits good gain, low noise, excellent stability, low distortion, and a reasonable level of recovered audio. BFO level requirements are reasonable and non-critical. This chip also handles strong signals very well and this ability simplifies the design of the AGC system.

### the audio stages

Detected signals from the product detector are coupled through an audio interstage transformer to the following stages. If more selectivity is desired for the reception of CW signals, the audio is routed through an audio filter.

Operational amplifiers have made filtering for selectivity at audio frequencies a practical method to use in the design of a new receiver or to improve an older receiver. This receiver uses a design based on an MC1458 dual-operational-amplifier integrated circuit. No critical parts are required, as experiments have shown that excellent performance can be obtained using typical 5 percent resistors and polystyrene capacitors. When it comes right down to it, it is

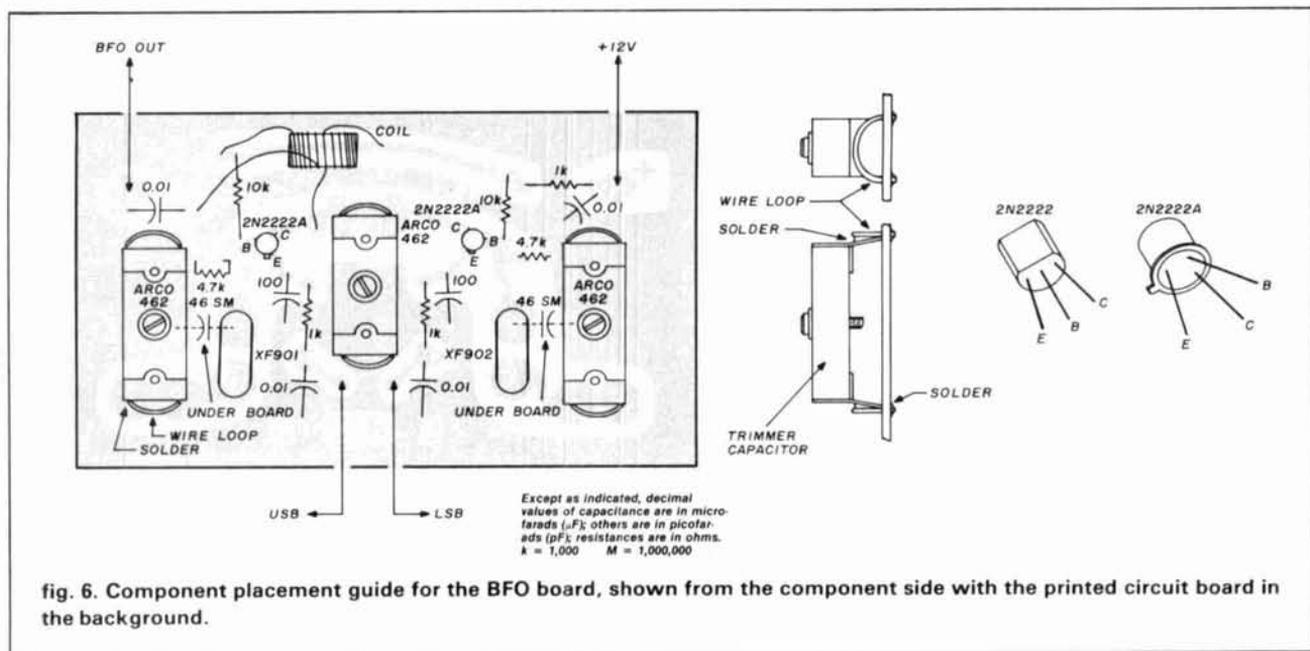
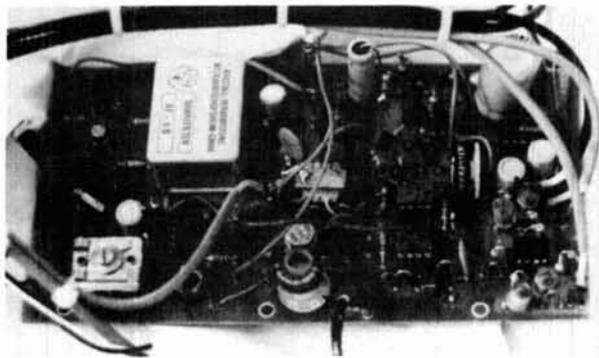
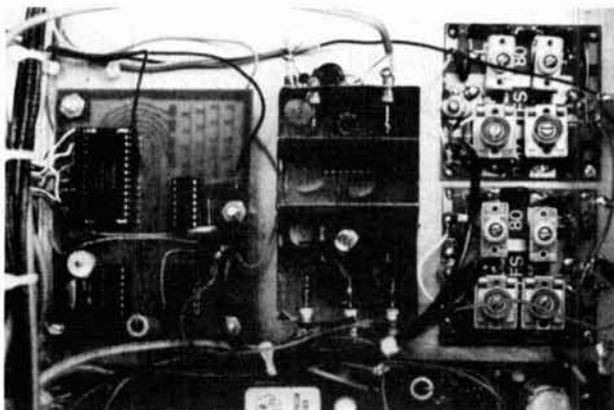


fig. 6. Component placement guide for the BFO board, shown from the component side with the printed circuit board in the background.



The main receiver board. Note the shielded wiring used on all audio and rf connections. From left to right are the mixer, crystal filter, i-f amplifier, product detector, AGC circuit, audio filter, and audio amplifier.



Three of the assembled boards. From left to right they are the digital readout board, the VFO, and the bandpass-filter board for 80 and 20 meters. A shielded control line goes to the VFO.

not important whether the center frequency is at 1.0 kHz or 1.1 kHz, or that the bandwidth at  $-6$  dB is 200 Hz or 210 Hz. The design specifications call for a bandwidth of about 200 Hz at  $-6$  dB, and a center frequency of 1.0 kHz. This is wide enough to eliminate any ringing tendency, yet narrow enough to cut through some of the worst interference.

One of my most basic concepts of receiver design is that simple is usually best. This idea is carried to the extreme when you consider the audio output stage. Only three parts are needed. The LM380-N integrated circuit will provide about 2 watts output in this configuration. It has low distortion, good gain, and is even thermally protected so you don't have to be concerned if the speaker becomes disconnected. I have used this receiver mobile and have found the audio output to be more than adequate when connected to an external speaker of good quality. The output stage will drive any load between 3 and 16 ohms. Don't ruin the excellent audio quality of this

receiver by using an inferior speaker. Any of the many CB-type mobile speakers should be a good choice.

Incidentally, the audio chip has two input pins. One is used here, the other left floating. If the receiver is used as part of a transceiver, the other pin can be connected to the sidetone oscillator.

### the AGC system

After weeks of experimenting with both audio- and rf-derived AGC systems, it became apparent that an audio-derived, full-hang AGC system worked best under signal conditions ranging from casual ragchews to weak-signal CW work, DX pileups, and Field Day QRM.

Perhaps you have used a receiver and noticed that the S-meter (actually an indicator of AGC action in the receiver) would deflect up scale on signals not even detected in the audio output. This is typical of receivers using rf derived or i-f derived AGC systems that do not have sufficient selectivity ahead of the detectors for the AGC.

Because of this problem, the desired signal completely disappears or appears to become very weak because of the AGC action. Obviously, this is not an ideal situation. The receiver sensitivity should be totally controlled by the signal you wish to detect, not by QRM.

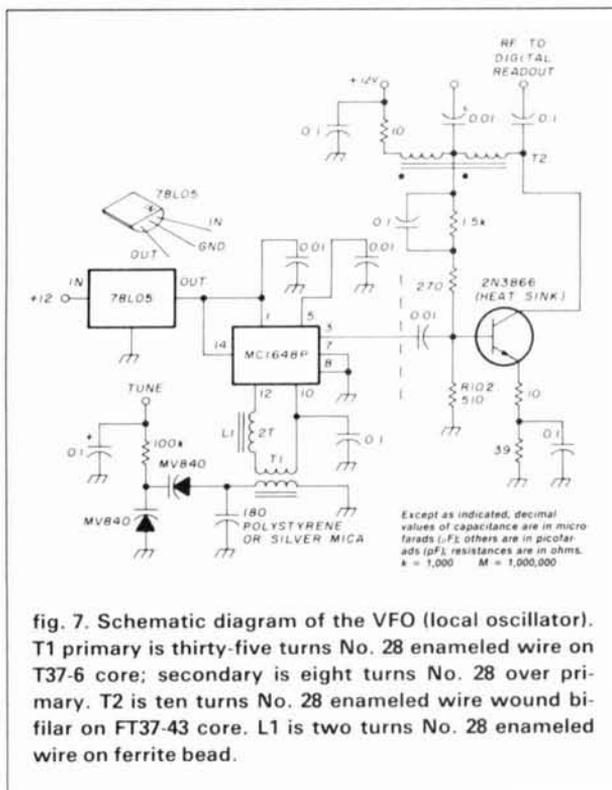


fig. 7. Schematic diagram of the VFO (local oscillator). T1 primary is thirty-five turns No. 28 enameled wire on T37-6 core; secondary is eight turns No. 28 over primary. T2 is ten turns No. 28 enameled wire wound bifilar on FT37-43 core. L1 is two turns No. 28 enameled wire on ferrite bead.



# IN THE GOOD OLD SUMMERTIME

The publishers of *The Final Exam* offer you books to while away those lazy summer days!

\* Teaching Novice classes? Your students will thank you for using the **Novice Class edition of *The Final Exam***. Not a Q & A manual, but a straightforward book that tells your students what you want them to know while keeping them amused. Your students will finally *enjoy learning!* Used in classes all over the country. Only \$4.95 plus \$2.25 Shipping & Handling (S & H) for a single copy. Quantity discounts usually available through your local dealer.

\* Want to keep up with changes in the FCC rules? For only \$9.95 per year we offer you a subscription to **Part 97 of the FCC Rules & Regs** with verbatim updates mailed 1st Class every 2 months. There's no better service anywhere!

\* **The Complete Idiot's Guide to DX** by Stu Gregg is just what beginning DXer's need. With a sense of humor, Stu teaches the basic ins and outs of DX. Only \$9.95 (plus \$2.50 S & H).

\* Got an Apple II<sup>™</sup>, II+<sup>™</sup>, or IIe<sup>™</sup> and like DX? **The DX-Pediter** will help you tremendously with your record keeping while you work on DXCC! On 5 1/4" floppy with good documentation for \$29.95 (plus \$2.00 S & H).

\* Can't remember where you saw an important formula or table with ham data? Look in **Band-Aids!** This is an encyclopedia of miscellaneous info for hams for just \$9.95 (plus \$2.25 S & H).

\* Here's the newest book by Bob Shrader - W6BNB: **Amateur Radio Theory & Practice**. If you really want to *understand* ham radio theory, then this book is a must! Available for \$19.95 (plus \$3.50 S & H).

\* Antenna enthusiasts! You need **Antennas** by John Kraus - W8JK. This is loaded with calculus and trig but is the "Bible" of antenna books. Only \$44.95 (plus \$4.00 S & H).

\* Do you want antenna applications? Order **Antenna Engineering Handbook**. This 1,013 page book by H. Jasik has more info than you'll use in three lifetimes. Just \$74.95 plus (\$4.00 S & H).

\* Want a good theory book on electronics? Get **Electronic Communication** by Bob Shrader. Need to pass the FCC's General Radiotelephone exam? Used in classrooms throughout the country, this theory book does the trick. Order one today for \$26.95 (plus \$4.00 S & H).

\* Ready to learn solid state? Get **Electronic Principles** by Malvino. This is the book to read after *Electronic Communication*. Put it on your bookshelf for \$26.95 (plus \$4.00 S & H).

\* California orders must include 6 1/2% sales tax (no tax on S & H). Visa & MasterCard accepted. All of the above items are in stock at this time. Prices valid until September 1, 1983. Free shipping via UPS or Parcel Post on orders over \$75.

## In The Works

**The Ham Radio Instructor's Guide** (Vol. I) will instruct you how to teach ham classes. The first volume discusses the psychology of learning, lesson plans, course development, etc. What's more, an organization is being developed to certify ham radio instructors. Dick Bash - KL7HP is almost finished with the book and plans to have it available in September. Price will be \$14.95 (tentative) plus \$2.50 S & H.

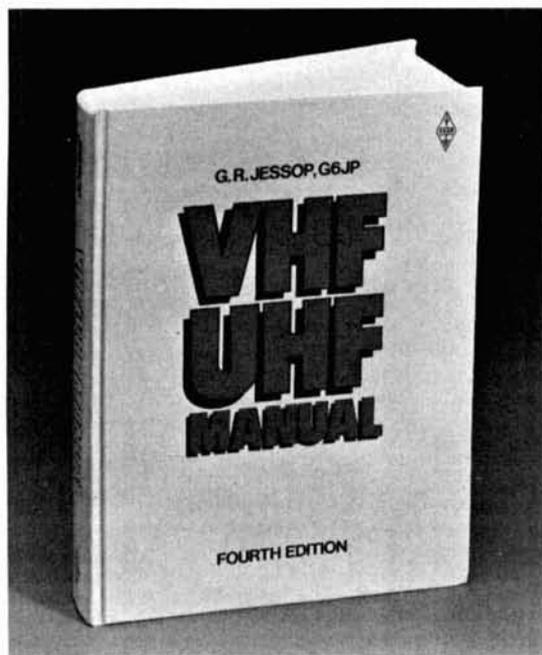
### - Attention Authors -

We are seeking authors for books on RTTY, satellites (Phase III-B or later), antennas, and VHF/UHF theory. Please send for our information sheet and get your book published now!

Orders should be mailed to:

## Bash Educational Services, Inc.

P.O. Box 2115 • San Leandro, CA 94577 • 415-352-5420  
Telephone orders accepted Monday - Friday, 10 AM - 6 PM (California time)



## NEW FROM RSGB!

**VHF-UHF Manual** by G. R. Jessop, G6JP. You will find the new fourth edition of **VHF-UHF Manual** jam-packed with practical theory and construction projects for the region above 30 MHz to 24 GHz. The microwave chapter has been expanded to 83 pages; and includes information on: converters, cavity amplifiers, Gunn diodes, waveguides, directional couplers, and antennas. Receivers and transmitters for these bands are covered in 181 pages. The balance of this 512-page book contains chapters on propagation, tuned circuits space communications, filters, test equipment, antennas, and a handy data section. (Since this is a British publication, there is little coverage of the 6-meter band, but many of the 4-meter band projects can be adapted by the experienced amateur for use on 6-meters.) Copyright 1983 Hardbound \$17.50.

## THE AMERICAN RADIO RELAY LEAGUE, INC.

225 MAIN STREET  
NEWINGTON, CT 06111



106

### AMATEUR MICROWAVE TV ANTENNA'S

1.9 to 2.5 GHz Frequency Range  
50 db System Gain

Complete System (Rod Style as pictured, 25 db Gain)

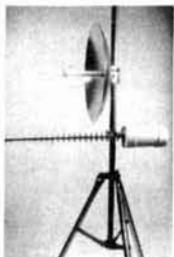
PS-3 ..... \$69.95

Complete System (Dish Style as pictured, 50 db Gain)

PS-5 ..... \$109.95

All systems come complete with Accessory package of

- Control Box
- 60' Coax Cable
- Mounting Hardware
- Matching Transformer
- Instructions
- 90 Day Warranty



### S.E.I. Inc.

912 West Touhy Avenue  
Park Ridge, Illinois, 60068  
Out of State Call 1-800-323-1327  
In State Call 312-564-0104

C.O.D.'s Accepted • Special Quantity Pricing  
Dealers Wanted



## WARNING

### SAVE YOUR LIFE OR AN INJURY

Base plates, flat roof mounts, hinged bases, hinged sections, etc., are not intended to support the weight of a single man. Accidents have occurred because individuals assume situations are safe when they are not.

Installation and dismantling of towers is dangerous and temporary guys of sufficient strength and size should be used at all times when individuals are climbing towers during all types of installations or dismantlings. Temporary guys should be used on the first 10' or tower during erection or dismantling. Dismantling can even be more dangerous since the condition of the tower, guys, anchors, and/or roof in many cases is unknown.

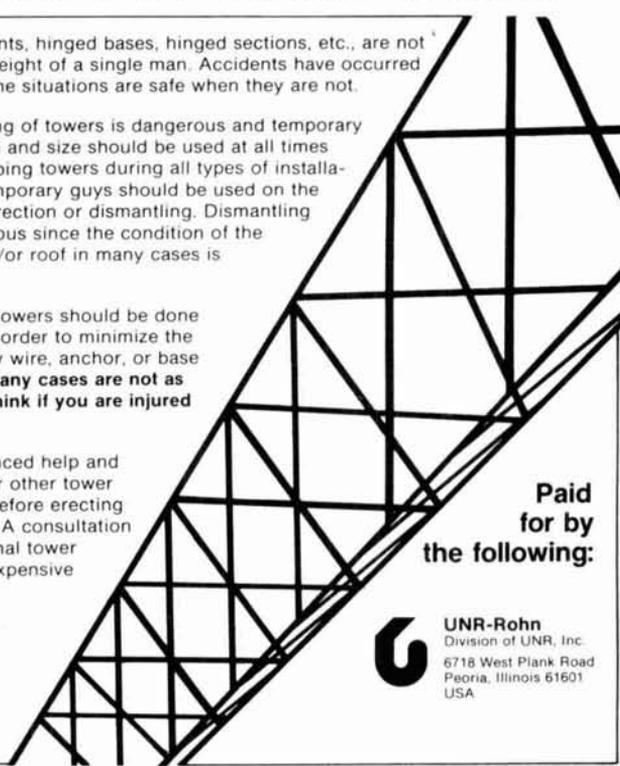
The dismantling of some towers should be done with the use of a crane in order to minimize the possibility of member, guy wire, anchor, or base failures. **Used towers in many cases are not as inexpensive as you may think if you are injured or killed.**

Get professional, experienced help and read your Rohn catalog or other tower manufacturers' catalogs before erecting or dismantling any tower. A consultation with your local, professional tower erector would be very inexpensive insurance.

**Paid for by the following:**



UNR-Rohn  
Division of UNR, Inc.  
6718 West Plank Road  
Peoria, Illinois 61601  
USA



176

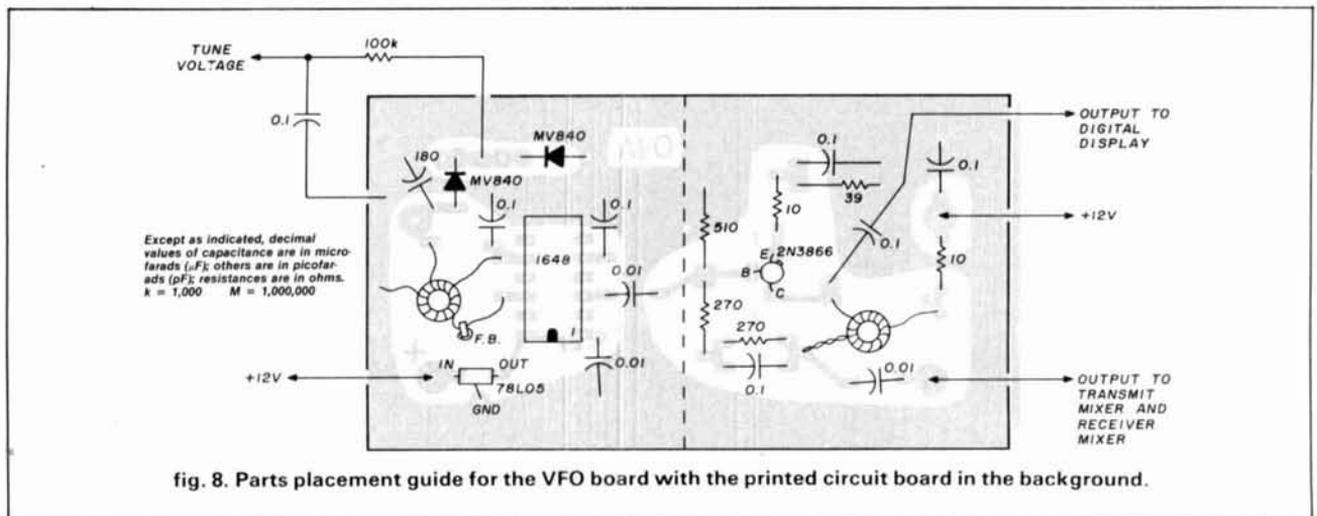


fig. 8. Parts placement guide for the VFO board with the printed circuit board in the background.

In practice, this is nearly impossible to do. But, through the use of selective filters and an audio-derived AGC system (as used in this receiver), this ideal comes closer to reality than you find in many commercial receivers.

A signal, first of all, must be detected and be present in the product-detector output to produce any AGC action. The strength of this signal determines how much AGC voltage will be applied to the i-f amplifier stage. When the need for a control voltage no longer exists, an FET switch is turned on, thereby shunting this voltage to ground, which brings the receiver back to maximum gain within a period of time determined by the time constants. The type or strength of the signals received does not affect this hold-in time. This type of circuit is discussed in greater detail in an ARRL publication.<sup>1</sup>

Two AGC time constants are available. The slower one is excellent for general SSB and CW use and the faster one allows good copy under adverse conditions.

### the BFO

The beat-frequency oscillator is crystal controlled for stability. The circuit consists of two oscillators which share a common output tuned circuit (see **figs. 5 and 6**). The upper and lower sideband crystals are selected by grounding the appropriate control line. This board, like all the others, can be placed anywhere in the cabinet. Since only dc is being switched, it is not necessary to keep the control wires very short.

Each crystal has a trimmer capacitor so it can be set exactly on frequency. Another trimmer capacitor peaks the output tuned circuit at 9.0 MHz.

### the VFO

Readers who are familiar with synthesized 2-meter

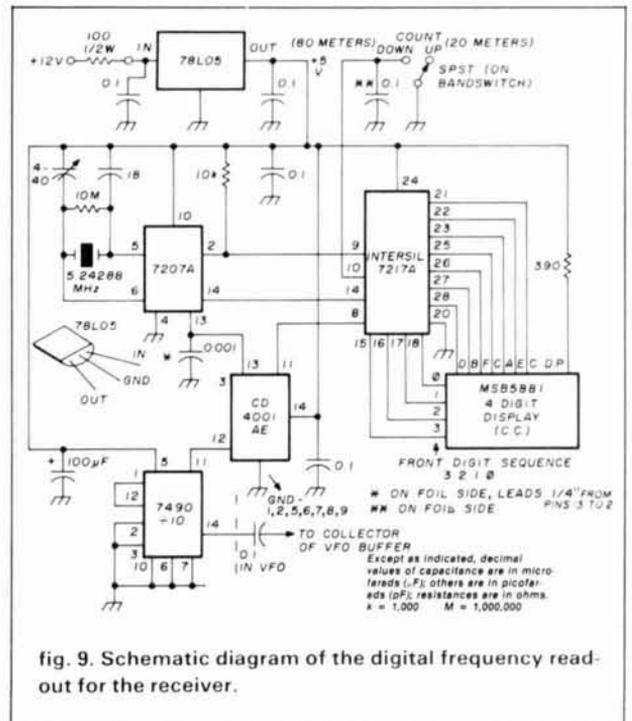


fig. 9. Schematic diagram of the digital frequency read-out for the receiver.

equipment will probably recognize the MC1648 integrated circuit used in the VFO (**figs. 7 and 8**). It has become fairly common in VHF equipment but has not been used before, as far as I know, in a high-frequency receiver. It operates very well in this configuration.

One problem which may occur when using this integrated circuit is that it can oscillate above 250 MHz. The high-frequency oscillation is prevented by link coupling the tuned circuit to the IC through an rf choke. This low value inductance, as well as short lead length, proper pc board layout, and proper bypassing, prevents instability.

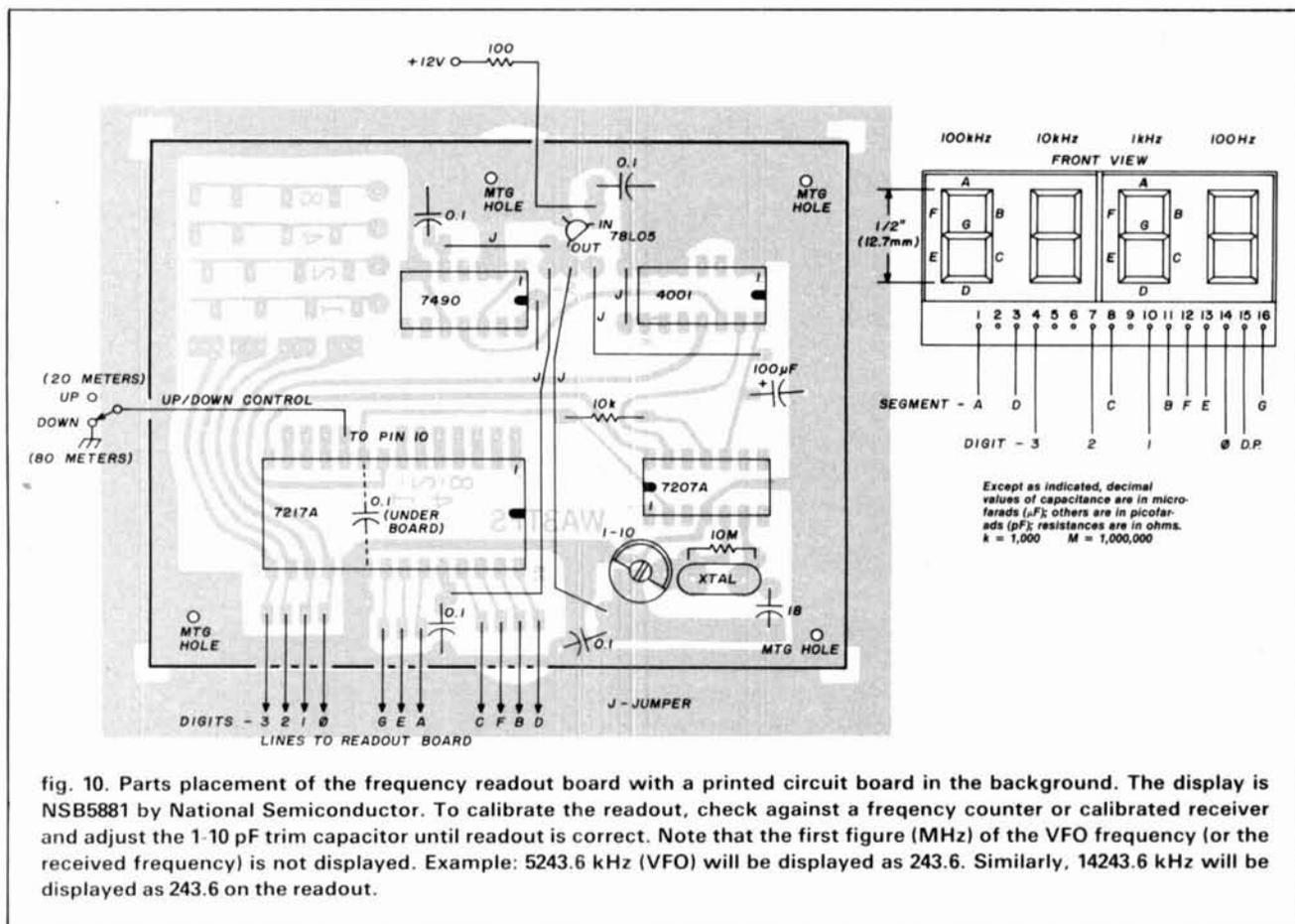


fig. 10. Parts placement of the frequency readout board with a printed circuit board in the background. The display is NSB5881 by National Semiconductor. To calibrate the readout, check against a frequency counter or calibrated receiver and adjust the 1-10 pF trim capacitor until readout is correct. Note that the first figure (MHz) of the VFO frequency (or the received frequency) is not displayed. Example: 5243.6 kHz (VFO) will be displayed as 243.6. Similarly, 14243.6 kHz will be displayed as 243.6 on the readout.

Two varactor diodes are biased by a regulated dc voltage which is controlled by a panel-mounted ten-turn potentiometer. A Jackson Brothers 6:1 vernier drive gives good bandsread.

VFO output is amplified and buffered by a Class-A 2N3866 stage. Output from the buffer is applied to the mixer stage in the receiver. Output to the digital readout is taken via a capacitor from the collector of this stage. This eliminates the need to add pulse shaping in the digital counter.

The regulated voltage, which is used to tune the VFO, is derived from a 6-volt, three-terminal integrated-circuit regulator which is mounted on the S-meter/voltage-regulator board.

Temperature compensation was found to be unnecessary for base-station applications. After a short warm-up period the drift is low enough to allow me to copy the ARRL RTTY bulletins without retuning. If you wish to use your receiver under adverse conditions, such as might be encountered during mobile operation, it may be necessary to add some sort of temperature compensation. Several schemes have been published and just about any of them will work. One simple method I suggest is to wire a 120-pF N750 ceramic capacitor in series with a low-value

piston trimmer (approximately 2-5 pF) across the two varactor diodes. The trimmer should be adjusted to mid-range with a cold receiver. Hook a frequency counter to the VFO output and turn on the receiver. Plot the drift over about an hour's time. If drift is excessive, adjust the trimmer slightly, allow the receiver to cool and try the test again. This takes quite a bit of time, but once the magic combination is found, no further adjustment is needed.

### digital readout

From the initial planning stages of this receiver, I decided to use a digital frequency display, but did not want the high current consumption, heat, or complexity of the usual designs. An Intersil LSI counter chip, along with three other integrated circuits, provides a four-digit readout with an accuracy of  $\pm 100$  Hz (fig. 9) with a components layout and printed circuit board shown in fig. 10.

The counter counts the VFO output and displays the last four digits. This corresponds to the frequency of the received signal. For example, a received frequency of 14,230.6 kHz is displayed as 230.6. On 80 meters, the counter counts down so that a received frequency of 3,976.8 kHz is displayed as 976.8.

# 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

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

**QSL'S** by W4TG. Prices from \$16 per 1000. Send SASE to PO Box F, Gray, GA 31032.

**TRAVEL-PAK QSL KIT** — Converts post cards, photos to QSLs. Stamp brings circular. Samco, Box 203-c, Wynant-skill, New York 12198.

**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 K2RPZ Print, P.O. Box 412, Rocky Point, NY 11778 (516) 744-6260.

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

## Foreign Subscription Agents for Ham Radio Magazine

Ham Radio Austria  
Karin Ueber  
Postfach 2454  
D-7850 Loerach  
West Germany

Ham Radio Belgium  
Sterehouse  
Brusselssesteenweg 416  
B-9218 Gent  
Belgium

Ham Radio Canada  
Box 400, Goderich  
Ontario, Canada N7A 4C7

Ham Radio Europe  
Box 2084  
S-184 02 Upplands Vasby  
Sweden

Ham Radio France  
SM Electronic  
20 bis, Ave des Clairons  
F-89000 Auxerre  
France

Ham Radio Germany  
Karin Ueber  
Postfach 2454  
D-7850 Loerach  
West Germany

Ham Radio Holland  
Postbus 413  
NL-7800 Ar Emmen  
Holland

Ham Radio Italy  
Via Pordenone 17  
I-20132 Milano  
Italy

Ham Radio Switzerland  
Karin Ueber  
Postfach 2454  
D-7850 Loerach  
West Germany

Ham Radio UK  
P.O. Box 63, Harrow  
Middlesex HA3 6HS  
England

Holland Radio  
143 Greenway  
Greenside, Johannesburg  
Republic of South Africa

**FOR SALE:** 73 Magazine, charter issue 1960 (October) through 1966, complete. Write W3IMC, 8315 Liberia Avenue, Manassas, VA 22110. (703) 369-1893.

**CHASSIS** and cabinet kits. SASE K31WK.

**EXCELLENT** looking HW-101, needs alignment — \$190. Drake 2A; accessories \$120. Mint HW-8/p.s. and key, phones \$145. D-104 \$45. Write KA9KAN.

**ELECTRON TUBES:** Receiving, transmitting, microwave . . . all types available. Large stock. Next day delivery most cases. Daily Electronics, 14126 Willow Lane, Westminster, CA 92683. (714) 894-1368.

**WANTED:** Cash paid for used speed radar equipment. Write or call: Brian R. Esterman, 735 Laramie Ave., Wilmette, Illinois 60091. (312) 251-8901.

**DIL AWARDS** are back. Full size certificates for those not so good operators. Radios biggest egotist. Nothing ever works. Four different put-downs. Be the first to give them. \$6.00 PP. Interstate, 29 Parker Pl., Saddle River, NJ 07458.

**WANTED:** SBE-34 Coadapter Model SB2-CW, Hy-Gain 18HT Hy-tower. K6KZT, 2255 Alexander, Los Osos, CA 93402.

**BUY SELL TRADE** — Next 6 issues \$2.00. WA4OSR's Rigs & Stuff, Box 973-H, Mobile, AL 36601.

**BEAM HEADINGS.** The best for less. Great new beam heading listings are computerized, include all the islands, all the new prefixes. No more confusion. Accurate and up-to-date listings for all countries and islands, by prefix, plus all 50 states. Two printouts, large and easy to read. Only \$6.95, complete. Send QTH, check, MO, VISA/MC (number, expiration) to Foundation Publishing, Box 805, Merrimack, NH 03054.

**PRE-1946 TELEVISION SETS** wanted for substantial cash. Finder's fee paid for leads. Also interested in spinning disc, mirror in-the-lid, early color sets, 9AP4 picture tubes. Arnold Chase, 9 Rushleigh Road, West Hartford, Conn. 06117 (203) 521-5280.

**WANTED:** Defective Bird watt meter elements (slugs). Bob Dunn, K6ZTQ, 908 Elder Court, Los Angeles, CA.

**MUSEUM** now open for radio historians and collectors. Free admission. Old time Amateur (W2AN) and commercial station exhibits, 1925 replica store and telegraph displays. 15,000 items. Write A.W.A. for details: Bruce Kelley, W2ICE, Holcomb, NY 14469.

**PLASTIC CARTON** Sealing tape, tan, 165' rolls, 4 2" - \$6; 1-3/4" - \$5; 1-1/2" - \$4; 1" - \$3; one each \$4.50. Add \$1 shipping. Three or more orders shipped free. Satisfaction guaranteed. Lisaius, 116 Orton, Caldwell, NJ 07006.

**MULTI-BAND ANTENNA "KTSB"** — 160m thru 10m, ready to use! Only \$59.95 pp USA. Catalog available. Kilo-Tec, PO Box 1001, Oak View, CA. (805) 646-9645.

**FREE** ad when you subscribe. Get "The Radio Exchange" — the speedy and inexpensive newsletter for buy/sell/trade of radio & computer equipment. 24 issues (1 year) \$8.00. The Radio Exchange, P.O. Box 486, Dept. C, Forest Lake, MN 55025.

**WANTED:** Highest prices paid for Harris RF 301 and associated equipment. Call collect (212) 925-6048.

**ROHN TOWERS** — Wholesale direct to users. All products available. Write or call for price list. Also we are wholesale distributors for Antenna Specialists, Regency, H-Gain and Wilson, Hill Radio, P.O. Box 1405, 2503 G.E. Road, Bloomington, IL 61701-0887. (309) 663-2141.

**MOBILE IGNITION SHIELDING.** Estes Engineering, 930 Marine Dr., Port Angeles, WA 98362.

**SPANISH FOR HAMS.** Booklet/cassette \$6.50. KA8GWI, 15625 Mayfield, Huntsburg, OH 44046.

**CABLE CONVERTERS, decoders.** Free catalog. APS, POB 263 HR, Newport, RI 02840.

**HAM HOLIDAY** Sri Lanka. Write to Spangles Travels, 84 Templers Road, Mount Lavinia, Sri Lanka. Enclose 5 IRCs.

**RTTY-EXCLUSIVELY** for the Amateur Teleprinter. One year \$7.00. Beginners RTTY Handbook \$8.00 includes journal index. PO Box RY, Cardiff, CA 92007.

**HALLICRAFTERS \$\$\$** Serious collector needs Hallicrafter and other Ham equipment manufactured before 1940

# NOW!



## a 30 watt amplifier that also CHARGES!

35 mA rate recharges your handheld when it's off, maintains charge in the receive mode.

And it adds 30 watts of mobile talk-out power; makes an incredible performer of your HT-based mobile radio system.

All at the price of an amplifier alone! An incredible value.

Only \$74.95! Order today. Call toll-free

1-800-USA-MADE

Charge VISA, MC or mail check, money order. Add \$3.00 for shipping; Illinois residents also add \$4.50 sales tax.

**VoCom**  
PRODUCTS CORPORATION  
65 East Palatine Road  
Prospect Heights, IL 60070  
(312) 459-3680

Current consumption with this design is very low, and no noise from the counter can be heard in the audio output. The time base for the counter is a 5.24288 MHz crystal.

### S-meter/voltage regulator

A meter amplifier designed to drive a low-current meter is included on this board (see **figs. 11 and 12**). The meters are readily available as CB surplus. Their current ranges are between 50 and 250  $\mu$ A, and their cost is very low. A trim pot is used to set the meter to zero under no-signal conditions. Sensitivity of the amplifier is adjusted by changing the input resistor.

The board also holds a 6-volt, three-terminal integrated circuit and trim pots to set the upper and lower tuning range of the VFO. The trim pots should be set to allow a tuning range of about 4990 kHz to

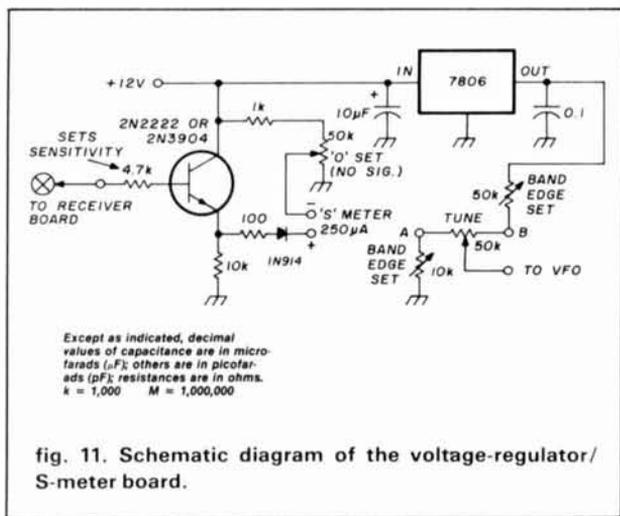


fig. 11. Schematic diagram of the voltage-regulator/S-meter board.

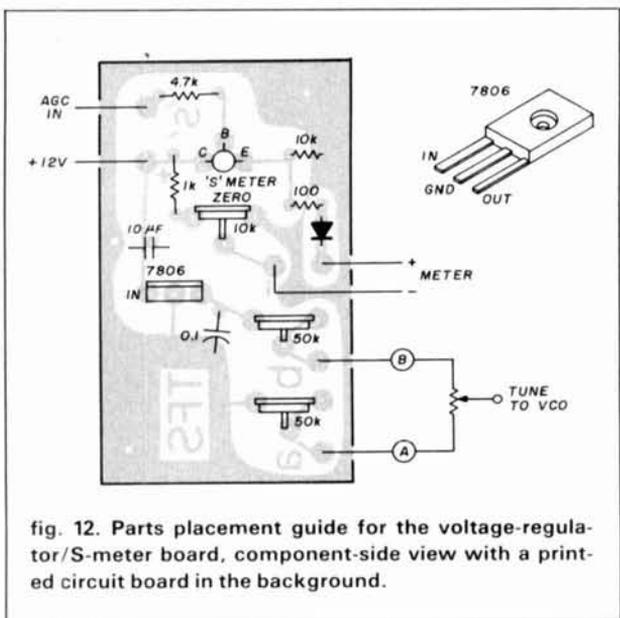


fig. 12. Parts placement guide for the voltage-regulator/S-meter board, component-side view with a printed circuit board in the background.

5510 kHz. This range could be extended slightly to allow tuning in MARS or CAP frequencies.

### tuneup

Tuneup is a breeze!

1. Set BFO to frequency on either upper or lower sideband.
2. Peak i-f amplifier for maximum signal strength.
3. Peak bandpass filters for maximum at the center of each band.
4. Set AGC level at +5 volts with no signal on the input.
5. Set the timebase for the display on the digital display board so that the displayed frequency is accurate.
6. Set trimpots on the VR/S-meter board for the proper tuning range.
7. Set the zero adjust for the meter with no signal input.
8. Repeat as needed.

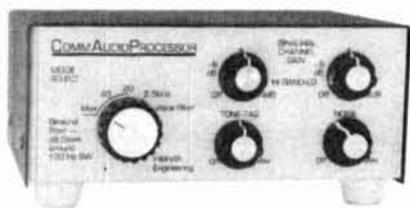
This receiver has been compared with some of the best available to Amateurs; in all cases it's held its own. The receiver sounds much quieter than any of the other receivers. Signals seem to pop out of the background. There is no roar of noise in the speaker when no signal is being received.

Single-tone dynamic range tests at 14.2 MHz work out to about 124 dB (**table 3**). This is with a signal

table 3. Specifications for the two-band receiver.

tuning range	3.5 to 4.0 MHz 14.0 to 14.5 MHz
VFO frequency	5.0 to 5.5 MHz (remotely tuned via dc)
i-f	9.0 MHz center frequency
BFO	USB: 8998.5 MHz LSB: 9001.5 MHz
digital readout	5.24288 MHz crystal
time base	
tuning resolution	$\pm 100$ Hz
voltage requirements	+ 12 Vdc; on-board regulation supplied as needed
current requirements	approximately 100 mA at medium volume setting
selectivity	SSB: 2.4 kHz (6 dB down) 1.8 shape factor (6.60 dB) 2.2 shape factor (6.80 dB) CW: peak type audio filtering; approximately 1-kHz center frequency with 6-dB bandwidth of 200 Hz
blocking	Better than 120 dB. (20-kHz spacing, 1- $\mu$ V received signal strength at 14.2 MHz)

# COMM AUDIO PROCESSOR



- 9TH ORDER CW FILTER 100HZ WIDE AT 750HZ
- TONE-TAG AT BINAURAL CROSS-OVER ON CW
- VOICE FILTER - SUPPLIES FILTER BANDS AT 300 TO 400HZ AND 1500 TO 2500HZ FOR SUPERB SELECTIVITY ON VOICE.
- BINAURAL SYNTHESIS THAT SUPPLIES TWO OUTPUT CHANNELS WITH CROSS-OVER AT 750HZ - OPERATIONAL WITH ALL FUNCTIONS -
- AUDIO WHITE-NOISE GENERATOR - SEE JAN'80 HR ARTICLE OR SEND SASE FOR COPY -
- BROCHURES ON CAP AND OTHER PRODUCTS --

**Hildreth Engineering**

P.O. Box 60003 Sunnyvale, CA 94088

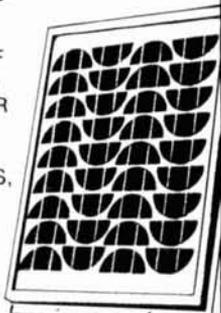
✓ 250

## PHOTOWATT PHOTOVOLTAICS

*Best Performance  
Best Price*

SEND \$2.00 FOR CATALOG OF PHOTOVOLTAICS, WIND AND WATER EQUIPMENT, INVERTERS, D.C. POWERED LIGHTS, STEREOS AND MUCH MORE.

ALTERNATIVE ENERGY ENGINEERING  
P.O. BOX 339 DEPT. HR  
REDWAY, CA 95560 (707) 923-2277



✓ 104

## RADIO DIRECTION FINDER The SuperDF

Inexpensive kit and assembled units for use with Hand-Held, Mobile, or Base Station. 100 to 260 MHz or 200 to 550 MHz with one antenna. Non-ambiguous. No overloading. Use with unmodified HT, scanner, or transceiver. No attenuator or "S" meter needed. Can DF signals below the noise. Averages out local reflections while mobile-in-motion. Used by FCC, US Army, State of California, Coast Guard Aux. Prices start at \$125. For details send SASE to; BMG Engineering, 9935 Garibaldi Ave, Temple City, Cal, 91780

✓ 111



More Details? CHECK—OFF Page 92

for restoration and eventual museum exhibit. Need Hallcrafters, National, Hammarlund, Patterson, RCA, RME, Grebe, etc. Condition not important. Also need QST mags Vols. I & II and old tubes. All letters answered. Write Dave Medley, WA5YXA, 6621 Duffield Drive, Dallas, Texas 75248.

**WANTED:** Schematics-Rider, Sams or other early publications. Scaramella, P.O. Box 1, Woonsocket, RI 02895-0001.

**BACK ISSUES** of Ham Radio, QST, CQ and 73 magazines in good condition. 1960 thru 1980. Sold by the year only, \$12.00 per year postpaid. Bill DuHart, W4VMS, 3846 Winona, Pensacola, FL 32504.

**WANTED:** Early Hallcrafters "Skyriders" and "Super Skyriders" with silver panels, also "Skyrider Commercial", early transmitters such as HT-1, HT-2, HT-8, and other Hallcrafters gear, parts, accessories, manuals. Chuck Dachs, WD5EOG, The Hallcrafters Collector, 4500 Russell Drive, Austin, Texas 78745.

**WANTED:** 2C39 tubes for local repeater. Must be good. Ken Booher, 1421 Williamsburg Rd., Flint, MI 48507. (313) 238-8272.

**RUBBER STAMPS:** 3 lines \$4.50 PPD. Send check or MO to G.L. Pierce, 5521 Birkdale Way, San Diego, CA 92117. SASE brings information.

**I AM INTERESTED** in setting up a regular sked with other hams who are interested in working the Historical Processes of Photography such as Carbro, Bromoil, Oil Transfer, etc. Please contact W2OQK, Tracy Diers, 58-14-84th St., Elmhurst, NY 11373.

**RADIO WEST!** High quality coverage communications receivers with Collins filters and other DX modifications! Catalog 50¢ (refundable). Radio West, 3417 Purer Rd., Dept HR, Escondido, CA 92025 (619) 741-2891.

**GROUND RADIALS WORK.** Solve your vertical antenna radial problems with the fantastic ground plane one (GP-1). A 10" diameter, 24-point cast aluminum buss that fits any 2" diameter or smaller mast. Radial problems solved for only \$24.95. Send a SASE for photos and brochure. Lance Johnson Engineering, P.O. Box 7363, Kansas City, MO 64116.

**VERY in-ter-est-ing!** Next 5 issues \$2. Ham Trader "Yellow Sheets", POB356, Wheaton, IL 60189.

**SIGNAL/ONE** transceiver, model CX-11A. Solid state 1.5 to 30 MHz, full QSK cw, 150 watt model. Very clean, little use. Contact Mike Russell, at 8668 Celestine Ave., San Diego, CA 92123, or call (619) 278-9333 for details.

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

**SIGNAL/ONE** transceiver, model CX-7B. One tube in transmitter. Carefully modified power supply, all production updates, receiver RIT, and more. Unit includes spare PA tubes and power supply components. Contact Mike Russell, WB5CSO, at 8668 Celestine Avenue, San Diego, CA 92123, or call (619) 278-9333 for details.

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

**WANTED, MILITARY SURPLUS RADIOS.** We need Collins 618T, ARC-94, ARC-102, 718F-2, MRC-95, MRC-108, VC-104, 671U, RT-712/ARC-105, RT-804A/APN-171, ARC-114, ARC-115, RT-823/ARC-131 or FM-622, RT-857/ARC-134 or Wilcox 807A, ARC-159, ARC-164, RT-859/APX-72, APN-153, Antenna Couplers 490T, CU-1658A, CU-1669A, CU-1239/ARC-105, Sperry Rand 3226A1, 3226B1, 490B-1, 690D-1. Top dollar paid or trade for new amateur gear. Write or phone Bill Step, 704-524-7519, Slep Electronics Company, Highway 441, Otto, NC 28763.

**IBM-PC RTTY & ASCII.** SASE for full details. E. Alline, NESS, 773 Rosa, Metairie, LA 70005.

**VARIABLE VOLTAGE SUPPLY,** 0-25V, 3A. Kit \$50, Assembled \$65. (+ \$3.00 shipping.) Hollan Electronics, P.O. Box 18632, Austin, TX 78760.

**LOW VOLTAGE MEMORY ADAPTER** for your present Voltmeter. \$25.00 + \$1.00 shipping to: Hollan Electronics, P.O. Box 18632, Austin, TX 78760.

**CUSTOM P/C BOARDS.** Send schematic for quotes. 1-4 transistors and/or IC's, \$15 single board. Orders of 1-10 please enclose payment. Hollan Electronics, P.O. Box 18632, Austin, TX 78760.

# RTTY

**NEW**



## TU-470

- Full featured RTTY to 300 baud plus CW terminal unit.
  - 3 Shifts, active filters, remote control, xtal AFSK, FSK, plus much more.
- Suggested retail price...\$499.95  
Introductory offer...**\$429.95**  
Offer Expires 9-1-83



## TU-300

- RTTY terminal unit to 300 baud.
  - 3 Shifts, active-filters, xtal AFSK, FSK, plus more.
- kit **\$289.95**  
wired **\$399.95**



## TU-170A

- Single shift RTTY terminal unit.
  - Xtal AFSK, FSK, active-filters and more.
- Kit **\$189.95**  
wired **\$289.95**



## TU-170

- Single shift RTTY terminal unit.
  - Low cost, AFSK, active-filters.
- \$149.95**  
(Kit only)



## DM-170

- Single shift RTTY demodulator.
  - Low cost, active-filters, autostart.
- \$47.95**  
(Kit only)

SALES ONLY

## 1-800-HAM-RTTY

**Flesher Corporation**  
P.O. BOX 976  
TOPEKA, KS. 66601

✓ 135

spacing of 20 kHz. A CW signal of  $0.2 \mu\text{V}$  is very easily copied.

At the time of this writing, the receiver which I have described has been duplicated several times with consistent results. The receiver design has since been expanded to include two other boards which give it transceive capability on SSB and CW. This combination has been used to work forty-six states and several countries. Output power is four watts.

I have also designed a heterodyne-oscillator board that allows the receiver to be used on 160 through 10 meters.

## packaging

The photographs show a few ideas for packaging your receiver. One uses a cabinet available from Radio Shack and other similar stores. Other versions are built into aluminum chassis which are used as

cabinets. Surplus cabinets salvaged from old test equipment can be found for a minimal price. One of the receivers shown makes use of two standard Bud chassis (AC402 —  $7 \times 5 \times 2$  inches) assembled top-to-top with a front panel.

A very economic approach is to strip out an old low-cost receiver or transmitter. This will provide you with not only the chassis and cabinet, but also all the hardware you may need. Because of the design of the receiver, you need not worry about the mechanical arrangement of the various controls, as everything is switched with voltages. An old CB transceiver is another possibility. A new paint job and some rub-on letters will give a modern appearance. The only limit to the project is your imagination.

## conclusion

Experiments have been performed using this design in a dual-diversity configuration, with excellent results. Basically, the design consists of one VFO board, one BFO, a digital frequency readout, two receiver boards, one audio stage, and a logic board to complete the hook-up.

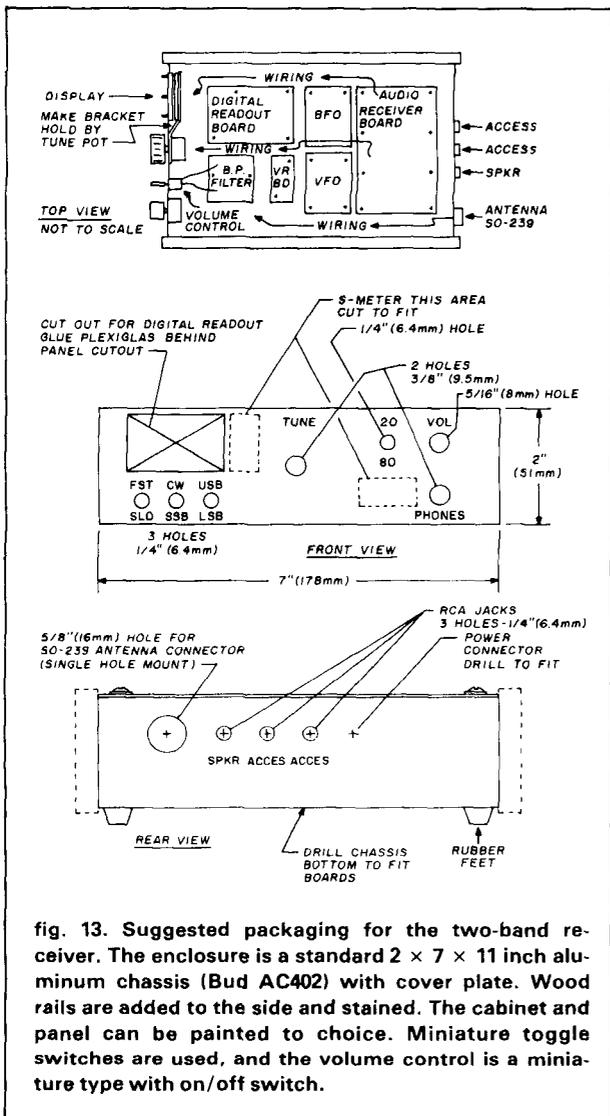
This entire project has been approached from the viewpoint of an Amateur Radio operator, rather than as an engineer. It is relatively inexpensive and provides maximum performance at minimum cost, compared to receivers of similar performance. The design is easy to build, adjust, and package. None of the circuits are unstable, nor do they require any tinkering to achieve best performance. Best of all, the very nature of the design project promotes experimenting in the fascinating field of communication receivers.

As I have done with several of my projects, I have assembled several kits of parts for this two-band receiver. The kit includes all six pc boards and all parts needed to assemble them. A four-digit,  $\frac{1}{2}$ -inch display and a Jackson Brothers vernier drive are also included. Documentation includes schematics, parts lists and layouts, block diagrams, and instructions. Drilling templates are provided for the version using a  $2 \times 7 \times 11$  inch ( $5 \times 17.8 \times 27.9$  cm) chassis as a cabinet, **fig. 13**. The builder must supply the hardware, wiring, and cabinet. The cost of the kit is \$320 here in the United States. Please send an SASE to the author with any inquiry.

## references

1. Wes Hayward and Doug DeMaw, *Solid State Design for Radio Amateurs*, ARRL Inc., Newington, Connecticut 06111, pages 89, 92-94, 111-114, 117-119.
2. Doug DeMaw, *ARRL Electronics Data Book*, ARRL Inc., Newington, Connecticut 06111, page 55.
3. *Toroid Core Data Sheets*, Amidon Associates, 12033 Otsego Street, No. Hollywood, California 91607.

ham radio



**fig. 13.** Suggested packaging for the two-band receiver. The enclosure is a standard  $2 \times 7 \times 11$  inch aluminum chassis (Bud AC402) with cover plate. Wood rails are added to the side and stained. The cabinet and panel can be painted to choice. Miniature toggle switches are used, and the volume control is a miniature type with on/off switch.

## RF CIRCUIT DESIGN

BY CHRIS BOWICK, WD4C

NEW

RF Circuit Design is written for those who desire a practical approach to the design of small and large signal RF amplifiers, impedance matching networks, and filters. An expert in the RF circuit design field will find the book to be a valuable reference manual, while the newcomer will find numerous examples to guide him every step of the way.

### CONTENTS:

#### RESONANT CIRCUITS

Loaded Q - Insertion Loss - Coupling - Formulas

#### FILTER DESIGN

Low Pass - High Pass - Band Pass - Band Stop

#### IMPEDANCE MATCHING

The L and Pi Networks - The Smith Chart as a Tool

#### RF AMPLIFIER DESIGN

Matching - Matching - Y and S Parameter Design

#### POWER AMPLIFIER DESIGN

Matching - Matching - Broadband - Transmitters - Power Transition Characteristics

Rad Match, Much More!!!!



Published by Howard W. Sams & Co., Inc.

To order your copy, send check or money order for \$22.95 to:

CHRIS BOWICK, WD4C

200 ABRI PLACE

LILBURN, GA. 30247

✓ 115

## Coming Events ACTIVITIES

"Places to go..."

**COLORADO:** The Ski Country Amateur Radio Club's second annual Swapfest, July 23, Colorado Mountain College, 1402 Blake Avenue, Glenwood Springs. Free admission. Tables \$5.00 each. Talk in on 07/67. For further information: Frank, WA0BBI, Box 280, El Jebel, Colorado 81628.

**ILLINOIS:** The Hamfesters Radio Club is having its 49th annual Hamfest and Picnic, Sunday, August 14, Santa Fe Park, 91st and Wolf Road, Willow Springs, southwest of Chicago. Exhibits for OMs and YLs. Famous Swappers Row. Tickets \$3.00 at gate; \$2.00 advance. For tickets send check or MO with SASE to Hamfesters, P.O. Box 42792, Chicago, IL 60642.

**ILLINOIS:** The annual Belvidere Hamfest, Sunday, July 31, Boone County Fairgrounds, Highway 76, Belvidere. Tickets \$2.00 advance; \$2.50 at gate. Tables \$2.00 each. Saturday night camping. Talk in on 52 simplex. For information: Bob Anderson, K9DCG, 910 Locust Street, Belvidere, Illinois 61008.

**ILLINOIS:** The DuPage Amateur Radio Club's Hamfest/Computerfest, Sunday, July 10, 9 AM to 4 PM, Downers Grove American Legion Post grounds. Tickets \$2.00 at gate only. Large outdoor flea market. Plenty of parking. Refreshments available. Talk in on 144.89/145.49. For information SASE to: W9DUP, P.O. Box 71, Clarendon Hills, IL 60514. (312) 971-1156.

**ILLINOIS:** The Quad-Co. Amateur Radio Club's 26th annual Hamfest of the "Breakfast Club", July 16 and 17, Terry Park, just east of Palmyra. Saturday night dancing and movies. Bring your basket lunch. Games, contests, golf and fishing. Bring your swap gear. Talk in on 3973 kHz from noon Saturday to 11 AM Sunday. Camping facilities from Friday afternoon to Monday AM. Pre-registration by July 7, \$1.50. \$2.00 at gate. Write Hamfest, c/o Quad-Co. ARC, 602-D East Walnut, Chatham, IL 62629.

**ILLINOIS:** The Fox River Radio League Hamfest, the oldest in Illinois, Sunday, August 21, Kane County Fairgrounds, St. Charles. Exhibits, contests, demos and part of the flea market indoors. Additional outdoor flea market area. Tickets \$2.00 advance, \$3.00 at gate. Overnight parking Saturday, August 20, for campers and motorhomes advance only \$3.00. Talk in on 146.94 simplex or 147.21/82 (Aurora). Campers, exhibitors, flea market space: George R. Isely, WD9GIG, 736 Fellows Street, St. Charles, IL 60174. Advance tickets: Business SASE to Gerald Frieders, W9ZGP, 1501 Molitor Road, Aurora, IL 60505.

**INDIANA:** The combined LaPorte-Michigan City Amateur Radio Clubs will sponsor their Summer Hamfest, Sunday, July 17, LaPorte County Fairgrounds, State Road 2, 8 AM to 2 PM. Donation \$3.00 at gate. Refreshments. Indoor tables 40¢/ft. by reservation to P.O. Box 30, LaPorte, IN 46350.

**KENTUCKY:** The Bluegrass Amateur Radio Society will sponsor the Central Kentucky ARRL Hamfest, Sunday, 8 AM to 5 PM, August 14, Scott County High School, Longlick Road and US 25, Georgetown. Tech forums, awards, exhibits. Free outdoor flea market space. Tickets \$3.50 advance, \$4.00 at gate. For information/tickets: Edward B. Bono, WA4ONE, P.O. Box 4411, Lexington, KY 40504.

**LOUISIANA:** The Central Louisiana Amateur Radio Club will sponsor a Hamfest, Saturday and Sunday, July 30 and 31, Bolton Avenue Community Center, Alexandria. Swap tables available. For information: K5HJCJ, Central Louisiana ARC, P.O. Box 68, Alexandria, LA 71309.

**MARYLAND:** BRATS, the Baltimore Radio Amateur Television Society's famous Maryland Hamfest, Sunday, July 31, Howard County Fairgrounds, West Friendship, 15 miles west of Baltimore. Fairgrounds available for setup Saturday, July 30 at 2 PM. Overnight RV facilities. Talk in on 147.03 (+600), 146.76 (-600), 146.52 and 29.54/64. For table reservations and information: Mayer Zimmerman, W3GXX (301) 655-7812.

**MICHIGAN:** The Hiawatha Amateur Radio Association is celebrating its Golden Anniversary by sponsoring the 35th annual Upper Peninsula Hamfest, July 30, 9 AM to 5 PM, Michigan National Guard Armory, Ishpeming. Registration \$1.00. Tables available at \$3.00 each. Talk in on 146.1676. Come and help us celebrate! For information: George Lehtinen, W8IOC, 100 N. R2, Ishpeming, MI 49849. (906) 485-5038.

## BUTTERNUT ELECTRONICS COMPANY



Model 2MCV "Trombone" Model HF6V Model 2MCV-5 "Super Trombone"

## THE WINNERS

Model HF6V - Completely automatic bandswitching 80 through 10 plus 30 meters. Outperforms all 4- and 5-band "trap" verticals of comparable size. Thousands in use worldwide since December 81! 160 meter option available now. retrofit kits for remaining WARC bands coming soon. Height: 26 ft/7.8 meters. Guying not required in most installations.

Model 2MCV "Trombone" - omnidirectional collinear gain vertical for 2 meters having the same gain as "double-NA" types, but the patented "trombone" phasing section allows the radiator to remain unbroken by insulators for maximum strength in high winds. No coils "plumber's delight" construction and adjustable gamma match for complete D.C. grounding and lowest possible SWR. Height: 9 ft/2.98 meters.

Model 2MCV-5 "Super-Trombone" - Same advanced features as the basic 2MCV but a full wavelength taller with additional "Trombone" phasing section for additional gain. Height: 15 ft/4.8 meters.

All BUTTERNUT ANTENNAS use stainless steel hardware and are guaranteed for a full year. For further information on these and other BUTTERNUT products write for our FREE CATALOG!

## BUTTERNUT ELECTRONICS

GARY AIRPORT, BOX 356 E. RTE 2  
SAN MARCOS, TEXAS 78666

## Free Tool Catalog



Thousands of hard-to-find products for building, testing, and repairing electronics. Everything is easy to order by phone or mail, ready for immediate delivery.

Contact East—Dept. 0218  
7 Cypress Drive, Burlington, MA 01803  
In a hurry to receive your catalog?  
Call (617) 272-5051.

✓ 126

Our 4th Year  
BUY • SELL  
TRADE  
ELECTRONICS

IN

## NUTS & VOLTS

The Nation's #1 Electronic  
Shopper Magazine

PO BOX 1111-H • PLACENTIA, CA 92670  
(714) 632-7721

Join 1000's of Readers Nationwide  
Each Month

U.S.A. SUBSCRIPTIONS

\$ 7.00 - 1 YEAR 3RD CLASS MAIL

\$12.50 - 1 YEAR 1ST CLASS MAIL

\$25.00 - LIFETIME - 3RD CLASS MAIL



With Free Classified Ad



✓ 165

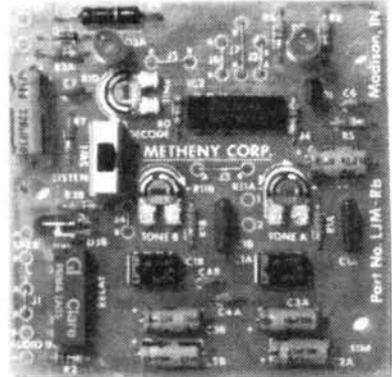
## \$15 DTMF DECODER \$15

The LJM2RK decoder kit converts your receiver into a special receiver or control. When a user-selected time-tone combination is received, the output provides a relay control for activating speakers or other devices.

**INPUT:** Audio from transceiver, scanner, etc.  
**OUTPUT:** SPST (N.O.) relay.

**FEATURES:** Single or dual tones adjustable over the 16 digit Touch Tone range • Adjustable response time • Relay output • Manual or auto reset • Single tone ON latching with different single tone reset OFF • Operates on 12VDC • Interfacing of multiple boards for multi-digit sequential activation and reset.

**APPLICATIONS:** Call-up system • Repeater or commercial controls • Etc. limited only to your imagination •



Actual Size 3"x3" - Shown Assembled

LJM2RK decoder kit includes all component, relay, and P.C. Board. . . . \$15 plus \$1.50 shipping.

LJM2RC enclosure kit includes molded case, speaker, input cable. . . . \$5 plus \$1.50 shipping.

For information and to order write:

**THE METHENY CORPORATION**  
204 Sunrise Drive, Madison, IN 47250



## The HAM SHACK

808 N. Main Street • Evansville, IN 47711



## NEW FROM ICOM

Full featured, all solid state Competition Grade Transceiver. Transmitter covers all ham bands plus three new WARC bands. Receiver covers 100 kHz through 30 MHz too!

**Receiver:** Sensitivity .25µV for 10 dB S/N, J-FET DBM, 105 dB dynamic range; 70.4 MHz 1st IF eliminates spurs; 9 MHz 2nd IF features high gain and PBT, IF notch, adjustable AGC and noise blanker (for woodpecker too) are just a few of the features.

**Transmitter:** 200 watts PEP input SSB/CW, 2SC2097 transistors feature high reliability in low IMD; -32 dB @ 100W internal cooling fan standard; XiT and high performance speech processor and much more.

And there's even more: Dual VFO's, 32 memories with lithium battery for seven year memory retention, scanning, FM board, wide selection of filters.

This is a value packed unit. Call or write today for more information. ✓ 142

For Discount Prices on Icom radios or accessories call Dan or Rick Mon.-Fri. 9-6 PM, Sat. 9-3 PM at

(812) 422-0231

**MICHIGAN:** The Amateur Radio Public Service Association of Saint Joseph County will hold its 5th annual Swap and Shop, Sunday, July 31, Saint Joseph County Fairgrounds, Centreville. Doors open 8 AM. Tickets \$2.00 advance, \$3.00 at gate. Indoor tables \$3.00. Trunk sales free. Saturday night camping available at \$6.00. Talk in on 52. For information: Warren Harder, N8EOX, 14820 Broadway Rd., Three Rivers, MI 49093.

**MISSOURI:** The 5th annual North Missouri Hamfest, sponsored by the NEMO ARC, Kirksville and the Tri-County ARC, Moberly, Sunday, August 7 at the air-conditioned Moberly Municipal Auditorium, Moberly. Inside flea market with limited number of free tables. Doors open for flea market and distributors 8 AM. Hamfest 9 AM to 3 PM. Tickets \$2.00 at door, \$1.50 advance. Refreshments served all day. Coffee and donuts for early birds. For information/tickets: Sam Fischer, KA0ILO, P.O. Box 341, Moberly, MO 65270. Talk in on 147.69/09.

**NEW HAMPSHIRE:** Fly-in to NH's 3rd largest electronic flea market, Saturday, July 16, Manchester Municipal Airport. Starts 9 AM. General admission \$1.00. Sellers \$5.00 with own tables. Refreshments available. Pre-registration to New Hampshire FM Association, 30 Meadowglen Drive, Manchester, NH 03103. Talk in on 146.52 FM. For information: Dick DesRosiers, W1KGG, (603) 668-8880 or Doug Aiken, K1WPM, 30 Meadowglen Drive, Manchester, NH 03103. (603) 622-0831.

**NEW JERSEY:** SCARC '83, the Sussex County Amateur Radio Club's fifth annual Hamfest, Saturday, July 16, Sussex County Farm and Horse Show grounds, Plains Road, off US 206, Augusta. General registration \$2.00. Outdoor flea market space \$4.00 advance, \$5.00 at gate. Indoor sellers \$5.00 advance, \$6.00 at gate. Talk in on 147.90/30 and 146.52. Free parking. For information or registration: Lloyd Buchholz, WA2LHX, 10 Black Oak Drive, RD 1, Vernon, NJ 07462.

**NEW YORK:** The Mt. Beacon Amateur Radio Club's Hamfest, Saturday, July 23, Arlington Senior High School, Poughkeepsie/LaGrange. Doors open 8 AM. Tickets \$2.00. XYL's and kids free. Tailgating space \$3.00. Tables \$4.00 (1 free table and admission). Talk in on 146.37/97 and 146.52. For information: Art Holmes, WA2TIF, 2 Straub Drive, Pleasant Valley, NY 12569. (914) 635-2614.

**NORTH CAROLINA:** The Cary Amateur Radio Club's 11th annual Mid-Summer Swapfest, Saturday, July 16, Lion's Club Shelter next to Cary Senior HS, Cary. 9 AM to 3 PM. Free admission. Buy, sell, trade. Open auction. Talk in on 146.28/88; 147.75/15; and 146.52. For information: Cary ARC, P.O. Box 53, Cary, NC 27511.

**NORTH CAROLINA:** The Western Carolina Amateur Radio Society's all new Hamfest and Computer Fair, July 30 and 31, Buncombe County Firemen's Training Center, Asheville. Open 9 AM. ARRL booth, seminar by Bob Grove, WA4PYQ, CW competition, RV parking and free camping (no hookups). See the latest in computer hardware and software. Talk in on 31/91, 16/76, 52 simplex. For ticket information: Garland Lance, NC4N, 854 Sandhill Road, Asheville, NC 28806.

**OHIO:** The 19th annual Wood County Ham-A-Rama, Sunday, July 17, Wood County Fairgrounds, Bowling Green. Gates open 8 AM. Free admission and parking. Trunk sales. Refreshments available. Dealer tables \$5.00 advance registration. Saturday setup until 8 PM. K8TIH talk in on 52. For information, dealer rentals, SASE to: Wood County ARC, c/o Craig Henderson, Box 366, Luckey, OH 43443.

**OHIO:** The Northern Ohio Amateur Radio Society's NOARSFEST, Saturday, July 23, Lorain County Fairgrounds, Wellington. 8 AM to 5 PM. Donations \$2.50 advance, \$3.50 at gate. Children under 12 free. Blacktopped flea market area, \$1.00 per car space. Free general parking. Refreshments available. Free overnight camping Friday night, no hookups. Mobile check-in, K8KRG, 146.52/52. Directions and info 144.55/145.15. For information/tickets: NOARSFEST, P.O. Box 354, Lorain, OH 44052.

**OREGON:** The 8th annual Lane County Ham Fair, July 16 and 17, Oregon National Guard Armory, 2515 Centennial, Eugene. Doors open 8 AM each day. Tech seminars, swap tables, 2 meter Bunny Hunt, kids' activities, computer demos. All day snack bar. Free parking for RV, no hookups. Saturday pot luck supper. Talk in on 52-52, 146.28/88, 147.86/26. For tickets and tables: Tom Temby, WB7WPU, 3227 Crocker Rd., Eugene, OR 97404. (503) 689-1761. Checks payable to Lane County Ham Fair.

**PENNSYLVANIA:** Nittany Amateur Radio Club's Hamfest & Computer Faire, July 9, New Location, Pleasant Gap Firemen's Park, Route 144, Pleasant Gap. Gates open 8 AM. All day technical operating sessions. Large tailgating area. Tickets \$3.00. Tailgaters \$5.00. Talk in on 146.16/76 and 146.25/85. For information: Dave Buckwalter, KC3CL, 1635 Circleville Rd., State College, PA 16801. (814) 234-0759.

**TEXAS:** The Austin ARC and the Austin Repeater Organization will sponsor Summerfest '83, August 12, 13 and 14, Austin Marriott Hotel, I-35 at Highway 290. Exhibits, meetings, indoor swapfest. Outdoor family activities. Admission \$5.00 advance; \$6.00 at door. Swapfest tables available at door. Reserved swapfest tables \$1.00 advance. Talk in on 146.34/94. For information: Austin Summerfest '83, P.O. Box 13473, Austin, TX 78711.

**WEST VIRGINIA:** The Triple States Radio Amateur Club will present its 5th annual Wheeling, WV Hamfest at Wheeling Park on Sunday, July 24, from 9 AM to 4 PM. Dealers, flea market and auction, free parking, refreshments, ARRL, SWOT booths, etc. Admission \$2.00, children under 12 free. Indoor display, tables available, price of admission only but reserve space. CONTACT: TSRAAC, Box 240, RD 2, Adena, OH 43901. Phone (614) 546-3930.

**WASHINGTON:** The Western Washington DX Club, W7FR, hosts the 31st annual Northwest DX Convention, Friday, Saturday and Sunday, July 29, 30 and 31, Double Tree Plaza Hotel, near South Center Shopping Mall and Seattle Tacoma Airport. Saturday night banquet, Sunday morning breakfast. Speakers, slides, symposia and more. For registration: Ruth Bennett, WA7RVA, 6729 Beach Drive S.W., Seattle, WA 98116. (206) 932-1335.

**WYOMING:** The 1983 ARRL Rocky Mountain Division Convention in conjunction with the 51st W.I.M.U. Hamfest, August 5, 6, and 7, Virginian Motel, Jackson. Talk in on 146.22/82 and 3923 kHz. For more information: R.L. "Pete" Stull, WB7AMP, (307) 382-9023 or Dave Gregory, N7COA, (307) 875-5324.

**WYOMING:** Fourth annual High Plains Ham Roundup, September 9 and 10, Medicine Bow National Forest, 10 miles east of Laramie, I-80. Enjoy a real Western Ham Roundup. Bring your own food and drink. Roast beef furnished for Saturday pot luck supper. Blue Grass band, barbershop quartet and sing-along. Talk in on 146.25/85, 146.22/82 or 146.52 simplex. For information: Mick Marchitelli, P.O. Box 731, Laramie, WY 82070.

**MONTANA-ALBERTA:** The 49th Glacier-Waterton International Hamfest, July 15-17, H.Q. at Waterton Home-Stead Campground, north of Waterton National Park entrance, Alberta, Canada. Bunny hunt, tech sessions, entertainment, swap tables. For information/pre-registration: P.O. Box 148, Milk River, Alberta, T0K 1M0.

**BRITISH COLUMBIA:** The Okanagan International Hamfest, July 30 and 31, Oliver Centennial Park, Oliver. Activities from Saturday, 1 PM, to Sunday, 2 PM. Entertainment, bunny hunts, pot luck luncheon Sunday. Talk in on 34/94 OKN Repeater - 76/76. For information: John Juul-Andersen, VE7DTX, 8802 Lakeview Dr., Vernon, BC V1B 1W3 or Lota Harvey, VE7DKL, 584 Heather Rd., Penticton, BC V2A 1W8.

**RADIO EXPO:** Sponsored by the Chicago FM Club, Saturday and Sunday, September 24 and 25, Lake County Fairgrounds, Routes 120 and 45, Grayslake, Illinois. Flea market opens 6 AM. Exhibits open 9 AM. Indoor flea market tables available at \$5.00 per day. Tickets \$3.00 advance, \$4.00 at gate, good for both days. Seminars, tech talks, ladies' programs. Talk in on 146.16/76, 146.52 and 222.5/224.10. For information: SASE to Radio Expo 83, Box 1532, Evanston, IL 60204 or (312) 582-6923.

## OPERATING EVENTS

"Things to do..."

**JULY 3 AND 4:** The Hannibal ARC will issue a third annual special certificate from the National Tom Sawyer Days celebration in Mark Twain's boyhood home town, Hannibal, Missouri. Hours: 1500-2100 UTC both days. Frequencies: Phone 7.245, 14.290, 21.400, 28.770. CW 7.125 and 21.125 MHz. To receive the certificate send large SASE and personal QSL card confirming contact to Hannibal ARC, W0KEM, 2108 Orchard Avenue, Hannibal, MO 63401. For further information: Tony McUmber, N108 Orchard Avenue, Hannibal, MO 63401. (314) 221-6199.

**JULY 4 AND 5:** High Plains ARC will operate K7YPT at the historic Fort Laramie from 0000Z July 4 to 0000Z July 5. Frequencies: Phone 3.900-3850, 7.250, 14.250-14.300, 21.300-21.360. Certificate for large SASE to: K7YPT, Rt. 2, Box 303, Torrington, WY 82240.

**JULY 9:** The Waterville, NY, Central School ARC, WD2ALL, will operate from 1300-2000 UTC to commemorate the birth of George Eastman of Photography fame. Frequencies: lower portion of General phone and Novice CW bands. FM operation also planned for 146.52. Certificate and Club QSL available for SASE to WD2ALL via Callbook.

Tell 'em you saw it in HAM RADIO!

## QUALITY MICROWAVE TV SYSTEMS

Complete Systems From \$69<sup>95</sup>

1.9 to 2.5  
GHz  
Antennas

**Galaxy  
Electronics**  
6007 N. 61st Ave.  
Glendale, Az.  
85301

1-602-247-1151  
1-800-247-1151

COO's / Dealers Wanted



138

**JULY 9 AND 10:** The Cascades ARS (CARS) in conjunction with the Michigan Space Center in Jackson, is offering a Space Day certificate to all stations who work WB8CSQ on 3.900, 7.235, 14.285, 21.360 and 28.510 starting 0000 GMT July 9 through 1700 GMT July 10. Mail log information and \$1.00 contribution for postage and materials to: CARS, Space Day 83, P.O. Box 512, Jackson, MI 49204.

**JULY 16 AND 17:** Wapakoneta, Ohio. Reservoir ARA will operate K8QYL from 1400Z July 16 to 0400Z and from 1400-1900Z July 17 from the home town of astronaut Neil Armstrong. Frequencies: Phone 7.260 and 14.285 MHz ± QRM. Certificate for QSL and large SASE to: K8QYL, P.O. Box 268, Celina, Ohio 45822.

**JULY 16 AND 17:** The Eastern Michigan Amateur Radio Club, K8EPV, will commemorate the annual Port Huron to Mackinac Island Yacht Race. Operation begins 10 AM EST (1500Z) through 10 PM EST (0300Z) on Saturday and Sunday. Frequencies: 3910, 7235 and 14285 phone; 3710, 7110 and 21110 CW. For an attractive certificate send legal size SASE to: K8EPV, 654 Georgia, Marysville, MI 48040; or C.B.A.

**JULY 23:** The Miami County ARC of Peru, Indiana, will operate K9ZEV in celebration of the 24th annual Peru Circus City Festival. Operation primarily from 1400 to 2300 UTC. Check on 20, 15 and 10 meters as conditions permit. For a special commemorative QSL card send SASE to: Les Cattin, KA9FMZ, 163 W. Third Street, Peru, IN 46970.

**JULY 30:** The Tuscarora Amateur Radio Association will operate KI3D from 1200Z to 2400Z, from the National Historic Site of Tuscarora Academy, established 1839. Frequencies: 10 kHz up from lower edge of the General phone bands. Certificate for business SASE to: William Bratton, Box 31E, Star Route, Mifflintown, PA 17059.

**JULY 30:** The Tank-Automotive Command ARC will operate W8JPW from 1300-2000Z to commemorate the 42nd year of the Detroit Arsenal, home of the nation's first defense plant and the US Army Tank-Automotive Command. Frequencies: Phone 7.250-7.274, 21.400 and 146.49 MHz. CW 7.055 from 1500-1700Z. Send 9 x 12 SASE for unfolded certificate to: W8JPW, US Army Communications Command, Att: CCNC-TAC-M, 28251 Van Dyke, Warren, MI 48090.

**JULY 30 AND 31:** The Pike County ARC will operate W9CZH from the Lincoln Boyhood Memorial, Lincoln City, Indiana, from 1700Z July 30 to 1700Z July 31. Frequencies: 3.925, 7.265, 14.305, 21.395 phone; 14.090 RTTY; 146.52 FM; 7.133 CW. A special QSL will be issued for your QSL and SASE to: KC9VH, Box 311, RR 1, Winslow, IN 47598.

**JULY 30:** Reservoir ARA will operate KR8M from 1330-1900Z from the Courthouse steps during the Celina, Ohio, Lake Festival. Frequency: 7.260 ± QRM. Certificate for QSL and large SASE to: KR8M, P.O. Box 268, Celina, Ohio 45822.

**AUGUST 6 AND 7:** The 21st annual Illinois QSO Party sponsored by the Radio Amateur Megacycle Society (RAMS) from 1800Z August 6 to 2300Z August 7, rest period 0500Z to 1200Z August 7. Frequencies: CW — 40 kHz from low end. Phone — 3890, 7230, 14280, 21375 and 28675. Novice — 25 kHz from low end. Exchange RST and County by Illinois stations. RST and state, province or country by others. For filing and further information: RAMS, K9CJU, 3620 N. Oleander Avenue, Chicago, IL 60634.

**AUGUST 13, 14 AND 15:** The 24th annual New Jersey QSO Party sponsored by the Englewood ARA. From 2000 UTC Saturday August 13 to 0700 UTC Sunday August 14 and 1300 UTC Sunday August 14 to 0200 UTC Monday August 15. Phone and CW same contest. A station may be contacted once on each band — phone and CW are considered separate bands. No CW contacts in phone band segments. General call "CQ New Jersey" or "CQ NJ". Suggested frequencies: 1810, 3535, 3900, 7035, 7135, 7235, 14035, 14280, 21100, 21355, 28100, 28610, 50.50.5 and 144-146. For filing or information: Englewood Amateur Radio Association, P.O. Box 528, Englewood, NJ 07631.

**AUGUST TO DECEMBER 1983:** Jamaica Amateur Radio Association Award commemorating Jamaica's 21st year of independence, August 6, 1983. This award is available to all licensed Amateurs for CW, phone or mixed modes. Rules: Contact with 5 different 6Y5 stations, any band, August to December 1983. Submit QSL cards or written proof with time, date, band, mode and 6Y5 stations worked and fee of \$3.00 U.S. or 10 IRC's and 8 x 10 SASE to: Awards Chairman, Gerald Burton, 6Y5AG, Box 214, Kingston 20, Jamaica W.I.

2 for 1  
Performance  
from  
**MIRAGE**

Dual-purpose power  
amplifiers for  
HT and XCVR!



- 1-10 Watts Input
- All-mode operation
- 5 year warranty

model:  
**B1016 (2 meters)**

1W In = 35W Out

2W In = 90W Out

10W In = 160W Out

with RX preamp!

\$279.95

**C106 (220 MHz)**

1W In = 15W Out

2W In = 30W Out

10W In = 60W Out

with RX preamp!

\$199.95

**D1010 (430-450 MHz)**

1W In = 20W Out

2W In = 45W Out

10W In = 100W Out

\$319.95

There's more, and  
WATT/SWR Meters, too!  
See your nearest Dealer

**MIRAGE  
MIRAGE  
MIRAGE**  
COMMUNICATIONS EQUIPMENT, INC.  
P.O. Box 1393  
Gilroy, CA 95020  
(408) 847-1857  
made in U.S.A.

sample issue only \$2.50 PPD

FSTV — NBTV — MSTV — SSTV  
FAX — 432 SSB/EME — SATELLITES  
MICROWAVE — COMPUTERS  
PACKET — DIGITAL TECHNIQUES  
12 ISSUES PER YEAR

**AMATEUR TELEVISION  
MAGAZINE™**

"OUR 16TH YEAR — SINCE 1967"

	Surface U.S./Canada	Surface All Mexico	Airmail Foreign	Airmail S. America	Airmail All Other
1/2 year	\$ 10.00	\$ 13.00	\$ 20.00	\$ 23.00	\$ 23.00
1 year	\$ 20.00	\$ 26.00	\$ 40.00	\$ 46.00	\$ 46.00
2 year	\$ 38.00	\$ 50.00	\$ 78.00	\$ 90.00	\$ 90.00
3 year	\$ 56.00	\$ 74.00	\$ 116.00	\$ 134.00	\$ 134.00

"FOR THE SPECIALIZED COMMUNICATION RADIO AMATEUR"

QCD Publications  
c/o Mike Stone WBOQCD  
P.O. Box H  
Lowden, Iowa 52255-0408

110  
master charge

## PACKET RADIO

The Vancouver TNC board used by hundreds of "packeters" in the U.S., Canada, and Australia is now available for only \$19.95. This high-quality, double-sided, plated-through board previously sold for \$30.00. See photo in October 1981 QST. A large assortment of public domain software is available for these boards on CP/M 8" diskettes. A limited PROM — programming service is also available. Write for details. (Include donation for postage.)

- TNC bare board and documentation \$19.95
- Parts kits for TNC board with 4K of blank EPROMS (2K RAM) \$117.00
- VADCG 1200 BPS Radio Modem bare board and documentation \$15.00
- A&T TNC's (limited number available) \$169.95

### VADCG

29 Shamokin Drive  
Don Mills, Ontario CANADA M3A 3H7  
(416) 441-2417 eves.

VADCG is a non-profit Amateur Radio Club.

270

# audio filter building blocks

## Active filters in theory and practice

In single-sideband and CW communications, the received audio signals are simple frequency-translated versions of the rf signal received at the antenna. This translation is accomplished by one or more mixer stages. The receiver block diagram usually includes an intermediate-frequency (i-f) stage that does most of the filtering to obtain selectivity. That is, this stage passes the desired signal on through but rejects any unwanted signals.

Fig. 1 is a block diagram of a simple receiver, which consists of a mixer and variable oscillator, i-f amplifier/filter, product detector, oscillator, and audio amplifier. The mixer and its variable oscillator translate the incoming signal from its original frequency to the i-f frequency. The i-f amplifier is also labeled as a filter since it has a bandpass frequency response and performs most of a receiver's filtering for selectivity. The output of the i-f stage is translated by the product detector to audio frequencies which are then fed to the audio amplifier and speaker. Since the signal present at the audio amplifier is a frequency-translated version of the signal at the i-f stage, filtering at the audio stage is equivalent to filtering at the i-f stage. Thus, receiver selectivity

can be improved by adding an audio filter between the output of the receiver and the speaker or headphones.

In practice, audio filtering has a few disadvantages when compared with i-f filtering. Any automatic gain control (AGC) action that takes place in the i-f because of a strong interfering signal may wipe out the desired signal, regardless of how good the audio filtering may be. Also, any distortion introduced in the i-f system due to interfering signals cannot be completely eliminated by audio filtering. However, audio filtering does improve reception and, since it can be added externally, no receiver modifications are necessary.

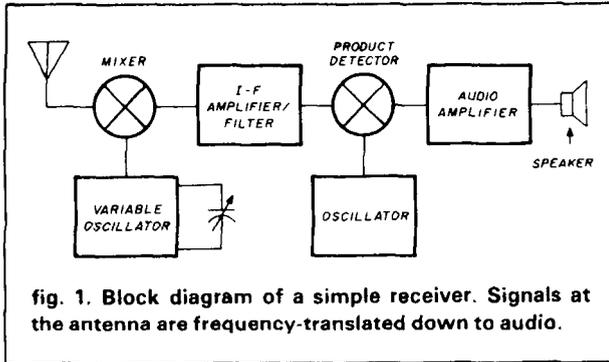
### building blocks

Here are some basic building blocks which can be used either individually or in cascade to produce a filter which meets your needs. These filters will all have unity gain (0 dB) in the passband to simplify their interconnection. All of the op-amps have been designed to use a single 12-volt supply. The circuits draw little current (typically 10-20 mA), so any simple power supply or battery can be used.

### cw filter

A very simple active audio filter for CW can be made using a state-variable filter (see fig. 2).<sup>1</sup> This filter has a bandpass characteristic which can be of

By Bob Witte, KB0CY, 2227 114th Drive, N.E.,  
Lake Stevens, Washington 98258



fairly high  $Q$  (very selective), and the center frequency of the filter can be varied using one variable resistor. The bandwidth can also be varied, but two resistance values must be changed to keep the bandpass gain constant. The values shown give a 3-dB bandwidth of 100 Hz and 400 Hz, although other bandwidths can be produced by changing  $R_o$  and  $R_Q$ , which must remain equal to preserve unity gain. The design equations for the filter are given in **table 1**. Also, be aware that decreasing the bandwidth much beyond 100 Hz is likely to result in an oscillator instead of a filter because of the less-than-ideal nature of op-amps. The LF356 op-amp (which is a fairly wideband device) was used to minimize these effects. With a lesser op-amp, the filter will have a more peaked response at higher center frequencies and the bandwidth will not be constant as the center frequency is varied. As with all high-gain, wide-bandwidth devices, be sure to keep the power supply well bypassed (a 0.1- $\mu$ F ceramic capacitor near each IC).

This particular configuration can be adapted to a notch filter by adding just one op-amp. This op-amp is configured as a summing amplifier which adds together the output of the bandpass filter and the input to the system. Since the bandpass-filter output is inverted (180-degree phase shift) relative to the input, the net result is that the bandpass output is subtracted from the input. This results in a notch filter, since the signals in the passband of the bandpass filter cancel when the inverted and non-inverted signals combine.

The depth of this notch is limited by the matching of the gain-setting resistors in the summing amplifier and also in the bandpass filter. Therefore, the 10-kilohm variable resistor was included to allow some compensation for gain errors. The notch depth can be adjusted by tuning in a carrier or crystal calibrator on a receiver, adjusting the tune control to notch out the carrier, and then adjusting the 10-kilohm variable resistor for minimum audio signal. The minimum notch will probably not occur at the same setting for both bandwidths, but tuning with one bandwidth should result in an adequate notch on the other.

**table 1. Equations for bandpass filter.**

$$\frac{V_{out}}{V_{in}} = -\frac{1}{R_o C_2} \left( \frac{S}{S^2 + S \left( \frac{1}{R_Q C_2} \right) + \frac{R_4}{R_1 R_2 R_3 C_1 C_2}} \right)$$

$$\text{bandwidth (Hz)} = \frac{1}{2\pi R_Q C_2}$$

$$\text{center frequency (Hz)} = \frac{1}{2\pi} \sqrt{\frac{R_4}{R_1 R_2 R_3 C_1 C_2}}$$

$$\text{passband gain} = \frac{R_Q}{R_o}$$

## SSB filter

An audio filter for use with single sideband can be built using only two op-amps. One op-amp is configured as a highpass filter with cutoff frequency around 300 Hz, and the other is configured as a lowpass filter with a cutoff frequency of about 3 kHz. This results in a bandpass characteristic encompassing the standard audio frequency range for voice transmission.

The design equations are given so that other highpass and lowpass cutoff frequencies can be used. A  $Q$  of 1 was chosen so that the peaking in the passband is limited to about 10 percent. For simplicity, all capacitors are of equal value in the lowpass filter. The design equations for these filters are given in **table 2**. The op-amps in this case can be one like the LM307, since the gain-bandwidth demands of the circuit are not excessive.

These two filters can, of course, be used separately. The highpass would be useful for filtering out 60-Hz hum from an older tube-type rig, and the lowpass alone will help most any sideband rig in reducing the high-frequency adjacent-channel interference.

**table 2. Equations for SSB filter.**

### Equations for highpass section.

$$\frac{V_{out}}{V_{in}} = \left( \frac{S^2}{S^2 + S \left( \frac{3}{R_2 C} \right) + \frac{1}{R_1 R_2 C^2}} \right)$$

$$\text{when } R_2 = 10R_1$$

$$\text{and } Q = 1$$

$$f_{3dB} = \frac{0.77}{6\pi R_1 C}$$

### Equations for lowpass section.

$$\frac{V_{out}}{V_{in}} = -\frac{1}{R^2 C_1 C_2} \left( \frac{1}{S^2 + S \left( \frac{3}{R C_1} \right) + \frac{1}{R^2 C_1 C_2}} \right)$$

$$\text{when } C_1 = 10C_2$$

$$\text{and } Q = 1$$

$$f_{3dB} = \frac{1.3}{6\pi R C_2}$$

## driving headphones

All of these circuits can be used to drive headphones without an additional amplifier stage. Fig. 4 shows a circuit to be used for connecting virtually any headphone to the output of an op-amp. The capacitor blocks the dc voltage that is present at the output of the op-amp, and the two resistors act as a voltage divider to reduce the level into the headphones. Most headphones are so sensitive that they need very little drive, so the signal is attenuated by these resistors.

## driving speakers

Fig. 5 shows a simple audio amplifier which uses one-half an LM1877 stereo-amplifier IC. The output of any of the filter sections can be used to drive the input of this amplifier. This is one of many audio-amplifier ICs that are ideal for this sort of application. This circuit was taken directly from the manufacturer's data book<sup>2</sup> and care should be taken in adjusting any of the values since the device is not necessarily stable at unity gain. Care should also be taken in by-

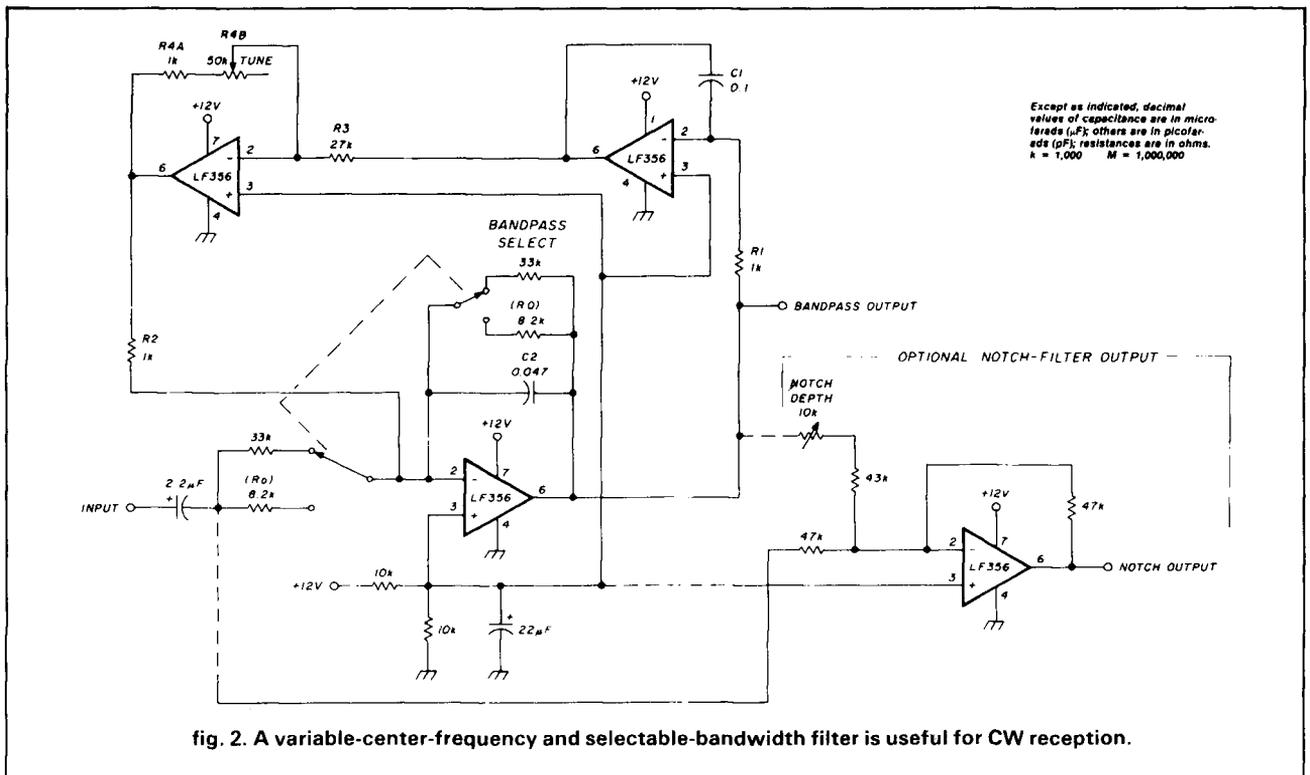


fig. 2. A variable-center-frequency and selectable-bandwidth filter is useful for CW reception.

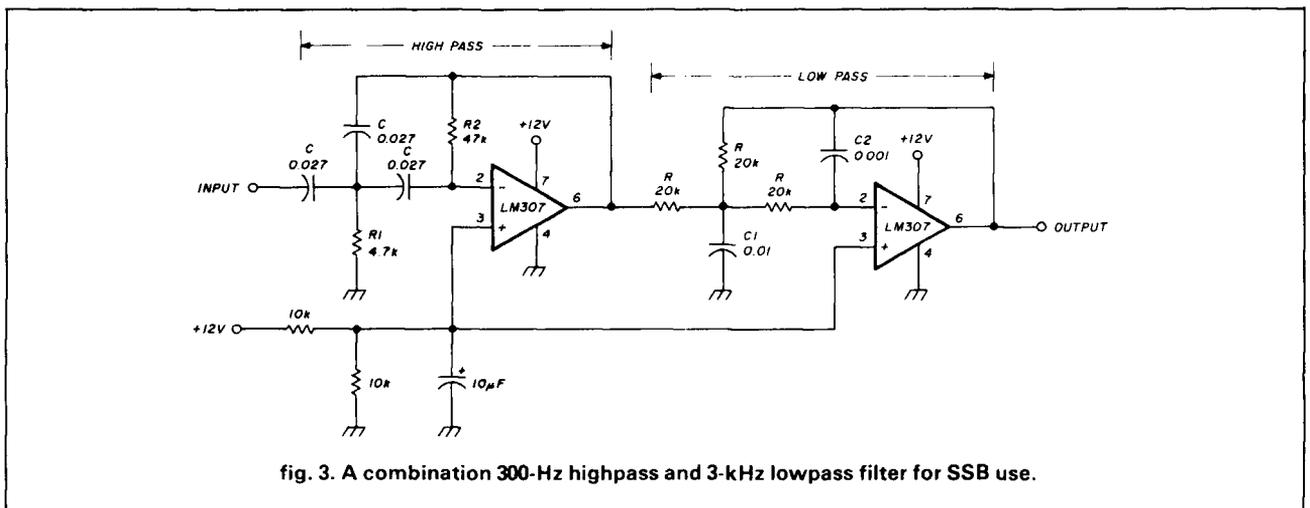


fig. 3. A combination 300-Hz highpass and 3-kHz lowpass filter for SSB use.

## GO MOBILE WITH YOUR H.T.!



Model I—Icom IC-2A/T, Etc.  
Model K-1 for TR-2500  
—slides on bottom of radio

*Guaranteed!*



Model K—TR-2400;  
—powered thru battery plug  
Model N—FT-208R

Model T—Simple mod for Tempo  
and all Santeac

NOW FOR FT-208R & TR-2500



Model Y—FT-207R, Wilson  
—fits into battery compartment

\*A unique battery eliminator\*  
HANDI-TEK Regulator allows  
constant hand-held operation  
from auto DC or base supply  
with no nicad drain and  
WITHOUT RADIO MODIFICA-  
TION! \$24.95 PPD in USA.  
Calif. add \$1.50 Sales Tax.

144  
HANDI-TEK

P.O. BOX 2205, LA PUENTE, CA 91746

## RELIABLE MICROWAVE TV ANTENNAS.

### 2.1 to 2.6 GHz Frequency Range

34db System Gain (or Greater)

Complete System (as pictured)	\$119.95
Down Converter Probe Style (Assembled and Tested)	\$49.95
Power Supply (12V to 16V DC+) (Assembled and Tested)	\$39.95



### PETERSON ELECTRONICS

4558 Auburn Blvd.  
Sacramento, CA 95841  
(916) 486-9071

C.O.D.'s  
SPECIAL QUANTITY  
PRICING  
Dealers Wanted



1 YEAR WARRANTY  
PARTS & LABOR

168

## CB TO TEN METER CONVERSION KITS

KITS for AM—SSB—FM 40 Channel PLL  
chassis conversions

DETAILED INSTRUCTIONS for easy installation with minimum time and equipment

BAND COVERAGE flexibility provides up to 1 MHz coverage for most PLL chassis.

PRICES Low cost prices range from \$8.00 to \$50.00

All kits are in stock including several different FM kits.

FREE CATALOG Write or call today.

### INDEPENDENT CRYSTAL SUPPLY COMPANY

P.O. Box 183  
Sandwich, Ma. 02563-0183  
(617) 888-4302

149

More Details? CHECK—OFF Page 92

# The Interface

## Software Available for Six Computers

The versatility of the personal computer gives you a whole new world with the Kantronics Interface™ and Hamsoft™ or Hamtext™. The Interface™ connects to any of six popular computers with Hamsoft™ or Hamtext™ giving you the ability to send and receive CW/RTTY/ASCII. An active filter and ten segment LED bargraph make tuning fast and easy. All programs, except Apple, are on program boards that plug directly into the computer.

Hamtext™, our new program, is available for the VIC-20 and Commodore 64, with all the features of Hamsoft™ plus the ability to save received information to disc or tape, variable buffer sizes, VIC printer compatibility, and much more. Our combination of hardware and software gives you the system you want, with computer versatility, at a reasonable price.

### Hamsoft™ Features

Split Screen Display  
1026 Character Type Ahead Buffer  
10 Message Ports-255 Characters each  
Status Display  
CW-ID from Keyboard  
Centronics Type Printer Compatibility  
CW send/receive 5-99 WPM  
RTTY send/receive 60, 67, 75, 100 WPM  
ASCII send/receive 110, 300 Baud

### Hamsoft™ Prices

Apple Diskette	\$29.00
Atari Board	\$49.95
VIC-20 Board	\$49.95
TRS-80C Board	\$59.95
TI-99 Board	\$99.95

### Hamtext™ Prices

VIC-20 Board	\$99.95
Commodore 64 Board	\$99.95



Suggested Retail \$169.95

For more information contact your local Kantronics Dealer or:  
Kantronics 1202 E. 23rd Street Lawrence, KS 66044

154

## 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

107

State  
of the art



by  
**K.V.G.**

### 9 MHz CRYSTAL FILTERS

MODEL	Appli- cation	Band- width	Poles	Price
XF-9A	SSB	2.4 kHz	5	\$53.15
XF-9B	SSB	2.4 kHz	8	72.05
XF-9B-01	LSB	2.4 kHz	8	95.90
XF-9B-02	USB	2.4 kHz	8	95.90
XF-9B-10	SSB	2.4 kHz	10	125.65
XF-9C	AM	3.75 kHz	8	77.40
XF-9D	AM	5.0 kHz	8	77.40
XF-9E	FM	12.0 kHz	8	77.40
XF-9M	CW	500 Hz	4	54.10
XF-9NB	CW	500 Hz	8	95.90
XF-9P	CW	250 Hz	8	131.20
XF910	IF noise	15 kHz	2	17.15

### 10.7 MHz CRYSTAL FILTERS

XF107-A	NB FM	12 kHz	8	\$67.30
XF107-B	NB FM	15 kHz	8	67.30
XF107-C	WB FM	30 kHz	8	67.30
XF107-D	WB FM	36 kHz	8	67.30
XF107-E	Pix/Data	40 kHz	8	67.30
XM107-S04	FM	14 kHz	4	30.15

Export Inquiries Invited.

Shipping \$3.50

### MICROWAVE MODULES VHF & UHF EQUIPMENTS

Use your existing HF or 2M rig on other VHF or UHF bands.

### LOW NOISE RECEIVE CONVERTERS

1691 MHz	MMk1691-137	\$224.95
1296 MHz	MMk1296-144	119.95
432/435	MMc432-28(S)	74.95
439-ATV	MMc439-Ch x	84.95
220 MHz	MMc220-28	69.95
144 MHz	MMc144-28	54.95

Options: Low NF (2.0 dB max., 1.25 dB max.), other bands & IF's available

### LINEAR TRANSVERTERS

1296 MHz	1.3 W output, 2M in	MM11296-144	\$339.95
432/435	10 W output, 10M in	MM1432-28(S)	269.95
144 MHz	10 W output, 10M in	MM1144-28	179.95

Other bands & IFs available.

### LINEAR POWER AMPLIFIERS

1296 MHz	10 W output	MML1296-10-L	\$ ask
432/435	100 W output	MML432-100	399.95
	50 W output	MML432-50-S	214.95
	30 W output	MML432-30-LS	189.95
144 MHz	100 W output	MML144-100-LS	254.95
	50 W output	MML144-50-S	214.95
	30 W output	MML144-30-LS	109.95
	25 W output	MML144-25	99.95

All models include VOX T/R switching.

"L" models 1 or 3W drive, others 10W drive.

Shipping: FOB Concord, Mass.

### ANTENNAS



#### 420-450 MHz MULTIBEAMS

48 Element	70/MBM48 15.7 dBd	\$75.75
88 Element	70/MBM88 18.5 dBd	105.50

#### 144-148 MHz J-SLOTS

8 over 8 Hor. pol	DB/2M	12.3 dBd	\$63.40
8 by 8 Vert. pol	DB/2M-vert	12.3 dBd	76.95
8 + 8 Twist	8XY/2M	9.5 dBd	ask

#### UHF LOOP YAGIS

1250-1350 MHz 29 loops	1296-LY 20 dBd	\$44.95
1650-1750 MHz 29 loops	1691-LY 20 dBd	55.95

Order Loop-Yagi connector extra:

Type N \$14.95, SMA \$5.95

Send 40¢ (2 stamps) for full details of all your VHF & UHF equipment and KVG crystal product requirements.



**si**

(617) 263-2145  
**SPECTRUM**  
**INTERNATIONAL, INC.**  
Post Office Box 1084  
Concord, MA 01742, U.S.A.

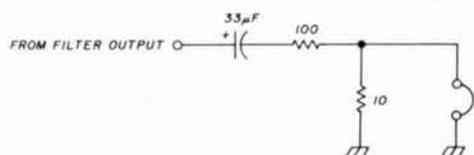


fig. 4. A circuit for coupling headphones to filter output.

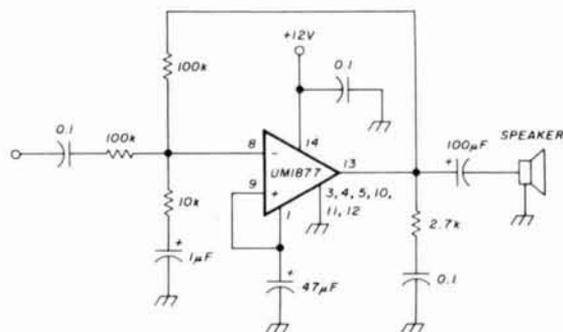


fig. 5. Unity-gain audio amplifier useful for driving a speaker from the filters.

passing the power supply near the chip, and all ground pins on the chip should be used.

### summary

Now that you have the basic blocks, you can string them together to form a variety of filter combinations. A simple one-evening project can be made out of the bandpass filter, either with or without the notch output. I built the filter with simple perforated-board techniques and housed it in a small case. Add the SSB filter if you work phone and, of course, provide some means of switching the filters in and out. The audio amplifier is necessary only if headphones alone don't quite suit you. With unity-gain stages, the output should be the same level as the input, so if the audio is taken from a speaker or headphone jack the level can be easily adjusted with the receiver volume control to a usable level.

Please send me an SASE with any inquiries concerning this article. For more information on op-amps in general, see reference 3.

### references

1. Aram Budak, "Passive and Active Network Analysis and Synthesis," Publisher Houghton-Mifflin, Boston, Massachusetts, 1974.
2. *Linear Databook*, National Semiconductor Corporation, Santa Clara, California, 1978.
3. Walter Jung, *IC Op-Amp Cookbook*, Howard W. Sams & Co., Indianapolis, Indiana, 1976.

ham radio

# COMPLETE READY-TO-USE SYSTEMS

## ATV TRANSMITTER/CONVERTER



**\$399**

- ★ High resolution and color video
- ★ 10 watts output
- ★ Broadcast standard sound
- ★ Tunable downconverter and preamp

**TC-1**

Connect to the antenna terminals of any TV set, add a good 450 MHz antenna, a camera and there you are . . . Show the shack, home movies, computer games, video tapes, etc.

## ATV DOWNCONVERTER



For those who want to see the ATV action before they commit to a complete station, the TVC-4 is for you. Great for public service setups, demos, and getting a buddy interested. Just add an antenna and a TV set tuned to CH. 2, 3, or 4 and plug in to 117 volts a.c. **\$89.00**

**TVC-4**

**TVC-4L extra low-noise version . . . \$105 delivered in USA**

## MODULES

**TXA5-4 Exciter/Modulator . . . . . \$89.00 ppd.**

Wired and tested module designed to drive PA5 10 watt linear amplifier. The 100 MHz crystal design keeps harmonics out of two meters for talk back. Video modulator is a full 8 MHz for computer graphics and color. Requires 13.8 VDC reg. @ 70 ma 80 mw output power. Tuned with crystal on 439.25, 434 or 426.25 MHz. Dual frequency model available . . . . . **\$115.00 ppd.**

**TVC-2 ATV Downconverter . . . . . \$55.00**

Stripline MRF 901 preamp and double balanced mixer digs out the weak ones and resists intermod and overload. Connects between UHF antenna and TV set. Output channels 2 or 3. Varicap tuner 420 to 450 MHz. Requires 12 to 18 VDC @ 20 ma. **Extrasensitive TVC 2L with bipolar preamp (.9 dB NF) . . . . . \$69.00 ppd.**  
**Supersensitive TVC 2G with GaAs Fet preamp ant. mount (.5 dB NF) . . . . . \$79.00 ppd.**

**FMA5 Audio Subcarrier Generator . \$29.00 ppd.**

Puts audio on your camera video just as broadcast does at 4.5 MHz. Puts out 1 V p-p to drive TXA5. Requires low Z mke, 150 to 600 Ω and 12 to 18 VDC @ 25 ma. Works with any transmitter with 5 MHz video bandwidth.

**PA5 10 Watt ATV Power Amplifier . \$89.00 ppd.**

The PA5 will put out 10 watts RMS power on sync tips when driven with 80 mw by the TXA5 exciter. 50 ohms in and out plus bandwidth for the whole band with good linearity for color and sound. Requires 13.8 VDC reg. @ 3 amps.

Call or write for our complete catalog of specifications, station setup diagrams, and optional accessories which include: antennas, modulators, test generators, cameras and much, much more. See Ch. 14 1983 ARRL Handbook.

TERMS: VISA or MASTERCARD by telephone or mail, or check or money order by mail. All prices are delivered in USA. Charge orders shipped within 24 hours. Personal checks must clear first.

(213) 447-4565 Charge card orders only

Let P.C. put you on the air and SAVE!

All four modules —

**Complete System price \$249.00**

SAVE \$13.00 over price if purchased individually

**P.C. ELECTRONICS** 2522 Paxson Lane

Tom W6ORG Maryann WB6YSS Arcadia, California 91006

## FIELD DAY TRANSCEIVERS

**RT-77/GRC-9**, portable 2-12 Mhz unit, 7 watts (AM), 15 W (CW) output. 11 tubes. Req. 580 V 100 ma, 6.6 V 2 amp, 120 V 45 ma, 1.5 V 500 ma, & 6.9 V 575 ma. 16x13x8", 35 lbs. sh. Used . . . **\$39.95**  
MANUAL . . . **\$8.50**

CONNECTORS \$4 ea w/set, pur.

**GN-58 HANDCRANK GENERATOR** w/legs & seat; powers RT-77 at reduced outputs 3.6 W (AM), 10 W (CW), 40 lbs. Used . . . **\$35.**

**RT-671/PRC-47**, 2-12 Mhz USB, CW; 100 watts max. Solid-state; Collins mfg. Req. 26 VDC inc. handset, antenna, other acces.; 180 lbs. sh. in transit case. Used-clean, **\$395.**

Prices F.O.B. Lima, O. • VISA, MASTERCARD Accepted. Allow for Shipping • Send for New FREE CATALOG '83 Address Dept. HR • Phone: 419/227-6573



## FAIR RADIO SALES

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

✓ 133

## FREE CATALOG HARD-TO-FIND PRECISION TOOLS

Lists more than 2000 items: pliers, tweezers, wire strippers, vacuum systems, relay tools, optical equipment, tool kits and cases. Send for your free copy today!

**JENSEN TOOLS INC.**

7815 S 46TH STREET PHOENIX, AZ 85040

✓ 151

## DIPOLE ANTENNA CONNECTOR



**HYE-QUE (HQ 1)** dipole connector has coax SO-239 socket molded into glass filled plastic body to accept coax PL 259 plug on feedline. Drip cap keeps coax fittings dry. Instructions included. Guaranteed. At your dealers or **\$5.95 postpaid**. Companion insulators \$1.25/pr.

✓ 117

**BUDWIG MFG. Co.**, PO Box 829, Ramona, CA 92065  
Ca. Res. add 6% Sales Tax

## 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.**

### QSO SERIES

each tape \$4.95 2/\$8.95 3/\$12.95

Here's the way to go for those planning to upgrade their present license to General or Extra Class. Both QSO tapes are reproductions of actual on-the-air CW contacts, similar in content to the FCC code exams. Both tapes are recorded at speeds faster than those encountered in the exams. Get the best practice for that all-important code test by mastering these tapes.

A 90 minute tape of 25 QSOs sent at 15 wpm.

HR-QSO-1

**\$4.95**

A 90 minute tape of 30 QSOs sent at 22.5 wpm.

HR-QSO-2

**\$4.95**

### PLAIN LANGUAGE TEXT SERIES

Now, there's an opportunity to practice copying code in plain language text, any time of the day. The PLT series is excellent for those who are learning code by the word method. These tapes can also be used to improve sending speed and accuracy by using the provided text and a code practice oscillator to send in time with the tape.

HR-PLT1 — \$4.95

HR-PLT2 — \$4.95

15 wpm code for 20 minutes

30 wpm code for 20 minutes

18 wpm code for 20 minutes

35 wpm code for 15 minutes

22 wpm code for 20 minutes

40 wpm code for 15 minutes

25 wpm code for 20 minutes

45 wpm code for 15 minutes

50 wpm code for 15 minutes

Please add \$1 for shipping.

## Ham Radio's Bookstore

Greenville, NH 03048

603-878-1441

# A PROVEN TOP-PERFORMER . . . . .

## AR-22 DIGITALLY SYNTHESIZED VHF FM RECEIVER

### FEATURES

- The smallest pocket-size receiver with full band coverage.
- Easy control and operation
- Super-Sensitivity . . . . 0.2uV 12dB SINAD
- Super-Selectivity . . . . 2 monolithic crystal filters and ceramic filter
- 450mW of clean and low audio distortion
- Low-stand-by current . . . 18mA
- Rechargeable NiCd battery pack

### SPECIFICATIONS

#### RECEIVER SYSTEM:

PLL frequency synthesized dual conversion superheterodyne

#### INTERMEDIATE FREQUENCY:

10.7MHz (1st. IF) and 455kHz (2nd. IF)

#### SENSITIVITY:

0.2uV across 50-Ohm at 12dB SINAD  
0.35uV at 20dB NQ

#### SELECTIVITY:

Better than 60dB EIA SINAD

#### INTERMODULATION RESPONSE:

Better than 65dB

#### SQUELCH SENSITIVITY:

0.2uV at threshold squelch, adjustable

#### FREQUENCY STABILITY:

± 10ppm over -10°C to +60°C

\*Complete specifications available on request

### 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)

All types of accessories included, \$170.00

To order direct include \$2.50 shipping and handling.  
From California add sales tax. Visa/MasterCard orders are welcomed. We will pay shipping and handling charge for all prepaid orders. **No C.O.D. please.**



## short circuits

### power supply

In the article "Dual Voltage Power Supply" (*ham radio*, March, 1983) there is an error on the schematic on page 35. The two outputs of power supply A are tied together at the voltmeter connections. This should not be. Also, at the top of the same schematic, resistor R24 had been labeled R2H.

### sideband transceiver

The following corrections should be made to the schematics and text of "15-meter Sideband Transceiver" (*ham radio*, March, 1983):

**fig. 1:** Change value of R26 from 100 to 10k ohms and value of R28 from 10k to 330 ohms.

**fig. 6:** Change component designations C66 to C60 and Q18 to Q24.

**fig. 7:** Add component values to R105 (100 ohms) and R106 (4700 ohms). R110 is a 2-watt resistor. Insert a resistor (R101, 330 ohms) in the collector lead of Q33.

**fig. 8:** Reroute emitter lead of Q25 to R88 and Q26 base junction. (It no longer goes directly to +10 volt bus.)

In the right-hand column on page 19, change component designations Q29 to Q20 and R66 to R67.

Be sure to check the artwork against the parts layout before beginning construction.

### repeater antenna beam tilting

In K7NM's article, "Repeater Antenna Beam Tilting" (May, 1983), eq. 2 should read as follows:

$$E_a = \frac{\sin n \left[ (180^\circ s) \cos \theta + \frac{d}{2} \right]}{n \sin \left[ (180^\circ s) \cos \theta + \frac{d}{2} \right]}$$

Eq. 4 should read this way:

$$A_h = \frac{0.0153P}{\sqrt{P}}$$

## ACE communications, inc.

3800 D WALNUT AVENUE, TUSTIN, CALIF. 92680 (714) 544-8281  
TELEX 855-306

✓ 101

## TS430S FILTER DEAL

For superior performance at lower cost, use top-rated 8-pole Fox Tango crystal filters to fill the optional spots in your rig. For example, our 1800 Hz FT2808 equivalent of the YK88SN has a 60/6dB shape factor of 1.7 compared with 2.0, a price of \$55 vs \$63, and squarer shoulders at the top with steeper skirts all the way down to more than -80dB.

For more pleasant audio use our 2100 Hz for SSB and/or our 6000 Hz for AM. For CW, our 400 Hz unit is better than the YK88C, while our 250 Hz is sharper than the YK88CN. The more you buy, the more you save!

### BIGGER IS BETTER!

Fox Tango filters are better because of their discrete crystal (not monolithic) construction. This makes them slightly larger than YK filters so they are patched into the circuit with short lengths of coax. Installation is easy — no drilling or circuit changes. Order with confidence.

### INTRODUCTORY PRICES — Complete Kit

- Any ONE filter . . . . . \$55
- Any TWO filters . . . . . \$100 (Save \$10)
- Any THREE filters . . . . . \$145 (Save \$20)

Includes all needed cables, parts, detailed instructions. Specify the type(s) desired.

AM — FT2811 (6000 Hz Bandwidth)

CW — FT2801 (250 Hz); FT2802 (400 Hz)

SSB — FT2808 (1800 Hz); FT2809 (2100 Hz)

Shipping \$3 per order. (\$5 air) FL Sales Tax 5%

### ONE YEAR WARRANTY

GO FOX-TANGO—TO BE SURE!

Order by Mail or Telephone.

AUTHORIZED EUROPEAN AGENTS

Scandinavia MICROTEC Makedien 26

3200, Sandefjord, NORWAY

Other INGOIMPEX, Postfach 24 49

D-8070, Ingoistadt, W. GERMANY



✓ 136

## FOX TANGO CORPORATION

Box 15944 H, W. Palm Beach, FL 33416  
(305) 683-9587

## TOLL FREE ORDERS • 1-800-826-5432

AK, HI, CA OR INFORMATION • (213) 380-8000

### 5 KEY ASSEMBLY

\$1.00 EACH

CONTAINS 5 SINGLE-POLE

NORMALLY OPEN SWITCHES

MEASURES 3 3/4" LONG

### 6 KEY ASSEMBLY

\$1.25 EACH

CONTAINS 6 SINGLE-POLE

NORMALLY OPEN SWITCHES

MEASURES 4 1/4" LONG

### 120V INDICATOR

NEON INDICATOR RATED

120 V 1/3 W MOUNTS IN

5/16" HOLE RED LENS

75¢ EACH

10 FOR \$7.00

100 FOR \$65.00

### MINIATURE

6 VDC RELAY

SUPER SMALL

SPDT RELAY.

GOLD COBALT

CONTACTS

RATED 1 AMP AT 30 VDC.

HIGHLY SENSITIVE. TTL

DIRECT DRIVE POSSIBLE.

OPERATES FROM 4.3 TO

6 V. COIL RES. 220 OHM

1 3/16" • 13/32" • 7/16"

AROMAT # RSD-6V

\$1.50 EACH

10 FOR \$13.50

### 13 VDC RELAY

CONTACT S.P.N.C.

10 AMP @ 120 VAC

ENERGIZE COIL TO

OPEN CONTACT

COIL: 13 VDC 650 OHMS

SPECIAL PRICE \$1.00 EACH

## SEND FOR FREE 40 PAGE CATALOG!

### MINIATURE TOGGLE SWITCHES

ALL ARE RATED 5 AMPS @ 125 VAC

#### S.P.D.T. (on-on)

P.C. STYLE, NON-THREADED BUSHING

75¢ EACH

10 FOR \$7.00

#### S.P.D.T. (on-on)

SOLDER LUG TERMINALS

\$1.00 EACH

10 FOR \$9.00

100 FOR \$80.00

#### S.P.D.T. (on-off-on)

SOLDER LUG TERMINALS

\$1.00 EACH

10 FOR \$9.00

100 FOR \$80.00

#### S.P.D.T. (on-off-on)

NON-THREADED BUSHING

P.C. STYLE

75¢ EACH

10 FOR \$7.00

#### S.P.D.T. (on-on)

P.C. LUGS, THREADED BUSHING

\$1.00 EACH

10 FOR \$9.00

100 FOR \$80.00

#### D.P.D.T. (on-on)

SOLDER LUG TERMINALS

\$2.00 EACH

10 FOR \$19.00

100 FOR \$180.00

## ALL ELECTRONICS CORP.

905 S. VERMONT • P.O. BOX 20406 • LOS ANGELES, CA 90006

- QUANTITIES LIMITED
- MINIMUM ORDER \$10.00
- USA \$2.50 SHIPPING
- NO C.O.D.
- FOREIGN ORDERS INCLUDE SUFFICIENT SHIPPING
- CALIF. RES. ADD 6%

✓ 103

# The T.E.L. Model CS-1100 Total Communication System.

AT LAST! There is a state-of-the-art CW/RTTY/ASCII communications system that meets the sophisticated operator's demands for a quality product.

Feature	Benefit
CMOS uprocessor based	No RFI problems.
Membranes Switch front panel	Insures reliability.
16 chr Intelligent LED display	Readable to 12 feet.
Super Narrow Filters	No tuning required.
Built-in 110 VAC supply	No extras to buy.
500 chr Buffer (all modes)	Review received text.
Parallel Data Port	Connect to any printer or computer.

CW Operation: Send/Rcv 5-90 wpm with Automatic Speed Tracking, Four, 99 chr memories with ability to insert text, will key any rig.

RTTY/ASCII: Receive at 60, 67, 75, 100 wpm and 110, 300 Baud with One Button Speed Selection.

A 30 day unconditional guarantee and 1 year parts/labor warranty assure satisfaction. Dealer inquiries invited. Send for a free data package and comparison sheet.



**Random Access Inc.**  
P.O. Box 61117 Raleigh, N.C. 27661

# YOU'LL NEVER GET A BETTER DEAL

## HUSTLER ANTENNAS

SF2 - "Buck Buster" 5/8" Wave  
2 Meter Antenna w/3/8 x 24"  
Threaded Base - 3dB gain **\$895**

CG144  
5.2dB gain **\$2395**  
Collinear  
w/3/8 x 24"  
Threaded Base

HOT - EASY ON/OFF  
TRUNK MOUNT  
with 3/8 x 24" Swivel Ball  
for CG144 & SF-2

G6144 - 6dB  
Base Antenna **\$6850**



G7144 - 7dB  
Commercial  
Grade Base Antenna **\$9800**

### And many other Hustler Antennas & Mounts

BBL144 .....	25 <sup>95</sup>	MRK-1 .....	13 <sup>75</sup>
BBL144 .....	35 <sup>00</sup>	SFM .....	24 <sup>75</sup>
BBL440 .....	24 <sup>75</sup>	THF .....	13 <sup>95</sup>
HLM .....	13 <sup>95</sup>	UHT-1 .....	8 <sup>95</sup>

**CECO STOCKS THE ENTIRE HUSTLER  
VHF/UHF & COMMERCIAL LINE  
DEALER INQUIRIES INVITED**



2115 AVENUE X  
BROOKLYN, N.Y. 11235  
(212) 646-6300  
(800) 221-0860  
TELEX: 235125

✓ 120

✓ 175

MAKE  
PROFESSIONAL LOOKING  
P.C. BOARDS FAST  
AND EASY

• SENSATIONAL  
• REVOLUTIONARY  
• FANTASTIC

# STAMP-IT ETCH-IT



Reduces Printed Circuit Board Art Work From 2 Hours to 10 Min

Simple as A.B.C.

A. Stamp Components on P.C. Board. B. Use Pen to Interconnect Lines. C. Etch Board.

Are you tired of the hours of small, detailed eye-straining art work that goes into making printed circuit boards? "STAMP IT, ETCH IT" is introducing a NEW product called "STAMP IT, ETCH IT" Kit. This Kit will take the tedious art work and many tiresome hours out of printed circuit board preparation in just a few short minutes you have a professional looking etched printed circuit board ready for drilling!

The "STAMP IT, ETCH IT" Kit is exactly as the name implies. Following the step by step simple instructions, you can have a printed circuit board and have saved hours of frustration. As easy as you use a rubber stamp to stamp messages on paper, you stamp your component connections on copper clad printed circuit boards.

In your "STAMP IT, ETCH IT" kit we supply all component stamps shown in SE-2 Kit. In the SE-2 kit we also have resist ink enough for months and months of experimenting, ink stamp pad, resist pen, and etching containers. The most revolutionary item in your "STAMP IT, ETCH IT" Kit is... The Fool Proof System of etching your printed circuit boards.

With our kits and our etching containers, you are able to etch a printed circuit board as fast as bubble etching machinery and the results are as good or better.



AT LAST  
COMPLETE LINE OF  
STAMP-IT ETCH-IT DIP IC SOCKETS  
A DREAM COME TRUE  
No Previous PCB Experience Necessary

IC-40	IC-36	IC-28	IC-8										
16 PIN DIP IC SOCKET	16 PIN DIP IC SOCKET	16 PIN DIP IC SOCKET	8 PIN DIP IC SOCKET										
IC-24	IC-18	IC-16	IC-14										
16 PIN DIP IC SOCKET	16 PIN DIP IC SOCKET	16 PIN DIP IC SOCKET	16 PIN DIP IC SOCKET										
<table border="1"> <thead> <tr> <th>PRICE EACH</th> <th>FOR COMPLETE KIT ORDER</th> </tr> </thead> <tbody> <tr> <td>16</td> <td>\$29.95</td> </tr> <tr> <td>36</td> <td>19.95</td> </tr> <tr> <td>28</td> <td>19.95</td> </tr> <tr> <td>8</td> <td>19.95</td> </tr> </tbody> </table>				PRICE EACH	FOR COMPLETE KIT ORDER	16	\$29.95	36	19.95	28	19.95	8	19.95
PRICE EACH	FOR COMPLETE KIT ORDER												
16	\$29.95												
36	19.95												
28	19.95												
8	19.95												
EB-22 22 PIN PCB EDGE CONNECTOR													

RAINBOW INDUSTRIES MADE UP A SE-D 400 KIT FOR THE PRINTED CIRCUIT BOARD MAKER WHO WANTS EVERYTHING - And Just For You

One Complete Package Pictured Below

**SE-2 KIT CONTAINS:**

- CONNECTOR FINGERS
- 16 PIN DUAL IN LINE IC SOCKET
- 10 PIN ROUND IC SOCKET
- 8 PIN ROUND IC SOCKET
- TO-5 TRANSISTOR SOCKET
- TO-18 TRANSISTOR SOCKET
- LARGE & SMALL DONUT PAD
- RESIST INK
- INK PAD
- RESIST PEN

**PLUS**

**\$12.95**

ONLY

PLUS 1 LB. POSTAGE

**ADDITIONAL STAMPS**

Bread board stamps for all integrated circuits. Great for experimenters.

Only \$2.95 each or all four \$9.95

#1 DUAL INLINE	#2 FLAT PACK
#3 8-PIN ROUND	#4 10-PIN ROUND

- RESIST INK 95c per bottle
- RESIST PEN ea. 95c
- INK PAD ea. \$1.15
- Etching Containers 10 for 95c

**SE-2 KIT**

- CONNECTOR FINGERS
- 16 PIN DUAL IN LINE IC SOCKET
- 10 PIN ROUND IC SOCKET
- 8 PIN ROUND IC SOCKET
- TO-5 TRANSISTOR SOCKET
- TO-18 TRANSISTOR SOCKET
- LARGE & SMALL DONUT PAD
- RESIST INK
- INK PAD
- RESIST PEN

**PLUS**

**SE-D8 KIT**

- 16 PIN DIP IC SOCKET

**ONE COMPLETE SE-D8 KIT**

**PLUS**

**SE-B3 KIT**

- 16 PIN DIP IC SOCKET

**ALL THESE EXTRAS**

- 16 Pin Socket of Ink
- 1 Bottle of Ink Stamp and etching container
- 1 Ink Stamp Pen
- 1 Ink Pad
- 1 Donut Pad
- 1 Donut Pad

**ALL FOR ONLY \$54.95**

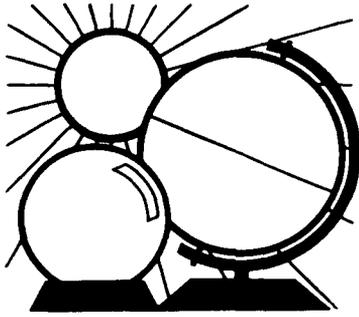
ASK FOR SE-D400 KIT

We will accept telephone orders for Visa & Mastercard  
No C.O.D. Orders

To Order Call 800-428-3500 317-291-7262  
Please add Sufficient Postage  
6254 La Pas Trail  
Indianapolis, Indiana 46268

\$5.00 Minimum Order  
PLEASE ADD POSTAGE

✓ 131



# DX FORECASTER

Garth Stonehocker, KØRYW

## last-minute forecast

The conditions this July will probably be considerably different from last year's. The summer months — normally a season of low maximum usable frequencies (MUFs) will bring even lower MUFs because of an advanced cycle smoothed sunspot number (SSN) as low as 60. Mid-latitude, zero-distance MUFs (foF2-local noon) show a nearly linear variation with SSN, with 5.5 MHz, 8 MHz, and 11 MHz corresponding to SSNs of 10, 60, and 120 respectively.

July's forecast on the higher hf bands (10-30 meters) is for good long-skip conditions occurring the first and last weeks of the month and decreasing at other times. High and low latitude short-skip openings are expected to increase through sporadic E propagation during disturbed periods around the 5th, 10th, 21st, and 31st of the month. The lower bands (30-160 meters) should have the best nighttime DX during the in-between non-disturbed periods.

A full moon occurs on the 25th and perigee on the 11th of the month. The Aquarid meteor shower starts

the 18th, peaks the 28th, and lasts until August 7th (all dates approximate). The radio-echo rate at maximum is about 34 per hour.

## fading — QSA and QSB

Carefully observing daily DX signal levels will provide information on the state of the ionosphere and enable near future forecasting. Signal strength variations, fading, either decrease (attenuation) or increase (focusing), and possibly signal distortion will be heard. Fading is characterized by the duration of the interval between fades and the depth or decrease in amplitude of the signal during those periods. Most of the attenuation occurs as the signal travels through the D region (60-80 kilometer height) of the ionosphere. However, significant variations also occur at the area of reflection in the ionosphere, with signal levels modulated by geomagnetic field variations.

The following table lists four common types of fading conditions with the first two related to D region travel and the latter two occurring during layer reflection:

type of "fade"	cause	when/where	duration
SID	flare-ultraviolet and X-rays	daylight	1-2 hours
PCA shortwave	flare-proton particles solar wind-electrons (explained next month)	polar daylight auroral zone (night)	1-3 days 2-5 nights
MUF failure	decreasing ionosphere (explained next month)	PM	½ hour

Solar radiation (ultraviolet and X-ray) produces D region absorption or attenuation, an attenuation that varies with the part of the sunspot cycle we're in, the time of year, and time of day. Signal level changes are slow and stable, except during solar flare induced sudden ionospheric disturbances (SID). These signal fades occur within 8 minutes on the sunlit propagation paths. The attenuation is a function of the cosine of the zenith angle to the sun. The typical time scale is a 10 to 20 minute decrease to maximum attenuation (lowest signal) and logarithmic return to the normal value within about one-half hour to two hours. The overall time (SID duration) is roughly related to flare size (importance or type) and radio flux (0.3 centimeter) burst shape and length.

Polar cap absorption (PCA) is also a D region slowly-varying attenuation effect produced inside of the auroral zone (polar cap) by protons arriving within an hour's time from certain solar flares. The attenuation is greater during daylight than at night. Therefore, the signal recovers somewhat each night then decreases during the day again, but shows improvement each day. The overall PCA attenuation duration is one to three days before normal propagation conditions are achieved again.

Both of these D region events occur mainly during the sunspot cycle peak and consequently should not bother us for a while. The shortwave fade and MUF failure are problems that can occur any time during the solar cycle and particularly during the solar cycle minimum. More about them next month.

## band-by-band forecast

Ten and fifteen meters will have long-skip conditions in the afternoon during the peak times of the 27-day solar maximum. Otherwise, look to sporadic E short-skip and multihop openings around local noon for DX on these bands. Transequatorial evening openings do not usually occur in the summertime.

**WESTERN USA**

GMT	PDT	N	NE	E	SE	S	SW	W	NW
0000	5:00	20	20	30	15	20	10	10	15
0100	6:00	20	20	30	15	20	10	10	15
0200	7:00	20	20	30	15	20	10	10	15
0300	8:00	20	20	30	15	20	10	10	20*
0400	9:00	20	20	40*	15	20	10	10	20
0500	10:00	20	20	30	20	20	10	10	20
0600	11:00	20	20	20	20	20	10	15	15
0700	12:00	20	20	20	20	20	15*	15	20
0800	1:00	—	—	20	20	20	15	15	20
0900	2:00	—	—	20	20	30	15	15	20
1000	3:00	—	—	—	—	30	15	20	20
1100	4:00	—	—	—	—	30	20	20	20
1200	5:00	—	—	—	—	—	20	20	20
1300	6:00	—	—	—	—	—	20	20	—
1400	7:00	—	—	20	15	—	20	—	—
1500	8:00	20	20	20	15	—	20	—	—
1600	9:00	20	20	20	15	—	20	—	—
1700	10:00	20	20	20	15	30	20	20	—
1800	11:00	20	20	20	15	20	20	20	—
1900	12:00	20	20	20	15	20	15	20	—
2000	1:00	20	20	20	15	20	15	15	20
2100	2:00	20	20	20	15*	20*	15*	15	20
2200	3:00	20	20	20	15*	15*	15*	15*	20
2300	4:00	20	20	20	15	15	10	15*	20

**MID USA**

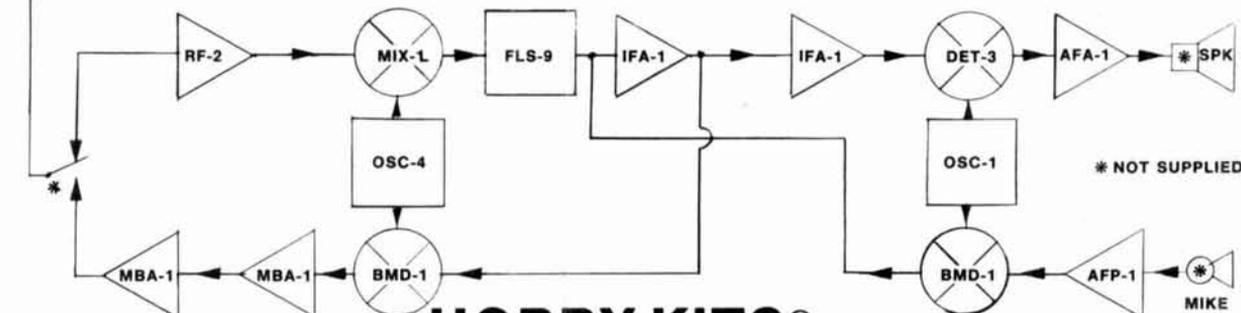
MDT	N	NE	E	SE	S	SW	W	NW
6:00	20	20	30	15	20	15*	15	15
7:00	20*	20	30	15	20	15*	15*	20*
8:00	15	20	30	15	30	15*	15*	20
9:00	20	20	30	15	30	15	15	20
10:00	20	20	40*	15	30	15	15	20
11:00	20	20	30	20	30	15	15	20
12:00	20	20	20	20	30	15	15	20
1:00	—	20	20	20	30	15	20	20
2:00	—	20	20	20	30	20	20	20
3:00	—	20	20	20	30	20	20	20
4:00	—	20	20	20	30	20	20	20
5:00	—	—	—	20	—	20	20	—
6:00	—	—	—	20	—	—	—	—
7:00	—	—	—	—	—	—	—	—
8:00	20	20	20	15	—	20	—	—
9:00	20	20	20	15	—	20	—	—
10:00	20	20	20	15	—	20	—	—
11:00	20	20	20	15	20	20	—	—
12:00	20	20	20	15	20	20	—	—
1:00	20	20	20	10	20	15	15	20
2:00	—	20	20	10	20	15	15	20
3:00	—	20	20	10	20	15	15	20
4:00	—	20	20	15	20	15	15	20
5:00	—	20	20	15	20	15	15	20

**EASTERN USA**

CDT	EDT	N	NE	E	SE	S	SW	W	NW
7:00	8:00	20*	20	30	15	30	15	15	20
8:00	9:00	20	20	30	15	30	15	15	20
9:00	10:00	20	20	30	15	30	15	15	20*
10:00	11:00	20	20	30	15	30	15	15	20
11:00	12:00	20	20	40*	15	30	15	15	20
12:00	1:00	20	20	30	15	30	15	20	20
1:00	2:00	—	20	20	20	30	20	20	20
2:00	3:00	—	20	20	20	30	20	20	20
3:00	4:00	—	20	20	20	30	20	20	20
4:00	5:00	—	20	20	20	30	20	20	20
5:00	6:00	—	20	20	20	—	20	20	—
6:00	7:00	—	—	20	20	—	20	—	—
7:00	8:00	—	—	—	20	—	—	—	—
8:00	9:00	—	—	—	20	—	—	—	—
9:00	10:00	20	20	15	15	—	20	—	—
10:00	11:00	20	20	15	15	—	20	—	—
11:00	12:00	20	20	15	15*	20	20	—	—
12:00	1:00	20	20	15	10	20	20	—	—
1:00	2:00	20	15	15	10	20	20	—	—
2:00	3:00	—	15	15	10	20	20	—	—
3:00	4:00	—	15	15	10	20	15	15	20
4:00	5:00	—	20*	20	10	20	15	15	20
5:00	6:00	20	15	20	15*	20	15	15	20
6:00	7:00	20	15	20	15*	20	15	15	20

\*Look at next higher band for possible openings.

# BUILD THIS SSB TRANSCEIVER FROM OUR MODULES



## HOBBY KITS®

EXPERIMENT — LEARN ELECTRONICS; BUILD AND DESIGN YOUR OWN AM, FM, CW, OR SSB RECEIVERS, TRANSMITTERS AND ETC. WITH OUR MINI-LINEAR CIRCUIT KITS

All kits Come Complete With Etched and Drilled Circuit Boards and All Parts Needed To Function As Described

AFA-1 AUDIO AMP, LM 380 1-2 Watts 4-16 OHM Output .....	\$4.95	MBA-1 FREQ. MULT. Tuned Output Buffer-Mult-Amplifier To 250 MHZ .....	\$5.95
AFP-1 AUDIO PREAMP, Dual Audio Preamp — For Mike Etc. ....	\$3.95	OSC-1 CRYSTAL OSC. 100 KHZ — 20 MHZ Not Tuned .....	\$3.95
BMD-1 BAL. MIX, LM 1496 Mixer — S.B. Modulator Tuned Output .....	\$9.95	OSC-2 CRYSTAL OSC. Ov. 18-200 MHZ Tuned Output .....	\$4.95
DET-1 AM DET. Am Envelope Detector With AGC Output .....	\$3.95	OSC-3 VARIABLE FREQ OSC Varactor Tuned 455KHZ .....	\$5.95
DET-2 FM DET. LM 3065 FM Detector (455 KHZ or 4-11 MHZ) .....	\$7.95	OSC-4 VARIABLE FRFY OSC Varactor Tuned 4-11 MHZ .....	\$5.95
DET-3 SSB DET. LM 1496 SSB Detector (Needs OSC-1 or OSC-4) .....	\$9.95	PSV-1 POWER SUPPLY LM 723 With Pass Transistor, 3 amps max .....	\$7.95
IFA-1 IF AMP, CA 3028 30 DB Gain, Optional AGC (455 KHZ or 9-11 MHZ) .....	\$6.95	PLL-2 TONE DETECTOR LM567 PLL Tone Detector .....	\$5.95
FLS-9 SSB FILTER 9 MHZ/2.1 KHZ BW with USB XAL for OSC-1 .....	\$49.95	RF/MIX-1 RF-AMP/MIXER CA 3028 — Tuned RF AMP/Mixer 1-100 MHZ .....	\$7.95
IFA-2 IF AMP, CA 3028 30 DB Gain 1-100 MHZ Optional AGC .....	\$6.95	RF/MIX-2 RF-AMP/MIXER 3N204 Tuned RF AM/Mixer 1 — 250 MHZ .....	\$7.95

MANY OTHER MODULES AVAILABLE

ADD \$2.00 SHIPPING & HANDLING

MORNING DISTRIBUTING CO.

P.O. BOX 717, HIALEAH, FLA. 33011

✓ 162

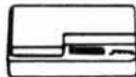
COMPLETE SET OF MODULES TO BUILD A  
1-WATT SSB/CW MONO-BAND TRANSCEIVER  
LESS CASE, CONTROLS, PWR SUPPLY  
(12 VDC), SPK AND MIKE

\$149.95 (Specify Band)

SEND \$2.00 FOR FULL CATALOG  
WITH CIRCUIT DIAGRAMS AND  
TYPICAL RECEIVER AND  
TRANSMITTER HOOK-UPS

## CABLE TV CONVERTERS VIDEO ACCESSORIES

BUY DIRECT & SAVE



**40 CHANNEL CONVERTER**  
**\$38** Regular \$69

Advanced Solid State design and circuitry allows you to receive mid & super band channels. Restores programming to Video Recorders.



**36 CHANNEL REMOTE CONTROL CABLE CONVERTER**  
**\$88.00**

**DIAMOND D-56 WIRELESS THE ULTIMATE CABLE T.V. CONVERTER**



**56 CHANNEL INFRARED REMOTE CONTROL**  
**\$139.00**

✓ 130

Send \$1 for Complete Catalog  
VISA • MASTERCARD • COD

**DIRECT VIDEO SALES**

P.O. BOX 1329  
JEFFERSONVILLE, INDIANA 47130

CALL

1-812-282-4766

## ALL BAND TRAP ANTENNAS!



PRETUNED-ASSEMBLED ONLY ONE NEAT SMALL ANTENNA FOR ALL BANDS! EXCELLENT FOR APARTMENTS! IMPROVED DESIGN!

FOR ALL MAKES AMATEUR TRANSCEIVERS! GUARANTEED FOR 2000 WATTS SSB INPUT FOR NOVICE AND ALL CLASS AMATEURS!

COMPLETE 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. 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 BANDS! NO BALUNS NEEDED!

80-40-20-15-10 -- 2 trap - 104 ft. - Model 998BUC . \$89.95  
40-20-15-10 -- 2 trap -- 54 ft. - Model 1001BUC . \$88.95  
20-15-10 meter - 2 trap - 26 ft. - Model 1007BUC . \$87.95

SEND FULL PRICE FOR POSTPAID INSURED. DEL. IN USA. (Canada is \$5.00 extra for postage - clerical - customs etc.) or order using VISA - MASTER CARD - AMER. EXPRESS. Give number and ex. date. Ph 1-308-238-5333 9AM - 6PM week days. We ship in 2-3 days. ALL PRICES. MAY 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-7

✓ 193

Kearney, Nebraska, 68847

NEW! NEW! NEW!

## RADIO ELECTRONICS BUYERS GUIDE

A Guide To  
Radio and Electronic Parts  
Sold By  
Retail Mail Order



Suppose you could buy a book that would quickly direct you to nearly any component you will ever need to complete your electronic projects! Maybe you want to build a circuit shown in a magazine construction article or one that you invented yourself! The Radio Electronics Buyers Guide is the book that will do the job! This guide catalogs radio, antenna, computer, electronic, microwave, and mechanical parts, from 75 mail order companies willing to sell in small quantities to YOU! The address, phone number, and ordering information is included for each supplier. Several sell military and surplus parts. Order your copy today and put excitement back into your circuit building. \$6.95 postage paid. Fast Response. Overseas orders please add \$1.50 for airmail.

HALLWARD PRODUCTS

39 Sunset Ct., St. Louis, MO 63121 ✓ 140

Twenty and thirty meters will be open all day and much of the night. If twenty does not stay open through the night, thirty probably will. Sporadic E short-skip is also often effective on these bands throughout the day. Propagation paths to most areas of the world are viable in a sequence that follows the sun's journey across the sky: east in the morning, south during mid-day, and west during the evening.

Thirty and forty meters will be the main nighttime DX bands this time of year, though long-skip distances will be shorter. Sporadic E openings are possible during more of the day into pre-sunrise and after sunset. With thunderstorm-induced static levels high in the evening, look to pre-dawn periods for best results.

Eighty and one-sixty meters are difficult DX bands this time of year. Short nights and high noise levels hamper DX operation with eighty having slightly lower noise levels. Most useful openings may occur during the pre-dawn hours. Sporadic E propagation signal strengths may exceed the static level near sunrise and sunset.

ham radio

# technical forum

Welcome to the ham radio Technical Forum. The purpose of this feature is to help you, the reader, find answers to your questions, and to give you a chance to answer the questions of your fellow Radio Amateurs. Do you have a question? Send it in!

Each month our editors will select the best answer received to a question previously posed in Technical Forum. We'll send the writer a book from our Bookstore as a way of saying thanks.

## measuring inductances

In February, 1983, Technical Forum published a request from K9EBA for information on the measurement of low values of inductance.

Several years ago the San Bernardino Microwave Society addressed this problem and came up with a simple circuit for measuring small values of inductance. It was published as a NASA Tech Brief. This circuit used the parts on hand at the time. The circuit works well and has been duplicated by several experimenters. It measures inductances between 30 nH and 30  $\mu$ H. This is not the only way the circuit can be implemented, nor even the best way, but it is one method that works.

The only trick in building the circuit is to minimize the stray shunt capacity across the unknown inductance. I used a 1-inch hole, with a 4-40 (M3) screw in the center and a thin sheet of plastic to support it. Fiber shoulder washers for the unknown terminal have too much stray capacity, but other than this, the circuit is straightforward and should pose no problems. — **Richard B. Kolbly, K6HIJ.**

Ed. note: An SASE to ham radio will bring the interested reader a copy of the NASA Tech Brief and associated technical support package describing the direct-reading inductance meter.

## impedance matching

I wound an rf impedance matching transformer on an iron powder toroid core (T225-2 mix) for a 50-ohm to 300-ohm transformation. I used a turns ratio of just under 2.5 to 1; that is, I wound seventy-three turns of No. 20 Formvar enamel wire next to the toroid core (300-ohm winding) and thirty turns of No. 16 Teflon-covered wire on top of it (50-ohm winding). There is more than one inch of empty core space between the ends of the high-impedance winding. The thirty turns of the low-impedance winding are centered over the middle of the seventy-three-turn winding. It is wound in the same direction and covers about half of the circumference of the toroid.

I tried to feed a few watts of rf power into a 300-ohm carbon resistor attached to the 300-ohm winding as a test on 29 MHz. It failed completely. It would not load up and had an SWR of over 10:1. I then checked the impedance of the low-impedance winding with an rf noise bridge (with the 300-ohm resistor still connected to the seventy-three-turn winding). I found that the impedance was indeed between 50 and 60 ohms resistive, but it had a very high capacitive reactive component of 60 to 70 pF.

Does anyone have any explanation of this result? — **Joseph Neiman, WB2NTQ.**

## static mystery

Over the past thirty-seven years of shortwave listening I have observed a steady increase of that hammering and hissing noise called "rain static." I do not remember a single incident of this phenomenon while operating in Switzerland from 1946 to 1948.

The first time I encountered it was in late 1948 in the vicinity of Cleveland, Ohio. At the time I guessed that the Cleveland weather conditions might be somehow different from Swiss weather conditions.

Through 1949 and 1950 I got used to rain static in New Jersey. When I returned to Switzerland I found things quiet again no matter how heavy the rain. But by about 1955 I began to notice subtle signs of Swiss rain static which appeared, through the years, more frequently and more intensively.

At present about forty percent of all medium-strength rainfalls here cause rain static, and the amount seems to be increasing.

It is known that split water droplets can become charged, probably by a kind of tribo-electric effect. If such droplets hit antenna elements, charge compensation by the antenna could account for the observed receiver noise. So the question remains, why was the effect not observed in Switzerland before 1955, but already encountered in Ohio by 1948 and in New Jersey shortly thereafter?

Could there be some connection with air pollution caused by industry and automobile traffic, thus enhancing charge separation of water droplets?

Not knowing enough about electrostatics and electrochemistry, let me present this problem to you and your readers in the hope that someone might provide a physical model or references to published work.

Are there any effective countermeasures which could eliminate this kind of interference? — **Bruno Binggeli, HB9FU.**



*Ham Radio's guide to help you find your loc*

## California

**C & A ELECTRONIC ENTERPRISES**  
22010 S. WILMINGTON AVE.  
SUITE 105  
CARSON, CA 90745  
213-834-5868  
Not The Biggest, But The Best —  
Since 1962.

**FONTANA ELECTRONICS**  
8628 SIERRA AVENUE  
FONTANA, CA 92335  
714-822-7710  
714-822-7725  
The Largest Electronics Dealer in San  
Bernardino County.

**JUN'S ELECTRONICS**  
3919 SEPULVEDA BLVD.  
CULVER CITY, CA 90230  
213-390-8003  
619-463-1886 San Diego  
800-882-1343 Trades  
The Home of the One Year Warranty  
— Parts at Cost — Full Service.  
Habla Espanol

**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  
800-441-7008  
Icom, Ten-Tec, DenTron, Yaesu,  
Azden, Santec, KDK, 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  
Your complete Amateur Radio and  
Computer Store.

## Illinois

**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;  
9:30-8:00 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.

## Kentucky

**L & S RADIO**  
307 McLEAN AVENUE  
HOPKINSVILLE, KY 42240  
502-885-8071  
Ten-Tec, Azden, Ameritron Sales and  
Service.

## Maryland

**THE COMM CENTER, INC.**  
LAUREL PLAZA, RT. 198  
LAUREL, MD 20707  
800-638-4486  
Kenwood, Drake, Icom, Ten-Tec,  
Tempo, Microlog, AEA, Ameritron.

## 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.

## 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  
Dale Porray "Squeak," AD7K  
Outside Nev: 1 (800) 634-6227

**JUN'S ELECTRONICS**  
460 E. PLUMB LANE — 107  
RENO, NV 89502  
702-827-5732  
Outside Nev: 1 (800) 648-3962  
Icom — Yaesu Dealer

## New Jersey

**RADIOS UNLIMITED**  
P. O. BOX 347  
1760 EASTON AVENUE  
SOMERSET, NJ 08873  
201-469-4599  
800-526-0903  
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.

**Dealers:** *YOU SHOULD BE HERE TOO!*  
*Contact Ham Radio now for complete details.*

# nateur Radio Dealer

## 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,  
Ten-Tec, 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  
Featuring Kenwood and all other  
Ham gear. Authorized sales and ser-  
vice. Shortwave headquarters. Near  
I-270 and airport.

## 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.

### THE VHF SHOP

BOX 349 RD 4  
MOUNTAINTOP, PA 18707  
717-868-6565  
Lunar, Microwave Modules, ARCOS,  
Astron, KLM, Tama, Tonna-F9FT,  
UHF Units/Parabolic, Santec, Tokyo  
Hy-Power, Dentrion, Mirage,  
Amphenol, Belden

## Texas

**MADISON ELECTRONICS SUPPLY**  
1508 McKINNEY  
HOUSTON, TX 77010  
713-658-0268  
Christmas?? Now??

## 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.

## 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

# QUALITY SPECIALS

## WIDEBAND RF TRANSFORMERS

10 KHz to 800 MHz MICROMINIATURE					
RATIO	MODEL	PRICE	MODEL	PRICE	
1:1	T1 1	\$4.95	TMO 1:1	\$8.95	
2:1	T2 1	\$4.95	TMO 2:1	\$8.95	
4:1	T4 1	\$4.95	TMO 4:1	\$8.95	
9:1	T9 1	\$5.45	TMO 9:1	\$8.45	
16:1	T16 1	\$5.95	TMO16:1	\$8.45	

T MODELS ARE PLASTIC. TWO MODELS ARE HERMETICALLY SEALED METAL CASES FOR GOOD  
EMI SHIELDING. NEW FROM MINI CIRCUIT LABS

## FERRITE BEADS

HOLE DIAMETER OR EQUIV. WIRE GAUGE	MATERIAL TYPES	PRICE
18 GAUGE	A, B, C	\$0.15
16 GAUGE	A, B	.20
12 GAUGE	A, B	.25
1.87 inch (100ohm)	A, B	.50
2.40 inch (100ohm)	B	.70
3.40 inch (100ohm)	E	.75
22 GAUGE HOLES IN SPECIAL 6 HOLE BEAD	B, C	.25
.128 inch BEAD MOUNTED ON 18 AXIAL WIRE LEADS (SOLDERABLE)	B	.20

## BALUN CORES

2 HOLE		
HOLE DIAMETER OR EQUIV. WIRE GAUGE	MATERIAL TYPES	PRICE
22 GAUGE	A, B, E	\$0.25
14 GAUGE	A, B, D	.50
8 GAUGE	D, E	.95

4 HOLE		
SPECIAL 4 HOLE CORE 18 GAUGE HOLE SIZE		PRICE
	D	.60

ORDER BY SPECIFYING HOLE SIZE AND MATERIAL DESIRED

MATERIAL TYPE	BEST USE IN TUNED CIRCUIT	GENERAL EMI ATTENUATION APPLICATIONS
TYPE A	100KHz to 1MHz	BL. 100-40MHz
TYPE B	100KHz to 1MHz	40MHz to 200MHz
TYPE C	100KHz to 4MHz	ABOVE 200 MHz
TYPE D	1MHz to 10MHz	ABOVE 200 MHz
TYPE E	200KHz to 10MHz	ABOVE 200 MHz

SEND FOR FREE  
CATALOG OF NEW DEVICES

**GOLDSMITH  
SCIENTIFIC  
CORPORATION**

P.O. BOX 318H, COMMACK, NY 11725

PHONE ORDERS WELCOME—(516) 979-7944

MASTER CARD AND VISA ACCEPTED

NEW YORK STATE RESIDENTS ADD SALES TAX  
POSTAGE—ADD 5% PLUS \$1.50 INSURANCE. C.O.D. \$2.00 EXTRA  
AVAILABILITY OF CERTAIN ITEMS MAY BE LIMITED.

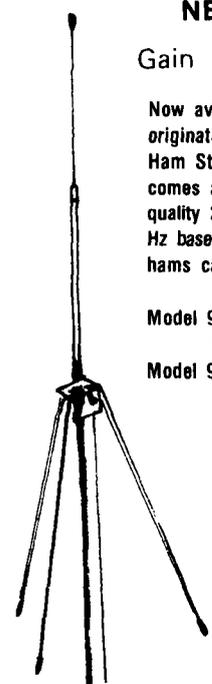


NEW!

Gain 6 DB

Now available from the  
originator of 75-10 meter  
Ham Stick Mobile Whips  
comes a professional  
quality 2 meter and 220m  
Hz base station at a price  
hams can afford.

Model 9040  
220 MHz 27.95  
Model 9201  
2 meter 28.95



**WINTENNA, INC.**  
911 AMITY ROAD  
ANDERSON, S.C. 29621  
(800) 845-9724

**TUBES, SEMICONDUCTORS, IC'S  
DIODES AT SUPER LOW PRICES  
IN DEPTH INVENTORY  
EIMAC, SYLVANIA, GE, CETRON**

OA2	\$2.75
3-400Z	115.00
3-500Z	99.00
4CX250B/7203	58.00
4CX1000A/8168	430.00
4PR60C/8252W	295.00
4X150A/7034	58.00
5AR4	4.73
5C22	165.00
5R4GB	3.85
6AK5	4.26
6AL5	2.93
6AQ5	2.85
6CA7	5.61
6DJ8	2.75
6JG6A	6.56
6JS6C	6.05
6KD6	6.90
6L6GC	5.25
6KV6A	6.02
6LF6	7.19
6LQ6	6.83
6MJ6	7.28
12AT7	2.93
12AU7	2.63
12AX7A	2.64
572B/T160L	46.00
705A	10.00
811A	13.50
813	40.00
829B	40.00
832A	38.00
833A	185.00
866A	9.50
872A	24.00
M-2057	15.00
5670	4.40
5684	33.00
5687	4.00
5751	4.00
5814A	3.70
5879	5.75
5894	65.00
6005	5.25
6146B	7.50
6360	6.50
6528A	75.00
6550A	7.50
6883B	9.00
7360	12.25
7558	7.00
7591A	4.70
7868	3.75
8072	95.00
8417	6.87
8874	195.00
8875	210.00
8877/3CX1500A7	475.00
8908	12.95
8950	11.50
MRF-453	18.50
MRF-454/A	18.50
MRF-455/A	18.50
2N6084	15.00



188

Full line of Sylvania ECG Replacement Semiconductors Always in Stock. All Major Manufacturers Factory Boxed, Hard To Get Receiving Tubes At Discount Prices.

Minimum Order \$25.00. Allow \$3.00 For UPS Charges. Out of Town, Please Call Toll Free: 800-221-5802 and Ask For "ABE".

**TRANSLERONIC INC.**

1365 39th STREET, BROOKLYN, N. Y. 11218H  
Tel. 212-633-2800/Wats Line 800-221-5802  
TWX710-585-2460 ALPHA NYK.



### power triode

The EIMAC Division of Varian has announced the availability of a new ceramic/metal power triode intended for use as a cathode-driven amplifier for hf and vhf service. This compact tube (3CX800A7) is intended for high power linear amplifier service. A single tube will produce a full 2 kW PEP or 1 kW CW input power.

The rugged 3CX800A7 is rated for 800 watts plate dissipation and will deliver full power output with less than 40 watts peak drive power. Power gain is better than 15 dB. The air-cooled anode requires less than 20 cfm with a back-pressure rating of 0.35 cfm for full dissipation at sea level.



Height of the 3CX800A7 above the socket plane is only 2-1/4 inches (5.7 cm), making the tube well suited for compact linear amplifier design and compatible with modern, low-profile styling.

For further details, contact Varian, EIMAC Division, 301 Industrial Way, San Carlos, California 94070. RS#301

**Editor's Note:** Both Henry Radio and Ehrhorn Technological Operations (ETO) have designed new amplifiers around this new tube. Contact them for details.

### polarization control

TEM Microwave Corporation is pleased to announce its model SC-10 polarization control interface. The SC-10 is designed to interface with satellite TVRO receivers that have odd/even channel logic output signals, such as the R.L. Drake ESR-24, or SPDT contacts, such as

the Automation Techniques GLR-500 series. The SC-10 produces the correct power and drive signals to control the popular servo motor type feed systems, such as the Chaparral Polarator 1<sup>TM</sup> or the Boman EFH-75. Other features of the SC-10 include independent front panel horizontal and vertical fine adjustment control and LED indicators that show which control is enabled, a mode switch for choice of either Satcom or Westar-type polarization, and a built-in regulated power supply.



The size is 4 x 5 x 2 inches (10.16 x 12.7 x 5.08 cm). Power is UL listed plug-in wall transformer. For more information, contact TEM Microwave Corporation, 22518 - 97th Avenue North, Corcoran, Minnesota 55374. RS#302

### 1/4-wave replacement antennas

Centurion International, Inc., has introduced a new line of 1/4-wave, flexible, miniaturized replacement antennas for VHF frequencies. The new "style-S" antennas measure approximately 3 inches in length by 3/8-inch in diameter. These antennas are smaller in diameter than other 1/4-wave miniaturized antennas and are more flexible. Their reduced size makes them a good choice for use with smaller portable two-way radios and speaker microphones.

Designated the "Skinny Mini," the antennas are encapsulated in high-gloss PVC and remain flexible from -55C to 100C. Style-S antennas, like style-M, are available with any of more than twenty different base connector configurations, to fit virtually any radio made.



For more information, contact Centurion International, Box 82846, Lincoln, Nebraska 68501. RS#303

## 1296 & PHASE III

MAKI UTV 1200 - \$399<sup>95</sup>  
2M or 6M I.F. / 3 WATTS

- 4 TRANSVERTER MODELS
- TX/RX CONVERTERS
- PRE-AMPS, AMPS, FILTERS

THEY'RE BACK...

## KENPRO ROTORS

KR400..... 149<sup>95</sup>

KR500..... 189<sup>95</sup>

LARGE SASE for catalog

## SPECTRUM WEST

5717 NE 56th, SEATTLE, WA  
206-523-6167 ✓ 179 98105

## FCC LOWERS REQUIREMENTS — GET YOUR RADIO TELEPHONE LICENSE

FCC changes make obtaining a High-level Radio Telephone License much easier now. Eliminate unnecessary study with our shortcuts and easy to follow study material. Obtaining the General Radio Telephone License can be a snap! Sample exams, also section covering Radar Endorsement.

A small investment for a high-paying career in electronics.

**\$19.95 ppd.**

Satisfaction Guaranteed

### SPI-RO DISTRIBUTING

P.O. Box 1538  
Hendersonville, N. C. 28793

✓ 180

## California Antenna Systems

Antenna Alternatives for the Radio Amateur

### Introducing

#### HOT DIPPED GALVANIZED TOWERS

**TRI-STACK** Stacking Towers, 10' to 120'  
TS10 - 40' side supported package, all hardware  
complete - \$299. \*

#### TRI-TEL Telescoping Crank up Towers

TT237 37' self support, 9 sq ft - \$499. \*  
TT354 54' self support, 9 sq ft - \$799. \*

We have a full line of major brand antennas and accessories. Call for discount price quotes.

#### FREE 2 Meter JAYBEAM -

Choice of LW5/2M 5 el. yagi or UGP/2M ground  
plane with Tower purchase, offer limited. Our way  
of saying "Thanks!"

\*Terms: Certified Check or M.O. with order. Prices FOB  
Shingle Springs, CA 95682. Freight collect. Allow 2 to 6  
weeks delivery. Calif. Residents add 6% Tax. Prices subject  
to change without notice.

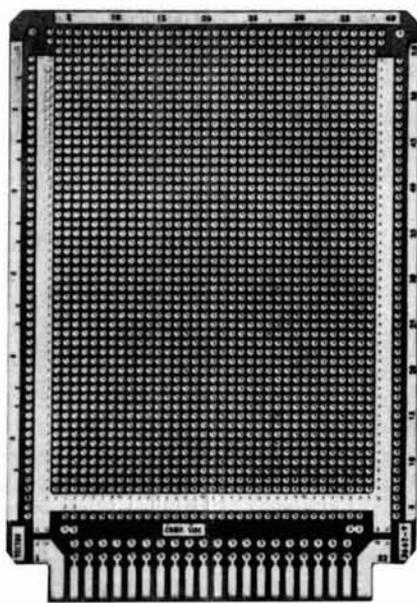
6020 Windy Ridge Road  
Shingle Springs, California 95682  
Telephone (916) 677-9540

✓ 119

## plug-in circuit boards

Three new plug-in circuit boards from Vector Electronic Company incorporate individual solder pads and drilled, plated-through holes. The design allows complete freedom in component location and spacing while providing quick and easy solder mounting of components with solderable or wrap-post leads. The boards have 2064 holes in the component area, allowing placement of up to fifty fourteen-pin DIPS or forty sixteen-pin DIPS. One card, the Model 4610-3, is form and fit compatible with STD system cards with 28/56 card-edge contacts. The Model 3662-9 and Model 3619-6 have 22/44 and 36/72 card-edge contacts to mate with the most frequently used connectors.

All boards are 4.5 inches wide by 6.5 inches long by 0.062-inch thick (11.43 × 16.51 × 0.16 cm) and have 0.042-inch (0.107-cm) diameter plated-through holes on 0.1-inch (0.25-cm) centers.



Fabricated of FR-4 (G10) epoxy glass laminate, the pads are 2-ounce copper cladding with bright tin plating for easy soldering. Card-edge connectors are nickel plated and gold flashed to ensure long life and low resistance. Zoned-wiring locations, etched into the cladding, permit easy component identification.

In single quantities, the 22/44-contact Model 3662-9 is priced at \$26.80 each; the 28/56 contact Model 4610-3 is \$26.50 each; and, the 36/72 contact Model 3619-6 is \$26.80 each. For more information, contact Vector Electronic Co., Inc., 12460 Gladstone Avenue, Sylmar, California 91342. RS#304

Say You Saw  
It In HAM RADIO

# !NEW!

FROM  
**KENWOOD**



**TS430S**  
New Gen. Cov.  
Solid State Transceiver



**R2000**  
New Gen. Cov.  
Rcvr. W/memories



**TS930S**



THE  
COMM  
CENTER 20810  
INC. ✓ 187  
Laurel Plaza  
Route 198  
Laurel, Md.  
MD.: 301-792-0600  
OPEN MON. THROUGH SAT.

CALL TOLL FREE  
**1-800-638-4486**



## ten-meter fm transverter

A unique 2-meter to 10-meter linear transverter recently introduced by Heil, Ltd., allows a 2-meter radio to receive and transmit on the ten-meter band from 28.00 to 29.70.

The Model 210 is primarily designed for use in the 29.30 to 29.70 fm band using a one-watt "handie talkie" or mobile transceiver for excitation, but is also usable on SSB, CW, a-m, and RTTY by exciting with an all-mode two-meter rig. The Model 210 has three SO-239 connectors on the rear panel, a two-meter one-watt input, a two-meter antenna, and a ten-meter antenna. With the front panel function switch in the "out" position, the two-meter antenna is connected to the two-meter transceiver or "handie talkie." Switching to the "in" position will cause the transverter to operate and produce a signal in the ten-meter band. The receiver sensitivity is  $0.3 \mu\text{V}$  for 10 dB quieting. The output power is approximately 4 watts out at 29.60.



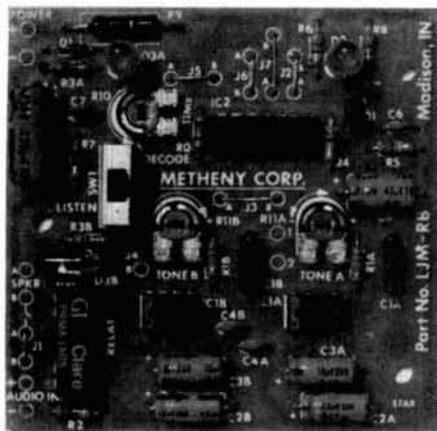
The price (subject to change) is \$100.00. For further details, write Heil Sound System, Heil Industrial Blvd., Marissa, Illinois 62257. RS#305

## emergency tone decoder

The Storm Alert LJM2RK time-dual tone emergency decoder kit from Metheny converts receivers into special-purpose receivers or controls. When a user-selected time-tone combination is received, the output provides a relay control for activating speakers or other devices.

Special features include single or dual tones adjustable over the touch tone range; adjustable time delay; relay output; manual or auto reset; single tone ON latching with different single tone reset OFF; and interfacing of multiple boards for multi-digit sequential activation and reset.

Kit LJM2RK includes a printed circuit board with components, relay, and a silk screened component identification and solder mask for ease of assembly. An optional enclosure kit, LJM2RC, includes a custom-molded case, speaker, audio input cable, and hardware for



the decoder kit. Kit LJM2RK costs \$15.00; the enclosure kit, LJM2RC, is priced at \$5.00.

For complete details and information about specific applications, contact The Metheny Corporation, 204 Sunrise Drive, Madison, Indiana 47250. RS#306

## multimode transceiver

The FT-726R — the world's first Amateur HF/VHF/UHF transceiver capable of full duplex operation for satellite work — is now available from Yaesu Electronics Corporation.

The basic unit comes equipped for 2-meter operation on SSB, CW, and fm. Optional units may be plugged in, enabling operation on 10 or 6 meters, 430 to 440 or 440 to 450 MHz on 70 cm. The optional SU-726 satellite unit allows crossband full duplex operation, for simultaneous uplink transmit and downlink receive operation on Amateur satellites.

Controlled by an eight-bit microprocessor, the FT-726R features a dual VFO and memory frequency management system, with independent frequency/mode storage on each VFO or memory; mode-inverting satellite transponders are therefore covered with ease. The transmit and receive frequencies may be varied during satellite work to allow easy zero-beat capability while following Doppler shift.

Equipped with many features found only on



hf transceivers, the FT-726R includes an SSB speech processor, i-f shift, variable i-f bandwidth tuning, i-f noise blanker, RIT, multimode squelch, and a receiver audio tone control. A CW filter, DTMF encoding microphone (YM-

48), desk microphone (MD-1B8), external speaker (SP-102), and CTCSS units are all available as options.

For further information, contact Yaesu Electronics, P.O. Box 49, Paramount, California 90723. RS#307

## handheld airband transceiver

The TR-720 is a solid-state, fully synthesized, portable airband transceiver covering the 720 COM channels between 118 and 136 MHz and 200 NAV channels from 108 to 118 MHz. It measures only  $6.6 \times 2.6 \times 1.5$  inches and weighs just 19 ounces. It employs microprocessor technology, has a twist-off battery pack, comes with a complete set of accessories, is FCC type accepted, and carries a full one year warranty. It is available for \$795.00 from local Avionics dealers, or directly from the manufacturer.



For information, contact Communications Specialists, Inc., 426 W. Taft Ave., Orange, California 91665. RS#308

## power bars

A new line of Hammond power bars features an attractive, contemporary, brushed-aluminum case with matte black receptacle housing. Reduced in size, (11, 14 and 17 inches in length), standard models are available in four, six, or eight-receptacle sizes with either 6 or 15 foot cords, and with or without lighted, rocker type on/off switches. Also available are 4 and 6 foot long power bars, each with eight receptacles. Appropriate for work station mounting, all power bars are CSA approved and fitted with 120 Vac, 15A circuit breaker.

For more information, contact Hammond Manufacturing Company, Inc., 1690 Walden Avenue, Buffalo, New York 14225. RS#309



### New DTMF Receiver Kit turns phones into control devices.

With Telone's TRK-956 kit, you get all the parts necessary to breadboard a central office quality DTMF detection system for only \$22.75. That's the lowest installed cost for a DTMF system. All you provide is 5V dc. For decoding DTMF signals from telephone lines, radios, and tape players, use the TRK-956. To order call: (800) 227-3800 ext 1130. [In CA, (800) 792-0990 ext 1130.]

**TELONE**

✓ 185

### CABLE CONVERTER SALE

MAGNAVOX FV-25 - 26 CHANNEL WITH REMOTE CONTROL - VHF-MIDBAND-SUPERBAND - REG \$59.95 - NOW **\$49.95**

JERROLD JSX-3D1C - 36 CHANNEL WITH IN BAND GATED SYNC DECODER - REG \$209.95 - NOW **\$149.95**

JERROLD SB-3 - IN BAND GATED GATED SYNC DECODER - USE WITH ANY CONVERTER WITH OUTPUT ON CHANNEL 3 - REG \$149.95 - NOW **\$99.95**

UHF BLOCK CONVERTER - CONVERTS MIDBAND AND SUPERBAND TO UHF - REG \$39.95 - NOW **\$26.95**

SEND \$1.00 (REFUNDABLE) FOR CATALOG

ADD \$4.25 SHIPPING/HANDLING FOR EACH UNIT ORDERED

NYS ADD SALES TAX - C.O.D.'S OK

24 HOUR ORDER LINE  
(607) 962-7313

✓ 182

ORDER DIRECT FROM -

**TAYCO COMMUNICATIONS**  
R3-146A NARROWS CREEK ROAD  
CORNING, NEW YORK 14830

### NEW NEW NEW COMPUTER SAVER

Do you have 8 or more interface cards you use occasionally but hate to keep tearing into your computer to get at them and risk damaging them?

Then **Switch-A-Slot** is for you!

**Switch-A-Slot** lets you select up to 4 cards for each port. Select the card to run with the turn of a switch. NO new programming tricks to learn.

#### Switch-A-Slot

**SAVES** wear and tear on cards and computer  
**SAVES** power (only the card that's on draws power)

**PROTECTS** cards from being damaged by static electricity and scratches

Switch-A-Slot works with most cards:  
light pen printers  
modems clock cards, etc

Models available for:

Apple II Apple IIe Franklin

**INTRODUCTORY PRICE \$155**

(includes shipping)

Please send orders with payment to:

**BIT "O" BYTE**

PO Box 60972, Sunnyvale, CA 94088

✓ 114

### uhf linear amplifier

The newest uhf linear amplifier from Tokyo-Hy Power Labs is designed for use with 10-watt output 430-450 MHz crystal-controlled or synthesized rigs. Input for the HL-45U is 2 to 15 watts with output of 10 to 45 watts. It operates from a 13.8 volt dc source and draws 7 amps at 45 watts output. It is all-mode (SSB, CW, and fm), has a built-in 12 dB low noise receiver pre-amplifier, and employs carrier operated switching (COX).

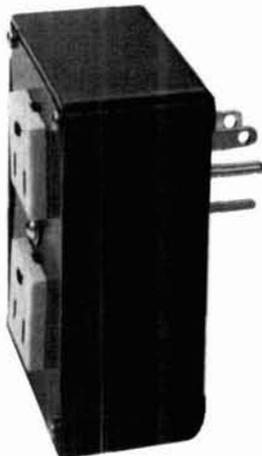


The HL-45U measures 4.9 x 2.7 x 6.7 inches (124 x 68 x 170 mm) and weighs 2.76 pounds (1.25 kg). The suggested retail price of the HL-45U is \$199.95.

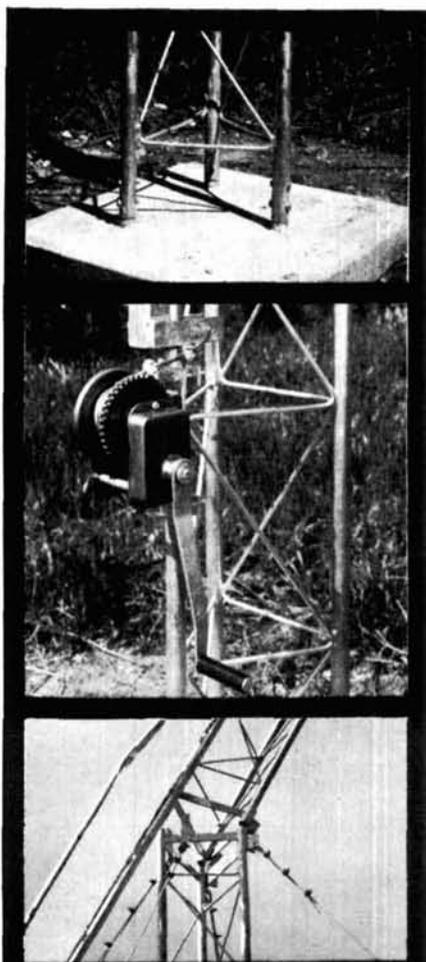
For further information contact THL Sales Department, Encomm, Inc., 2000 Ave. G, Suite 800, Plano, Texas 75074. RS#310

### wall socket RFI control

Electronic Specialists' new Direct Plug Super Filter and Suppressor features a dual-pi filter to control electrical interference. A 6500-ampere spike/surge suppressor protects equipment from damage caused by lightning or heavy machinery spikes.



For further information, contact Electronic Specialists, Inc., 171 S. Main Street, Natick, Massachusetts 01760. RS#311



## ROHN

### "FOLD-OVER" TOWERS

#### ■ EASE OF INSTALLATION

ROHN "Fold-Over" Towers are quickly and easily installed. The "Fold-Over" is safe and easy to service.

#### ■ ADAPTABILITY

ROHN has several sizes to fit your applications or you can purchase the "Fold-Over" components to convert your ROHN tower into a "Fold-Over".

#### ■ HOT DIP GALVANIZED

All ROHN towers are hot dip galvanized after fabrication.

#### ■ REPUTATION

ROHN is one of the leading tower manufacturers, with over 25 years of experience.

Write today for complete details.

QUALITY STEEL PRODUCTS BY

## ROHN

Box 2000 Peoria, Illinois 61656  
U.S.A.

✓ 190

July 1983 **hpa** 91

# 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 Comm. ___ 101	JDL Industries ___ 150
Alden Elec. ___ 102	Jensen Tools ___ 151
All Elec. ___ 103	KCS Elec. ___ 152
A. E. E. ___ 104	Kantronics ___ 153, 154
Am. Whole. Elec. ___ 105	Kenwood * ___
ARRL ___ 106	Long's ___ 155
Amidon ___ 107	MFJ ___ 156
Antenna Dev. & Manu. ___ 108	Macrotronics ___ 157
Applied Inv. ___ 109	Metheny Corp. ___ 158, 306
ATV Magazine ___ 110	Microlog ___ 159
BMG Eng. ___ 111	Mirage Comm. ___ 160
Barker & Williamson ___ 112	Missouri Radio ___ 161
Barry * ___	Morning Dist. ___ 162
Bash Ed. Ser. ___ 113	Nampa Satellite ___ 163
Bit "O" Byte ___ 114	Nemal ___ 164
Bowick's ___ 115	Nuts & Volts ___ 165
Buckmaster ___ 116, 198	Oak Hill Academy A. R. S. * ___
Budwig ___ 117	P.B. Radio ___ 166
Butternut * ___	P. C. Elec. * ___
Bytesize ___ 118	Paramount Comm. ___ 167
Cal. Ant. Sys. ___ 119	Peterson Elec. ___ 168
Ceco ___ 120	Phillips-Tech ___ 169
Centurion ___ 121, 303	Pro-Search ___ 170, 171
Coin Inter. ___ 122	RF Products ___ 172
Comm. Spec. ___ 123, 308	Callbook ___ 173
Comp. Trader ___ 124	Radiokit ___ 174
Connect Sys. ___ 125	Radio Warehouse * ___
Contact East ___ 126	Random Access ___ 175
Cushcraft ___ 127, 128	SEI ___ 176
Digital Micro ___ 129	Satellite TV Mag. ___ 177
Direct Video ___ 130	Spectronics * ___
Elec. Rainbow ___ 131	Spectrum Int. ___ 178
Elec. Spec. ___ 132, 311	Spectrum West ___ 179
Encomm ___ 310	Spi-Ro Dist. ___ 180
Fair Radio ___ 133	Sunderland Software ___ 181
Ferritronics ___ 134	Tayco ___ 182
Flesher ___ 135	TE Systems ___ 183
Fox-Tango ___ 136	TEM ___ 302
GSM ___ 137	TET Antennas ___ 184
Galaxy Elect. ___ 138	Telex Comm. * ___
Goldsmith Scientific ___ 139	Teltone ___ 185
Hallward Prod. ___ 140	Tennessee Elect. ___ 186
Hammond ___ 309	The Comm Center ___ 187
H. R. B ___ 141	Transleteronic ___ 188
Ham Shack ___ 142	Tri-Ex ___ 189
Hamtronics ___ 143	UNR-Rohn ___ 190
Handi-Tek ___ 144	VADCG ___ 270
Heil Sound ___ 305	Vanguard Labs ___ 191
Henry Radio ___ 145, 196	Varian ___ 301
Hildreth ___ 250	Vector ___ 304
Hoosier ___ 146	VoCom ___ 192
Icom ___ 148	Western Elec. ___ 193
Independent Crystal ___ 149	WinTenna ___ 194
	Yaesu ___ 195, 307

\* Please contact this advertiser directly.  
Limit 15 inquiries per request.

July 1983

Please use before August 31, 1983

Tear off and mail to  
HAM RADIO MAGAZINE — "check off"  
Greenville, N. H. 03048-0498

NAME .....

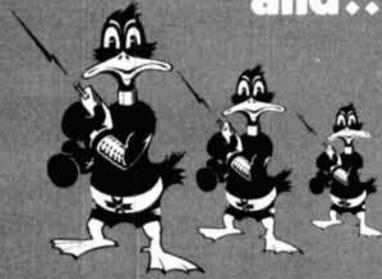
CALL .....

STREET .....

CITY .....

STATE ..... ZIP .....

## Ducks are getting smaller! and...



## better!



Actual Size

Because you and the leading radio manufacturers want the best-performing, the best looking antenna; Centurion has grown to be the Duck leader. We've developed many smaller antennas to make the hand-held radio perform better, and now the newest duck...the Tuf Duck "mini". It's shorter (about 3") yet it's a full 1/4 wave radiator on VHF.

 **CENTURION**  
**TUF DUCK™**  
**ANTENNAS**

**CENTURION**  
Phone 402/467-4491  
Telex 48-4377 CENTURION LCN  
P.O. Box 82846 Lincoln, NE 68501 2846

# Advertisers iNdex

Ace Communications	80
Alden Electronics	20
All Electronics Corp.	80
Alternative Energy Engineering	69
Amateur-Wholesale Electronics	51
American Radio Relay League	64
Amidon Associates	77
Antenna Development & Manufacturing, Inc.	34
Applied Invention	52
ATV Magazine	73
BMG Engineering	69
Barker & Williamson, Inc.	57
Barry Electronics	19
Bash Educational Services	63
Bit "O" Byte	91
Chris Bowick's RF Circuit Design	71
Buckmaster Publishing	45, 52
Budwig Manufacturing Co.	79
Butternut Electronics	71
Bytesize Micro Technology, Inc.	59
California Antenna Systems	89
Ceco Communications	81
Centurion International	92
Coin International, Inc.	60
Communications Specialists	95
Computer Trader	44
Connect Systems	96
Contact East	71
Cushcraft	45, 47
Digital Microsystems	46
Direct Video Sales	84
Electronic Rainbow, Inc.	81
Electronic Specialists	60
Fair Radio Sales	79
Ferritronics, Ltd.	57
Flesher Corp.	69
Fox Tango Corp.	80
GSM, Inc.	47
Galaxy Electronics	73
Goldsmith Scientific Corp.	87
Hallward Products	84
Ham Radio's Bookstore	47, 50
Ham Shack	72
Hamtronics, N.Y.	40, 41
Handi-Tek	77
Henry Radio	10, 11
Hildreth Engineers	69
Hoosier Electronics	50
Icom America, Inc.	Cover II
Independent Crystal Supply Company	77
JDL Industries	7
Jensen Tools	79
KCS Electronics Corp.	60
Kantronics, Inc.	35, 77
Trio-Kenwood Communications	2, Cover IV
Long's Electronics	24, 25
MFJ Enterprises	1
Macrotronics	21
Metheny Corp. The	72
Microlog	9
Mirage Communications Equipment, Inc.	73
Missouri Radio Center	52
Morning Distributing Inc.	84
Nampa Satellite Receiver Systems	44
Nemal Electronics	44
Nuts & Volts Magazine	71
Oak Hill Academy Amateur Radio Session	52
P.B. Radio	13
P.C. Electronics	79
Paramount Communications	59
Peterson Electronics	77
Phillips-Tech Electronics	60
Pro-Search	48, 49
RF Products	60
Radio Amateur Callbook	35
Radiokit	45
Radio Warehouse	45
Random Access, Inc.	81
SEI, Inc.	64
Satellite TV Magazine	57
Spectronics	35
Spectrum International, Inc.	78
Spectrum West	89
Spi-Ro Distributing	89
Sunderland Software	47
Tayco Communications	91
TE Systems	13
TET Antennas	50
Telex Communications	28
Teltone Corp.	91
Tennessee Electronics	79
The Comm Center	89
Transleteronic, Inc.	88
Tri-Ex Tower Corp.	59
UNR-Rohn	64, 91
VADCG	73
Vanguard Labs	52
VoCom Products Corp.	67
Western Electronics	84
WinTenna, Inc.	87
Yaesu Electronics Corp.	Cover III

# **ham radio**

## **Reader Service**

For literature or more information, circle the appropriate number on this card, affix postage and send to us. We'll hustle your name and address to the companies you're interested in.

101 113 125 137 149 161 173 185 197 209 221 233 245 257 269 281 293 305 317 329 341  
102 114 126 138 150 162 174 186 198 210 222 234 246 258 270 282 294 306 318 330 342  
103 115 127 139 151 163 175 187 199 211 223 235 247 259 271 283 295 307 319 331 343  
104 116 128 140 152 164 176 188 200 212 224 236 248 260 272 284 296 308 320 332 344  
105 117 129 141 153 165 177 189 201 213 225 237 249 261 273 285 297 309 321 333 345  
106 118 130 142 154 166 178 190 202 214 226 238 250 262 274 286 298 310 322 334 346  
107 119 131 143 155 167 179 191 203 215 227 239 251 263 275 287 299 311 323 335 347  
108 120 132 144 156 168 180 192 204 216 228 240 252 264 276 288 300 312 324 336 348  
109 121 133 145 157 169 181 193 205 217 229 241 253 265 277 289 301 313 325 337 349  
110 122 134 146 158 170 182 194 206 218 230 242 254 266 278 290 302 314 326 338 350  
111 123 135 147 159 171 183 195 207 219 231 243 255 267 279 291 303 315 327 339  
112 124 136 148 160 172 184 196 208 220 232 244 256 268 280 292 304 316 328 340

*Limit 15 inquiries per request.*

NAME \_\_\_\_\_ CALL \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

Please use before August 31, 1983

**July 1983**

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

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.



# Food for thought.

Our new Universal Tone Encoder lends its versatility to all tastes. The menu includes all CTCSS, as well as Burst Tones, Touch Tones, and Test Tones. No counter or test equipment required to set frequency—just dial it in. While traveling, use it on your Amateur transceiver to access tone operated systems, or in your service van to check out your customers' repeaters; also, as a piece of test equipment to modulate your Service Monitor or signal generator. It can even operate off an internal nine volt battery, and is available for one day delivery, backed by our one year warranty.

- All tones in Group A and Group B are included.
- Output level flat to within 1.5db over entire range selected.
- Separate level adjust pots and output connections for each tone Group.
- Immune to RF
- Powered by 6-30vdc, unregulated at 8 ma.
- Low impedance, low distortion, adjustable sinewave output, 5v peak-to-peak
- Instant start-up.
- Off position for no tone output.
- Reverse polarity protection built-in.

## Group A

67.0 XZ	91.5 ZZ	118.8 2B	156.7 5A
71.9 XA	94.8 ZA	123.0 3Z	162.2 5B
74.4 WA	97.4 ZB	127.3 3A	167.9 6Z
77.0 XB	100.0 1Z	131.8 3B	173.8 6A
79.7 SP	103.5 1A	136.5 4Z	179.9 6B
82.5 YZ	107.2 1B	141.3 4A	186.2 7Z
85.4 YA	110.9 2Z	146.2 4B	192.8 7A
88.5 YB	114.8 2A	151.4 5Z	203.5 M1

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

## Group B

TEST-TONES:	TOUCH-TONES:	BURST TONES:			
600	697 1209	1600	1850	2150	2400
1000	770 1336	1650	1900	2200	2450
1500	852 1477	1700	1950	2250	2500
2175	941 1633	1750	2000	2300	2550
2805		1800	2100	2350	

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

Model TE-64 \$79.95

 **COMMUNICATIONS SPECIALISTS**

426 West Taft Avenue, Orange, California 92667  
(800) 854-0547/ California: (714) 998-3021



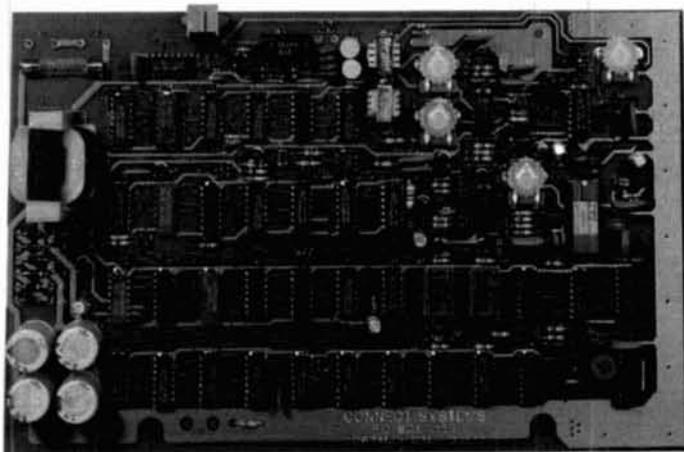
# ANNOUNCING PRIVATE PATCH II

## TONE TO PULSE SIMPLEX INTERCONNECT

AT LAST...Professional quality interconnect at an *affordable* price! Imagine the convenience of having your own private, commercial quality mobile telephone in your car. And without the hassles of shared systems. Put your base FM transceiver to work while on the road. Our *ultra state of the art* digitally processed audio scheme (Patent pending) *totally* eliminates the continuous train of squelch tails which has kept you away from sampling interconnects. Our nonsampling approach has additional benefits: 1. Interface to your transceiver is the **MOST SIMPLE EVER**. Connects only to microphone and speaker jacks! **NO INTERNAL CONNECTIONS OR MODIFICATIONS REQUIRED!** 15 minutes typical installation time. 2. Works with **ANY FM transceiver**. (T/R speed is not critical.) 3. Operates through any repeater or simplex without use of tone equipment. Imagine having **TOTAL** access to your own home phone from 100 miles away! Our *busy channel ringback inhibit logic* prevents "accidental" interference to a QSO in progress when a phone call is received. This feature will keep you out of hot water with co-channel users! Discover for yourself what high quality simplex interconnect sounds like. Call us, and listen to actual "on the air" tapes of this incomparable interconnect product.

## STANDARD FEATURES

- Compatible with either rotary or tone exchanges
- 16 Digit buffer memory — dial as fast as you want
- 3201 tone decoder chip
- High quality glass circuit board
- CW identification



**QUALITY AND ENGINEERING...  
THAT YOU CAN DEPEND ON!!**



- Five digit user programmable sequential access code — 60,000 code combinations
- Sophisticated toll restrict — restricts any quantity of leading digits
- Both accessing and dialing are compatible with speed dialing equipment
- Operates superb through repeaters — no special tone equipment required
- Three/six minute "time out" timer is resettable from mobile four CW ID warnings during last minute
- Ringback (reverse patch) pages you once with CW ID — answer when convenient with your access code
- Busy channel ringback inhibit logic — prevents accidental interference to QSO in progress
- Most easily interfaced autopatch on the market
- Positive control logic
- Fully digital timing — there are *no* timing adjustments! assures quick easy set-up
- Touch tone™ digits and strobe pulse available on DIP socket
- Modular phone jack and cord
- Self contained 115 VAC supply (230 VAC 50/60 cycle export model available)

**PRIVATE PATCH II \$475**

**NOW REDUCED**

**PRIVATE PATCH I \$399**

HAS MOST OPERATIONAL FEATURES  
OF PRIVATE PATCH II — BUT IS FOR  
USE ONLY ON DTMF EXCHANGES

**AND OF COURSE:**

**ONE YEAR WARRANTY  
14 DAY RETURN PRIVILEGE  
UNMATCHED CUSTOMER SERVICE**



SEND OR CALL FOR BROCHURES  
INQUIRE ABOUT COMMERCIAL MODELS

DEALERSHIPS INVITED

✓ 125

# Connect Systems

Formerly Auto Connect

P.O. BOX 4155  
TORRANCE, CA 90510  
PHONE (213) 540-1053

# YAESU FT-726R TRIBANDER

NEW GALAXIES OF PERFORMANCE ON VHF AND UHF

FULL DUPLEX!!

SATELLITES!!

SCATTER!!

FM!!

EME!!



The New Yaesu FT-726R Tribander is the world's first multiband, multimode Amateur transceiver capable of full duplex operation. Whether you're interested in OSCAR, moonbounce, or terrestrial repeaters, you owe yourself a look at this one-of-a-kind technological wonder!

#### Multiband Capability

Factory equipped for 2 meter operation, the FT-726R is a three-band unit capable of operation on 10 meters, 6 meters, and/or two segments of the 70 cm band (430-440 or 440-450 MHz), using optional modules. The appropriate repeater shift is automatically programmed for each module. Other bands pending.

#### Advanced Microprocessor Control

Powered by an 8-bit Central Processing Unit, the ten-channel memory of the FT-726R stores both frequency and mode, with pushbutton transfer capability to either of two VFO registers. The synthesized VFO tunes in 20 Hz steps on SSB/CW, with selectable steps on FM. Scanning of the band or memories is provided.

#### Full Duplex Option

The optional SU-726 module provides a second, parallel IF strip, thereby allowing full duplex crossband satellite work. Either the transmit or receive frequency may be varied during transmission, for quick zero-beat on another station or for tracking Doppler shift.

#### High Performance Features

Borrowing heavily from Yaesu's HF transceiver experience, the FT-726R comes equipped with a speech processor, variable receiver bandwidth, IF shift, all-mode squelch, receiver audio tone control, and an IF noise blanker. When the optional XF-455MC CW filter is installed, CW Wide/Narrow selection is provided. Convenient rear panel connections allow quick interface to your station audio, linear amplifier, and control lines.

Leading the way into the space age of Ham communications, Yaesu's FT-726R is the first VHF/UHF base station built around modern-day requirements. If you're tired of piecing together converters, transmitter strips, and relays, ask your Authorized Yaesu Dealer for a demonstration of the exciting new FT-726R, the rig that will expand your DX horizons!

Price And Specifications Subject To  
Change Without Notice Or Obligation

**YAESU**  
*The radio.*



483

✓ 195

**YAESU ELECTRONICS CORPORATION** 6851 Walthall Way, Paramount, CA 90723 • (213) 633-4007  
**YAESU CINCINNATI SERVICE CENTER** 9070 Gold Park Drive, Hamilton, OH 45011 • (513) 874-3100

# FM "Dual-Bander"

**NEW**



**2 m & 70 cm in single compact package, LCD, 25 W, optional voice synthesizer.**

## TW-4000A

**KENWOOD's TW-4000A FM "Dual-Bander" provides new versatility in VHF and UHF operations, uniquely combining 2 m and 70 cm FM functions in a single compact package.**

### TW-4000A FEATURES:

- **2 m and 70 cm FM in a Compact Package**  
Covers the 2 m band (142.000-148.995 MHz), including certain MARS and CAP frequencies, plus the 70 cm FM band (440.000-449.995 MHz), all in a single compact package. Only 6-3/8 (161)W x 2-3/8 (60)H x 8-9/16 (217)D inches (mm), and 4.4 lbs. (2.0 kg).
- **Large, Easy-to-Read LCD Display**  
A green, multi-function back-lighted LCD display for better visibility. Indicates frequency, memory channel, repeater offset, "S" or "RF" level, VFO A/B, scan, busy, and "ON AIR." Dimmer switch.
- **25 Watts RF Power on 2 m/70 cm.**  
Hi/Lo power switch.
- **Optional "Voice Synthesizer Unit"**  
Installs inside the TW-4000A. Voice announces frequency, band, VFO A or B, repeater offset, and memory channel number.
- **Front Panel Illumination**

- **10 Memories with Offset Recall and Lithium Battery Backup**  
Stores frequency, band, and repeater offset. Memory 0 stores receive and transmit frequencies independently for odd repeater offsets, or cross-band operation.
- **Programmable Memory Scan**  
Programmable to scan all memories, or only 2 m or 70 cm memories. Also may be programmed to skip channels.
- **Band Scan in Selected 1-MHz Segments**  
Scans within the chosen 1-MHz segment (i.e., 144.000-144.995 or 440.000-440.995, etc.). The scanning direction may be reversed by pressing either the "UP" or "DOWN" buttons on the microphone.
- **Priority Watch Function**  
Unit switches to memory 1 for 1 second each 10 seconds, to monitor the activity on the priority channel.
- **Common Channel Scan**  
Memory 8 and 9 are alternately scanned every 5 seconds. Either channel may be recalled instantly.
- **Dual Digital VFO's**  
Selectable 5-kHz or 10-kHz for 2 m, and 5-kHz or 25-kHz for 70 cm. Depress "UP" or "DOWN" key on the front panel for band change in 1-MHz steps.
- **16-Key Autopatch UP/DOWN Microphone (Supplied)**
- **Repeater Reverse Switch**

- **High Performance Receiver/Transmitter**  
GaAs FET RF amplifiers on both 2 m and 70 cm, high performance MCF's in the 1st IF section, provide high receive sensitivity and excellent dynamic range. The high reliability RF power modules assure clean and dependable transmissions on either band.
- **Rugged Die-cast Chassis**
- **Optional Two-Frequency CTCSS Encoder**  
Easily mounted inside the radio, allows DIP switch programming of two different tone frequencies, for 2 m and 70 cm.
- **"BEEPER" sounds through speaker.**
- **Easy-to-Install mobile mount**
- **TW-4000A accessories:**
- **VS-1 Voice Synthesizer**
- **TU-4C Two-Frequency Programmable CTCSS Encoder**
- **KPS-7A Fixed station power supply**
- **SP-40 Compact mobile speaker**

More information on the TW-4000A and TS-780 is available from all authorized dealers of Trio-Kenwood Communications, 1111 West Walnut Street, Compton, California 90220.

# KENWOOD

...pacesetter in amateur radio

## All mode "Dual-Bander"

### TS-780

**2 m & 70 cm all mode, dual digital VFO's, 10 memories, scan, IF shift...**

### TS-780 FEATURES:

- USB, LSB, CW, FM all mode, covering the 2 m band (144.000-148.000 MHz) and the middle 70 cm band (430.000-440.000 MHz). UP/DOWN band switch.
- Dual digital VFO's with normal/tight drag switch. VFO steps in 20-Hz, 200-Hz, 5-kHz, or 12.5-kHz, plus "FM CH" channel-

ized tuning. Split (cross) frequency operation possible. F. LOCK switch provided.

- 10 memories include band and frequency data, backed up by internal batteries (not supplied). Battery life exceeds one year. Memories 9 and 10 for priority instant recall.
- Band scan, with selectable 0.5, 1, 3, 5, and 10-MHz scan bandwidth.
- Memory scan selectable for all memories, or 2 m or 70 cm only.
- IF shift circuit rejects adjacent interference.
- High sensitivity and wide dynamic range • 7-digit

fluorescent tube digital display • 10 watt RF output • 2 m  $\pm$ 600-kHz TX offset switch with reverse switch • Tone switch for optional TU-4C two frequency tone

encoder unit • VOX and semi break-in CW built-in • FM center-tune meter • Noise blanker for SSB, CW.

Subject to FCC approval

